SCS Learning Education Online

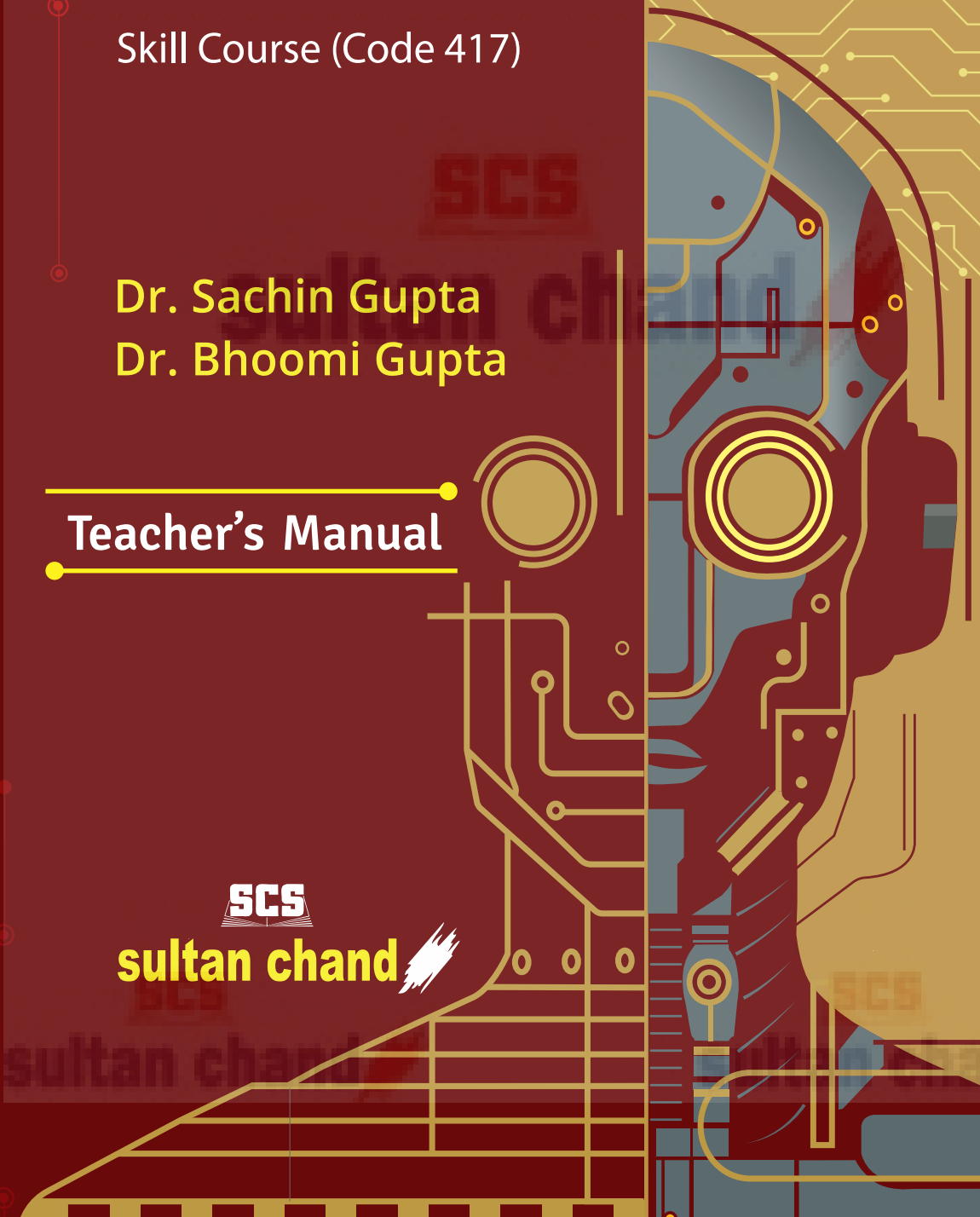
Class X

DECODING ARTIFICIAL INTELLIGENCE

Skill Course (Code 417)

Dr. Sachin Gupta
Dr. Bhoomi Gupta

Teacher's Manual



SCS sultan chand

with Project Work

Decoding Artificial Intelligence
Teacher's Manual
Book X

EMPLOYABILITY SKILLS

CHAPTER 1: Communication Skills–II

Unsolved Questions

Ans 1. Communication forms the foundation of a society, facilitating the exchange of information, ideas and emotions. This sharing of information allows individuals to understand each other and work collectively towards common goals.

Effective communication facilitates the transfer of knowledge and understanding, allowing individuals to collaborate, make decisions and solve problems together. People use communication to convey their needs, share experiences, build relationships and convey emotions.

