

# iNTELLiCODE

## Artificial Intelligence CBSE Code 417

### Teacher's Reference Manual Class X

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# Employability Skills

## Unit 1: Communication Skills - II

### SESSION 1: Various Methods of Communication

#### Exercise

**1. What do you mean by oral communication?**

Oral communication is a means of verbal communication where sender and receiver remain present in person. It is done by speaking to each other.

**2. List the things we should keep in mind while communicating orally.**

Active listening, clarity of the purpose of communication, clear and direct communication, suitable language and vocabulary.

**3. How does body language influence our communication positively?**

Confident and clear voice, direct, frank eye contact reflects confidence, truth and sincerity. Eye contact engages others in our conversation. Positive postures and gestures reflect interest, suitable smile, understanding, sincere eyes, composed and calm face and proper use of personal space together make our body language positive.

**4. How does body language influence our communication negatively?**

Unclear speech, low voice, improper eye contact reflects lack of confidence or you are lying, fidgeting, slumping, changing posture frequently show lack of interest, frown, grimace, lack of smile, and not respecting personal space together make our body language negative.

**5. Explain the role of non-verbal communication in our day to communication.**

Non-verbal communication occurs along with non-written verbal communication (oral, telephonic, video meeting) and greatly affects the verbal communication. Verbal communication refers to what is said while non-verbal communication is how it has been said. The factors that constitute non-verbal communication are in general referred to as body language that includes our posture, gestures, expressions, tone and quality of voice, and our movements etc. Our emotions also play a vital role. How do we respect personal space of others, how do we greet people, shake hand and converse with right expressions and posture determine the effectiveness of our verbal conversation.

**6. What are the importance and limitations of visual communication?**

Visual communication is instant, specific, clear and with zero ambiguity. Visual symbols support what we communicate. The creativity of symbols, charts and graphics make the communication interesting and break the monotony of speech and written word.

#### Limitations

- It has its usefulness up to some extent only.
- It cannot replace the content of speech and written word completely.
- It plays supporting role in communicating our ideas.
- Symbols which are not accepted as standard are difficult to understand.

**7. List the meaning of any 10 signs and symbols you have seen around in public places.**

No U turn, Stop, No parking, No smoking, Speed limit 45, One way, Road Diversion, No Horn, School ahead, Left turn.

## SESSION 2: Providing and Receiving Feedback

### Exercise

#### 1. What is the role of feedback in communication cycle?

A feedback completes the communication cycle. Feedback helps in improving upon the communication. Further responses in an ongoing communication are devised by the feedback received. This leads to the fulfilment of the actual purpose of communication. This helps in making all the parties satisfied which are involved in the process of communication. Since feedback improves quality of communication, the productivity of those involved is enhanced and it also aids in rendering suitable environment for deliveries to achieve the goals.

#### 2. How should we perform feedback gathering during communication cycle?

- Listen to the feedback giver and let him/ her finish before responding.
- Try to make note – either mental or on paper – of what is being shared by the feedback giver.
- Your body language while receiving the feedback should reflect positive vibes and attitude.
- Remember that feedback is for improvement in further performance. Do not take it as personal criticism.
- Do not let emotions come in the way of feedback exchange process. Here, your emotional intelligence needs to be in a balanced mode.
- To clarify any doubts or to seek any explanation on anything that you do not understand, ask precise and short questions. Do not spiral into long, disconnected, vague queries for they will lead into further confusion and beat the entire purpose of feedback.
- If you think that instant response is not possible from your side on the feedback ask permission for sometime to draft or create your response so that you come back effectively, clearly and in a positive way to take the discussion further on the feedback.

#### 3. List 4 examples of providing feedback.

- A team leader in an office providing inputs on his analysis of his team mates' performance.
- A teacher discussing the test performance of students to help them improve on their studies and result.
- A client sharing his views on the product delivered by the vendor.
- A business analyst providing pointers to the sales team after analysing its sales performance.

#### 4. List the advantages of feedback in brief.

The feedback is given to people to help them improve their performance or output. A feedback completes the communication cycle. Feedback also helps communicators adapt to the changes in communication. Feedback helps communicators devise their next response and ensure that actual purpose of communication is met. Feedback brings about the fruitful end of the communication. Feedback enriches the quality of communication, productivity of the people and creates a conducive environment for performance and achieving the goals.

#### 5. List 4 major skills of giving and receiving feedback.

##### Feedback giving skills:

- Give timely feedback. Delay in feedback loses its effectiveness.
- Feedback should not judge or compare a person. It should not 'smell' of bias.
- Feedback should be fair and supportive.
- Feedback should be complete and consistent throughout a communication cycle.

### Feedback receiving skills:

- Being attentive while receiving feedback.
- Making mental or paper notes.
- Keeping a check on emotions.
- Do not feel being criticized or pinned down. Take it with a pinch of salt and work upon the feedback.

#### **6. What is the basic difference between specific and general feedback?**

General feedback is most suitable for short durations such as a feedback after a class test. This helps in quicker improvements. General feedback covers just the general details which help in improving on the further actions to be done such as upcoming exam.

Specific feedback includes point-by-point details. It also goes in quiet detail for the corrective actions suggested by the feedback giver to the feedback receiver. Specific feedbacks are helpful in improving all the areas that are required to achieve a goal.

## **SESSION 3: Communication Barriers and Its Measures**

### **Exercise**

#### **1. Is it true that every communication may have certain barriers? How?**

There is nothing like perfect communication environment or process. Barriers are always there in any kind of communications such as environment, noise, prejudice, body language, emotions etc.

#### **2. How do communication barriers adversely affect communication cycle?**

Not using simple, non-ambiguous, clear and relevant language. The image and impression of the other person makes us prejudiced towards him and we judge according to it what he/ she says. Disability in hearing, negative body language, difference in accent, pronunciations, customs & culture, noise, distance, location etc. adversely affect our communication cycle.

#### **3. List certain major communication barriers in day to day communication.**

Language, inappropriate emotions, perceptions and prejudice, body language, cultural and language differences, noise, physical barriers.

#### **4. List major ways to overcome common communication barriers.**

Be prepared, use of suitable language, right emotions and attitude, drop prejudices, handle physical challenges, positive body language, establish expectations, proper use of communication medium.

#### **5. List some day-to-day real life communication barriers you have observed.**

Emotions, attitude, language, lack of attention, improper body language, prejudice and perceptions.

#### **6. How does body language pose barriers in communication? How can we take care of it?**

Often, signals from body language are either avoided or misinterpreted. The reason is that body language signals are too fast, simultaneous and dynamic. There could be several possible reasons of incorrect devious body language signals such as a person looking dull may be not well but still be interested in what you say or a person giving cold handshake may still come up as enthusiastic and confident during later communication process.

## SESSION 4: Principles of Effective Communication

### Exercise

**1. Identify the types of phrase in the following paragraph.**

Please refer to question A of Session 5. Use this question there.

More questions for this session:

**1. How can you say that a communication done is effective? Take a small example.**

If the communication purpose is established, it is clear, complete with no ambiguity and is based on right facts then we can say that it is done effectively. For example, when teacher mentions the objectives of the classroom session then it is clear, complete and based on facts such as “After this session, you will be able to list 3 advantages of computers.”

**2. What factors determine an effective communication?**

Sender, proper encoding of message, communication channel, proper decoding of message, complete, clear, short, correct and concrete message.

**3. List any 5 characteristics of effective communication**

An effective communication is:

1. based on right facts and clear.
2. concise and to-the-point.
3. helps in developing relationships and goodwill.
4. leads to achieving set goals and outcomes.
5. establishes clear responsibility of the people involved in the process.

**4. List 7 Cs of effective communication.**

Complete, concise, considerate, clear, concrete, courteous and correct.

## SESSION 5: Basic Writing Skills

### Exercise

**A. Identify the types of phrase in the following paragraph:**

pleasantly surprised (adjective) meeting her friend (verbal), at the airport (prepositional). had been sitting (verbal), in the waiting lounge (prepositional), spotted her (verbal and noun). a lot of experience (noun), time flied very fast (verb, adverb), boarded the same flight (verb), bound to Mumbai (prepositional).

**B. Identify the parts of speech in the following paragraph:**

NOUN	PRONOUN	VERB	ADJECTIVE	ADVERB	PREPOSITION	CONJUNCTION	INTERJECTION
Girl	Her	Lived	Poor	Very much	On	Who	Wow
Anna	She	Thought	New	Suddenly	In	So	Alas
Mother		Loved	Useful		To	And	
Year		Thinking	Beautiful			Which	
Gift		Sew	Long			But	
Hair		Buying	Colourful				



hair ribbons		Wished	Too old				
Clothes		Buy	Shining				
Villagers		Did	Enough				
set of needles		Got	Short				
Threads		Called					
glass box		Said					
Money		Have					
Idea		Saying					
eve of new year		Remove d					
Cap		Showed					
Barber		Bought					
		Selling					

### Exercise

#### A. Identify main clause and conjunctions in following Complex Sentences:

MAIN CLAUSE	CONJUNCTION
1. The science show was very interesting	as
2. that he's rich and famous	Now
3. he trained thoroughly	Even though
4. winter is coming	Since
5. she was younger	When

#### B. How can you say that following sentences are compound sentences:

The following are compound sentences because they have two independent clauses (undelined) separated by conjunctions (bold)

1. She walked to class, **but** Ravi ran.
2. I like pizza, **but** my brother likes green vegetables.
3. The nurse held up a doll, **and** the little girl giggled.

### Exercise

#### A. Fill in the blanks with the suitable article:

1. the
2. The
3. an
4. a
5. The

#### B. Is there anything wrong with these sentences? Why?/ Why not?

All sentences are okay because 'the' is not used before sports name, food item, metal name, proper noun, food name like breakfast, lunch, dinner and colour name.

### Exercise

#### 1. Write a paragraph with a topic on the following hints:

Traveling is fun with adventure. It is a good hobby as it presents opportunities to visit new places and meet interesting people. Travelling lets us make new friends in far places. We get to learn about various cultures, a variety of languages and cultures. Visit to different places enhances knowledge, we meet different people. It accounts for good for health since a tourist is an active

and dynamic person. Travelling keeps us fit. Travelling is also a good career option. One can write about the places travelled and publish them in the form of books, blogs and articles. When we meet different cultures and people, we develop an understanding about them, It inculcates good habits such as patience, care, love and concern for others. Overall benefit of travelling is that it improves personality. The only downside of travelling is that it is an expensive hobby. It needs money to travel to different places. Food, stay and other related expenses make it an exclusive hobby. It also claims a lot of time.

## **Assessment**

### **1. Describe briefly how we can ensure effective verbal communication.**

We can ensure effective verbal communication by active listening, asking questions, being clear on the agenda of the communication, by encoding correct, clear and complete messages, by using proper language and vocabulary, by being prepared before communicating, by anticipating responses for better communication, by avoiding out-of-context references.

### **2. How is active listening important in verbal communication?**

In oral communication attention is the key. Sufficient amount of attention helps understand the message and decode it correctly. Active listening also enables us to ask correct questions to seek any clarity. This leads to mutual understanding and overcomes any barriers. It also helps in avoiding any conflicts later.

### **3. How does body language affect our non-verbal communication?**

Confident and clear voice, direct, frank eye contact reflects confidence, truth and sincerity. Eye contact engages others in our conversation. Positive postures and gestures reflect interest, suitable smile, understanding, sincere eyes, composed and calm face and proper use of personal space together make our body language positive.

Unclear speech, low voice, improper eye contact reflects lack of confidence or you are lying, fidgeting, slumping, changing posture frequently show lack of interest, frown, grimace, lack of smile, and not respecting personal space together make our body language negative.

### **4. List some positive body language signs concerning body posture, gestures, expressions, eye contact, touch, personal space and voice.**

Erect stance, relaxed, straight posture, attentive eye contact, sincere nod with the face, sitting with open hands, straight shoulders are signs of positive postures and gestures. Direct, frank eye contact reflects confidence, truth and sincerity. Eye contact engages others in your conversation. Proper handshake and touch. Being respectful to other people's personal space creates a good impression and people open with you quickly. Clear and confident voice.

### **5. How is visual communication different from general communication we do day-to-day?**

In visual communication, message is decoded and encoded in the form of symbols, pictures, graphics, signs and charts etc. Visual communication is required where message has to be communicated quickly such as traffic signals. Visual communication supports general communication. General communication is suitable where detailed process is needed to communicate information. General communication relies on the language and body language.

### **6. What important role does feedback play in effective communication?**

Without feedback communication cycle is incomplete. Feedback helps in further communication during the process. Suitable feedback prepares us for next response in a better way. Feedback completes the communication cycle by achieving the set goals. A good feedback enhances the quality of communication, increases productivity and helps in performing well to achieve the goals.



## 7. List certain ways of giving and receiving feedback.

### Providing Feedback

- Give positive feedback.
- Feedback on behaviour and attitude.
- Discuss negatives tactfully and suggest improvement.
- Do not be personal in giving feedback.
- Chose a place where no one should disturb.

### Receiving Feedback

- Do not interrupt the feedback giver.
- Listen attentively.
- Keep positive body language.
- Understand that feedback is not criticism.
- Be in self-control.
- Ask short, specific questions.
- If needed, ask time to prepare for your response.

## 8. How are general and specific feedback different? What is the advantage of specific feedback?

General feedback is quick feedback. It takes shorter time. This helps in achieving short term goals and quicker improvements. General feedback covers just those details which are useful in improving on just those actions which are required further to improve upon the performance.

Specific feedback is a detailed feedback and includes point-by-point findings. It also details upon the suggestions for improving on the gaps. Specific feedbacks are helpful in improving all the areas that are required to achieve a goal.

## 9. What do you mean by communication barriers? How can we overcome these barriers?

Any factor or element that affects the communication process adversely is called communication barrier. There are several factors that constantly function as barriers for better communication. Physical conditions constitute the environment of communication. Hot or cold room, bad seating, poor light, defective communication medium, slow speed of internet while interacting online are environmental barriers in communication. These can be anticipated and taken care of in most of the cases.

Noise, distractions of any sort, distance, undesired turn of events during the communication process are situational barriers which are sometimes difficult to anticipate and need to be handled deftly as they occur.

We tend to jump to conclusions. Emotional state, patience level, temperament, liking and disliking of the communicators are some barriers in effective listening. Unprejudiced, fair and attentive listening is a skill that can be developed slowly for successful receiving and decoding of the message.

## 10. Describe some important principles of effective communication.

- Setting up a communication code: Communication code means deciding the manner in which the communication must occur. The language, environment and mode of communication also help in setting up the code of communication.
- Proper message encoding: For effective communication, message needs to be encoded well. Such message is clear, complete and correct. Well encoded message has clear purpose.

- Proper message decoding: Decoding of the message is done by the receiver. It means how the receiver interprets the message. Active listening, being aware of the purpose of the communication and a considerate temperament are the keys to correctly decode the message.
- Suitable response to the message: The suitable response of the receiver is also an important factor. This decides further progress of successful communication.

### 11. Describe any 5 Cs of effective communication.

- Complete Message: A message should cover who, what, when, where, why and how. Who this message is meant for?, What exactly do you need to convey?, When is the right time to communicate?, Where are the participants?, Why do you need to do this communication?, How are you going to communicate?.
- Concise Message: Concise message is short but complete or appropriately sized. Message with unnecessary details adds to confusion. A too short message may not be clear or incomplete.
- Considerate Message: Consideration makes a good communicator. A considerate communicator keeps the requirements of the recipient. Such as language of the message should be easier for receiver to understand.
- Clear Message: A clear message is always in plain, easy language with no unnecessary details to avoid ambiguity and confusion. Message should have facts specified in short and simple sentences.
- Concrete Message: A concrete message mentions expected outcomes of the communication. Concrete message focuses on the central idea and purpose of the communication.

### 12. What do you mean by complete, concise and concrete message?

Complete message should cover who, what, when, where, why and how. Who this message is meant for?, What exactly do you need to convey?, When is the right time to communicate?, Where are the participants?, Why do you need to do this communication?, How are you going to communicate?.

Concise message is short but complete or appropriately sized. Message with unnecessary details adds to confusion. A too short message may not be clear or incomplete. Concise message contains necessary and relevant information.

A concrete message contains expected outcomes of the communication. Concrete message encompasses the core idea and purpose of the communication. It avoids unnecessary details to prevent confusion.

### 13. How is a phrase different from a sentence? Give 2 examples.

A set of words that indicates some object or action but does not makes complete sense is called a phrase while a group of words that makes complete sense is called a sentence.

A phrase is a part of a sentence. For example:

Phrase: a red bicycle

Sentence: Lata is riding a red bicycle.

Phrase: is sitting

Sentence: The monkey is sitting on the tree.

### 14. Giving 2 example each, explain compound and complex sentence.

Compound sentence: A compound sentence has at least two main, independent clauses and may have subordinate clauses. All clauses are separated by conjunctions (like and, but, while, when, which, whereas, therefore etc.)

E.g. I would like to have a coke or a cold coffee.

Here, or is conjunction joining two main clauses - have a coke and a cold coffee.

Complex sentence: A complex sentence has only one main clause and at least one subordinate clause.. E.g. She was not happy with Ravi because he was late for work.

[first clause is main and second one is subordinate]

Because Ravi was late for work she was not happy with him.

[first clause is subordinate and second one is main]

**15. How does article differ in usage for consonants and vowels? Explain with 2 examples.**

Indefinite articles, 'A' and 'an' are indefinite articles which are used with singular noun.

For example,                      There bought a book.    I saw an aeroplane.

Article 'an' is used before vowel sounds and 'a' is used before a consonant sound.

For example,                      He eats an apple daily.    Butterfly is an insect.

**16. Site 4 examples where article "The" could be used.**

Specifically for a person – Ravi is the captain of his school cricket team.

The Time is a famous magazine world over.

We went to see the Taj Mahal last week.

I bought a new book today. I will read the book at night.

**17. What are the basic rules of good paragraph writing?**

Keep the focus on the topic.

Break longer text into smaller paragraphs.

The sentences in the paragraph describing the topic should have a logical sequence.

Avoid repeating same thing through different sentences.

When you conclude the paragraph, it should cover the central idea of the topic.

**18. To wrote an essay about your school, which basic writing skills would you apply?**

An essay is a long piece of text composed of several paragraph. So, the main topic of the essay will be divided into smaller sub-topics. Each sub-topic will be described in one or two paragraphs. To compose these paragraphs, we shall apply the paragraph writing rules and then assemble all the paragraph together to complete the essay. In the ending paragraph of the essay, the central idea of the main topic will be described as short summary. This way, a big essay will be divided into multiple paragraphs to be written and arranged in a logical sequence.

## **Unit 2: Self-Management Skills – II**

### **SESSION 1: Stress and Its Effects**

#### **Exercise**

**1. What do you mean by stress? What is the difference between eustress and distress?**

When body and mind try to adjust with the changes around us, we go into a state of stress. Eustress is the good effect of stress like we feel elated when we pass the exam with flying colours. Distress is negative form of stress like we feel discouraged when we fail in achieving something.

**2. List some common symptoms of physical and psychological stress.**

Common physical effects of distress: Headache, Muscular tension, fatigue, chest pain, upset stomach, disturbed sleep and low energy.

Common psychological effects of distress: Anxiety, feeling demotivated, loss of attention, depression and frustration, angry outbursts, drug and alcohol abuse, social withdrawal, over reaction.

**3. List some distress symptoms due to over-work or over-study.**

Headache, fatigue, disturbed sleep, low energy, anxiety, feeling demotivated, loss of attention, depression and frustration, angry outbursts and over reaction.

**4. How does stress affect working women?**

Working women experience tremendous stress. Taking care of domestic chores and home making becomes difficult. Balancing with relations, friends and work causes a great deal of stress.

### **5. What do you mean by internal stress?**

Internal stress is the outcome of our thought process. It is more of a mental state that brings about anxiety, fear of any possible problem, unrealistic expectations etc. Internal distress needs to be dealt with timely otherwise it may cause headache, heart trouble, insomnia, memory loss, loss of focus etc.

### **6. What is fight-flight-freeze response?**

Fight-flight-freeze is the response due to need of survival in sudden danger. One part of our nervous system controls fight-or-flight response. This prepares the body for violent response. After the response is through, other part of nervous system helps body to return to normal condition.

In freeze response, body is unable to respond for certain duration until the danger passes or the victim succumbs to the danger. This response triggers when impending danger seems too much to deal with. It also triggers during certain very normal situations such as public speaking.

## **SESSION 2: Stress Management Techniques**

### **Exercise**

#### **1. Being a student, list some common stress symptoms you feel.**

Students should answer this themselves.

#### **2. List the sources of this stress.**

Students should answer this themselves.

#### **3. List some good working or study habits.**

- Discipline and plan.
- Do not try to please everyone. Leant to say no if you really cannot help something.
- Keep work-family balance. For scholars, keep a study-recreation balance.
- Plan your breaks and holidays.
- Stick to deadlines or self-study timetable.
- Do not over-work or over-study.

#### **4. How will you manage internal stress?**

- Positive attitude.
- Adapt to the changing situations as much possible.
- Be firm not angry or aggressive.
- Keep fit.
- Manage time effectively.
- Good sleep, laughter, hobbies, good meal.
- No smoking, alcohol and any such vice.
- If needed, seek medical advice.

#### **5. How does going on vacations, morning walks and following a hobby help in reducing stress?**

Take nature walks or early morning walks to relax the mind and re-energise the body. Going on vacations boosts energy due to change of place and climate. Following a hobby boosts positive stress.

## **SESSION 3: Ability to Work Independently**

### **Exercise**

#### **1. What do you mean by working independently?**

Being able to work independently means accomplishing the tasks assigned to you without unnecessarily claiming the time of other people. It means you are aware of your strengths and weaknesses, able to adapt with the team, own your task and take responsibility of any mistakes.

## 2. List the skills required to work independently.

- Ability to organise work as the needs arises.
- Personal integrity.
- Ability to handle multiple tasks efficiently.
- Self-awareness of abilities and limitations.
- Self-discipline and self-regulation.
- Communication skills.
- Ability to adapt to the changing situations.
- Handling failures and setbacks positively and responsibly.

## 3. What do you mean by multi-tasking, self-discipline and agility?

Multitasking means doing multiple tasks as per their priority and completing all of them successfully.

Self-discipline and self-regulation come from self-management. Able to identify time-wasting activities. Knowing how to regulate yourself to utilise the time at hand for completing tasks timely.

Ability to adapt to the changing situations and managing time accordingly is called agility. Delivering with short time lines and knowing how to utilise time effectively.

## 4. Can you cite any failure which became a learning experience for you?

Students should answer this themselves.

## 5. What are internal and external self-awareness?

Internal self-awareness: This is built on our value and belief system. Our values determine our passions and standards. With self-awareness we get familiar with them. These help us in dealing with our surroundings and situations.

External self-awareness: When we can successfully assess how other people view us is called external self-awareness. The benefits of external self-awareness are self-improvement, leadership skills, interpersonal skills etc.

## 6. List some ways to become self-aware.

- Reflect on your thoughts.
- Practice good listening and become a good listener.
- Ask for feedback from others about yourself.
- Think in terms of “what” instead of “why”. For example, What could be the possible reasons instead of why it is happening to me?

## 7. How self-motivation and self-regulation help you achieve your goals?

Self-motivation enables us to take action on our ideas and thoughts. Our weaknesses control our self-motivation. To counter this, we need to be self-aware. Being self-aware in a proper way helps us convert our thoughts into actions. For this self-regulation and discipline is also necessary. By using all our strengths and abilities we overcome our weaknesses which brings in self-regulation and which, in-turn, helps us achieve our goal.