Moreover, communication is crucial for the transmission of culture and knowledge from one generation to the next. Through spoken and written communication, older members of the society can pass down their experiences, wisdom, traditions and values. This passing on of knowledge helps maintain the identity and continuity of a society over time.

Ans 2.

		Verbal Communication	Written Communication
(*i*)	**Definition**	Involves spoken words to convey information, ideas and emotions.	Involves written or printed words to convey messages.
(*ii*)	**Dynamics**	Dynamic and immediate interaction.	Static and provides a permanent record.
(*iii*)	**Modes**	Face-to-face conversations, phone calls, video calls, presentations, etc.	Emails, letters, reports, essays, social media posts, etc.
(*iv*)	**Feedback and Clarification**	Allows real-time feedback and clarification.	Feedback is delayed and might not be immediate.
(*v*)	**Emotional Connection**	Allows emotional connection.	Lacks immediate emotional impact.

Ans 3. Non-verbal communication refers to the transmission of messages and information through means other than words. It involves using various non-verbal cues such as facial expressions, gestures, body language, posture, eye contact, touch and vocal cues like pitch, tone and rhythm, in addition to proxemics (the use of space). These cues can convey emotions, attitudes, intentions and other information without the need for explicit verbal expression.

Some essential parts of non-verbal communication include:

Facial Expressions	Our faces express how we feel. For example, when we smile, it usually means we're happy or friendly. When we frown, it might mean we are sad or upset.
Gestures	We use hand movements and gestures to express ourselves. For instance, waving "hello" is a friendly gesture. Thumbs up is a sign of approval while pointing can show you're indicating something specific.
Eye Contact	When we look someone in the eyes, it usually means we are paying attention to them. It shows we are interested in what they are saying. But if we avoid eye contact, it might mean we are shy or not very interested.
Body Language	How we stand or sit can say a lot. For instance, if we stand up straight and look confident, it shows we are self-assured. But if we slouch and look down, it might mean we are feeling unsure or sad.
Tone of Voice	How we say something matters. If we say "thank you" with a happy and grateful tone, it sounds sincere. But if we say it with an annoyed tone, it might not be as genuine.
Distance	How close or far we stand from someone can convey a message. If we stand really close, it might show we are comfortable with them. If we keep our distance, it might mean we want some space.

Ans 4. Visual communication is a method of conveying information, ideas or messages through visual elements such as images, graphics, charts, diagrams and symbols, rather than through words or text. Visual communication can be highly effective because it appeals to our sense of sight, making complex information more understandable and engaging.

Visual communication offers several important benefits over verbal and non-verbal communication as listed below.

(*i*) *Universally Understandable:* Visuals can be understood across cultures and languages, making them universally accessible and eliminating language barriers.

(*ii*) *Engagement:* Visuals capture attention and keep the audience engaged, enhancing message retention and understanding. They further help in reaching a wide audience.

(*iii*) *Immediate Comprehension:* Visuals are processed quickly by the brain, allowing for rapid understanding of the intended message.

(*iv*) *Inclusivity:* Visual communication includes individuals with varying levels of literacy making information accessible to a broader audience.

(*v*) *Memorability:* People tend to remember visual information better than text, making it an effective way to convey important information that needs to be retained.

(*vi*) *Simplicity and Clarity:* Visuals can simplify complex concepts or instructions, making them easier to comprehend and follow.

(*vii*) *Safety and Emergency Situations:* In situations where immediate action is required, visual symbols and signs can convey critical instructions swiftly, potentially preventing accidents or harm.

Ans 5. Feedback is the guiding compass in communication, pointing you in the right direction and helping you understand where you need to adjust. Feedback is important in communication for several reasons, as listed below:

(*i*) Clarity and understanding
(*ii*) Correcting mistakes
(*iii*) Building relationships
(*iv*) Encouraging communication
(*v*) Understanding others
(*vi*) Effective problem-solving

Feedback Example 1:

Consider a teacher explaining a new topic in class, like how the water cycle works. While teaching, the teacher might realize some students have not understood the topic properly. He might say, "Does anyone have any questions or want this part to be explained again?"

This is a way for the teacher to get feedback from the students. If a few students raise their hands and say they are confused, it helps the teacher understand that particular topic needs to be explained in a different manner. So, feedback helps the teacher know if their teaching is clear and if students are able to understand the lesson properly.

Feedback Example 2:

Consider a teacher giving feedback on a student's presentation. The teacher might say, "Your content was good, but you can improve your speaking skills." This helps the student understand how they should prepare their presentations and improve upon the skills they are currently lacking.

Ans 6. Communication barrier is an obstacle that gets in the way of effective communication between two or more persons. It makes it difficult for information and thoughts to be understood by both parties. Communication barriers can take various forms, such as language differences, misunderstandings and confusions.

Given below are the types of communication barriers and their examples:

(*i*) *Internal Barriers*

Example: Yash, a student, has been asked to share his thoughts in class, but he gets really nervous and his mind goes blank. This feeling of nervousness is an internal barrier. It is like a mental wall that can make it tough to speak up, even though he knows what he wants to say. To overcome this, it is best to take a deep breath, practise the speech and remind yourself that it is okay to make mistakes—to err is human!

(*ii*) *External Barriers*

Example: When a classroom is located near a busy road, the noise from the traffic outside makes it difficult for students to hear and concentrate on the teacher's lecture.

Ans 7. The role of feedback in overcoming communication barriers is:

(*i*) *Understanding:* It helps the receiver understand what they did right and what they need to work on, without any confusion.
(*ii*) *Motivation:* It encourages them because it shows they are doing well in some areas and gives tips to improve in others.
(*iii*) *Focused Improvement:* It tells the receiver exactly where to focus their efforts to get better.

(*iv*) *Two-way Talk:* The receiver can ask questions and have a real conversation about the feedback.

(*v*) *Continuous Learning:* It helps the receiver keep learning and getting better over time.

(*vi*) *Better Results:* By following the advice, they can get better results in their work.

Example 1: If a teacher gives descriptive feedback on a student's assignment, they might say, "Your introduction and first two paragraphs are great! But for a stronger ending, summarize your main points and give a clear final thought. Keep it up!" This helps the student know exactly what to do to improve their writing.

Example 2: If a teacher gives constructive feedback on a student's drawing, they might say, "You used bright colors nicely, but try making your lines straighter for neater edges." This helps the student realize his area of improvement.

Ans 8. The communication cycle is a model that helps us understand how communication works between individuals or groups. Any exchange of ideas between two or more people can be characterized with the help of a back-and-forth process, which allows the exchange to proceed gradually. This back-and-forth exchange is known as the communication cycle.

Each communication cycle has some essential elements which contribute to the overall process of effective communication:

(*i*) *Sender:* The cycle begins with the sender—the person who initiates the communication by encoding a message. Encoding means putting thoughts and ideas into words or symbols that convey meaning.

(*ii*) *Message:* The sender formulates a message, which contains the information or ideas they want to communicate.

(*iii*) *Channel:* The message is transmitted through a communication channel, which could be verbal (speaking, writing) or non-verbal (gestures, body language).

(*iv*) *Receiver:* The message reaches the receiver—the person or group for whom the message is intended. The receiver decodes the message, interpreting the words or symbols to understand the intended meaning.

(*v*) *Feedback:* After understanding the message, the receiver provides feedback to the sender. Feedback is a crucial part of the communication cycle as it helps the sender know if the message was understood as intended.

Ans 9. Sentences can be categorized into four basic types, based on their purpose and structure. These types are assertive/declarative, interrogative, imperative and exclamatory sentences.

(*i*) *Assertive/Declarative Sentences:* Declarative sentences make statements or express facts, opinions or ideas. They typically end with a period (.) to indicate a complete thought. For example, *She enjoys reading books*.

(*ii*) *Interrogative Sentences:* Interrogative sentences ask questions and seek information. They typically start with a question word (who, what, when, where, why, how) or an auxiliary verb and end with a question mark (?). For example, *Where is the nearest library*?

(*iii*) *Imperative Sentences:* Imperative sentences give commands, instructions or make requests. They usually start with a verb (the base form) and can be either a direct command or a more polite request. For example, *Close the door*. (command) / *Please pass me the salt*. (request)

(*iv*) *Exclamatory Sentences:* Exclamatory sentences express strong emotions or excitement. They typically end with an exclamation mark (!) to emphasize the emotion. For example, *What a beautiful sunset*!

Ans 10. In English, a phrase is a group of words that works together, but it doesn't have both a subject and a verb. It is a small piece of sentence. The role and importance of phrases in constructing sentences are as follows:

(*i*) They describe actions.

(*ii*) They give additional information.

(*iii*) They show relationships between words.

Examples of Phrases:

- *Under the table* (describes where)
- *Very slowly* (describes how)
- *In the garden* (describes where)

On the other hand, a sentence is a complete thought or idea that contains a subject (who or what the sentence is about) and a verb (what the subject is doing). A sentence can stand alone and make sense by itself.

Ans 11. Articles are words that are used to specify a noun as definite (the) or indefinite (a, an). They provide important information about the noun they precede.

(*i*) Definite articles refer to specific or particular nouns and are represented by the word "the". Use "the" when referring to a specific noun that is known to both the speaker and the listener or that has been previously mentioned in the conversation.