## Assessment

### 1. What do you mean by the term self-management?

Managing oneself in order to achieve desired goals and targets is called self-management. Every task we do has a thought process behind it. This gives birth to a plan to follow in order to accomplish that task. Self-management **Exercise** which involves management of resources, time management, identifying goals to achieve and prioritizing the goals.

### 2. Why is self-management important for us?

Self-management brings inspiring personality, clarity of thoughts, respect for the importance of time, higher achievement rate, self-discipline, social popularity.

### **3. Differentiate between eustress and distress with example.**

Positive stress is known as eustress while negative form of stress is called distress. Eustress is commonly identified by excitement, elation and charging up of emotions. Like, when we get promoted to a higher class, we feel happy, excited, elated. Eustress promotes positive feelings like motivation, positive energy, excitement. But eustress is generally short term.

Distress is the reaction of our body to the harmful situations - real or imaginary. Distress affects us physically as well as psychologically. Headache, muscular tension, fatigue, disturbed sleep, anxiety, feeling demotivated etc are symptoms of distress.

### **4. Discuss how stress affects us physically and psychologically.**

Distress is the reaction of our body to the harmful situations. Distress affects us physically as well as psychologically.

Common physical effects of distress: Headache, Muscular tension, Fatigue, Chest pain, Upset stomach, Disturbed sleep and Low energy.

Common psychological effects of distress: Anxiety, Feeling demotivated, Loss of attention. Depression and frustration, Angry outbursts, Drug and alcohol abuse, Social withdrawal, Over reaction.

### **5. What is chronic distress? Discuss stress in professionals due to work.**

Distress which is ignored for a long time and then it becomes like a habit. It seriously affects our body and mind. Our profession determines the amount of stress. Some common reasons for work related distress are higher performance expectations, difficult deadlines, job insecurity, team conflicts, differences with superiors, working conditions and hours etc.

### **6. What do you mean by internal distress? How will you manage it to reduce its adverse effects?**

Anxiety, fear of impending disaster, unreal worries. Internal distress builds up inside and leads to headache, heart ache, insomnia, memory loss, chronic anxiety, high blood pressure and loss of focus.

Some tips to deal with internal stress are:

- Positive attitude.
- Adapt to the changing situations.
- Keep fit.
- Manage time well.
- Good sleep, laughter, hobbies, good meal etc.
- Quit smoking, alcohol and any such vice.
- If needed, seek medical advice.

### **7. Explain the distress effects due to environment and surroundings.**

Our unsuitable surroundings and environment cause distress. When we talk about environment, there are following two aspects:

Quality of surroundings: Noisy, dirty, polluted, crowded, low quality of life (food, water, electricity and other amenities)

Work and living conditions: Distractions, congested work place, interaction and relationship with people, shabby place.

### **8. Explain fight-flight-freeze response during mortal danger. How does our nervous system handle this response?**

Fight-flight-freeze is the response due to need of survival in sudden danger. One part of our nervous system controls fight-or-flight response. This prepares the body for violent response. After the response is through, other part of nervous system helps body to return to normal condition.

In freeze response, body is unable to respond for certain duration until the danger passes or the victim succumbs to the danger. This response triggers when impending danger seems too



much to deal with. It also triggers during certain very normal situations such as public speaking.

**9. How can we identify the source of stress?**

Find answers to the following questions:

- What are the real reasons of my anxiety? (Are they real or imaginary?)
- Am I working under pressure for long? (Do I need a break?)
- Do I really feel right? (Am I not well or need to take medical advise?)
- Am I emotionally upset at something or someone? (Do I need to talk to someone?)
- Are my activities time-wasting? (Do I need to review my working or study plans?)

**10. How can healthier life style help us manage stress well?**

- Avoid smoking/ alcohol/ drugs. These are not medicines and always cause harm.
- Good eating habits to control over or undereating as well as quality of food.
- Develop good sleeping habit. Sufficient sleep of 6-7 hours is a must for brain to function well. Avoid spending late hours with cellphone or TV. Go to bed timely and regularly.
- Inculcate creative hobbies to boost health and activate mind such as painting, gym, sports, yoga, etc. Spend quality time with family and friends to keep off stress.
- Keep good company of positive, happy people and avoid people with negative thoughts, who always discourage or talk low-esteem.

**11. What are the healthy working or study habits that help reduce stress?**

- Bring a schedule and plan in work and study. Consider time planning. Avoid procrastination.
- Do not try to please everyone. Leant to say no if you really cannot help something.
- Plan to keep a balance between work and family. For scholars, keep a study-recreation balance.
- Plan your breaks and holidays and try to enjoy them fully.
- Stick to your plans or timetables.
- Avoid over-work or over-study.

**12. How can you say that sometimes eustress helps in counterbalancing distress?**

In most of the cases, it is not possible or it is difficult to change your surroundings, environment, working conditions, school or college. We can still do certain things to adapt well in such case like taking nature walks or early morning walks to relax our mind and re-energise our body, going for vacations for a change of place and climate and return with boosted energy, adopting hobbies to boost your eustress and participating in community activities.

**13. List some tips to manage environmental stress.**

- Take nature walks or early morning walks to relax your mind and re-energise your body.
- Go for vacations for a change of place and climate and return with boosted energy.
- Adopt yoga, fitness training, activity club to boost your eustress.
- Participate in community activities that help in improving environment and surroundings like anti-pollution drive, swachhta abhiyaan activities etc.

**14. Despite the importance of team work, how does the ability to work independently helps an individual? Give example.**

Most of the tasks are accomplished through teamwork. But there are many cases where our ability to work independently is important. Working independently is not like working alone. Being able to work independently means accomplishing the tasks assigned to you without unnecessarily claiming the time of other people. For example, if you are a part of the Green Club team in your school which has planned to plant certain tress in a locality. You are assigned to collect funds for procuring seeds for 20 trees by next Sunday then no other team member should help you in this. It is something you need to do independently.

**15. List some major traits of an individual able to work independently.**

- Ability to organise work as the needs arises.
- Personal integrity.
- Ability to handle multiple tasks efficiently.
- Self-awareness of abilities and limitations.
- Self-discipline and self-regulation.
- Communication skills.
- Ability to adapt to the changing situations.
- Handling failures and setbacks positively and responsibly.

**16. Write a note on personal skills discussing their benefits.**

Personal skills are self-developed by self-motivation. Personal skills help us to accomplish our tasks with our own efforts alone. This ability us to work independently in different ways such as organising our work, managing multiple tasks, being aware of our limitations and strengths, self-management and ability to handle failures. Personal skills give us efficiency to stand out in our performances.

**17. How can we say that one is self-aware? Explain two types of self-awareness.**

When we are aware of our strengths, weaknesses and beliefs etc. then it is called to be self-awareness.

Internal self-awareness: Our values, beliefs, passions and standards are discovered by internal self-awareness. These traits help us in adapting to our surroundings and environment. Internal self-awareness helps us determine our favourite subject, sports, our aspirations, likes, dislikes. Our attitude is determined on these values.

External self-awareness: Ability to assess other people's viewpoint about us is external self-awareness. It helps in self-improvement, honing good leadership skills, understand people and determine people's liking/ disliking about us. External self-awareness helps us deliver tasks in a better way.

## Unit 3: Basic ICT Skills – II

### ASSESSMENT

**1. Define the term Operating System. List its 3 major functions.**

Operating system is the system software that controls entire functioning of a computer system. It also acts as an interface between the user and the computer system.

Three major functions of an operating system are:

1. Managing applications and giving them access to hardware services.
2. Managing data and system resources.
3. Providing user interface to work with the computer system.

**2. List some major operating systems of different types.**

Single user OS – DOS, Multi-user OS – Unix, Windows, Real-time OS – Cocoon, Mobile OS – iPhone OS, Android, Distributed OS – Windows Server.

**3. What do you mean by the terms Icons, Desktop and Taskbar?**

Small pictures on the screen that denote a program are called icons. The screen that appears when operating system is loaded is called Desktop. Desktop is the basic component of GUI. Every part of GUI appears over the desktop. Usually, a horizontal bar at the bottom of the screen is called Taskbar. It contains Start button and various other buttons on it. It also displays information such as time and notifications etc.

**4. What is the use of Computer icon and Recycle Bin?**

Computer icon is found in the desktop. It opens the Computer window which shows the drives, files and folders on the computer system. Recycle Bin icon is also found on the

Desktop which opens Recycle Bin window. Deleted files are found in Recycle Bin from where either they can be permanently deleted or restored back.

**5. How do you move or copy computer file from one location to another?**

Easiest way to move or copy a computer file from one location to another is to first select the desire file and press Ctrl+C to copy or Ctrl+X to move (cut). Then, go to the destination location and press Ctrl+V to paste the file there.

**6. How is a file different from a folder?**

A file stores the data such as text, numbers or multimedia like picture, video, audio etc. Depending on the data they store, files are of different type such as simple text file, video file, audio file etc. Files are identified by their primary names and their types are identified by their extension names e.g. story.txt is a text file while house.jpg is an image file.

Folder stores files and other folders called sub-folder. Folders help in organizing our data on the computer. Folders are like sections of cupboard to keep different objects.

**7. What is the difference between moving and copying a folder?**

Moving the file (Ctrl-X to cut and Ctrl+V to paste) means that the same file is shifted to the new location. Copying the file (Ctrl-C to copy and Ctrl+V to paste) means the original file remains in its original location and its copy is created in the new location.

**8. Why is it necessary to maintain your computer system regularly?**

As we work on the computer system over the time, computer is loaded with the files we create and it takes more time to access the files on the disk. A lot of files created earlier become useless over the time. To tidy up the computer with necessary files organised properly on the disk, we need to maintain the computer. In addition to this, computers also need physical care such as regular cleaning, safety form dust and moisture etc. We also need to keep computer safe from harmful programs such as viruses and from unauthorized access when it is online.

**9. What is the use of disk defragmenter and disk cleanup utilities?**

Defragging means joining the pieces together. Computer stores larger files by breaking them into parts as the space is available on the disk. This makes the file access slower. To rearrange the files on the disk, we need defragmenter utility. Disk cleanup is useful to remove unnecessary clutter of files and data from the disks to make more space on the disk.

**10. Why are regular backups of data important?**

Computers are basically used to process data and to store it on the disks. If anything goes wrong with the computer system and it crashes due to any reason such as virus, electrical spike, accidental delete, data corruption, physical damage to the disk etc., then data can be restored if it has been backed up earlier. It is due to these reasons, we need to take regular data backups on a separate storage media.

**11. What preventive measures should we take against computer viruses?**

To prevent computer virus we need to practice basic internet discipline such as avoiding opening untrusted emails and websites, use spam filters, use strong passwords etc. To protect the computer we should take regular data backups and install updated antivirus and updated genuine operating system.

**12. List any 5 symptoms of a computer virus.**

5 common symptoms of a computer virus are slowed down computer speed, sudden system crash, sudden computer restart, programs responding too slowly and strange error messages.

**13. List any 4 practices to keep your computer work smoothly for a longer time?**

1. Keep the computer clean, safe from dust and handle the device carefully.
2. Ensure proper usage of the computer such as proper shutdown.
3. Regularly maintain computer by running computer maintenance utilities, anti-viruses and operating system updates.
4. Use genuine software and avoid accessing unknown resources, websites and emails when online.

**14. List 3 types of viruses.**

Boot sector virus, File virus and Macro virus.

**15. How can you say that a computer is infected by some virus without running any antivirus?**

Viruses corrupt the files and interfere in the proper functioning of the computer system. Some common symptoms that indicate the presence of viruses on a computer are slowed down computer, computer taking too long to start, strange, unwanted files created, files renamed or deleted on their own, strange notifications and messages pop-up, programs taking too long to respond, storage media seems busy for a longer duration etc.

## **Unit 4: Entrepreneurial Skills - II**

### **SESSION 1: Characteristics of an Entrepreneur**

#### **Exercise**

**1. How entrepreneurs positively contribute to society?**

Entrepreneurs do a lot of good to the society. They earn money with great struggle and pay taxes thereby returning back to the economy. They take green initiatives for sustainable development and use resource efficiently for the sake of society.

Entrepreneurs help enhance the living standards of community. They create employment and their innovations help improve the quality of life of all the stakeholders such as employees and customers.

Entrepreneurs are self-employment. They grow their business to provide more job opportunities and address the problem of unemployment up to some extent.

**2. List main characteristics of an entrepreneur.**

Entrepreneurs are great planners. They possess remarkable confidence. They are creative, risk takers, and professional in their approach. They are innovative thinkers and are always open to challenges. They know how to deal with failures. They have social and leadership skills. They are a passionate people.

**3. What are the main functions of an entrepreneur?**

Management: Predicting outcomes, planning various operations, organising, coordinating and controlling the team, monitor various functions and perform interactions with employees and customers.

Sales and Promotion: It deals with earning revenues and developing business relations. Dealing effectively with customers, promoting the innovative product and creating sales strategies.

Finance and Commerce: Identifying sources of funding and associating with prospective investors. Commercial functions include monitoring various operations of the business such as production, manufacturing, service delivery etc. Participate in financial transactions, analysing the financial figures and plan ahead.

### **SESSION 2: Role and Significance of an Entrepreneur**

#### **Exercise**

**1. How do entrepreneurs enhance living standard of people and create jobs?**

Entrepreneurs play a key role in increasing the standard of living in a community. They create jobs and also develop and adopt innovations leading to improved quality of life of their employees, customers, and other stakeholders in the community.

Entrepreneurs create opportunities for jobs. They take risks of self-employment. As their business grows, opportunities for more jobs are created. This greatly contributes to the eradication of unemployment problem in the nation.

## **2. How do entrepreneurs contribute to industrial development and economical growth?**

Entrepreneurs setting up new businesses and industrial units help with regional development by locating in less developed and backward areas. The growth of industries and business in these areas leads to infrastructure improvements like better roads and rail links, airports, stable electricity and water supply, schools, hospitals, shopping malls and other public and private services that would not otherwise be available.

India's MSME sector, accounts for over 35% of the country's GDP by making use of resources like land, labor and capital that add to the national income, national product and per capita income of the country.

## **3. How do entrepreneurs mobilise public wealth and contribute to society?**

By establishing the business entity, entrepreneurs invest their own resources and arrange for capital and investments. The source of funding may be investors, lenders and the public. This mobilizes public wealth and benefits people as well as all stakeholders in the form of the success of the growing business. This kind of contribution of funds from different sources makes the foundation on which the business entity is erected.

Entrepreneurs often do more for the greater good than the average person. They make honest money with great struggle and pay for taxes and public services thereby contributing and returning to the economy. Many of them take green initiatives for environment and contribute to the charities for social causes.

# **SESSION 3: Myths Related to Entrepreneurship**

## **Exercise**

### **1. Do you think entrepreneurship is easy? Why/ Why not?**

No. Entrepreneurship involves greater risks. Conceiving an innovative service or product is challenging in itself. Then convincing people of your idea and mobilising funds also needs a lot of efforts. Making the service/ product reach the masses and get accepted is another barrier to scale. At every step there are new kind of challenges.

### **2. Entrepreneurs have a time-bound schedule. Do you think this statement is true? Why/ Why not?**

Yes. An entrepreneur walks, talks, eats and sleeps his/her dream. They do not have the time-bound schedule of an employee. They also do not have luxury to hire a big team that works for them. They are actively involved in all processes of their venture so there is no time-bound schedule for them. They have luxury of flexibility but idea of freedom is a big myth.

### **3. Is it a myth that every start-up should begin with a new product or service?**

Entrepreneurs do the things differently or innovatively. As an entrepreneur if you have a new product to offer, up is good but most start-ups have found innovative and creative ways in offering the same products and services. This is called disruption. Paytm, Uber, Ola etc. are disruptions.

### **4. Do start-ups need a huge amount of funds to begin? Explain.**

One aspect of innovation is thinking of an idea which can be launched at a smaller scale that can start with a small amount. At later stages, it can be scaled up to bigger product and using

more funds as it would be easier to do so once brand is established in the market. Most of the start-ups begin at small scale, home based ventures.

## SESSION 4: Entrepreneurship as A Career Option

### Exercise

- 1. Find some good entrepreneurship course on internet. Make a small write up about them and the institutes that provide these courses.**

Students should devise this answer themselves as instructed in the question.

- 2. Go to entrepreneur.com, business.com and franchise.com and spend some time there to find out what sorts of business opportunities are there for youth.**

Students should devise this answer themselves as instructed in the question.

- 3. List a few advantages of entrepreneurship.**

Some common advantages of having entrepreneurship as career are:

1. Control: You plan, chose and design the things the way you need or like.
2. Excitement: Each day brings its own challenges, opportunities, risks and rewards.
3. Flexibility: Working hours can be planned as per the required work and commitments.
4. Freedom: In terms of location, timings and team building there is comparatively more freedom.
5. Recognition: Once business grows, people begin to recognise you and get inspired by you.
6. Growth: You can determine the pace of start-up's growth as you require.

- 4. List a few disadvantages of entrepreneurship.**

Some common disadvantages of having entrepreneurship as career are:

1. Competition: You need to be on constant lookout to update yourself on the competition in market.
2. Lone struggling: Entrepreneurs are normally a small team. Struggle is not contributed by many stakeholders. Mostly risk taking lies on the entrepreneur him or herself.
3. No regular income: Income in business is not predictable. It directly relates to your efforts and revenues earned.
4. Greater responsibilities: As an entrepreneur you own everything so you shoulder the bigger responsibility of all the processes and functions in your business.
5. Longer working hours: There are no fixed hours and days for an entrepreneur. He/ she eats and sleeps the business. They always think what new can be added for further growth.
6. Funding and finances: If business goes down, managing new finances could be difficult.

### Assessment

- 1. Describe any 4 characteristics of an entrepreneur?**

Entrepreneurs are some of the world's most powerful transformers. Elon Musk, Bill Gates, Steve Jobs are entrepreneurs who imagine the world differently.

Entrepreneurs know what they wish to achieve and they have a plan to achieve it. They are creative. Creativity causes innovations. Innovative ideas come out of the box thinking and the



base of it is creativity. They take risks. They are skilled in social interactions and open to knowledge, learning and failures. Entrepreneurs like to work with democratic teams. Entrepreneurs resolve conflicts and recognise the good achievements. They are customer oriented and passionate. If they meet the failures, they look for what had gone wrong and how it could be corrected. Then, they set on with even more passion to retry. Entrepreneurs are leaders. An entrepreneur leads by example and for customers he demonstrates a code of ethics which are qualities of a leader.

**2. How can you say that 'innovation' sets the entrepreneurs apart from businessmen?**

Creativity is a basic skill of an entrepreneur. Creativity brings innovation. Entrepreneurs look around and observe the problems prevailing in the society. Then they think of a viable and innovative solution for that problem. The solution is built up in a planned way and sold to the target customers. The funds are arranged by loans or investors. In this approach of functioning entrepreneurs are different from businessmen. Businesses are launched with investments and creating a product which could be in demand and manufactured by others also. Business do not opt for innovations necessarily.

**3. List the functions of an entrepreneur.**

Management, sales and promotion, Finance and commerce.

**4. Discuss in brief any 3 major functions of entrepreneur.**

Management: Predicting, planning, organising, coordinating and controlling the team, functions and interactions.

Sales and Promotion: It influences the processes of bringing in revenues and developing business relations. Addressing the customer segment and promoting the innovative product, devising promotional strategy and activities are one of the prime concerns of an entrepreneur.

Finance and Commerce: Identifying sources of funding and getting prospective investors. Commercial functions include looking into production and manufacturing process or the processes related to service delivery. Involving into financial transactions, analysing the financial figures and plan ahead.

**5. How does entrepreneurship influence society and nation's growth?**

By their nature and motivation entrepreneurs are job creators. This kind of job creation by new businesses is very rewarding for nation's economy as it addresses problem of unemployment up to some extent.

Entrepreneurs set up new businesses and industrial units in less developed and backward areas. The growth of industries and business in these areas leads to infrastructure improvements like better roads and rail links, stable electricity and water supply, schools and other public and private services. Entrepreneurs play a key role in increasing the standard of living in a community. They develop and adopt innovations leading to improved quality of life of their employees, customers, and other stakeholders in the community. Entrepreneurs make honest money with great struggle and pay for taxes and public services thereby contributing and returning to the economy. Many of them take green initiatives for environment and contribute to the charities for social causes.

**6. List any 4 major myths about entrepreneurship.**

1. Entrepreneurship is easy to do.
2. You have more freedom in entrepreneurship.
3. You need to create an entirely new product or service to sell.
4. Lot of funding is required to start the business.

## **7. Discuss about any 3 myths related to entrepreneurship.**

Myth: Entrepreneurship is easy to do

Fact: Conceiving an innovative service or product is challenging in itself. Then convincing people of your idea and mobilising funds also needs a lot of efforts. At every step there are new kind of challenges.

Myth: You have more freedom in entrepreneurship

Fact: An entrepreneur does not have the time-bound schedule. They are actively involved in all processes of their venture so there is no time-bound schedule for them. They have luxury of flexibility but idea of freedom is a big myth.

Myth: You need to create an entirely new product or service to sell.

Fact: Entrepreneurs do the things differently or innovatively. As an entrepreneur if you have a new product to offer, it is good but most start-ups have found innovative and creative ways in offering the same products and services. This is called disruption. Paytm, Uber, Ola, Netflix, Savn, Olx etc. are disruptions.

## **8. Write a brief note on how entrepreneurship can be a good career option.**

Entrepreneurship is a vast field providing several opportunities and choices to make from. You can begin your own start-up with an innovative idea or you can associate with an existing start-up and contribute to its growth.

As a career it is suitable for people who work independently. They are passionate and ambitious. They believe in their ability to generate wealth for self and opportunities to earn and grow for others.

Today various short-term and fulltime entrepreneurship courses are available which can be pursued to prepare before actually starting with a start-up. Universities and private management institutes provide a range of courses to choose from. These courses prepare you with necessary skills and knowledge required to become an entrepreneur.

Many business follow up franchising framework to grow their business. Advantages of taking a franchisee of a business that you save a lot of time and effort in establishing the business. As a franchisee you get a ready setup.

Instead of thinking and deploying a new idea, an existing business can be bought which has growth potential in future and then innovations can be added to it to give it a new shape.

## **Unit 5: Green Skills**

### **SESSION: Understanding Sustainable Development**

#### **Exercise**

#### **1. Define the term sustainable development.**

Sustainable development means the economic development that is achieved without harming and depleting natural resources. Sustainability is development that takes care of the needs of the present while being concerned about future generations, balancing between economic growths, care for the environment and social well-being.

#### **2. What are the 3 fundamental components or pillars of sustainable development?**

The three fundamental components to sustainable development are Economic development, Social development and Environmental protection. Economic development is about

providing incentives for businesses and other organizations to adhere to sustainability guidelines. Social development is about awareness and protection of the health of people from pollution and other harmful activities of business. Environmental protection is the need to protect the environment.

### **3. What are the 4 Ps of sustainable development? Explain them briefly.**

Sustainable development encompasses 4 Ps: People who represent the socio-cultural issues. Planet which represents the environmental issues. Profit that represents the economic issues. Policy which refers to visionary political leadership and implementation of policies needed to make sustainable development a reality. Today, countries are agreeing to the importance of conserving natural resources. Process is slow but has begun. People are adopting to greener ways that will improve their health, farmers are practicing smart agriculture and industries are realizing as to how much they can save through energy efficiency.

### **4. What is UN's sustainability development program 2030?**

On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development — adopted by world leaders in September 2015 at an historic UN Summit — officially came into force. Eradicating poverty in all its forms and dimensions is an indispensable requirement for sustainable development. There must be promotion of sustainable, inclusive and equitable economic growth, creating greater opportunities for all, reducing inequalities, raising basic standards of living, fostering equitable social development and inclusion, and promoting integrated and sustainable management of natural resources and ecosystems.

### **5. Go to <https://www.un.org/sustainabledevelopment/sustainable-development-goals/> and read more about UN's SDGs.**

To be done by students practically.

## **SESSION 2: Importance of Sustainable Development**

### **Exercise**

#### **1. Why sustainable development is necessary?**

Sustainable development is necessary because it will provide for essential human needs. Sustainable development promises to reduce struggle for basic amenities by growing population.

It addresses agricultural requirement. Sustainable development focuses on sustainable agricultural methods such as effective seeding techniques and crop rotation to promote high yields while maintaining the integrity of the soil, which produces food for a large population.

Climate change can be mitigated by sustainable development practices. Renewable energy sources like solar energy and nuclear energy are the better options.

Sustainable development practices have the ability to create more financially sustainable economies through renewable forms of energy.

Sustainable development practices encourage the use of renewable energy resources, and organic farming practices that are environment friendly.

#### **2. Discuss some examples of sustainable development.**

India as a responsible country has taken some environment friendly initiatives as below:

1. India earlier followed Kyoto protocol to fight climate changes and signed Paris agreement focusing on bringing down global temperatures.
2. India is second highest in the world, after China, in running 1500+ projects in energy efficiency, fuel switching and solid waste management.

3. Climate change programs focusing on water, agriculture, tourism, transport and forestry etc. are run in 32 states and union territories.
4. India levies carbon tax on industrial coal usage. Clean energy initiatives and research is funded under National Clean Energy fund created by this tax.
5. A huge fund has been provisioned to take care of the areas which are vulnerable to the adverse effects of climate and environmental changes.

## **SESSION 3: Sustainable Development: Challenges and Solutions**

### **Exercise**

#### **1. List some common challenges in sustainable development.**

Climate changes, energy usage, border conflicts, hunger and malnutrition, corruption, rapid urbanisation, lack of vision and policy.

#### **2. Discuss briefly why sustainable development is a challenge for developing countries?**

Achieving sustainable development requires global as well as local actions.

Global warming, floods, droughts, extreme winters and summers in many parts of the world create a barrier in achieving goals associated with sustainable development. Hunger and malnutrition in many countries is on priority than sustainable development.

War and border conflicts among countries shift the focus away from the priority of sustainable development. To accommodate the growing population due to decreased death rates, more and more agricultural lands and forests are converted into urban areas and cities.

Use of fossil fuel and coal needs to be minimised.

Many countries struggling with their economic crises find it difficult to mobilise funds for sustainable development. Corruption is the biggest impediment in the way to achieve sustainable development. Businesses and industries, for their vested interests, resort to every unfair mean to carry on with their profit programs.

Certain small, underdeveloped countries do not know how to approach towards gaining sustainable development. This gap in the vision delays the development process and more damage is done meanwhile.

#### **3. What are the ways to overcome the challenges in the way of sustainable development?**

Integration of economic, social and ecological dimensions brings in sustainable development. Let us look at the ways to overcome the challenges in sustainable development.

1. A stable, dedicated and fair government is a must for paving the ground for sustainable development programs.
2. Entrepreneurs working for the betterment of society and coming up with innovative ideas should be promoted and supported.
3. Equal opportunities for employment.
4. Renewable energy consumption.
5. Control of environmental abuse. Strict and stringent laws and their strict implementation against poaching, illegal mining, exploitation of forests and rivers, oil spillage in oceans and harvest stubble burning etc.
6. Community mobilisation through awareness programs using mass communication.
7. Reforms in education sector.
8. Eradicating and controlling diseases and malnutrition.

9. Countries like Singapore, Sweden, Netherlands and South Korea have done remarkable innovations in sustainable development. Their achievements can be studied and adopted suitably to achieve the same success.
10. Gender equality and poor women upliftment.
4. **What are some initiatives by India towards sustainable development in the country?**

India as a responsible country has taken some environment friendly initiatives as below:

1. India earlier followed Kyoto protocol to fight climate changes and signed Paris agreement focusing on bringing down global temperatures.
2. India is second highest in the world, after China, in running 1500+ projects in energy efficiency, fuel switching and solid waste management.
3. Climate change programs focusing on water, agriculture, tourism, transport and forestry etc. are run in 32 states and union territories.
4. India levies carbon tax on industrial coal usage. Clean energy initiatives and research is funded under National Clean Energy fund created by this tax.
5. A huge fund has been provisioned to take care of the areas which are vulnerable to the adverse effects of climate and environmental changes.

## **ASSESSMENT**

1. **What do you mean by environment? Which components is our environment made of?**

Our environment is everything that surrounds us- from the trees, mountains, roads, buildings, things and even people. It is a combination of both natural and human-made elements.

Community of living and non-living organisms living interdependently with each other is called ecosystem. like, Forest, Pond etc. An ecosystem is a dynamic entity with constant interactions occurring among the organisms and with the surroundings.

Our environment is mainly made of the lithosphere - the hard top layer of the earth, the Hydrosphere - various sources of water and different types of water bodies, the atmosphere - the thin layer of air that surrounds the earth and the biosphere that includes all life.

2. **What is Ecosystem? Give an example of an ecosystem and briefly explain it.**

Community of living and non-living organisms living interdependently with each other is called ecosystem. like, Forest, Pond etc. An ecosystem is a dynamic entity with constant interactions occurring among the organisms and with the surroundings.

An ecosystem is a dynamic entity with constant interactions occurring among the organisms and with the surroundings. In a garden various plants, insects like bees and butterflies, microorganisms in soil and air together constitute the ecosystem of the garden.

3. **List any 5 disastrous effects on environment caused by human activities.**

Pollution, deforestation, global warming, climate change, rapid urbanisation.

4. **What is the importance of green economy in the modern world?**

The Green Economy is an alternative vision for growth and development and sustainable development. Green Economy can promote safer economic, environmental and social well-being. Green economy addresses low carbon emissions, efficient use of resources, and social benefits. Green economy improves social well-being, equity and reduces environmental risks. It is a viable alternative to today's economic structures, which encourage waste and threats to the environment. The concept of the green economy is emerging as a priority for government for sustainable and environment-friendly growth.

**5. What is sustainable development? How is it different from traditional way of development?**

Sustainable development means the economic development that is achieved without harming and depleting natural resources. Traditional ways of development generally are not concerned about future generations, balancing between economic growth, care for the environment and social well-being.

**6. Describe the 3 fundamental components or pillars on which sustainable development is based.**

The three fundamental components to sustainable development are Economic development, Social development and Environmental protection. Economic development is about providing incentives for businesses and other organizations to adhere to sustainability guidelines. Social development is about awareness and protection of the health of people from pollution and other harmful activities of business. Environmental protection is the need to protect the environment, whether the concept of 4 Rs (reduce, recycle, recover, and reuse) are being achieved or not.

**7. What do the 4 Ps represent in sustainable development?**

Sustainable development encompasses 4 Ps: People who represent the socio-cultural issues. Planet which represents the environmental issues. Profit that represents the economic issues. Policy which refers to visionary political leadership and implementation of policies needed to make sustainable development a reality. Today, countries are agreeing to the importance of conserving natural resources. Process is slow but has begun. People are adopting to greener ways that will improve their health, farmers are practicing smart agriculture and industries are realizing as to how much they can save through energy efficiency.

**8. Write a note on the 2030 Agenda for Sustainable Development of UN Summit discussing briefly about its 17 sustainable development goals.**

On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development — adopted by world leaders in September 2015 at an historic UN Summit — officially came into force. Eradicating poverty in all its forms and dimensions is an indispensable requirement for sustainable development. There must be promotion of sustainable, inclusive and equitable economic growth, creating greater opportunities for all, reducing inequalities, raising basic standards of living, fostering equitable social development and inclusion, and promoting integrated and sustainable management of natural resources and ecosystems.

**9. How is sustainable development beneficial for the economy, society and environment of a nation? Discuss briefly.**

Sustainable development is necessary because it will provide for essential human needs. Sustainable development promises to reduce struggle for basic amenities by growing population. It addresses agricultural requirement. Sustainable development focuses on sustainable agricultural methods such as effective seeding techniques and crop rotation to promote high yields while maintaining the integrity of the soil, which produces food for a large population. Climate change can be mitigated by sustainable development practices. Renewable energy sources like solar energy and nuclear energy are the better options. Sustainable development practices have the ability to create more financially sustainable economies through renewable forms of energy. Sustainable development practices encourage the use of renewable energy resources, and organic farming practices that are environment friendly.



**10. How the problems of climate change, hunger and degrading biodiversity addressed by sustainable development approach?**

Climate change can be mitigated by sustainable development practices which discourage the use of fossil-based sources of fuel. Renewable energy sources like solar energy and nuclear energy are the better options.

Sustainable development practices have the ability to create more financially sustainable economies. Developing countries that cannot access fossil fuels can opt for renewable forms of energy to power their economies. The growing population compels people to struggle for the limited life essentials like food, shelter, and water. Sustainable development can reduce this by renewable and sustainable options.

Life ecosystem is designed in such a way that species depend on one another for survival. Sustainable development practices encourage the use of renewable energy resources, and organic farming practices that are environment friendly.

**11. What are the common modern problems which stand as a challenge in the way of sustainable development?**

Climate changes, energy usage, border conflicts, hunger and malnutrition, corruption, rapid urbanisation, lack of vision and policy.

**12. Suggest a few ways to meet the common challenges of sustainable development.**

A stable, dedicated and fair government is a must for paving the ground for sustainable development programs.

Entrepreneurs working for the betterment of society and coming up with innovative ideas should be promoted and supported.

Equal opportunities for employment.

Renewable energy consumption.

Control of environmental abuse. Strict and stringent laws and their strict implementation against poaching, illegal mining, exploitation of forests and rivers, oil spillage in oceans and harvest stubble burning etc.

Community mobilisation through awareness programs using mass communication.

Reforms in education sector.

Eradicating and controlling diseases and malnutrition.

Countries like Singapore, Sweden, Netherlands and South Korea have done remarkable innovations in sustainable development. Their achievements can be studied and adopted suitably to achieve the same success.

Gender equality and poor women upliftment.

## **Subject Specific Skills**

### **UNIT 1: Introduction to Artificial Intelligence**

#### **Chapter 1: Foundational Concepts of Artificial Intelligence**

**A. Very Short answer type questions.**

**1. What do you mean by the term “intelligence” in simple sense?**

Ability to interpret information and preserve it as knowledge to use in various situations as and when required is called intelligence.

**2. List any 5 types of intelligence.**

Linguistic, Spatial, Interpersonal, Intrapersonal, Kinaesthetic.

**3. Lalit is very fast at calculations and takes quick decisions. Which type of intelligence does he have?**

Logical.

**4. Meera is a good dancer while her sister Neera plays flute. Which type of intelligence do they have?**

Musical.

**5. Raju likes to make friends. He has a large friend circle. Name 2 skills he has which help him in making friends.**

Interpersonal skills and communication skills.

**6. Anu seems to identify each and every tree in her locality. Which intelligence does she possess?**

Naturalist.

**7. Define the term “Artificial Intelligence”.**

Science and engineering of making machines that exhibit near-human intelligence is called artificial intelligence.

**8. Does your Washing Machine exhibit artificial intelligence? Why/Why not?**

Artificially intelligent machine is capable to learn from the data it processes and analyses. This characteristic is not found in the washing machine hence it is not an artificially intelligent machine.

**B. Short answer type questions.**

**1. What do you mean by Artificial Intelligence?**

Artificial Intelligence refers to conceiving, designing and developing machines which exhibit or simulate human intelligence.

AI is the art and science of developing machines running on intelligent algorithms that make them capable of thinking, acting and learning like human beings.

**2. Explain the term “Intelligence” very briefly.**

Ability to interpret information and retain it as knowledge to apply in various life situations, problem solving and decision making is called intelligence.

**3. List any 5 types of intelligence and explain any two of them briefly.**

Five various types of intelligence are logical, linguistic, kinaesthetic, interpersonal, intrapersonal and spatial.

**Spatial visual intelligence:** Ability to perceive the world as if made of images and visuals, ability to visualise is spatial visual intelligence.

**Kinaesthetic intelligence:** This intelligence refers to the intelligent, skilful use of the body. Persons who show skilful use of body and limbs are said to possess kinaesthetic intelligence such as dancers, sportspersons, stage artists etc.

**4. What is the difference between interpersonal and intrapersonal intelligence?**

Interpersonal intelligence enables the person socially more interactive as compared to the person who has intrapersonal intelligent. Interpersonal intelligence tends to be more communicative, outgoing and having a large circle of friends. Intrapersonal intelligence tends to be retrospective and reflective. Such persons are quiet and thinkers.

### C. Long answer type questions.

#### 1. What is artificial intelligence? How is it different from human intelligence?

Artificial Intelligence is the field of developing machines running on intelligent algorithms that make them capable of thinking, acting and learning like human beings.

Artificial intelligence is different from human intelligence in following fundamental ways:

- AI requires sophisticated technology and equipment while human intelligence is a natural process carried out by brain alone.
- AI is effective in selective areas or domains while human intelligence is comparatively versatile.
- AI needs special care and means to keep it unbiased and ethical while human intelligence is usually rational.
- AI systems are able to process and analyse bulk data fast and easily while human intelligence has its limit to process a given lot of data.
- AI interprets all the data in the form of numbers at lower level while human intelligence encodes information in the form of electrical pulses and chemical form.

#### 2. Write a brief note on different types of intelligence.

There are different types of intelligence seen in people. People with logical and mathematical intelligence have abilities such as calculations, deductions, logical reasoning, understanding symbols and signs etc. Linguistic intelligence helps in learning new languages, write, compose and sing. People with spatial visual intelligence are able to visualise and perceive the world in terms of images and visuals. Skilful use of the body especially limbs is called kinaesthetic intelligence. Such people are dancers, actors, sportspersons and stage performers etc. People who have musical intelligence are able to understand musical notes and musical sounds. They can compose music, learn and play different musical instruments and vocals. Interpersonally intelligent persons are socially outgoing and skilful communicators. Seeing other's perspective is their prime trait. People with intrapersonal intelligence are self-aware, self-disciplined and self-reliant. This intelligence makes an individual to look within through retrospection and self-analysis. Existential intelligence has religious inclinations and spiritual awareness. Such people seek answers to life and world mysteries, purpose of existence and other spiritual aspects. Naturalists interact and relate with the surroundings and environment. Such people can differentiate among plants, animals and humans and understand natural various phenomena.

#### 3. Briefly, discuss various types of intelligence.

**Logical and mathematical:** This type of intelligence refers to the mathematical abilities such as calculations, deductions, comparison, logical reasoning, understanding symbols and signs, classification, measurements, problem solving etc.

**Linguistic:** Ability to interact, learn new languages and speak, write, compose, sing and converse in different languages, etc. is called linguistic intelligence.

**Spatial Visual:** Ability to visualise, think, imagine, perceive the world in terms of images and visuals, create a picture in mind of anything that is not actually there is spatial visual intelligence.

**Kineasthetic:** This intelligence refers to the intelligent or skilful use of the body especially limbs. Dancers, actors, sportspersons, stage performers and all the professions that involve dexterity of limbs demonstrate it through kineasthetic intelligence.

**Musical:** This intelligence is visible in individuals who have the ability to understand musical notes, rhythm and sounds. Such individuals can compose music, learn and play different musical instruments and they are skilful at vocals.

**Interpersonal:** Ability to interact with others socially is interpersonal intelligence. It involves interpersonal skills, communication skills and ability to interact with other people in the most suitably possible manner. Sympathy, empathy and seeing other's perspective are the traits of such intelligence.

**Intrapersonal:** Self-awareness, self-discipline, self-management, self-reliance are the traits of this intelligence. This intelligence makes an individual to look within, retrospect, self-evaluate, reflect and self-analyse. Such people are interested in philosophy and study of human nature.

**Existential:** This refers to the religious inclination of the individual. The spiritual awareness, seeking answers to questions on the existence of life, purpose of existence and other spiritual aspects of the world.

**Naturalist:** Ability to interact and relate with the surroundings and environment is naturalist intelligence. Differentiating among plants, animals and humans, inclination to learn and understand about natural phenomena – clouds, rains, outer space, ecosystem, mother nature etc.

#### **4. What are the challenges in making intelligent machines? How is a smart device different from an AI device?**

Machines are faster in processing data than human brain but not as flexible in learning as human brain. Machines rely on the program they run. Machines do not have natural intelligence to observe surroundings and interpret experiences. Machines need properly structured data to learn facts from it. Machines cannot make decisions on their own but up to some extent they can be trained into analysing the data to figure out patterns and set of rules of their own (deep learning).

A smart device still runs as it is programmed. All its features are programmed however, it may interact in human language or identify images/faces like smartphones, smart watches etc. But they are not intelligent. An AI device is capable of all what a smart device can do but AI-enabled device learns from the data and its service gets better as it learns. AI-enabled device runs on algorithms which are capable of learning from data and evolve their functioning further.

#### **D. Select the correct answer.**

1. c. Both a) and b)
2. c. Linguistic intelligence
3. a. Ability to dance skilfully
4. b. Existential
5. a. Training data
6. d. Testing data
7. b. Facial recognition

#### **Case Study/Competency-based questions.**

- A. I. By seeing and by hearing.  
II. a  
III. Identifying and avoiding the furniture items and barriers during the movement.  
IV. c

- V. Intelligence enables us to reason on the basis of collected facts.
- B. I. Artificially intelligent algorithm.
  - II. True
  - III. Our online navigation and interactions create our unique profile called browsing fingerprint which helps algorithms display the adverts of our interest.
  - IV. Compiling and analysing the data.
  - V. Better customer acquisition (making new customers) and effective promotion in lesser expenses.

## Chapter 2: Basics of Artificial Intelligence

### A. Very Short answer type questions.

#### 1. Which type of machines work on a set of rules?

Reactive machines.

#### 2. Define strong intelligence.

Strongly intelligent machine is capable of doing variety of tasks by the help of autonomous decisions of its own depending on the situation.

#### 3. Name 3 types of machine learning.

Supervised learning, unsupervised learning, reinforcement learning.

#### 4. Which machines can interact socially?

Machines based on the theory of mind intelligence.

#### 5. Define narrow intelligence.

Limited intelligence to perform certain specific tasks without the ability of decision making is called narrow intelligence.

#### 6 Write 2 applications of NLP.

Document classification, smart interactive voice-based chatbots based on AI algorithms.

#### 7. What does the AI domain Computer Vision deal with?

Analytics of visual data such as images, video and audio-video

#### 8. Write one application of Computer Vision.

Object identification.

### B. Short answer type questions.

#### 1. What is an ANN?

Artificial neural network is composed of input layer, output layer and one or multiple hidden layers which process the output coming from input layer and other layers. The output is finally passed on to output layer. Due to multiple hidden layers in an ANN, the machine learning is termed as deep learning.

#### 2. What do you mean by Computer Vision and NLP?

Computer vision is the AI domain that deals with analytics of visual data such as images and videos while Natural Language Processing is another AI domain in which machines processes natural languages spoken and written by humans.

#### 3. How is deep learning different from supervised learning?

In supervised learning a machine is provided with the data and the set of rules and guidance to process the data along with the desired output. In deep learning, machines are fed with data only but no rules or guidance to process the data and no hints of desired output. DL machine figures the relationships in data values on its own.

**4. What makes Theory of Mind machines more intelligent than weak AI machines.**

Theory of mind machines are able to interact socially with others which needs natural language processing and voice response. This is not the trait of weak AI machine which are limited to specifically assigned tasks.

**5. Explain the term Machine Learning.**

When data and set if rules are used to train a machine into understanding data trends and accomplish certain desired tasks then the process is called machine learning.

**6. How is weak AI different from Generalised AI?**

<b>WEAK AI</b>	<b>STRONG AI</b>
1. Needs guiding rules to perform tasks.	1. Can perform tasks autonomously.
2. Programmed by developer. Does not learn in true sense.	2. Programmed once and then learns on its own.
3. Simulate human intelligence.	3. Can think, decide and evolve in intelligence.
4. Perform specific tasks in controlled way.	4. Work constantly and learn from it.

**7. How are Data, Computer Vision and NLP related together?**

Data, in the form of visuals, is helpful in Computer Vision and data in the form of speech, voice, audio and music, can help in natural language processing. When data is available in the form of audio-visuals then both, Computer Vision and NLP come into play. Very efficient and useful applications can be designed by integrating Data, Computer Vision and NLP.

**8. How is limited memory machine different from reactive machine?**

Limited memory machine retains memory in real time and utilises it for immediate use only. For example, self-driven car can retain memory of the surroundings while going through the traffic and detecting objects and obstacles around it. Another example is chatbots.

Reactive machine is the most basic (weak) kind of intelligence with no previous memory or learning. They perform specific tasks that involve responding to some event or stimuli like playing a strategy game or simulated sport.

**C. Select the correct answer.**

- |                              |                              |
|------------------------------|------------------------------|
| 1. b. Dedicated task         | 6. b. Limited memory machine |
| 2. d. Retaining              | 7. a. Artificial neuron      |
| 3. a. Reactive machine       | 8. b. Deep                   |
| 4. d. Self-aware machine     | 9. d. Reinforcement          |
| 5. c. Theory of mind machine | 10. a. CV                    |

**Case Study/Competency-based questions.**

A. I. Handwriting recognition

II. Analysing multiple voice data.

III. c

IV. A machine reading out text form a printout involves the image of the printed page and processing of human language printed on the page. So, this involves both Computer Vision and Natural Language Processing domains.

V. Natural language processing.

B. I. Analyses

II. c



III. Structured data is symmetrical. It has a definite structure such as table or markup or data blocks but voice has no definite structure and symmetry hence it is categorised as unstructured data.

IV. Video does not have definite structure and symmetry hence it is unstructured data.

V. NLP application: Voice-based smart chatbots, CV application: Face recognition

## **Chapter 3: Applications of Artificial Intelligence**

### **A. Very Short answer type questions.**

#### **1. What is a nudge in smart emailing?**

Beside email messages which are a few days older, colourful follow-up reminder one-liners appear that bring the attention of the user to a possibly ignored old message.

#### **2. List any 2 applications of AI in the field of education.**

Adaptive learning, voice driven interactive learning systems.

#### **3. What is voice recognition?**

Voice recognition is the ability of an AI enabled algorithm to recognise the users by their voice.

#### **4. What do you mean by sustainable?**

Any useful service, action or entity that adds to economy and society without threatening the environment and future generations is called sustainable.

#### **5. What is a chatbot?**

AI enabled, smart chat engines or programs are called chatbots.

#### **6. How AI helps online games become better?**

AI algorithm enables the game program to learn from the actions and strategies of the player and accordingly adapt to them thus making game more challenging and interesting.

#### **7. What is speech recognition?**

Speech recognition is the ability of an AI enabled algorithm to understand what has been spoken in natural language.

#### **8. What is smart email drafting?**

The email program is aided by AI algorithm that learns from the mails typed by the user and suggests words and phrases while user types new email messages.

### **B. Short answer type questions.**

#### **1. What are the 4 key applications of AI in education and training sector?**

1. Predicting performance and identifying students who need more help.
2. Smart assessments and robot-assisted classroom teaching.
3. Adaptive learning content (content that adapts according to the capacity of the learner).
4. Use of AI in game-based teaching and educational research.

## 2. How is a smart city different from ordinary city?

A smart city provides conditions conducive to live in a clean and healthy environment with quick access to quality services, non-stop energy supply and better connectivity without running the risks for future generations and environment.

## 3. List 4 key applications of AI in customer support.

1. Use of smart chatbots to handle customer queries and enquiries.
2. Analysing customer sentiments about the products.
3. Enhancing customer browsing experience on the website.
4. Selective digital marketing and product recommendation to the customers.

## 4. What are the benefits of a smart home or a smart city?

A smart city should provide conditions conducive to live in (clean, healthy environment, quick access to services) and work (clean, non-stop energy and better connectivity) without running the risks for future generations (sustainable).

## 5. In which 4 key operations AI is useful in E-Commerce retails business?

1. Customer relation – enhancing user experience by recommending relevant products while browsing.
2. Sentiment analysis of customers through their reviews and ratings.
3. Customer support – through smart chatbots equipped with NLP capabilities.
4. Smart search – web site search or product catalog search made easier by AI.

## C. Long answer type questions.

### 1. Describe application of AI in Education and Training or Customer support systems.

Education and training: Predicting performance, smart assessments, assistance in checking assignments and identifying students who need more help, technology-based classes, remote-teaching-learning, educational research, automated training systems, immersive training, virtual-reality based training, robot-assisted teaching and training, virtual excursions are some common applications. Machine learning is used to create adaptive and smart educational content.

Customer Support Systems: AI revolutionizes the customer support and response systems using natural language processing and smart search capabilities such as smart chatbots to respond with much helpful information quickly. Chatbots can understand natural human language which makes them easier to use. Any support system like customer response systems, service support systems and most Interactive Voice Response Systems (IVRS) use speech recognition feature of AI. They can understand and interpret the query asked or assistance requested. Google Assistant, Amazon Alexa are popular examples. AI-enabled customer support systems understand customer intent faster and accurately then respond in a better way.

### 2. How is AI useful in service-oriented and product-oriented business?

Service-oriented Businesses: Banking, education, transport, hotels etc. are service-oriented businesses. AI systems analyse their data to produce results in following useful ways:

- Checking useful trends and patterns to offer new services.
- Understanding customer behaviour and sentiments (like/dislike).

- Assessing customer loyalty.
- Assessing customer feedback and experience.
- Assessing service improvement areas.
- Predicting customer behaviour.
- AI-driven recruitment to reduce time-to-hire, costs and better quality.

Product-oriented Businesses: Businesses that produce or manufacture tangible products use AI in various stages of product development. Automobile, factories, construction are some major areas. Some popular AI applications are:

- Driverless, autonomous vehicles to be used in various areas.
- AI-driven home appliances, security systems, communication systems, and home maintenance systems.
- Durable homes which withstand changing weather, maintaining inner temperature, smart cities equipped with AI-enabled traffic control systems, smart route search, citizen safety systems, disaster prevention and alert, smart public transport systems.
- AI-driven autonomous, intelligent robots in public areas, homes and schools etc. to enhance public assistance and to minimize threat to human lives in dangerous work places such as underground constructions, mining etc.

### **3. Describe the role of AI in Public services?**

In government and public services, AI systems can control city transport systems by routing of vehicles, smart traffic control and smart parking etc. In public healthcare, decision systems for heart stroke prevention, early cancer detection, expert diagnosis systems, rehabilitation through AI-assisted physiotherapy, data analytics for prevention of disease outbreak, genetic data analysis. Studies related to population can be helped by AI. Emerging patterns in the demographics of an area or section of community, looking for patterns to control poverty, hunger, homelessness, unemployment, malnutrition etc. This way, AI can help in addressing social issues efficiently. Data related to land, agriculture, and environment is enormous. AI can help in preventing damage to environment, managing damage due to natural calamities, improving agricultural practices and improving environmental care by analysing data and give new insights.

### **4. How do social media check misuse of content?**

Facebook, Instagram and many news websites use AI to make their platforms more intelligent in response, maintain user privacy, prevent security lapses and to keep a check on the spread of fake news and rumours. Machine learning algorithms use natural language processing and computer vision to identify unconstitutional content and block it. Users can also report such content.

### **5. How Email service is helped by AI?**

Artificial intelligence algorithms can identify spam emails and filter them out automatically to prevent clutter of mail box. Smart email drafting feature predicts the content that you intend to type. It can check if you have not forgotten to attach the file you talked about in the message. It prompts you to take action on an email not read for long by displaying a message beside that mail. This feature is called nudge. Assistance in multi-lingual messages and access to translation services are other features. An AI system can slowly learn about your emailing pattern and help you organise your mails efficiently.

### **6. Write a brief note on smart city.**

A city that uses information technology and other technological advancements to enhance quality of public services, adequate management of resources to provide real value for life to live in is termed smart city. There are various services and operations that go on in an

urban setup such as AI-enabled traffic system and public transport, smart electricity grid for dynamically changing power demands, analysing power consumption to assess adequate power usage, smart systems that predict accidents, smart dustbins and waste containers signalling the central waste collection unit when they are about to fill. Machine learning and AI enabled bots/drones to help in analysing agricultural and environmental data for a huge variety of issues such as pollution, air quality, climate change, environment abuse and accurate weather prediction. Surgical robots, expert diagnostic systems, smart patient care, smart device-based patient therapy, hospital administration, patient management, health data analysis etc. by deep learning techniques. In schools, AI-enables systems can be helpful in many ways such as personalised assessments, teacher assistants, simple bots to help in day-to-day administration, answer sheets corrections, performance predictions, student health advise systems etc. With the aid of AI, Machine Learning and Deep Learning, E-Governance can have prediction of trends in huge demography data of the country and implement effective redressal. Public safety through AI-enabled surveillance system, robots in fire-fighting, preventing crime by marking danger zones, detecting and preventing fake news propagation, taking spotting and checking domestic violence etc.

**D. Select the correct answer.**

1. c. Both a) and b)
2. d. Nudge
3. b. Computer Vision
4. a. Location
5. d. Travel
6. a. Twitter
7. b. Social
8. d. All of these
9. c. Sustainability
10. a. Robotics

**Case Study/Competency-based questions.**

I. AI-enabled education system provides adaptive content according to the pace and performance of the learner, smart chatbots help students in searching answers and handling queries.

II. Speech

III. True

IV. AI-enabled chat bots can understand human language due to their NLP algorithm and can learn from the interactions.

V. The 2 benefits of AI for social media platforms are preventing hate speech and preventing fake news propagation.

## **Chapter 4: Artificial Intelligence Ethics**

**A. Very Short answer type questions.**

**1. What do you mean by ethics?**

A set of moral principles that govern us in doing right actions and avoid wrong ones is called ethics.

**2. What is good AI?**

Artificially intelligent application that is able to avoid unethical treatment to the user such as bias, violation of human rights etc. is called good AI.

### **3. What is unethical AI?**

Artificial intelligence that functions without considering its ill-effects on society is called unethical AI like biased decisions, violation of human rights etc.

### **4. List any two ways in which power of good AI can be used.**

Enhancing human potential to be more productive and working towards equity for all.

### **5. What is bias?**

Bias means deciding unfairly or any action that is not fair to all those involved.

### **6. How AI access should work for physically challenged people?**

AI systems are sophisticated. They should be easy to use by physically challenged users. For example, voice commands, gesture commands, easy facility to raise alarm, braille facility for visually impaired etc.

## **B. Short answer type questions.**

### **1. Explain ethical AI with a small example.**

An ethical AI system must be developed around the ethical guidelines of a society or people it is going to influence. Ethics work on mutual trust. Human-machine interaction must be within the borderline of such ethics – trust, values, morals and fair deal. Ethical AI-based systems need to be unbiased in their functioning and should be affordable and accessible by all. They must not compromise with human rights and citizen privacy. For example, a digital assistant must not listen to everything we speak and should not share all the spoken data to unauthorized agencies.

### **2. How good AI can enrich human lives?**

Ethical AI can help see useful trends and patterns in data to devise ethical solutions. It must positively increase human potential and productivity. It can help developing useful public services and fair solutions for society. It can support and promote equity and harmony and reduce conflicts. Ethical AI can help improve environment.

### **3. How privacy is an issue with AI?**

Compromise with individual privacy in the name of data-acquisition, surveillance and a check on right to liberty, data protection breach and copyright breach are certain issues which need to be ethically balanced while developing AI systems. In order to provide smart services AI system must not expose private data to unauthorized agencies and compromise on individual data security.

### **4. How AI should be accessed by all for everyone's benefit?**

Access to AI at an equal and fair level is possible when policies are in place to make its access affordable by all and reachable by all. AI infrastructure and training facilities should be available as part of public services for all sections of society.

## **C. Long answer type questions.**

### **1. Write a note explaining the terms - ethics, ethical AI and unethical AI.**

A set of governing moral principles is called ethics. The principles and morals that govern someone's behaviour is referred to ethics for that individual. Ethical principles serve as a guideline to distinguish between wrong and right while making decisions. An ethical AI system must be developed around the ethical guidelines of a society or people it is going to influence. An ethical reference is a must in place while developing intelligent machines and conceiving their relationships with humans. An ethical AI system is not-biased, it sets

the accountability correctly for responsible people, it is transparent, it maintains security about data and identity. It respects people's privacy and rights. An ethical AI system takes care of human dignity and values. An AI system that does not care for above things is an unethical AI.

## **2. How bias plays role in making and AI unethical?**

Bias means inclining to one preferred side due to some prejudice or predefined purpose. A biased AI system is that which is trained with incorrect data with a lot of unnecessary information (noise) or incomplete details. Such an AI algorithm learns only what has been fed with the available data and it is not able to make decisions what it has not learnt due to absence of some useful and necessary data. If such an AI algorithm is deployed with real data its decisions are not accurate and hence unfair, leading to resentment and grievances.

## **3. Write a brief note on good AI.**

Good AI is another name for ethical AI and ethical practices to develop efficient AI systems. Good AI functions on principles such as respecting Human rights, rights related to data, transparency, accountability with guidelines governing its working and decision-making, awareness of misuse and competence. Existing human rights policies need revision and any new policies need inclusion for good AI to deploy. Detailed policies and means are needed to ensure that people have access to their data and that their privacy is not compromised. System is required to ensure the effectiveness of the AI systems. Laws to ensure responsibility, liability and accountability of AI systems are needed when a system malfunctions and breaches human rights. AI system developers should ensure prevention of system misuse.

## **4. What is the proposed framework for ethical AI?**

An ethically aligned design for AI addresses following principles:

- Human rights – AI systems should respect, promote and protect human rights.
- Well-being – AI developers should be responsible to keep human well-being in central focus for a successful AI system.
- Rights related to Data – People should have rights and means to control and share their data. Right to individual identity of anyone should not be breached.
- Effectiveness – AI system should be robust and not prone to efficient working.
- Transparency – The working and data processing functionalities of AI systems should be discoverable and investigable as and when required.
- Accountability – AI system should have a base of rational guidelines governing its working and decision-making.
- Awareness of misuse – Provisions must be there to prevent AI -system from misuse.
- Competence – The AI developers should possess right and sufficient knowledge and skill required to develop intended AI system.

## **5. How AI should benefit all sections of society and what will be its impact on employment in future?**

The sections of society who can afford and who have access to the technology and devices can enjoy the benefits of the power of AI but many sections of the society may not have that privilege. As an emerging technology, the access to the training for AI and to the AI development tools is not available to everyone. Suitable initiatives are needed to let young people have access to the facilities to get trained in AI concepts. Suitable infrastructure and facilities are needed for AI training, research and development. AI has very impactful applications in agriculture and it directly relates to farmers in the villages



across the country. How the benefits if AI enabled systems should be accessible by the rural regions is important to consider. Access to AI at an equal and fair level is possible when policies are in place to make its access affordable by all and reachable by all.

It is feared that unskilled sector of industry will be affected by AI badly. AI systems will replace human teams in dealing with bulk of data. Robotics is another emerging threat to replace human labour. Professionals with traditional skills need to upgrade to survive the competition. We need to deal with a suitable balance to sustain the employments and in advancing with AI.

**D. Select the correct answer.**

- |    |    |              |
|----|----|--------------|
| 1. | b. | wrong, right |
| 2. | a. | Developers   |
| 3. | c. | Data         |
| 4. | d. | Currency     |
| 5. | b. | Cloud        |

**Case Study/Competency-based questions.**

I. Super-intelligence is the intelligence that surpasses human intelligence.

II. False III. c

IV. If people are in control of their data then they will not be vulnerable to surveillance, hacking, cybercrimes etc.

V. Before having me registered on their website the company must inform me how they are going to use my data and that my data is safe and secure.

VI. Data privacy and data protection are important to prevent our sensitive data fall into unauthorised ownership for misuse.

## UNIT 2: AI Project Cycle

### Chapter 1: AI Project Cycle: Problem Scoping

**A. Very Short answer type questions.**

**1. What do you mean by stakeholder?**

People affected by the solution of the problem directly or indirectly are called stakeholders.

**2. List the stages of an AI Project Cycle.**

Problem scoping, data acquisition, data exploration, modelling, evaluation.

**3. What is a goal?**

The achievable solution to the problem as per the plan is called a goal.

**4. What do you mean by the term project?**

Any planned activity to be finished over a period of time to achieve set goals is called project.

**5. What is a problem statement?**

Describing the exact problem in concise and complete form is called problem statement.

**B. Short answer type questions.**

**1. Briefly explain the first W of 4W framework in problem scoping.**

The major scoping activities are described as part of 4 important parameters defined by 4W framework. 4Ws stand for: **Who, What, Where** and **Why**.

Who refers to the people who are facing the problem and the people who will be affected by the solution of the problem directly or indirectly. All such people are called stakeholders.

What describes the problem clearly and distinctly along with the goals to achieve to solve the problem.

Where refers to the context of the problem. It shows the exact situation, area or boundary where the problem is occurring.

Why refers to the rationale of the solution. It describes the benefits from the solution to the problem and its value to the stakeholders.

**2. What is fourth W for in 4W framework of problem scoping?**

Why is the 4<sup>th</sup> W of 4W framework? This question answers the rationale of the solution. It describes the benefits to be drawn from the implemented solution to the problem at hand. It also helps you describe how valuable will be the solution to the stakeholders. The answer to this question must inform the stakeholders how the situation will be improved after implementing the solution.

**3. List 2 examples of specific goals.**

Develop the handwriting analyser within 60 days to analyse 500 samples in 1 minute.

Create the burglar alarm system in 30 days that raises alarm of 120 decibel hearable within 500 meters radius.

**4. Explain problem scoping.**

Trying to see or define what is to be done to solve a problem is called problem scoping and once it is defined, then it is called the problem scope.

A problem scope is mutual understanding of all stakeholders about what is to be done to solve that problem. Problem scoping gives a clear vision of the problem which is otherwise very abstract and undefined. It also distinctly defines what will be the outcomes of entire problem-solving exercise.

**5. How can we identify a problem?**

The scope of the problem cannot be defined until the problem is understood completely and correctly. Getting familiar with all aspects of the problem is the prerequisite to defining problem scope. A problem which is identified and understood could be described in writing. This is called problem statement. The problem statement is short and includes the problem description.

**C. Long answer type questions.**

**1. Briefly describe the stages of AI project cycle.**

AI project has following stages.

**Problem scoping:** This is the initial stage that defines the goals to be achieved through AI system and the problems it will address.

**Data acquisition:** Collecting and compiling the relevant data in such a way that it is used to train the AI system.

**Data exploration:** Having the relevant data collected, going through and analysing the data for some useful information that can be derived out of it. Arranging the information in a proper format or layout.

**Modelling data:** Using the data to train the various AI systems to be selected. Presenting the data to the AI systems in such a way that they should perform predictions which meet the goals set in problem scoping.

**Evaluation:** Gauge and analyse the outputs (predictions) of the AI systems and select the best suited AI system to be deployed.

**2. Briefly describe the 4W framework in problem scoping.**

The major scoping activities are part of 4 important parameters defined by 4W framework - **Who, What, Where** and **Why**.

**Who?:** Primarily, we should be familiar with the people who are facing the problem and the people who will be affected by the solution of the problem directly or indirectly. All such people are called stakeholders. The stakeholders include people in various capacities such as operators of the system for which problem needs to be solved, users of the system, investors, managers and owner of the system etc.

**What?:** The scope of the problem cannot be defined until the problem is understood completely and correctly. A problem which is identified and understood must be described in writing. This is called problem statement. Once the problem is understood, it becomes easier to set the goals to solve the problem

**Where?:** This question defines the context of the problem. It shows the exact situation, area or boundary where the problem is occurring. It clearly shows you when and where exactly the real problem arises and helps you pinpoint the affected area of the system.

**Why?:** This question answers the rationale of the solution. It describes the benefits to be drawn from the implemented solution to the problem at hand. It also helps you describe how valuable will be the solution to the stakeholders.

**3. How are goals and problem statement related to each other. Explain with an example.**

Problem statement describes the stakeholders, problem and the proposed solution to the problem. The goals are translated into the proposed solution to the problem in the problem statement. Goals cover the entire purpose of the problem-scoping exercise. Without clear goals, problem statement cannot be completed. For example, to develop a system that predicts the behaviour of the customers whether they shall buy the new product or not, the problem statement looks like this:

<b>Our</b>	<b>STAKEHOLDERS</b>	<b>WHO</b>
	XYZ.com	
<b>are facing a problem that</b>	<b>PROBLEM STATEMENT</b>	<b>WHAT</b>
	They are not able to figure which customers have regularly bought which products from their website and hence it is difficult to promote new products among them.	
<b>Occurs when/ while</b>	<b>CONTEXT</b>	<b>WHERE</b>
	During online browsing of customer in the online product catalog.	
<b>The ideal solution would be</b>	<b>SOLUTION AND ITS BENEFITS</b>	<b>WHY</b>
	Deploy a smart system to analyse the purchase history of the customers and predict if they are likely to buy a product or not.	

**D. Select the correct answer.**

1. c. Plan
2. d. Goals
3. b. Scope
4. a. Modelling
5. b. First
6. d. Undefined
7. c. Both a) and b)

**Case Study/Competency-based questions.**

<b>Our</b>	<b>STAKEHOLDERS</b>	<b>WHO</b>
	Students	
<b>are facing a problem that</b>	<b>PROBLEM STATEMENT</b>	<b>WHAT</b>
	They find it difficult to revise several topics in the huge course since it takes a lot of time and effort to browse through the books .	
<b>Occurs when/ while</b>	<b>CONTEXT</b>	<b>WHERE</b>
	During exam, it is limited time to revise course quickly and easily.	
<b>The ideal solution would be</b>	<b>SOLUTION AND ITS BENEFITS</b>	<b>WHY</b>
	Deploy a smart system which helps student revise the concepts without having to search the topics and chapters themselves. It is a mobile app to which students can ask questions regarding topics. It will learn from the questions asked to relate the topics and display the links to other related topics also with the previously asked questions.	

## Chapter 2: AI Project Cycle: Data Acquisition

**A. Very Short answer type questions.**

**1. What is a data source?**

The entity from which data is collect or any entity that produces or stores data such as databases, data files etc.

**2. List any 2 data quality features.**

Relevance and accuracy.

**3. What is web scraping?**

Collecting data of a website in an organised form is called web scraping.

**4. What is a complex data type?**

Data types which represent various media of such as images, audio, video etc. are called complex data types. They need special methods for processing.

**5. List any 4 distinct sources of data?**

Databases, data files, Business documents, live stream of video/ audio etc.

**6. List 4 examples of some data features.**

Characters – ‘A’, ‘\$’, ‘k’ etc.; strings – “delhi”, “amrita”, “10-A”, “123” etc.; numbers – 1, 12, 20.78 etc.; dates – 15/10/2022, Mar-10-2022, 10/26/2022 etc.

## 7. What is an API?

Piece of code that lets one computer program to use features and data of another program is called application programming interface (API).

Data is the raw piece of information which alone does not make any sense.

## 8. What is a system map?

System map is a tool to show the relationships among various elements of a problem area in a graphical form to understand the system better.

### B. Short answer type questions.

#### 1. How are testing data and training data related together?

Training data is used in modelling phase to feed to the AI algorithm to make it learn from it through guidelines and rules (supervised learning). This may be without guidelines too (unsupervised learning). Once AI system is trained its performance is evaluated in evaluation phase by the help of testing data. Training data processing reveals if model shows higher accuracy, precision and recall.

#### 2. Explain the components of a system map.

A system map includes the following:

Circles: Denote entities, objects and elements that make the system under analysis.

Arrows: Denote the relationship between two entities or elements. Comparative lengths of arrows denote shorter or longer time duration during which the change has occurred.

+ and – signs: + denotes direct relationship wherein increase in one value increases the related value while – denotes inverse relation wherein decrease in a value increases the related value or vice versa.

#### 3. Briefly describe any 3 data sources for data acquisition.

Databases: Databases are the most common source of data. They store details in tables which can be collected by using various query statements.

Customer reviews, feedback and their browsing history makes a bulk data lot which can be collected and tidied up.

Live data of videos, chats, audio, software applications.

#### 4. Describe some data formats.

How data is presented or stored is determined by various formats. Numbers with decimal places may have the decimal places defined in a system that they can store as many decimal places only. For example, monetary figures have 2 decimal places while scientific notations may have more than 10 decimal places. Dates can be presented in various formats like 12-29-2022, 29-Dec-2022 and 29-12-2022 etc. Text can be in various cases like UPPERCASE, lowercase etc.

#### 5. Which type of data need sophisticated methods to acquire it?

Unstructured data such as paragraphs, chat transcripts, patient history, detailed documents etc. as well as semi-structured data like CSV files, XML files etc. need sophisticated methods to acquire owing to their complexity and bulk both.

### C. Long answer type questions.

#### 1. Write a brief note on data features.

Data values are found in various forms such as:

- Characters or individual letters, symbols, marks. E.g. a, A, @, \*, ! etc.

- Strings of letters, also called text. E.g. “India”, “Ravi”, “House”
- Numbers. E.g. 10, 1, -9, 200

These are called data features or types.

Some variations of above data features are:

- Phrases and sentences – variations of strings.
- Numbers with decimal places
- Dates

Data is presented or stored in various formats. Numbers with decimal places, for example, amount has 2 decimal places while scientific notations may have more than 10 decimal places. Dates can be presented in various formats like 12-29-2022, 29-Dec-2022 and 29-12-2022 etc. Text can be in various cases like UPPERCASE, lowercase etc. In addition to this, there are audio, video, images, 3 dimensional (3D) objects etc. These are found in variety of formats like audio is coded as mp3, wav etc.; video as mpeg, mp4 etc.; images as jpg, gif, png etc.

## 2. Describe training and testing data sets by taking the example of your school.

An artificial intelligence system relies on a lot of data for the training of the machine algorithm. Bulk data is the prerequisite for an AI system training and testing. Data that is used to train the machine algorithm is called training data. After processing the data, an AI system generates useful predictions which is another form of data called testing data. For example, if a state has 50,000 students in class 9<sup>th</sup> and their academic performance is needed to be analysed to predict how they shall fare in class 10<sup>th</sup> next year. The performance data of all their exams and assessments in previous year was collected to train an AI model. For each student, there are 5 records of data. That makes 5 X 50,000 = 2,50,000 records. Of these, 60% (1,50,000 records) can be taken to train the model and after training rest of the 40% records i.e. 1,00,000 can be used to test the performance of the model.

## 3. Describe briefly any 5 data quality features.

Five data quality features are:

**Relevance:** Data should not be out of context. Only the data values relevant to the problem must be acquired.

**Accuracy:** Data values should be correct and without missing values.

**Volume:** Higher the volume of data, better would be the training of the machine. There will be sufficient data for testing the model also.

**Format:** In many AI applications different data formats also help in better training of the machine. AI system needs a variety of combination of data depending on the domain and problem scoping.

**Data source:** Data accuracy depends on the source from which the data is collected. For example, data collected from public domain like Internet may not be authentic while data collected from an authorised source such as a government or certified organisation.

## 4. Briefly describe how data acquisition is done from various types of data sources.

Depending on the source of data, there are different methods or processes of acquiring the data. Certain data sources like database tables, spreadsheets retain the data



in an organised fashion and it is easy to acquire the data. Many software applications allow to export data in various formats which are easier to process. Data acquisition needs more efforts and sophisticated methods with the data which is not organised. For example, images, plain text, audio and video etc. Some data can be gathered from hard copies and online forms as CSV files. Live data is acquired via webcam, CCTV, Chatbot interface, satellite etc. Programming APIs help in collecting data from software applications. Web scraping can be done to collect the data of a website in an organised format. A traditional method is using pen-paper to collect the data in printed formats filled by hand. Such documents can be scanned and then, softcopy can be processed to extract the data.

**D. Select the correct answer.**

1. b. Data format
2. a. Input Testing data is \_\_\_\_\_
3. d. Programming
4. b. Complex
5. c. Training
6. d. All of these
7. a. Complex data
8. c. Both a) and b)
9. a. API

**Case Study/Competency-based questions.**

1. Data exploration
2. Modeling
3. Problem scoping, evaluation
4. False
5. Problem scoping

### **Chapter 3: AI Project Cycle: Data Exploration**

**A. Very Short answer type questions.**

**1. Define the term data exploration.**

To analyse the data for useful information or relationships between data elements to find out which data is useful is called data exploration.

**2. What is the basic purpose of data exploration?**

To extract useful information from the data (extracting data features) and finding out which data is useful for modelling is the basic purpose of data exploration.

**3. Give 2 examples each of structured and unstructured data?**

Structured data is usually from databases and spreadsheets while unstructured data is a text paragraph or online chat data.

**4. Ravi was not able to write his Math test. How this missing value in the marksheet should be handled?**

NULL i.e. no marks available.

**5. What is feature engineering?**

Technique of extracting useful relationships among data values and identifying useful trends in data is called feature engineering.

**6. What do you mean by data visualisation?**

Presenting data relationships in an easier, graphical form is called data visualisation.

**7. What is the significance of visual data?**

Data relationships presented in a visual form such as graph or chart are easier to interpret and data features can be easily extracted.

**8. Why do we have a variety of charts and graphs to visualise data?**

A variety of data features (comparisons, distributions, relationships etc.), cannot be presented in a single form that is why variety of charts and graphs are needed to visualise the data.

**9. What does data wrangling do?**

Data wrangling converts the raw data into suitably structured clean data for AI algorithms to process.

**10. What is the characteristic of structured data?**

Structured data is easier to explore, needs less time and efforts to tidy up, contains relevant, valid and complete data devoid of any missing values.

**B. Short answer type questions.**

**1. “Data acquired cannot be used as it is for modelling.” What does this statement mean?**

In most of the scenarios, data acquired from various sources may not be suitable to use as is because AI algorithm mostly need data translated as numbers so various types of data needs to be converted into number equivalent. E.g. female=1, male=2. Data needs to be cleaned from irrelevant, invalid data and missing values need to be handled to prevent AI algorithm from being biased. In short, data needs to be given the suitable form as required by the AI algorithm before modelling.

**2. List 2 characteristics of structured and unstructured data with one example each.**

Structured data (e.g. database tables and spreadsheets.) is mostly in symmetrical, tabular form. Such data is easy and inexpensive to acquire and explore. Unstructured data has not defined structure. It needs sophisticated ways to acquire and clean.

**3. How do missing values lead to bias?**

Any missing values in the training data set for any AI model leave gaps in the information which affects the reliability and accuracy of the model in establishing relationship among data points. For example, if there are no marks for a student in a test he/she missed then the gap may be translated into zero which will affect the overall percentage/average performance of the student. This will affect any predictions done by the system regarding that student’s performance which is unfair.

**4. List various ways to handle missing values.**

- Remove the records that contain missing values.
- Find the missing values and fill the gaps.
- Fill missing values from other similar records.
- Calculate missing values from the existing data.
- Predict missing value after careful analysis of present data.

**5. List the 3 requirements to visualise data using graphs and charts.**

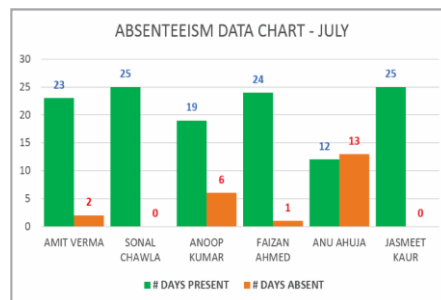
Data visualisation is needed for comparing the values using bar charts, tables and line charts etc., establishing relationships among data points using scatter plots, bubble charts etc. and to analyse data distribution and composition in the form of percentage using pie chart, mekko chart etc.

**C. Long answer type questions.**

**1. Giving an example, explain how values are compared using charts.**

Consider the attendance data of some students. Its column chart is given here to compare the attendance and derive following conclusions.

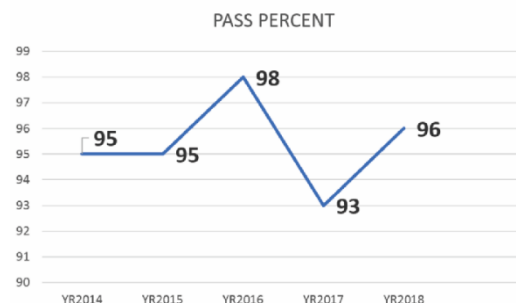
TOTAL DAYS OF CLASSES HELD:		25
STUDENT NAME	# DAYS PRESENT	# DAYS ABSENT
AMIT VERMA	23	2
SONAL CHAWLA	25	0
ANOOP KUMAR	19	6
FAIZAN AHMED	24	1
ANU AHUJA	12	13
JASMEET KAUR	25	0



- Sonal and Jasmeet are most regular students.
- Amit and Faizan are almost regular.
- Anoop attended almost half of the classes conducted.
- Anu attended below 50% of the classes conducted.

**2. Giving an example, explain how values are related together using charts.**

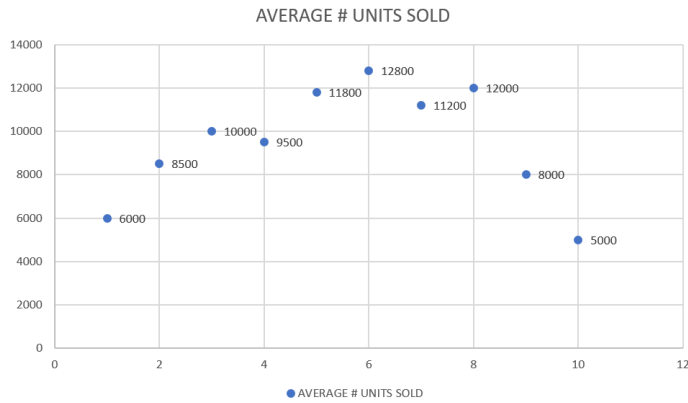
The given line chart shows that in 2018, school has improved a little to 96% from a drastic drop of performance (93%) and is yet to improve to achieve 98% (its highest performance in the previous 4 years). However their overall performance across 4 years is mostly consistent.



**3. Giving an example, explain how distribution of values is analysed using charts.**

The distribution means part of whole. Consider the data-set and the scatter chart on it. Data-set shows rating-wise average unit sale of items in a month.

AVERAGE RATING	AVERAGE # UNITS SOLD
1	6000
2	8500
3	10000
4	9500
5	11800
6	12800
7	11200
8	12000
9	8000
10	5000



**4. Giving an example, explain how composition of values is analysed using charts.**

Composition is the combination of parts that make a whole. Pie chart is a good tool to analyse such data. Consider the following data-set that shows the number of items purchased by 5 most frequent deals and the Pie chart shows each dealers percentage contribution in the whole.

DEALERS	PURCHASE (# ITEMS)
DEALER 1	1015
DEALER 2	1310
DEALER 3	580
DEALER 4	918
DEALER 5	1512



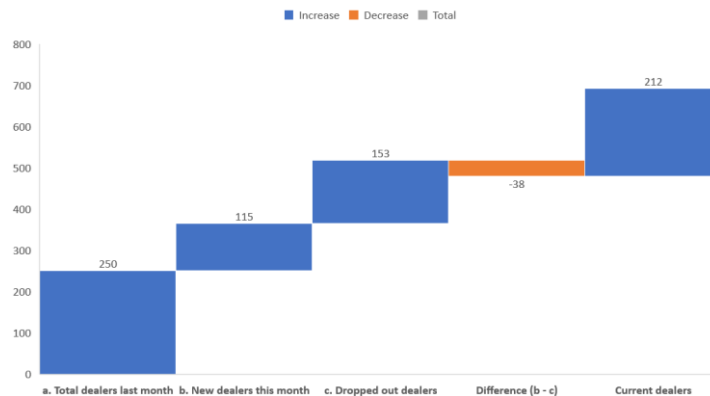
**5. Explain any 5 distinct types of charts and their use with an example.**

For 4 charts, refer to the previous questions and fifth is given here:

Consider the data-set showing details of total dealers registered on the portal last month, new dealers joined in, unsubscribed (drop out) dealers and current dealers in the system.

a. Total dealers last month	250
b. New dealers this month	115
c. Dropped out dealers	153
Difference (b - c)	-38
<b>Current dealers</b>	<b>212</b>

Waterfall chart shows the data so that effect of certain data values on other data values could be analysed.



**D. Select the correct answer.**

1. b. Raw, testing
2. b. Acquisition
3. a. Structured
4. b. Unstructured
5. c. Missing, calculated
6. d. Biased
7. c. Feature engineering
8. a. Data visualisation
9. c. Both a) and b)
10. a. Line
11. b. Scatter plot
12. b. Mekko
13. a. Pie
14. c. Both a) and b)
15. b. Flowchart

**Case Study/Competency-based questions.**

1. Column chart: Regular burgers are much in demand. Jumbo burgers have almost similar demand in all 3 months, Medium burger sale is improved by the end of the quarter. Regular burger sales dropped in March.
2. Pie chart: Regular burger has contributed highest (15%) in entire quarter sale. Regular burger needs attention to increase its demand.
3. Histogram: Overall sales improved in Feb but again came down in March.

## **Chapter 4: AI Project Cycle: Modelling & Evaluation**

**A. Very Short answer type questions.**

**1. Define the terms:**

- a. ML – Machine learning is a subset of artificial intelligence. In this concept, machine is made trained to perform desired tasks by the help of datasets called training data.
- b. DL – Deep learning is an advanced form of ML based on artificial neural networks. DL is useful where machine is not given guidelines and rules as to what to do with the data.
- c. Supervised Learning – In this learning, the machine is fed with training data along with set of rules guiding the machine into what to do with the data and the labels that describe the data and desired output.
- d. Unsupervised learning - In this learning, the machine is fed only with the training data but no guiding rules as to what to do with the data, no labels that describe the data and no desired output are provided to the machine. Machine remains on its own to analyses the data.

e. **ANN** – Artificial neural network is composed of input and output layers and in the middle, the hidden layers of artificial neurons that correlate inputs given to them.

**2. What do you mean by predictor and predicted variable?**

Input values or variables that are used by the AI model (algorithm) for analytics are called predictors and the values which are produced as output are called predicted variables.

**3. What is the basic difference between classification and clustering?**

<b>CLASSIFICATION</b>	<b>CLUSTERING</b>
Used in supervised learning (rule-based approach)	Used in unsupervised learning (learning-based approach).
In training data, data-values are identified with predefined labels or properties.	No training data provided to machine. Data values do not have any labelling or properties. Machine has to identify properties itself.
Used to group the instances on the basis of differences. E.g. High performing and low performing students.	Used to group the instances on the basis of similarity. E.g. All students who got distinction in all subjects.
The basis of classification is known beforehand.	The basis of identification not known since similarity among instances are identified.

**4. If prediction of a patient’s health is to be done, which model is suitable?**

A patient’s health data is a set of continuous values over a period of time so regression model is suitable.

**5. If common items on an online retail portal have to be put in one category then which model is suitable to do so?**

Grouping similar items together is called clustering so clustering model will be most suitable.

**6. Buying behaviour of customers of an online portal needs to be analysed as per their gender then which model is suitable?**

Here, the property gender is known already so classification model will be most suitable.

**7. What is a hidden layer?**

Hidden layer in an ANN contains the nodes which have computational functions. All computations on the input values are executed in the hidden layer of an ANN.

**9. What are ANNs used for?**

ANNs are used where very accurate and precise predictions need to be done. ANNs have their application in image identification, facial recognition, object and gesture recognition, any sort of complex classification and clustering etc.

**B. Short answer type questions.**

- 1. Describe the use of the following models:**
- |                          |                      |
|--------------------------|----------------------|
| <b>a. Decision tree</b>  | <b>b. Regression</b> |
| <b>c. Classification</b> | <b>d. Clustering</b> |
| <b>e. ANN</b>            |                      |

a. Decision trees are used for classification predictions by answering to questions in a Yes-No form.

b. Regression is a statistics technique used for forecasts by analysing relationship between predictor and predicted variables in usually continuous data such as monthly salary, sales over a period of time.



- c. Classification model works on data sets containing discrete values such as strength of class, population count. It is used to classify the values on the basis of a given criteria.
- d. Clustering model is used to classify the data points on the basis of similar properties. E.g. customers who bought the same item.
- e. Artificial Neural Network is a deep learning model used in unsupervised learning. It is used in object identification, facial recognition and several natural language processing applications.

**2. How is learning-based approach different from rule-based approach?**

Learning based model is more advanced than rule-based model as it is not fed with the guidelines or rules as to how to deal with the data. It is programmed to make its own deductions of trends and relationship between data points on its own. Rule-based learning model is fed with data along with a set of rules and labels to guide it for data analytics.

**3. How is bivariate regression different from multivariate regression?**

Regression model observes how change in a variable affects the change in another related value. The value to be output is called predicted value and input value is called predictor variable. Bivariate regression involves one predictor and one predicted variable only. Hence the name bivariate. Multivariate regression includes more than one input and output variables.

**4. What do you mean by discrete and non-discrete values?**

Discrete values are unique in themselves. They are not the part of any sequence. For example, height and weight of the survey participants. Height of each person has no relation with the height of another person. Non-discrete values are part of a series of values such as monthly salary of an employee in a year. Here, salary amount of one month will affect the aggregate such as total salary, average salary etc.

**5. Briefly describe the parts of an ANN.**

An artificial neural network is a multi-layered model with outermost layer termed as input layer and at the other end, there is output layer. In the middle there may be one or more layers called hidden layers. All the computations occur usually in the hidden layers. Input layer provides required input data to the hidden layer. Data values are processed and passed on from one hidden layer to next for further processing. Finally, the output is passed on to the output layer.

**C. Long answer type questions.**

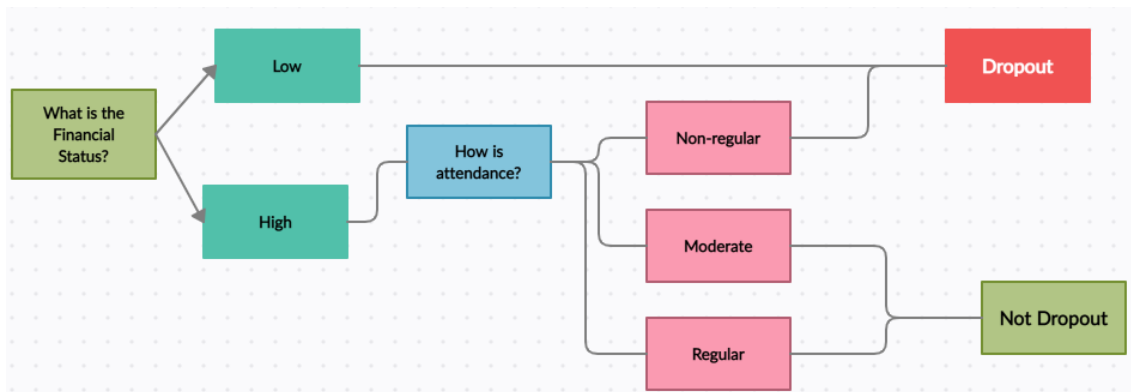
**1. Describe the structure and use of decision tree with an example.**

Consider the following dataset. We need to depict this using a decision tree to predict if a student would be a dropout on the basis of his/her attendance and financial status.

Attendance (1=regular 2=moderate, 3=nonregular)	Financial Status (0=low, 1=high)	Dropout from course?
1	0	YES
2	1	NO
2	0	YES
1	1	NO
3	0	YES
3	1	YES

Decision tree begins with a root that mentions a question. Two or more branches come out of it in the form of answers. These branches either connect to another node asking another question or decision (prediction) of the tree. The ending nodes which do not connect to another node via any branch are called leaves.

Below is the decision tree for the above scenario. Notice that due to low financial status, students were dropping out irrespective of attendance so there is no need to check for attendance of a such students. (The chart is made at creately.com)



**2. Write a note on supervised and unsupervised learning.**

Machine learning has following approaches:

Supervised ML: In this approach, the computer system equipped with ML ability is fed with the inputs and also informed about what prediction it is supposed to do. The inputs are labelled and explained. This is most commonly used learning in almost all the industries. It mostly uses classification and regression algorithms for predictions.

Unsupervised ML: In this approach, machine is fed with the input data without any labels or description and the desired output is not known. The machine is on its own to figure out correlation among data values. Such learning mostly uses clustering and artificial neural network algorithms to segregate similar data values in same cluster.

**3. How is clustering different from classification in use and working?**

CLASSIFICATION	CLUSTERING
Used in supervised learning (rule-based approach)	Used in unsupervised learning (learning-based approach).
In training data, data-values are identified with predefined labels or properties.	No training data provided to machine. Data values do not have any labelling or properties. Machine has to identify properties itself.
Used to group the instances on the basis of differences. E.g. High performing and low performing students.	Used to group the instances on the basis of similarity. E.g. All students who got distinction in all subjects.
The basis of classification is known beforehand.	The basis of identification not known since similarity among instances are identified.

**4. Describe the working of an ANN.**

The prime purpose of an artificial neural network is to recognise patterns and do predictions. Their design is inspired by human brain. All the data interpreted by a neural network is in numerical form. An ANN is in the form of 3 or more layers of nodes

(neurons). The bottom layer (or left) is called the input layer, top most (or right) is output layer and in between these two, are one or more *hidden* layers. Each hidden node is capable of performing some sort of computation called *function* on the input it receives. Each node receives 2 components as input:

- Data to compute upon.
- Weight that depicts the relative importance of data among other data values.

Initially, the weights assigned to the data values are calculated randomly. Considering the weight, the hidden node computes the data and generates the output. This output is passed on to the next hidden layer. Nodes of each hidden layer execute their functions on the input and finally the output reaches the output layer.

**5. Discuss the scenarios where learning-based approach is better than rule-based approach.**

Challenges with rule-based systems are - chances of addition of contradicting rule while adding new rules, upgrade and upkeep of such systems are time-consuming and expensive, not versatile to be used in multiple domains since all problems cannot be defined by a structured set of rules.

In learning-based approach, the data is fed to the machine and it is supposed to analyse it to find possible patterns and trends in the data for making any predictions. This is the reason that such systems are suitable to handle abstract, unstructured and random data. Learning-based approach is suitable where step-by-step rule-based learning cannot be applied easily. It is useful where useful predictions are based on a number of factors which are difficult or not possible humanly. Predicting customer behaviour, monitoring financial transaction for frauds, medical diagnostics, legal research and advise etc. are the application areas for learning-based approaches.

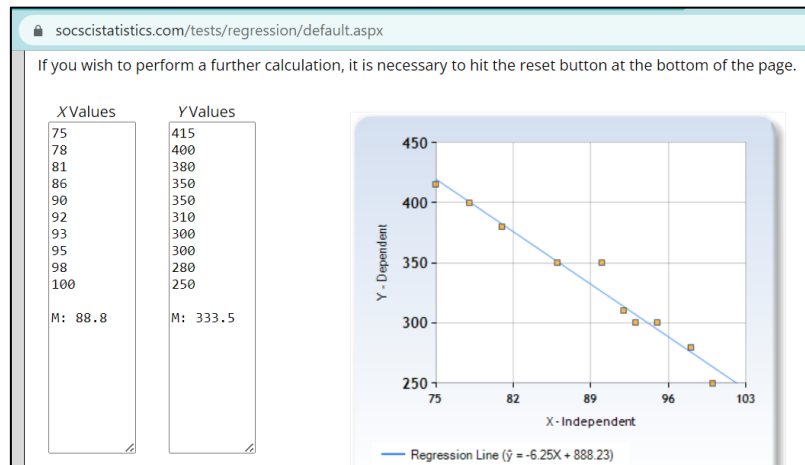
**D. Select the correct answer.**

1. d. Deep
2. a. Data
3. a. Mathematical
4. a. Rules
5. b. Facts
6. a. Developer
7. b. Learning
8. a. Conclusion
9. a. Leaves
10. c. Both a) and b)
11. d. All of these
12. a. Independent
13. d. Does not change
14. b. Two
15. c. Artificial neural network
16. d. Hidden

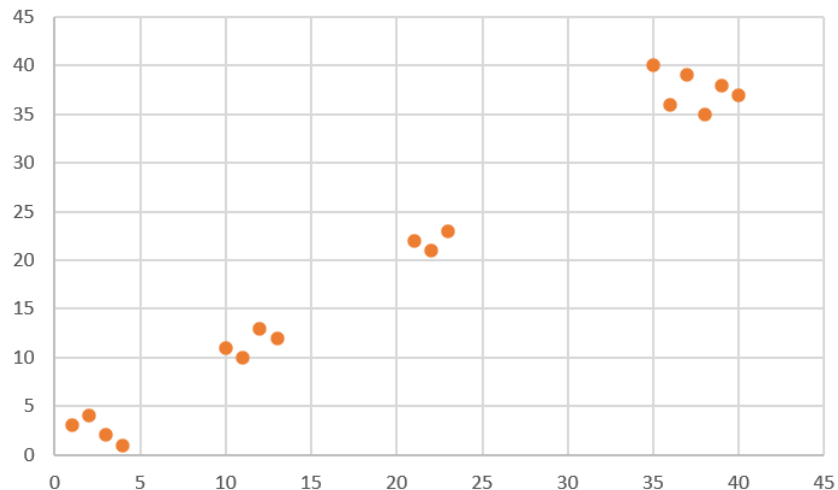
17. c. Both a) and b)  
 18. a. ANN

**Case Study/Competency-based questions.**

A. This is negative strong correlation. As fuel charges go up, consumption decreases.



B. People who had similar or matching food items are clustered together on the chart.



**UNIT 3: Python Programming**

As per CBSE instructions in the curriculum, this unit will have only practical assessment.

**UNIT 4: Data Science**

**Chapter 1: Introduction to Data Science**

A. Very Short answer type questions.

1. What do you mean by the term datification?

Describing life events and entities in the terms of data values is called datification.

**2. Define the term data science.**

Science of discovering knowledge by analysing data is called data science. Data science can also be defined as an approach or methodology applied on the data-sets to derive useful conclusions from them.

**3. List four characteristics of Big Data.**

Voluminous, heterogenous, continuous, unstructured.

**4. Give one example each of structured, semi-structured and unstructured data.**

Database tables are structured, an HTML file or CSV file is semi-structured and user chat data is unstructured.

**5. List 5 common sources of big data.**

E-commerce websites, social media, online financial transactions, educational websites, emails.

**6. List any 3 benefits of data science.**

Discovering unanswered facts from the vast data, better, smart and quick decision making, unlocking hidden intelligence.

**7. List 3 disadvantages of data science.**

Higher costs, rare and expensive expertise, data privacy issues.

**8. What does the data-trail left by us online tell to the social media platforms?**

Such data-trail is called digital fingerprinting of the individual and helps the online businesses understand our preferences, like/dislikes and create our digital profile as a potential customer.

**9. What do you mean by psychographics?**

We are analysed on the basis of our personality, values and beliefs, interests, lifestyle, opinions etc. This is called psychographics.

**10. What are the 2 major ways in which data science helps E-Commerce portals?**

User or visitor experience on the website while shopping and customer loyalty or retention for a longer time.

**11. List 2 applications of Computer Vision and Natural Language Processing in healthcare?**

With the help of CV and NLP in healthcare undetectable diseases can be diagnosed and patient care can be improved bringing down the mortality rate. Support can be improved for physically challenged patient and senior citizens.

**12. Give 2 examples of fraudulent online transactions.**

Personating a bank website and stealing user's credit card data. Luring customer into transferring huge amount of money to an account.

**13. What do you mean by Customer Lifetime Value?**

Estimate of benefits from a customer's lifetime to a business is called Customer Lifetime Value.

**14. Define SEO in one line.**

SEO is the process to increase the visibility of a website by making it appear in the top search results returned by search engines.

**15. What is IoT?**

Network of devices sharing data and signals over a network through Bluetooth or other short-range protocol is called Internet of Things.

**16. List 2 examples if real-time predictive analysis.**

Stock price monitoring, space data analytics.

**B. Short answer type questions.**

**1. Which type of data needs more cleaning and pre-processing before analysis? Explain with an example.**

Unstructured or abstract data generated online through the activities of people is not in a structured, symmetrical, clear form. Online search results, chat transcriptions, text descriptions, history (patient, employee, subscriber etc.) are some common examples of unstructured data. Such data needs sophisticated ways to gather useful data pieces out of it and structured values to describe abstract data.

**2. Discuss any 2 distinct examples of semi-structured and abstract data.**

Examples of semi-structured data: CSV files, QR Codes.

Examples of abstract data: Online search results, chat transcriptions.

**3. How are big data and data science related?**

data science involves the tools and methods that deal with enormous, dynamic and complex form of data which is generated from a variety of sources. Such data is called big data. Thus, data science helps in analytics of big data.

**4. Discuss any 2 distinct characteristics of big data.**

**Big Data is voluminous:** Millions to billions of transactions every moment online give rise to a constant flow of big data from various sources such as businesses, enterprises, and social media platforms. This vast ocean of data constitutes the size of the big data.

**Big Data is heterogenous:** Sources of Big Data are diverse. There is a lot of variety in the structure and type of data generate by different sources. All the data that is generated is not in any structured symmetry.

**5. List 5 major benefits of data science and discuss briefly any 2.**

Five major benefits of data science are:

1. Unlocking hidden intelligence
2. Answering the unanswered
3. Precision and speed
4. Better decisions making, strategies and opportunities
5. Understanding data with different perspectives

**Answering the unanswered:** Data science can open the ways to find answers to many questions which remain unanswered. For example, it may show the useful relationships between the hunger data and poverty statistics of a region or, how the unemployment data in a particular sector relates to the skill and literacy data in that sector.

**Better decisions making, strategies and opportunities:** Owing to its accuracy and ability to analyse big data to see useful patterns and trends, data science helps businesses make better decisions through accurate predictions.

**6. How do social media platform benefit from Data Science?**

Social media platforms use all the data related to our interactions such as amount, location, frequency, duration etc. Data science methods process these numbers into profitable predictions such as managed advertising, maintaining customer loyalty,



understanding customer trends and sentiments, identifying threats and challenges to growth, doing social experiments like gauging your reaction to a particular incident etc.

**7. Briefly describe the impact of data science on healthcare.**

Data science has tremendous scope in healthcare. Data science can help bringing down expenses in research, medicare, diagnosis and treatments. Other benefits are accurate diagnosis to minimise mortality rate, improved research on fatal and incurable diseases such as Covid-19, improve processes at facilities, minimise deaths due to incorrect diagnosis, enhance surgeries, operations, testing etc., advancements in medical imaging through Computer Vision and Natural Language Processing and improve distribution and availability of medical services to the community.

**8. How data science is helping us in addressing environmental issues?**

Data science deals with environmental data related to ecologies, pollution, atmosphere, weather and climate etc. Data science is helping to interpret and derive useful and actionable information. For example, understanding growth of plants in extreme temperatures or impact of changing weather on the local crops. Sciences related to environment such as agricultural, ecology, geology etc. greatly benefit from data science. It also benefits the researches helping scientists study the environmental parameters for predictive analysis to aid in addressing problems related with environment such as drinking water scarcity, global climate change, food grain quality, natural disasters, weather predictions etc.

**9. How do IoT devices communicate with each other?**

IoT devices are fitted with various sensors and controllers. Sensors helps them in capturing data. Through these sensors they communicate with other devices by exchanging signals and data over short-range networking protocols.

**10. What do you mean by search algorithm?**

Search algorithm makes search engines fast, efficient and accurate in returning search results. The software components that gather information online for search engine is called crawler or spider. The other component is the database that contains the search URLs. Database is updated dynamically by the crawlers. Data science methods help in efficient update of the search databases and searching logic of the crawler.

**11. Briefly describe real-time predictive analysis.**

Online transactions are fast. Industries such as banking and finance etc. need instant results of analysis of real-time data being generated as the operations are occurring. This process is called real-time predictive analysis. It is helpful in instant fraud detection, stock price monitoring, critical patient monitoring, environmental variables monitoring, space missions etc.

**12. Briefly describe role of data science in electronics industry.**

Data science helps in analysing machine generated data (readings, signals, scans, device memories, codes etc.) to help in following ways:

- Predicting device malfunction.
- Analysing device usage data.
- Analysing data from electronic chips in various projects.
- Analysing graphical data from images to detect anomalies such as tiny fatal tumour, internal infection, deforestation etc.

- Performing analysis on data to do root cause analysis failures.
- Monitoring communication data among devices.

**C. Long answer type questions.**

**1. What is data science? Briefly discuss its advantages.**

Science of discovering knowledge by analysing data is called data science. Data science involves mathematical techniques and algorithms to analyse data and derive some useful insight. Data sets have patterns and internal relations which can be revealed by applying data science techniques. Data science practices are capable to see the useful trends and meaningful patterns accurately thereby generating useful intelligence that can be used in a variety of useful ways. Principles, methods and tools of data science make it possible to do so. Businesses need timely and precise insight into the data. Data science helps data scientists to come up with precise predictions and trends out of the vast data. Data science makes businesses improve upon making better decisions and effective strategies.

**2. Discuss why traditional computer applications and hardware cannot process big data.**

Today, there is immense amount of data generated from countless computers and other devices world over as part of world wide web. This enormous amount of data is continuously generated. Also, there is a lot of data generated in past decades. A traditional computer system has not been designed to handle such huge and constant feed of data. Also, data is in a variety of forms and structures. Most of the data is unstructured and complex (images, audio, video). To handle and manage such data, highly advanced means of technology and techniques are needed which are available as faster mainframe and super computers as well as technologies such as cloud computing. Cloud computing is a network of powerful computers providing data processing, data storage and data management tools over internet.

**3. Briefly discuss how data science and artificial intelligence are related.**

Data science prepares the data to be used by AI models. Data science is the practice and Machine Learning (ML) is the tool for predictions. Data science methods prepare the training data and testing data for AI model. Testing data is used to test the machine performance after training. So, there is technology involved at two levels – first, acquiring data and preparing data-sets for AI model using various statistical methods, data cleaning and visualisation, database skills and some data-related programming. Second, technology to develop AI applications using extensive programming skills in Python, R etc., algorithm techniques and cloud computing.

**4. Describe the impact of data science in social media and E-Commerce.**

Social media platforms such as Facebook, Instagram, Twitter, LinkedIn etc. have our online browsing details All interactions we do are digital in nature hence they are translated easily into numbers such as amount, location coordinates, times, dates, frequency, duration, averages etc. Data science methods can be used to process these numbers into profitable predictions for businesses. We are analysed on the basis of our personality, values and beliefs, interests, lifestyle, opinions etc. This is called psychographic analysis. This data can be used for targeted advertising, contacting more customers, improving customer relation, innovations and new product ideas, understanding customer sentiments and trends, identifying threats and challenges, identifying social threats such as terrorism, crime, fake news and hate speeches

E-commerce businesses are concerned about customer experience. Data collected from the transactions done on the web sites, reviews, rating and detailed analysis of social

media data help E-commerce industries understand how to improve on the customer experience on their web site and in their services. Customer loyalty and customer retention is the core of an E-commerce portal's survival. This data also helps machine learning algorithms see patterns and trends after data analytics. The result is accurate predictions which help businesses.

**5. How do banking and finance benefit from data science?**

Data science can help banking and finance sector as:

- With the advent of automations and machine learning, financial frauds can be detected and prevented through predictive analysis.
- Clustering and classification of customer data are two popular data science techniques done on the basis of customer's likes, dislikes, preferences, behaviour, buying capacity, payment history and financial health etc.
- Risk analysis and modelling by analysing financial data before granting credits and loans or doing investments etc.
- Targeted promotions of various schemes, services and financial products.
- Evaluation of benefits from a customer's lifetime to predict future business and revenues. This is called assessment of Customer Lifetime Value (CLV).
- Improved customer care.
- Automated smart security by facial recognition, document scans, fingerprint scan through Computer Vision.

**6. How data science can help in improved healthcare services?**

Imaging of human body is a common occurrence in hospitals. Millions of patients are scanned and X-rayed through various advanced machines. Visual and numerical data collected through these equipment are analysed by algorithms to predict life threatening diseases such as cancer cells, tumours, organ cirrhosis, internal infections etc., to diagnose undetectable diseases like dormant cysts, bacterial infections, artery blockages, heart problems etc., to raise alarm for a likely medical threat etc. Microscopic, hard to detect irregularities and anomalies can be detected by machine learning algorithms as the data is in numeric form. Data science can help bringing down expenses in all areas. Other benefits include disease prevention through predictive analysis, accurate diagnosis, improve patient care, enhance medical processes.

**7. "Data science is a boon to banking sector" – explain this statement.**

Data science was first used in banking and finance field since this is the domain which deals purely in numbers – denominations, profit, loss, loan, returns, investments, frauds, payments, credits, revenues, costs, expenses, stocks etc.

*Now, please refer to question 2*

**8. How data science helps in improving services and products in various industries?**

Customers and end users are always looking for better, affordable and innovative services and products that make their life easier or that solve their problems in the best possible way. How do the businesses and service providers discover what customers need and what they did not like? This is possible only if the data about them is available for analysis. Data science techniques help in the acquisition of such data, cleaning up or tidying up the data after data exploration to filter out only the useful and relevant data, visualising the data to further analyse if it is suitable and complete for developing a model and then perform various data science methods for various purposes such as classification,

clustering, regression, predictive analysis, finding anomalies and detecting useful patterns for useful forecasts. These outputs by data science methods help in decision making and to develop better strategies for improved services, better product designs and innovations.

**D. Select the correct answer.**

1. b. Datification
2. b. Cannot be analysed in its original form
3. b. Unstructured
4. c. Semi-structured
5. c. Both a) and b)
6. d. None of these
7. c. AI algorithms
8. d. All of these
9. a. Programming
10. c. Big data
11. c. Immense volume of data
12. a. Amazon
13. d. Psychographics
14. c. Banking and finance
15. a. Customer lifetime value
16. d. None of these
17. b. Electronics
18. d. All of these

**Case Study/Competency-based questions.**

A I. a. Volume: Source of big data are all online servers, users and industries that make its size enormous.

b. Velocity: Big data generation is continuous from all online sources. It never stops.

c. Variety: Big data is in all forms – simple to complex. It includes text, numbers, images, visuals and audio.

d. Veracity: Big data accuracy is low since it is in very raw form and needs a lot of cleaning efforts.

e. Value: Usefulness of big data depends on the context and domain in which it is used.

II. All over internet, all computers, servers and users are constantly generating data in exabytes. This process never stops hence big data is continuous because it comes from billions of sources online.

III. a

IV. Original form of data is acquired from a variety of sources such as files, databases and web scraping, etc. Such data is very complex and unstructured. It contains a lot of unnecessary, irrelevant data called noise. To remove noise, it needs cleaning and tidying to make it suitable for AI models to analyse.

V. False (Big data cannot be installed or stored like this.)

**B I.** Data science techniques help us see useful trend in the social data accurately which we cannot find otherwise. Such useful findings in the data help in devising better strategies to address social problems.

II. The possible reason could be that Raghav is not expert of the insurance field so he finds it difficult as to what kind of information he should look for.

III. Data science is a new trend and experts in this field are hard to find and expensive hence the cost of adopting data science goes up.

IV. Sharing someone's data without his/her permission, using someone's data for any gain without his/her knowledge and permission.

V. True.

VI. Data science can be used for upliftment of people. It can be used to find solutions to provide equality to common people. Data science can be misused as a bias against a group of people. Data can carelessly fall into unauthorised hands.

## **Chapter 2: AI Project Cycle Framework and Data Science**

**A. Very Short answer type questions.**

**1. For what purpose data science is used in machine learning?**

Data science helps in data acquisition (collection), data cleaning, tidying and exploring the data through various visualisations to make it suitable for machine learning.

**2. What do you mean by stakeholders?**

People affected by the solution of the problem directly or indirectly are called stakeholders.

**3. What is a problem statement?**

Describing the exact problem in concise and complete form is called problem statement.

**4. On what basis a solution to a problem is considered best?**

The best solution helps in solving the problem completely. It improves the problem area and adds some value to it.

**5. Give some examples of data feature.**

Characters – 'A', '\$', 'k' etc.; strings – "delhi", "amrita", "10-A", "123" etc.; numbers – 1, 12, 20.78 etc.; dates – 15/10/2022, Mar-10-2022, 10/26/2022 etc.

**6. What is data wrangling?**

Data wrangling converts the raw data into suitably structured clean data for AI algorithms to process.

**7. What do you mean by clean data?**

Clean data is valid, accurate, relevant and devoid of missing values. It is in the form that is required for machine learning.

**8. What is the impact of missing values on a prediction algorithm to be trained?**

Missing values affect machine learning negatively. Due to missing values, the learning of the machine is incomplete and the predictions done by the machine may be biased and inaccurate.

**9. What is a multi-variate model?**

A prediction model that involves multiple predictors and multiple predicted variables is called a multi-variate model.

**10. Why do we evaluate a trained model?**

A trained model is taught to address a problem using training data-sets. It is then tested with another data-set to evaluate its level of training. The accuracy, precision and recall of a model needs to be up to the mark before it is deployed with real data.

**11. List 2 examples of real-time predictive analysis.**

Stock price monitoring, space data analytics.

**B. Short answer type questions.**

*Please ignore this section.*

**C. Long answer type questions.**

**1. Briefly describe Problem Scoping using 4W framework.**

The major scoping activities are described as part of 4 important parameters defined by 4W framework. 4Ws stand for: **Who, What, Where** and **Why**.

Who refers to the people who are facing the problem and the people who will be affected by the solution of the problem directly or indirectly. All such people are called stakeholders.

What describes the problem clearly and distinctly along with the goals to achieve to solve the problem.

Where refers to the context of the problem. It shows the exact situation, area or boundary where the problem is occurring.

Why refers to the rationale of the solution. It describes the benefits from the solution to the problem and its value to the stakeholders.

**2. Explain the relevance of problem statement template.**

Problem statement describes the stakeholders, problem and the proposed solution to the problem. In the form of proposed solution, the goal to be achieved are also cleared. Goals cover the entire purpose of the problem-scoping exercise. Without clear goals, problem statement cannot be completed.

**3. Explain the significance of data exploration.**

Before using the data, it needs to be tidied up for further analysis. So, data needs to be explored to check its relevance to the problem scope, validity, values need to be converted into suitable numeric formats, missing values need to be managed by calculations and substitutions. After this entire exercise the data is optimised to be visualised and analytics.

**4. How a prediction model is evaluated?**

After training the model with training data set, the model is evaluated through following standard process:

1. The model is fed with the testing records.
2. The model works upon the test data according to the training it received during training phase.
3. The model performs predictions or gives outputs on the basis of its training.

4. The number of predictions done correctly and incorrectly by testing data set are compared with those done during training.
5. The results are compared on the basis of some threshold decided by the data science professional.
6. If the correct predictions remain above the set threshold and incorrect predictions remain below the set threshold then the system is said to be deployable otherwise it is trained again.

**5. Briefly explain the terms:**

- |                                     |                         |                                 |
|-------------------------------------|-------------------------|---------------------------------|
| <b>a. Problem statement</b>         | <b>b. Goal</b>          | <b>c. Data feature</b>          |
| <b>d. Data scrubbing or munging</b> | <b>e. Missing value</b> | <b>f. Model g. Testing data</b> |

a. Problem scoping: Trying to see or define what is to be done to solve a problem is called problem scoping. Problem scoping gives a clear vision of the problem and distinctly defines what will be the outcomes of entire problem-solving exercise.

b. Goal: Goals define what the proposed solution to the problem is going to achieve. They also help in evaluating the outcomes with the desired results.

c. Data feature: It describes the type of data being processed. It tells the application whether data is a date, number or text etc. Data feature helps in finding relevant data.

d. Data scrubbing: The technique of data cleaning and preparing the data for easier access and analysis is called data scrubbing or munging. This process converts raw and unstructured data into suitably structured data.

e. Missing value: Missing values in the dataset result in incomplete or inappropriate training of the AI system and making it biased. Missing values need to be found, calculated, substituted or their absence should be labelled appropriately.

f. Model: Model refers to the technique or algorithm on which the data analytics is performed. It gets its name accordingly. E.g., model used to predict in Yes/No is a classification model.

g. Testing data: The set of data which is used to evaluate the performance of a trained model is called testing data.

**D. Select the correct answer.**

1. b. When
2. d. None of these
3. b. Buyer's database
4. c. Rationale
5. b. Solution
6. d. All of these
7. a. Relevance of data
8. c. NULL
9. a. testing, training
10. b. After its training



## Chapter 4: Basic Statistics, Data Exploration and Visualisation

### A. Very Short answer type questions.

#### 1. What is the role of statistics in data analysis?

Statistical methods provide techniques and formulas to apply on the huge ranges of data values to analyse the relationships among them.

#### 2. What will be the mean of the value set: 15, 26, 13, 13, 2, 12

13.5

#### 3. What will be the median of the value set: 15, 26, 13, 13, 2, 12

13  $[(13 + 13)/2]$

#### 4. What will be the variance of the value set: 15, 26, 13, 13, 2, 12

- Mean values sorted: 2, 12, 13, 13, 15, 26
- Mean of values = 13
- Diff of each value and mean are: -11.5, -1.5, -0.5, -0.5, 1.5, 12.5
- Squares of above diff: 132.25, 2.25, 0.25, 0.25, 2.25, 156.25
- Sum of above squares = 293.5
- Variance =  $293.5/6 = 48.91$

#### 5. What will be the mode of the value set: 12, 26, 13, 13, 2, 12

13

#### 6. What is standard deviation?

Square root of variance of the set of values is called standard deviation.

#### 7. How will you display top 5 and bottom 2 rows of the data loaded in a pandas object pan?

```
p = pan.read_csv("mycsvfile")
```

```
h = p.head(5)
```

```
t = p.tail(2)
```

```
print(h, "\t", t)
```

#### 8. In a pandas data frame what do you mean by index axis?

Index axis refers to the rows.

#### 9. By which axis numbers the columns and rows are indicated in pandas dataframe?

Axis 0 refers to rows or index axis while Axis one refers to the columns.

#### 10. What do you mean by outlier in data visualisation?

In a data plot, values which fall at a significant distance from the rest of the data range then they are called outliers.

### B. Short answer type questions.

#### 1. Briefly describe mean, median and mode with a single example.

Mean: The average value of a set of numbers is called mean. For example, mean of 85,98,73,48,69,28,96 will be 71 (sum of all values/count of values).

Median: Median is the middle-most value of a sequence of values. The values need to be presented in ascending or descending order. If the number of values is even then average

of the two middle values is taken. E.g., median of 10, 20, 30, 40, 50, 60 will be 35  $((30+40)/2 = 35)$ .

**Mode:** The value having maximum frequency (number of occurrences) in a series of values is called mode. E.g., in 12, 21, 13, 12, 24, 12, 10, 75, the mode is 12.

**2. How will you calculate the variance of runs made by a batsman in his 5 consecutive matches? Assume the runs. Maximum is half century.**

Runs made in 5 matches: 20, 0, 55, 12, 75.

$$\text{Mean} = (20 + 0 + 55 + 12 + 75)/5 = 32.4$$

Difference of mean and each value:

$$32.4 - 20 = 12.4 \quad 32.4 - 0 = 32.4 \quad 32.4 - 55 = -22.6 \quad 32.4 - 12 = 20.4$$

$$32.4 - 75 = -42.6$$

Squares of above values: 154, 1050, 511, 416, 1815

$$\text{Average of squares} = 154 + 1050 + 511 + 416 + 1815 = 3945/5 = 789$$

**3. How is standard deviation based on variance? Explain with a small example.**

Standard deviation is the square root of the variance.

E.g., Consider the values: 20, 0, 55, 12, 75.

$$\text{Mean} = (20 + 0 + 55 + 12 + 75)/5 = 32.4$$

Difference of mean and each value:

$$32.4 - 20 = 12.4 \quad 32.4 - 0 = 32.4 \quad 32.4 - 55 = -22.6 \quad 32.4 - 12 = 20.4$$

$$32.4 - 75 = -42.6$$

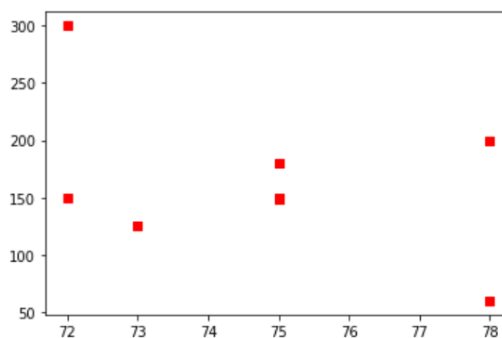
Squares of above values: 154, 1050, 511, 416, 1815

$$\text{Average of squares} = 154 + 1050 + 511 + 416 + 1815 = 3945/5 = 789$$

Standard deviation = square root of 789 = 28.

**4. What is the significance of Scatter Plot chart?**

Discontinuous data values are plotted using scatter plot chart. Scatter plot is used to study the relationship between two variables usually. For example, consider the price of gold in past 120 months and the amount sold every month by a jeweller or the price of gas every month in past 24 months and consumption of gas per month by a vehicle.



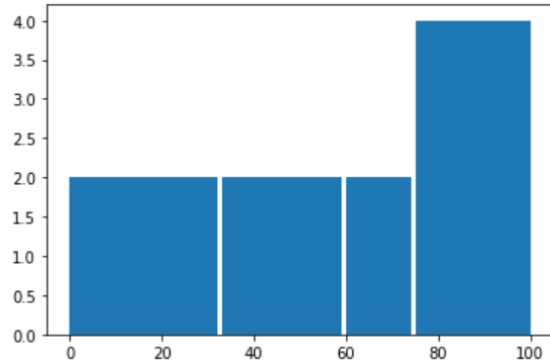
**5. What is the difference between scatter plot and bubble chart?**

Scatter chart is usually used to plot two variables on an x-y plane while bubble chart is used to plot multiple variables denoted by the colour and size of the bubble depending on the value represented by the bubble.

**C. Long answer type questions.**

**1. Describe the use of histogram with an example.**

A histogram is used to group the values to plot in multiple series of intervals. For example, you need to distribute the marks of the students in the range of 0-32, 33-59, 60-74 and 75-100 then 4 bars will be plotted for each group. The breakups of ranges in histogram are called **bins**.



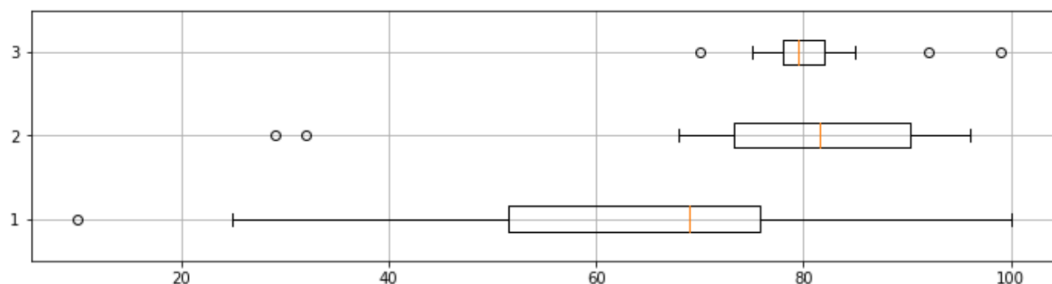
Consider the given histogram. There are 2 values in the range 0-33 i.e. **29** and **19**; 2 values in the range 34-59 i.e. **45** and **53**; 2 values in the range 60-74 i.e. **65** and **71** and finally, 4 values in the range 75-100 i.e. **75**, **78**, **79** and **81**.

**2. How box-whisker plot helps in exploratory data analysis?**

Explanatory data analysis is the process of describing the data in more useful details. The values in data set are described in the form of different ranges to understand how the data is spread. The comparison of such spread of data helps in making effective decisions. Box-Whisker shows distribution of values in 3 ranges called **quartiles** and 2 extreme values called **outliers**. The values falling far off than other data values in a set are called outliers. If the spread of data is not balance then it is called skewed data. This helps in evaluating the consistency in the data values.

**3. What do you mean by negative and positive skew of a box-whisker plot? Explain with distinct examples.**

Box-Whisker shows distribution of values in 3 ranges called **quartiles** and 2 extreme values called **outliers**.



[10, 25, 47, 53, 65, 69, 69, 70, 75, 78, 81, 100]  
 [29, 32, 68, 75, 75, 76, 87, 87, 89, 94, 96, 96]  
 [70, 75, 78, 78, 79, 79, 80, 81, 81, 85, 92, 99]

As you can see, first sales box-whisker has 3 outliers, second has 2 and third has 1 outlier. The third box-whisker is positively skewed (right side). The second box-whisker is balanced and first box-whisker is slightly negatively skewed (left side).

**4. Describe the parts of a box-whisker plot.**

A Box-Whisker plot has 5 part, such as:

- Lowest or **minimum** observation or lowest value in the data set.
- The first quartile or **Q1** (median of the first half of the data set i.e. first 25%).
- The second quartile or **Q2** (median of entire data set i.e. 50%).
- The third quartile or **Q3** (median of the second half of the data set i.e. rest 25%).
- Highest or **maximum** observation or highest value in the data set.

**D. Select the correct answer.**

1. a. Statistics
2. b. Variance
3. c. pandas
4. d. Comma
5. b. Row
6. a. Column
7. b. print()
8. a. Outliers
9. b. Q1 and Q3

## Chapter 5: Classification Model

**A. Very Short answer type questions.**

**1. Name any three popular classification algorithms?**

K-nearest neighbour, neural networks and random forest.

**2. On which concept does K nearest neighbour algorithm is based?**

KNN algorithm is based on the concept that similar objects or values or data points on a plot are closer to each other.

**3. If the classification of a new data point is being done by comparing 15 data points using KNN and the neighbours considered for classification are 3 then what will be the value of K here?**

In KNN, K denotes number of considered neighbours so here, value of K will be 3.

**4. Why KNN is called a lazy algorithm?**

KNN algorithm stores all the values in the data set in memory until the prediction is not computed hence it is called lazy algorithm.

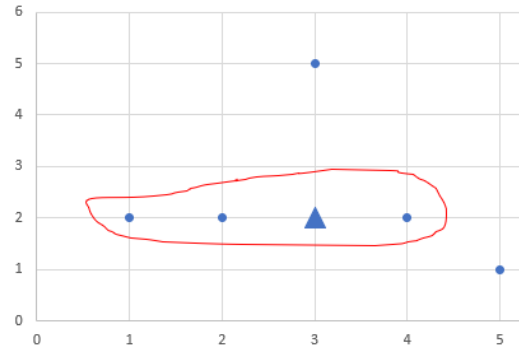
**5. What do you mean by classification?**

Grouping or segregating data values on the basis of a known property is called classification.

**B. Short answer type questions.**

**1. Define the term KNN with a small example.**

K-Nearest Neighbour algorithm is based on the concept that similar values tend to stay closer to each other on a plot. KNN algorithm analyses the data points grouped into separate classes and tries to predict in which class the new value falls in. For example, in the following plot, the new value 3,2 has 3 nearest neighbours, [1,2], [2,2] and [4,2]. Here, K is 3.



**2. Why KNN is called usually a supervised learning algorithm?**

KNN is a supervised learning algorithm because it needs to know the data values to analyse and the data value to do the prediction for. It also needs to know the desired output.

**3. What do you mean by distance function?**

In KNN and many other such algorithms, we need to calculate the distance between the data values over a plot. One of the ways to calculate the straight distance between two given data points is Euclidean Distance Function.

**4. List any 6 salient features or characteristics of KNN algorithm.**

The 6 salient features of KNN algorithm are:

1. It is the simplest yet most effective classification algorithm.
2. It assumes that almost similar values stay in close proximity.
3. It relies on the neighbouring points for classifying any new, unknown point.
4. It is a supervised machine learning algorithm because it tries to do prediction on the basis of known values.
5. K is the non-zero variable that denotes number of neighbours to be considered for prediction.
6. Works out reasonably accurate prediction for continuous values using Euclidean distance function.

**5. What do you mean by parameter tuning?**

Parameter tuning is the process of determining the most suitable value for K in K Nearest Neighbour algorithm. A lower or a higher value may lead to inaccurate or imprecise predictions. So, this needs to be determined by taking various values for K and then comparing them to select the most suitable.

**C. Select the correct answer.**

1. b. Classification
2. c. Data points nearest to new data point
3. a. KNN
4. b. Predictor variables
5. a. Parameter tuning

## UNIT 5: Computer Vision

### Chapter 1: Introduction to Computer Vision

#### A. Very Short answer type questions.

1. **What do you mean by the term “Computer Vision”?**

Computer Vision is the domain of artificial intelligence that primarily deals with processing of images for a variety of purposes.

2. **List any 4 applications of CV.**

Facial recognition, documents verification, Image-based search, autonomous vehicle.

3. **List 4 important factors that aid in vision.**

Colour, size, distance and resolution.

4. **What is a pixel?**

The term *pixel* is the combination of two terms – *picture element*. A pixel is the smallest unit that constitutes an image. An image is a dense array (arrangement) of hundreds or thousands of pixels.

5. **What do you mean by RGB model?**

Digital devices like computers, digital cameras etc. use RGB colour model. In this model primary colours are red, green and blue. Other colours are created by the varying intensities of these 3 basic colours.

6. **What is the minimum and maximum intensity of a colour in RGB model?**

Minimum is 0 (absence of that colour) and 255.

7. **What is a channel in a coloured image?**

Two-dimensional array of pixel values in an image is called channel. Coloured images have 3 channels – one for each primary colours (red, green and blue). Grayscale images have only one channel.

8. **What is the basic difference at pixel level in a coloured image and a grayscale image?**

Coloured images have 3 arrays of pixels called channels – one for each of the primary colours (red, green and blue). Grayscale images have only one channel.

9. **List 4 major tasks of Computer Vision.**

Classification, Classification and localisation, Object detection, Instance segmentation.

10. **Name some common image features used by computers for feature extraction.**

Edges, corners, dimensions and blobs.

#### B. Short answer type questions.

1. **Describe any 2 applications of Computers Vision.**

Facial Recognition: Facial recognition is one of the security features in handheld digital communication devices and various types of computers to unlock the device. Facial recognition is also useful in law enforcement in identifying faces of suspects, missing persons and known criminals. Other uses of facial recognition are ability of a smart home digital camera to distinguish between a friendly guest and stranger, tracking visitors/employees/passengers.

**Document Verification:** In all the industries involving extensive documentation need the accurate validation of the documents. Industries such as banking and finance, travel (passport, visa, identification documents), real estate, legal services (courts and panchayats), vehicle registration and verification are major areas where CV capabilities can be applied. This helps in fraud detection, authenticating individuals, verifying ownership of property, identifying forfeit currency and documents etc.

**2. Briefly describe application of CV in**

**a. Facial recognition. – refer to the previous question**

**b. Document verification - refer to the previous question**

**c. Education and Learning**

**Education and Learning:** Learning based on augmented reality and virtual reality need CV algorithms to convert all the static content into interactive immersive content for learning instead of developing content from scratch. Generating 3D visual from a 2D image, assignments and answer sheets verification, online class attendance, virtual tours and excursions can be enriched by CV applications. CV helps those learners who learn by watching. Learning through images and visuals can be made more intuitive and effective with CV applications.

**3. What kind of intelligence does CV help in providing to vehicles? Explain briefly.**

Vehicle control involves audio-visual data processing. In an autonomous vehicle, Computer Vision technique helps process real-time, rapid visuals. The CV algorithms controlling the vehicle is faster in processing speed so that instant control actions could be performed. CV helps in adding all intelligence to the autonomous vehicles. Such vehicles are able to quickly identify still and moving obstacles, road signs, gestures, signals from other vehicles, correct route, road conditions, local traffic rules, distance from other objects and vehicles, weather conditions, light conditions, barriers and diversions.

**4. Briefly explain how computers understand images.**

Computers perceive an image as a set of several pixels arranged in a grid form or array. A pixel is the smallest unit that constitutes an image. An image is a dense array of hundreds or thousands of pixels. Each pixel in a coloured image represents a mix of red, green and blue colour intensities which make different colours. In a greyscale image, various intensities of grey colours are found.

**5. What do you mean by image resolution?**

In any image, higher the number of pixels, clearer would be the image. This is called image resolution. Image resolution is the pixel count in the image. A pixel is approximately  $\frac{1}{96}$ th part of an inch i.e. 0.26 mm. Image resolution is generally specified as an array of pixels across width and height, for example 1561 x 747 means 1561 pixels across width and 747 pixels across height.

**6. What do you mean by classification and localisation in terms of CV?**

When a CV algorithm tries to identify a single object in an image and also tries to figure out which pixel coordinates constitute it then this is called classification and localisation. This is achieved by edge detection. For example, in an image of fruits, identifying apples and trying to locate the pixel positions of apples.



**7. What is object detection in CV parlance?**

When all the objects are localised (identified and their pixel values found) in an image by a CV algorithm then it is called object detection. For example, identifying a face in a group photograph.

**8. What is the purpose of instance segmentation in CV?**

Instance is one or more occurrences of an object of a class in an image. For example, in an image there are 12 instances of car. But, if algorithm tries to distinguish the cars on the basis of their colour or model then, the algorithm will first classify all cars as *cars* and then it will label them according to the colour or model. This process of classifying similar objects into another subclass is called instance segmentation.

**9. How do Corner detection and Edge detection help in object identification in an image?**

An edge generally denotes the abrupt or sharp change in the intensity of a range of pixels and helps in identifying the boundary of the two objects or regions. Edges and corners help in determining the shape of an object in the image. As compared to edges, corners are easier to detect since maximum change in the intensity of pixels occur at the corners. The reason is that a corner includes at least two edges and hence change in the intensity of the pixels is higher in corners as compared to edges.

**10. How are corners different from edges in an image?**

Corners include at least two adjacent edges and hence change in the intensity of the pixels is higher in corners as compared to edges.

**11. What do you mean by a Blob in an image in CV parlance?**

A blob is flat region in an image with zero or negligible intensity change in the pixels. Blobs usually make the major part of an image. As long as a blob is detected the inspection of the pixels can continue until considerable change in the intensity is detected which could mean either a corner or an edge.

**12. How is an edge different a blob in an image?**

An edge denotes a sharp change in the intensity of pixels while in a blob there is very slight or no change in intensity. Edges help in identifying and localising the objects in a visual while blobs help in figuring the shape, size or span of the object.

**C. Select the correct answer.**

1. c. Numbers
2. b. 3D
3. c. Gray
4. d. All of these
5. a. 2D
6. a. Classification
7. b. Localisation
8. c. Object detection
9. d. Instance segmentation
10. d. Image features
11. d. Edge

- 12. a. Corner
- 13. b. Blob
- 14. d. Edge

## Chapter 2: Introduction to OpenCV

### A. Answer the following questions.

#### 1. Write the steps to install opencv package?

Open **Anaconda Power shell** or **Anaconda Prompt** window from the Start menu, type **pip install opencv-python** and press **Enter** key.

#### 2. Write the statement to change GBR mode to RGB of an image using `mycv.cvtColor()`.

```
Img = mycv.cvtColor(myimage, mycv.COLO_BGR2RGB)
```

#### 3. What is the difference between `mycv.imread()` and `mycv.imshow()`?

`imread()` method is part of `mycv` package and it is used to load the image as coloured or grayscale (by passing 0 as second argument to it). On the other hand, `imshow()` method is part of `matplotlib` library and it is used to display the image over a plot.

#### 4. What do you mean by `imshow(image_object, cmap, interpolation)`?

In method `imshow(image_object, cmap, interpolation)`, `image_object` is the image loaded by the help of `cv2` package and `interpolation` is a named parameter which can take a value such as `bicubic` to display a clear image.

#### 5. How do you switch off the image plot axis?

```
from matplotlib import pyplot as plt  
plt.axis('off')
```

#### 6. What do `shape` property and `min()` and `max()` functions of an image do?

`Opencv` image property `shape` returns a tuple listing 3 values – image height, width and number of channels (here, they are 850, 1280 and 3 respectively).

Methods `min()` and `max()` of `opencv` image return minimum and maximum pixel value.

#### 7. Write the statement to add 5 subplots in an image plot with figure size 200, 200.

```
from matplotlib import pyplot as plt  
fig, plots = plt.subplots(1, 5, figsize=(200, 200))
```

#### 8. Write the statement to copy the region: 0:0, 100:100 to some other region in the image.

```
import cv2 as mycv  
i = mycv.imread('myimage.jpg')  
temp = i[0:0, 100,100]  
i[200:200, 200,300] = temp
```

9. **Write the statement to set the dimensions of an image in img object to width = 300, height=200.**

```
import cv2 as mycv
i = mycv.imread('myimage.jpg')
new_img = mycv.resize(i, (200, 300))
```

10. **What is happening in this statement?: `roi =img[10,10, 200,100]`. Here, img is the image object containing an image.**

In this statement, the pixel range from coordinates 10, 10 to 200, 100 are marked as region of interest in the image which means that this region will be retained and now the outer unwanted region of the image can be cropped.

11. **Show the use of `split()` function of opencv package by an example.**

```
import cv2 as mycv
from
i = mycv.imread('myimage.jpg')
b, g, r = mycv.split(i)
from matplotlib import pyplot as plt
plt.imshow(b)
plt.show()
plt.imshow(g)
plt.show()
plt.imshow(r)
plt.show()
```

12. **What should `img[0,0]` return where img is an image object containing an image.**

`img[0, 0]` will return the pixel values of the very first pixel i.e. the pixel in first row and first column of the numeric array of the image.

## Chapter 3: Convolution and CNN

- A. **Very short answer type questions.**

1. **What is the basic use of convolution?**

Convolution helps in extracting features of an image such as edge detection. Convolution is the fundamental mathematical operation used in many image processing operators such as blur, sharpen, emboss, blend etc.

2. **What is a kernel?**

In convolution, each element of the image array is multiplied by the values in another array which is smaller in size than the image array but in same proportion of dimensions. This multiplying array is called kernel. Kernel is the array that is used to convolute the image.

3. **Usually, the peripheral pixels of an image get excluded from convolution process. What do we need to include those pixels also in the process?**

To include peripheral elements of the image in convolutions, additional pixels are padded around the image to make space for the kernel to move. Padded pixels are given any assumed value such as -1 or 0. After convolution, the padded pixels are discarded.

**4. How many times a convolution process needs to be repeated for a coloured image and why?**

For coloured images, convolution needs to be done on all the 3 channels. So, it is three times – once for each channel.

**5. How many times a convolution process needs to be repeated for a grayscale image and why?**

In grayscale images, there is only one 2D channel (array) hence convolution needs to be done once.

**6. List the names of some common convolution filters.**

Blur, Edge detection, sharpen, blend, emboss

**7. Name the layers a Convolution Neural Network is composed of.**

A CNN includes the layers in this sequence - Convolution layer, Rectified Linear Unit layer, Pooling layer and Fully Connected layer.

**8. What do you mean by weight with reference to kernel?**

In Convolution layer, the convolution operation occurs over the image array with a kernel. The values of the kernel array are called weights.

**9. What is a feature map?**

A feature map is produced as output of convolution layer. Feature map contains the result of the filters applied either on an input image array.

**10. Why is ReLU layer called eliminative activation function?**

ReLU layer processes the feature map produced by Convolution layer. It eliminates all the negative values in the feature map to zero. That is why ReLU is also called as eliminative activation function.

**11. On what logic does ReLU layer work?**

ReLU performs simple arithmetic of the logic: if input is positive, pass it on as it is as output but, if it is negative then set it to zero. In short:  $Output = Max(0, input)$

**12. Name the 2 ways in which Pooling Layer performs down-sampling of an image.**

Max pooling and average pooling.

**13. List 4 applications of CNN.**

The four applications of CNN are image classification, face recognition, identifying digits in a product code, decoding a QR code, interpreting a road sign, validating documents etc.

**B. Short answer type questions.**

**1. Define the term Convolution.**

Convolution is a process of multiplying the pixel values of the image array with the values of another numerical array of similar proportion (not dimension) to bring considerable enhancement in the image.

**2. How does a blur filter work?**

Usually, in convolution, the values of image array and filter are added but in blur filter, the average of the values is taken that results in the blurring of the image.

**3. How edge detection is a two-pass process?**

Edge detection kernel is based on the concept that the pixels that make the edges of an object in an image will have higher intensity value while rest of the pixels will be close to zero. Edge detection occurs in two passes. First, the kernel convolutes across x-axis of the image array and then it is rotated to convolute its y-axis.

-1	0	1
-2	0	2
-1	0	1

-1	-2	-1
0	0	0
1	2	1

**4. What happens to an input image in Convolution layer?**

In Convolution layer, the kernels work as filters to extract basic features of the image such as edges, colour information, orientation of the image, to remove noise from the image etc. A feature map is produced as output of this layer. It contains the result of the filters applied on the input image values. The convolution layers nearer to the input image detect low-level features while deeper layers detect general features. Image sizes may be reduced here for better and accurate feature detection and help in focussing on the desired features only.

**5. What input does Rectified Linear Unit Layer take and what does it do with the input?**

Rectified Linear Unit layer processes the feature map produced by Convolution layer. It eliminates all the negative values in the feature map by converting them to zero. So, if input is positive, it is passed on as it is but, if it is negative then it set to zero.

**6. What input does Pooling Layer take and what does it do with the input?**

Pooling layer takes the image features from Rectified Linear layer and performs down-sampling of the input which means that the input is converted into a low-resolution sample that still contains the necessary features. A low-resolution image with necessary features is less sensitive to minor transformations and generated feature maps remain consistent. Pooling layer also downsizes the image for easier management and processing.

**7. What is the basic difference between Max pooling and Average pooling that occurs in Pooling layer?**

Max and Average pooling occur in Pooling layer. In Max Pooling, another convolution is done on the feature map output by the ReLU layer. When kernel is applied on the image, instead of sum of the multiplications, the maximum value of the multiplications is taken while in Average Pooling, instead of sum of the multiplications, the average value of the multiplications is taken.

**8. If a Fully Connected layer receives the input of an airplane's image then what will it do to the image in order to identify it?**

Fully Connected layer is the final layer of the CNN. The final image is composed of all the outputs flattened into a single image vector. The values in the vector represent the higher and lower probabilities of a possible feature. In this vector, the labels that may produce desired or accurate output or prediction have higher probability values than others. For

example, if the image has to be identified as an airplane then the labels representing the airplane (shape, size, location in the image, edge pixel values etc.) will have higher probability values. This will eventually help in classifying the object as of class airplane.

**C. Select the correct answer.**

1. a. Feature extraction
2. a. Kernel
3. c. 3
4. a. 1
5. c. Feature map
6. a. Max pool
7. a. Feature map
8. b. Negative values set to zero
9. c. Down-sampled image
10. d. Probability values are assigned

## **UNIT 6: Natural Language Processing**

### **Chapter 1: Introduction to Natural Language Processing**

**A. Very short answer type questions.**

**1. What do you mean by the term NLP?**

Natural Language Processing is an Artificial Intelligence domain that deals with the language-based interactions between humans and machines as well as between two machines.

**2. What is the basic difference between voice recognition and speech recognition?**

Voice recognition is the ability Since language is directly related with communication, NLP has tremendous use in all the industries where human interactions are involved such as customer support system, inquiry handling, education, counselling and consultation, crime detection through voice processing (what is spoken) and speech recognition (who has spoken).

**3. What is a wake (Corrigendum) word? Give example.**

Digital or virtual assistant can be initiated by a keyword called wake word. E.g., *Alexa* is the wake word for Amazon Alexa.

**4. What is a digital (virtual) assistant?**

Digital or virtual assistant is one of the most common applications of NLP. It executes some common tasks in response to voice command. E.g., you can ask Amazon Alexa to search for best price for an item online.

**5. Name two major types of bot.**

Script bot and Smart bot.

## **B. Short answer type questions.**

### **1. What is the significance of NLP in machine learning?**

Natural Language Processing intends to bridge the gap between human language and the way computer understands it. NLP is a domain of Artificial Intelligence. The focus of NLP is to enable machines decode, interpret and process human language and speech for various purposes such as voice assisted customer support, document classification, speech recognition, speech to text translation etc.

### **2. Describe briefly about digital assistants?**

Digital or virtual assistant are found in the form of application only or a combination of device loaded with application. It performs some of our tasks easily and quickly. It provides access to various online services also. For example, you can ask VA to read out new mails or switch on the TV. VA usually works on voice commands and can be initiated by a keyword called **wake word**. Interacting with a VA is very natural as if you are talking to a human. For example, *Alexa* is the wake word for Amazon Alexa. You can speak a natural English sentence to Alexa and it will interpret correctly what to do. Some popular Virtual Assistants are Amazon Alexa, Google Assistant, Microsoft Cortana and Apple Siri.

### **3. How is NLP useful on social media and E-Commerce portals?**

For social media, NLP and machine learning techniques can analyse the content for sentiment analysis of people towards any incident or product, estimating brand popularity index, identifying unconstitutional content such as hate speech and fake news, tracking threats such as militant activities, targeted digital marketing and classifying people into various groups.

E-Commerce portals are more concerned about their customer experience. Smart bots help a lot in that. Instead of taking time in email communication online or voice chat is faster. It is just like talking to a digital assistant. E-Commerce portals can gather customer feedback quickly, push-promos, aids physically challenged people in using their services, image-based product search and voice enabled authentication.

### **4. What is smart search feature of a search engine?**

As you type in the search box of a search engine, automatic search word suggestions appear. Google had pioneered the feature of *search autocomplete* in which search terms are suggested as you type depending on your previous searches, location and context of the search. Smart search feature is integrated in many E-Commerce sites to add product specific keywords depending on the customers buying history to facilitate deeper search and list more relevant items.

### **5. List 4 characteristics of Script bot.**

1. Script bots are based on simple rules hence they are easier to develop and deploy.
2. They have limited functionality. Intelligence logic is in-built as a script.
3. They are re-usable and can be easily integrated with the existing systems.
4. These bots do not lack functionality for natural language processing.

### **6. List 4 characteristics of a smart bot.**

1. Smart bots work on machine learning with NLP capabilities hence they are versatile in use.
2. Smart bots learn from user interactions and become more intelligent in their responses.



3. More coding efforts and time is needed to develop these bots. Hence they are expensive than script bots.

4. Such bots provide enriched user experience as compared to script bots.

**C. Long answer type questions.**

**1. Briefly describe the role of NLP in AI in general.**

Natural Language Processing enabled with Machine learning and Deep learning algorithms can enrich the interaction between humans speaking unstructured, complex and multiple languages. NLP models can easily process voice, speech and text in various highly unstructured and complex forms. NLP with AI has tremendous use in all the industries where human interactions are involved such as customer support system, inquiry handling, education, counselling and consultation, crime detection through voice processing (what is spoken) and speech recognition (who has spoken). Speech and face recognition (Computer Vision) can help in efficient crime prevention. Other areas are education and training, Voice User Interfaces (voice commands), Public alert and addressing systems, language translations and interpretation services, voice chats, multilingual chat bots, media and communication, entertainment and it's a long list.

**2. Briefly discuss how NLP helps in social media content analysis?**

NLP technique can analyse the social media content for a variety of purposes such as:

- Mass sentiment analysis – assessing what people feel or people's inclination towards any incident or product.
- Customer satisfaction analysis – assessing if customers like/dislike a product or service.
- Monitor brand promotion and popularity – estimating popularity index of any brand.
- Tracking popularity index of celebrities, public figures and political parties.
- Monitoring trending of a concept, slogan or drive – assessing the acceptance or rejection of a slogan or drive.
- Identifying unconstitutional content such as hate speech, bully language and fake news.
- Tracking threats such as militant activities, hostile conversations hidden in codewords.
- Targeted digital marketing by analysing customer interactions.
- Classifying potential customers on their location and perform product mapping such as customers in hill stations might not be interested in buying air conditioner or refrigerator.

**3. What is the role of a smart chatbot in customer support with reference to NLP?**

AI-based smart bots work on Machine Learning algorithm with Natural Language Processing capability. They analyse the speech for context, reference and intention. With more and more variety in the nature of the interaction, their intelligence evolves. The machine learning algorithm learns from the interactions and makes NLP functionality more effective, rational and useful. Such bots are useful in building public relation by providing enriched customer experience, better assistance to the person who approached for help. With voice-based response, smart bots are more effective. This way, smart bots have versatile functionality. Such bots provide enriched user experience as compared to script bots.

**4. Discuss a few major features of any smart software application or app.**

Let students answer this question themselves with their own research. Teacher can moderate their answer.

**5. Discuss your views on how NLP can help in education and training.**

Let students answer this question themselves with their own research. Teacher can moderate their answer.

**6. How is a rule-based chatbot different from a smart bot?**

<b>RULE-BASED SCRIPT BOT</b>	<b>AI-BASED SMART BOT</b>
1. Work on a set of limited rules called scripts.	Work on machine learning algorithm
2. Easier to develop and deploy.	Complex in development.
3. Limited functionality.	Versatile use in various industries.
4. No capability to learn from interacted data.	Can learn and evolve from interaction.
5. Lack language parsing and processing.	Capable of natural language processing.
6. Work on limited set of keyword and commands.	Can connect with documents and database on cloud.
7. They are cheaper.	They are comparatively expensive but worth the expense.

**D. Select the correct answer.**

1. c. NLP
2. a. Speech recognition
3. c. Wake word
4. b. Sentiment analysis
5. d. None of these
6. d. All of these
7. d. All of these

## Chapter 2: NLP: AI Project Cycle

**No Assessment**

### Chapter 3: How NLP Works?

**A. Very short answer type questions.**

**1. What do you mean by syntax of language?**

Syntax refers to the structure of the language such as articles, verb, phrases, nouns, pronouns, adverbs, adjectives etc. form the structure of the language. They are the building blocks of the language.

**2. What do you mean by language semantics?**

Semantics refers to the sense or meaning that the description holds. There could be sentences which are syntactically (grammatically) correct but lack semantics (meaning).

**3. What is a corpus?**

Entire text that comes from all the documents to be processed by a machine is called corpus.

**4. What is a stopword? Give examples.**

A stopword is a word, letter or special character which is irrelevant to the scope of natural language processing of the content. Examples are - auxiliary verbs (is, are, was), punctuations, prepositions (on, at, in), articles (a, an, the) and other such words like such, there, them, or, and etc.

**5. What is stemming?**

Stemming is the process to remove affixes from a word and keep only the root or original word. Such as, Hours > Hour, Eating > Eat, Humorous > Humor, Happily > Happy etc.

**6. What is lemmatisation?**

Lemmatization is the process of stemming as well as converting the stemmed words to their proper form to keep them meaningful. Example, Studies > Studi > Study.

**7. What do you mean by bag of words?**

Bag of words is an NLP algorithm which is used to extract two main features of text in the corpus - vocabulary and frequency. Vocabulary refers to the unique words identified in the corpus and frequency is the number of occurrences of each term in the corpus.

**8. What do you mean by Term Frequency and Document Frequency?**

Term Frequency is the number of occurrences of a term in a document while, Document Frequency is the number of documents in which a term has appeared at least once.

**9. What do you mean by Inverse Document Frequency?**

Inverse Document Frequency is the inverse of document frequency.

**10. How is IDF calculated?**

For any term the IDF is calculated as: Document count in the corpus / Document Frequency of that term. E.g. if a term pollution appears in 3 documents and there are 10 documents in the corpus then IDF will be  $10/3 = 3.33$ .

**B. Short answer type questions.**

**1. What do you mean by text normalisation?**

Text normalisation is the process to break the text into sentences and tokens then remove irrelevant tokens from it. Finally, the extracted text is converted to a numerical representation of each token. Original form of text is not suitable for a machine to process due to many unnecessary words and symbols in it. This way, the process of downsizing and simplifying the text to make it suitable for machine processing is called text normalisation.

**2. How can you identify a token as a stopword?**

Tokens which are repeated frequently and which do not describe the content. They are the part of the syntax of the language not semantics. For example, prepositions, conjunctions, articles, symbols, punctuations etc.

**3. How is stemming different from lemmatisation. Give 4 examples.**

Stemming is removing affixes from the main word and extracting its root often with an incorrect spelling. E.g. Caring > Car. Lemmatization converts the word to its correct, meaningful form according to the scope of the processing. E.g. Caring > Car > Care (not a vehicle).

**4. Why normalised text needs to be converted into numeric form for feature extraction?**

For NLP using an machine, normalised text needs to be converted to numeric form for feature extraction because machine does not understand the syntax or semantics of the grammar. It needs numbers to apply arithmetic and logic to complete the analysis.

**5. How BoW algorithm helps in feature extraction? Give a small example.**

If we input the normalised text to a BoW algorithm then it first creates a list of tokens in the corpus along with their frequency of appearance. Then it makes a document vector table which shows how many times each token is appearing in each of the document in the corpus.

For example: Document 1: *all for one one for all*. And then, Document 2: *all play together*. Here, number of documents is 2 and frequency of tokens is like this – all – 3, for and one – 2 each, play – 1 and together - 1

**6. What do you mean by document vector table?**

Document vector table contains all the terms in the corpus in the table header and displays the frequency of the terms in rows as one row for each document. The terms which do not appear in any document, for them, 0 is mentioned. For example: Document 1: *all for one one for all*. And then, Document 2: *all play together*.

	<i>all</i>	<i>for</i>	<i>one</i>	<i>play</i>	<i>together</i>	
<b>Document 1</b>	2	2	2	0	0	1
<b>Document 2</b>	1	0	0	1	1	1

**7. A term is appearing averagely 5 times in 20 documents of a corpus. There are 100 documents in the corpus. What will be the Inverse Document Frequency of that term?**

IDF = Document count in the corpus / Document Frequency of that term = 100/20 = 5

**8. What do the following functions of nltk library do?**

- a. sent\_tokenize()**                      **b. word\_tokenize()**                      **c. FreqDist()**

Method **sent\_tokenize()** takes the desired text as argument and returns a list of sentences in the text.

Method **word\_tokenize()** takes the desired text as argument and returns a list of individual tokens in the text.

Method **FreqDist()** takes the list of tokens as argument and returns the number of unique tokens and number of total tokens.

**C. Long answer type questions.**

**1. Briefly discuss how language is a challenge for a machine to process.**

Machines are not capable and efficient to understand and process the way human brain does. The reason behind this is the natural language grammar as well as meaning. The grammar of the language is referred to as syntax which includes all the rules of the usage, formations, narratives, pronunciations etc. Semantics refers to the inherent meaning of the words and narration in different contexts. Humans learn language slowly as they grow up through guided learning, practice and usage. Machines learn in a different way. Machines only understand numbers so if a machine needs to learn and process natural language then the content needs to be converted in to a numeric form that is suitable for machine. This is the first challenge. Other challenges are – how to make machine

understand and learn all the rules of the language (syntax) which are too complicated. Semantics of the language hardens this challenge since machines cannot figure the context like human brain does. Machines do not understand emotions, sarcasm and intent of the language used.

**2. How tokenization and stemming help in normalising the text. Explain with a small example.**

Tokenising is the process of breaking the text into separate words and symbols called tokens. Tokenisation is done after segmentation of the text. Segmentation gives the text broken into separate sentences called segments. Then segments are tokenised. In any language, a word is found in its variations or varied forms due to certain affixes. For example, copy, copies, copied, copious, copying. In normalisation, variations of words are reduced to the single root form of the word. Here, we know the root is “copy”. This root form is extracted by removing the affixes. This is called stemming. For example, copies > copi, copied > copi, copious > copi, copying > copi. One shortcoming of stemming is that the extracted root forms differ in spelling and meaning. For example, caring > car (it should be “care” not a vehicle – “car”). Correcting these forms into original token is called lemmatisation.

**3. What is the use of BoW and TFIDF algorithms?**

BoW algorithm is used to extract vocabulary and frequency from the corpus. Vocabulary refers to the unique words in the corpus and frequency is the number of occurrences of each word in the corpus. TFIDF is the term frequency and inverse document frequency of each term. These are the numeric terms which inform about the relevance and importance of the term in a document. These are helpful in document identification and classification.

For example, consider following 2 documents:

Document 1: It is a vicious circle. The emission of chlorofluoro carbons increases global warming and global warming leads to increased use of CFC emitting equipment across the globe.

Document 2: Chlorofluoro carbons or CFC are emitted by modern equipment that deplete Ozone layer.

After normalisation:

Document 1: vicious, circle, emit, chlorofluoro, carbon, globe, warm, globe, warm, increase, cfc, emit, equipment, globe

Document 2: chlorofluoro, carbon, cfc, emit, equipment, deplete, ozone, layer

BoW:

Vicious	1
circle	1
emit	3
chlorofluoro	2
carbon	2
globe	3
warm	2
increase	1
cfc	2
equipment	2

deplete 1  
ozone 1  
layer 1

Document Vector Table:

	<i>Vicious</i>	<i>circle</i>	<i>emit</i>	<i>Chlorofluoro</i>	<i>carbon</i>	<i>globe</i>	<i>warm</i>
<b>Document 1</b>	1	1	2	1	1	3	2
<b>Document 2</b>	0	0	1	1	1	0	0

	<i>increase</i>	<i>cfc</i>	<i>Equipment</i>	<i>deplete</i>	<i>ozone</i>	<i>layer</i>
<b>Document 1</b>	1	1	1	0	0	0
<b>Document 2</b>	0	1	1	1	1	1

Term Frequency (TF) is the number of occurrences of a term in a document. Document Frequency (DF) is the number of documents in which a term has appeared at least once. Inverse Document Frequency is calculated as: "Document count in the corpus / Document Frequency of that term". For example, IDF of the term "emit" will be  $2/3 = 0.666$ .

TFIDF of a term is calculated for each document as TF of that term \*  $\log_{10}$ (IDF of that word). For example, TFIDF of "emit" for Document 1 will be  $2 * \log_{10}(0.666) = 2 * -0.172 = -0.352$ .

**4. Consider the sentences below and create document vector table:**

**Set 1: mango sweet mango many benefit health**

**Set 2: banana benefit many way improve health**

Document Vector Table:

	<i>mango</i>	<i>sweet</i>	<i>many</i>	<i>benefit</i>	<i>health</i>	<i>banana</i>	<i>way</i>	<i>improvement</i>
<b>Set 1</b>	2	1	1	1	1	0	0	0
<b>Set 2</b>	0	0	1	1	1	1	1	1

**5. Calculate TF, DF and IDF of the token "sweet" in question 4.**

Document 1 Term frequency for sweet: 1

Document frequency: 1

Inverse document frequency:  $2/1 = 2$

**6. Apply methods word\_tokenize() and FreqDist() in question 4 and write the statements to plot the term frequencies.**

```
from nltk.tokenize import word_tokenize
from nltk.probability import fd
import matplotlib.pyplot as plt
```

```
text = "mango sweet mango many benefit health banana benefit many way improve health"
```

```
tokens = word_tokenize(text)
freq = FreqDist(tokens)
freq.plot(30, cumulative=False)
```

**D. Select the correct answer.**

- |    |    |                |     |    |                       |
|----|----|----------------|-----|----|-----------------------|
| 1. | b. | Syntax         | 2.  | a. | Semantics             |
| 3. | c. | Corpus         | 4.  | b. | Words                 |
| 5. | c. | Both a) and b) | 6.  | a. | Stemming              |
| 7. | b. | Lemmatisation  | 8.  | d. | Vocabulary, frequency |
| 9. | a. | Stopwords      | 10. | b. | Document frequency    |

## UNIT 7: Evaluation

### Chapter 1: Model Evaluation

**A. Very short answer type questions.**

**1. Define the term Scenario with reference to evaluation of AI model?**

The problem area for which a model has been developed is called scenario.

**2. What is a Confusion Matrix?**

Confusion matrix is a tabular representation to visualise the performance of an algorithm or model.

**3. List the parts of a Confusion Matrix.**

The 4 parts of confusion matrix are True Positive: Prediction is yes and it is true, True Negative: Prediction is no and it is true, False Positive: Prediction is yes and it is false and False Negative: Prediction is no and it is false.

**4. What do you mean by the accuracy of a prediction?**

Accuracy of a prediction is assessed in terms of percentage of correct predictions out of all the predictions done.

**5. What do you mean by the precision of a prediction?**

Precision is the estimate of true positives out of all the true predictions (true positives + false positives).

**6. What do you mean by recall?**

Recall is the percentage of all true positives and false negatives.

**7. Write the formula to calculate accuracy of predictions.**

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN} * 100$$

**8. Write the formula to calculate precision of predictions.**

$$\text{Precision} = \frac{TP}{TP + FP}$$

**9. Write the formula to calculate recall of predictions.**

$$\text{Recall} = \frac{TP}{TP + FN}$$



**10. What is the significance of F1 Score?**

F1 score measures the balance between the metrics precision and recall.

**B. Short answer type questions.**

**1. Explain Scenario with an example with reference to evaluation of an AI model.**

The problem area for which a model is developed is called scenario. Scenario depicts the real problem on which prediction model has to be deployed. Scenario provides real data which is fed into the model for processing. For example, how many subscribers are really going to watch the forthcoming web series.

**2. Explain True Positive with a small example.**

True positive means the predicted event actually occurred in real as it was predicted. E.g. The forest fire is likely to occur and it did occur in reality.

**3. Explain True Negative with a small example.**

True negative means the predicted event actually did not occur as it was predicted not to occur. E.g. The forest fire is not likely to occur and it did not occur in reality.

**4. Explain False Positive with a small example.**

False positive means the predicted event actually did not occur while it was predicted to occur. E.g. The forest fire is likely to occur and it did not occur in reality.

**5. Explain False Negative with a small example.**

False negative means the predicted event actually occurred while it was predicted not to occur. E.g. The forest fire is not likely to occur and it did occur in reality.

**6. Explain confusion matrix with a small example.**

Confusion matrix is a tabular comparison of true and false predictions with the reality. It is used to visualise the performance of a prediction model. Since the model already knows what or what not to predict, it most suitable for the models based on supervised learning. In the confusion matrix, real occurrences (Yes or True) and non-occurrences (No or False) are kept at the top and prediction parameters on left hand side. Confusion Matrix shows 4 permutations as below:

		REALITY	
		Subscriber watched the web series	Subscriber did not watch the web series
PREDICTION	Subscriber will watch the web series	True Positive	False Positive
	Subscriber will not watch the web series	False Negative	True negative

**7. In cases with higher False Negative predictions, which metrics would be suitable out of Precision and Recall? Why?**

In cases with higher False Negative predictions, recall metrics is most suitable because it considers all true positives as well as all false negatives. So, for situations where human lives or disaster is involved, it is better to consider recall metrics in such case.

**8. In cases with higher False Positive predictions, which metrics would be suitable out of Precision and Recall? Why?**

In cases with higher False positive predictions, precision metrics is most suitable because it considers all true and false positives. So, for situations where danger to human lives or disaster is predicted and does not occur, it will be a big comfort and reassurance.

**9. How do you calculate F1 Score? Demonstrate with a small example.**

F1 score can be calculated as:  $2 * (\text{Precision} * \text{Recall}) / (\text{Precision} + \text{Recall})$

E.g. To calculate F1 score, first precision and recall need to be calculated. If there are 200 False negatives, 350 True positives and 300 False positives then,

$$\begin{aligned} \text{Precision} &= (\text{TP} / (\text{TP} + \text{FP})) \\ &= (350 / (350 + 300)) \\ &= (350/650) = 0.5 \end{aligned}$$

$$\begin{aligned} \text{Recall} &= \text{TP} / (\text{TP} + \text{FN}) \\ &= 350 / (350 + 200) \\ &= 350/550 = 0.6 \end{aligned}$$

$$\begin{aligned} \text{F1 score} &= 2 * (\text{Precision} * \text{Recall}) / (\text{Precision} + \text{Recall}) \\ &= 2 * (0.5 * 0.6) / (0.5 + 0.6) \\ &= 2 * 0.3 / 1.1 \\ &= 2 * 0.3 = 0.5 \end{aligned}$$

**10. What is the basic difference between calculating Precision and Recall?**

Precision is the estimate of true positives out of all the true predictions that is the sum of true positives and false positives. It does not consider negatives. Since it considers positives only, for disastrous situations if model mostly predict that calamity will occur while actually it would not. This will seem like a sound alarm if it happens too often.

Recall takes into consideration the false negatives also so it is more suitable for disastrous situations since it calculates model performance predicting disaster is not likely but in real it does occur. For such situations, recall metrics is better than precision.

**C. Long answer type questions.**

1. The numbers of TP, TN, FP and FN for a scenario are 20, 50, 12 and 8 respectively. Calculate the following:

- a. Accuracy
- b. Precision
- c. Recall
- d. F1 Score

$$\begin{aligned} \text{Accuracy} &= (\text{TP} + \text{TN} / \text{TP} + \text{TN} + \text{FP} + \text{FN}) * 100 \\ &= (20 + 50) / (20 + 50 + 12 + 8) * 100 \\ &= 77.77 \end{aligned}$$

$$\text{Precision} = (\text{TP} / (\text{TP} + \text{FP})) = (20 / (20 + 12)) = (20/32) = 0.6$$

$$\begin{aligned}
 \text{Recall} &= TP / (TP + FN) \\
 &= 20 / (20 + 8) \\
 &= 20/28 \\
 &= 0.7
 \end{aligned}$$

$$\begin{aligned}
 \text{F1 score} &= 2 * (\text{Precision} * \text{Recall}) / (\text{Precision} + \text{Recall}) \\
 &= 2 * (0.6 * 0.7) / (0.6 + 0.7) \\
 &= 0.6
 \end{aligned}$$

2. **Consider question 1. In the following scenarios, which one or the combination of precision and recall will you consider out of Accuracy, Precision and Recall and why?**

- a. Student's performance in next exam.
- b. Forecast that customer will buy new product.
- c. Forest fire.
- d. Prediction of rain in a large agricultural region.
- e. Forecast of GDP growth on next quarter.
- f. Number of deaths in road accidents in a state

The numbers of TP, TN, FP and FN for a scenario are 20, 50, 12 and 8 respectively.

- a. Student's performance in next exam. – Accuracy, if student has failed in some of the previous exams otherwise Precision is okay if student has failed in a very few of the previous exams.
- b. Forecast that customer will buy new product. – Precision since it considers true positives (predicted yes and customer really bought) and false positives (predicted yes but customer did not buy). Since situation does not involve dangerous situation so precision is okay.
- c. Forest fire – Both recall and precision. Then, check the balance between the two with F1 score since wildlife and human lives are at stake.
- d. Prediction of rain in a large agricultural region. – Same as c since food production is involved.
- e. Forecast of GDP growth on next quarter. – Same as b.
- f. Number of deaths in road accidents in a state – Same as c.

3. **Consider question 2. Calculate accuracy, precision and recall for the 6 scenarios.**

Refer to the answer of Q1. You can assume different numbers of predictions for better practice.

4. **Consider question 2. For the scenarios where you suggested Precision and Recall both, how will you strike a balance between the two by applying F1 Score?**

In the scenarios for forest fire, rain prediction and road accident deaths, both recall and precision are being considered since human lives and food production (an important commodity) are involved.

If F1 score is calculated highest then precision and recall are balanced.

$$\begin{aligned}
 \text{Precision} &= (TP / (TP + FP)) \\
 &= (20 / (20 + 12)) \\
 &= (20/32) = 0.6
 \end{aligned}$$

$$\begin{aligned} \text{Recall} &= TP / (TP + FN) \\ &= 20 / (20 + 8) \\ &= 20/28 \\ &= 0.7 \end{aligned}$$

$$\begin{aligned} \text{F1 score} &= 2 * (\text{Precision} * \text{Recall}) / (\text{Precision} + \text{Recall}) \\ &= 2 * (0.6 * 0.7) / (0.6 + 0.7) \\ &= 0.6 \end{aligned}$$

Perfect F1 score is 1 and it is derived when both precision and recall are 1. Here, F1 score is just little high so model needs more training in correcting its precision and recall especially for predicting corrected false positives and false negatives then F1 score will be nearer to 1.

**5. Explain accuracy with the example of an AI model that predicts pass/fail of your class mates in next Practice Exam.**

If we consider any one student for whom predictions are done. All the True Positive, True Negative, False Positive and False Negative predictions need to be considered. Then the accuracy can be calculated as:  $= (TP + TN / TP + TN + FP + FN) * 100$

So, if we assume that the student passed as predicted in 3 exams, failed as predicted in 2 exams, failed in 1 exam while predicted otherwise and passed in 2 exams while predicted otherwise then:  $(3+2)/(3 + 2 + 1 + 2) = 0.62$ .

**6. Explain precision and recall with the example of an AI model that predicts death/no death of infants in past month.**

If we assume the predictions as: 300 deaths occurred as predicted, 100 deaths did not occur but predicted and 80 deaths did occur while predicted otherwise then,

$$\begin{aligned} \text{Precision} &= (TP / (TP + FP)) \\ &= (300 / (300 + 100)) \\ &= (20/400) \\ &= 0.7 \end{aligned}$$

Precision is higher considering the false positive cases.

$$\begin{aligned} \text{Recall} &= TP / (TP + FN) \\ &= 300 / (300 + 80) \\ &= 300/380 \\ &= 0.8 \end{aligned}$$

Recall is higher since percentage of False negatives is almost one fourth of the true positives.

**D. Select the correct answer.**

- |                      |                      |                     |                      |
|----------------------|----------------------|---------------------|----------------------|
| 1. c. Scenario       | 2. c. False positive | 3. a. True positive | 4. d. False negative |
| 5. b. True negative  | 6. d. Accuracy       | 7. a. Precision     | 8. b. Recall         |
| 9. c. Both a) and b) | 10. d. Error matrix  |                     |                      |