For example, *I saw the cat on the roof*. Here, "the" is used because it is a particular cat that both the speaker and the listener know of or have been discussing.

(*ii*) Indefinite articles include the words "a" and "an". They are used to refer to non-specific or unspecified nouns, indicating any member of a group.

Ans 12. A paragraph is a distinct section of text that presents and discusses a single main idea or topic. It is a fundamental unit of writing and is composed of one or more sentences that revolve around a central point. Within a paragraph, there is a logical flow of related thoughts.

Before writing a paragraph, several basic considerations should be taken into account to ensure clarity, coherence and effectiveness in communication.

(*i*) *Define the Topic or Main Idea:* Clearly understand and define the main idea or topic that the paragraph will revolve around. This provides a clear direction for your writing.

(*ii*) *Consider the Audience:* Think about the audience that will be reading the paragraph. Adapt the language, style and level of detail to suit their needs and understanding.

(*iii*) *Plan the Structure:* Outline the structure of the paragraph, including the topic sentence, supporting sentences and a concluding or transition sentence.

(*iv*) *Organize Supporting Ideas:* Arrange the supporting ideas or details in a logical order that strengthens the main point.

(*v*) *Ensure Cohesion and Flow:* Use appropriate transitional words and phrases to ensure smooth transitions between sentences and ideas.

(*vi*) *Stay Focused and Relevant:* Keep the paragraph focused on the main idea, avoiding irrelevant or off-topic information. Each sentence should contribute to the central point.

CHAPTER 2: Self-Management Skills–II

Unsolved Questions

Ans 1. Stressors are events, situations or conditions that trigger stress responses in individuals. These stress-inducing factors can vary widely in nature and intensity, and are perceived as challenges or threats by the person experiencing them. Recognizing the specific stressors that affect an individual is a dire necessity for effective stress management.

Identifying stress is important to address it effectively. Stress can present itself and affect a person in various ways. Thus, recognizing these signs is crucial. Stress may affect a person physically, mentally and emotionally. It may also cause changes in the behaviour of a person with others while interacting.

Ans 2. Some commonly observed symptoms of stress are presented below:

Physical Symptoms

- Headaches or migraines
- Muscle tension or body aches
- Fatigue and low energy levels
- Trouble sleeping or excessive sleep
- Changes in appetite—eating too much or too little

Emotional Symptoms

- Feelings of anxiety or nervousness
- Irritability or quick temper
- Sadness, low mood or frequent crying
- Difficulty concentrating or making decisions
- Feeling overwhelmed or out of control
- Difficulty in maintaining relationships
- Increased conflicts with family, friends or peers

Behavioural Symptoms

- Changes in academic performance or motivation
- Avoiding tasks or responsibilities
- Increased use of substances like caffeine, alcohol or drugs
- Withdrawal from social activities or isolating oneself

Cognitive Symptoms

- Racing thoughts or constant worrying
- Forgetfulness or memory problems
- Negative self-talk or pessimistic outlook

Identifying stress is important to address it effectively and it also aids in stress management. If one notices these signs, it is important to take them seriously and seek professional help. Talking to a trusted friend or supporting adults like parents, teachers or school counsellors is recommended as a first step in managing stress effectively.

Ans 3. Deep breathing involves taking slow, deep breaths. Inhale through your nose, hold for a few seconds and exhale slowly through the mouth. This relaxation technique helps in stress reduction by calming your mind and body. Managing stress is crucial for the overall well-being of humans.

Ans 4. Effective allocation of time and resources to accomplish tasks and goals while maintaining a balance between work, personal life and leisure forms a key aspect. The process of defining clear and achievable objectives, which provide direction and motivation for self-improvement, is imperative.

This helps in the ability to make thoughtful and informed decisions that align with personal values and long-term objectives. Thus, effective time management ultimately contributes to stress management and achieving personal goals.

Ans 5. The foundation of self-management, self-awareness is the ability to recognize and understand one's emotions, strengths, weaknesses, values and goals.

This skill involves managing and controlling one's emotions in a healthy way, allowing for effective responses to challenging situations.

It is essential to understand your strengths, weaknesses, values and beliefs. Knowing yourself well helps you make informed decisions that align with your true self. Self-management is essential for the personal development and well-being of human beings. It helps us in the following ways:

(*i*) *Enhanced Resilience:* The ability to recover from setbacks and adapt to challenges is a key component of self-management.

(*ii*) *Stress Reduction:* Self-management techniques help in managing and reducing stress, which is essential for both mental and physical health.

Ans 6. Emotional Regulation involves managing and controlling one's emotions in a healthy way, allowing for effective responses to challenging situations.

It is the ability to recover from setbacks and adapting to challenges is a key component of self-management. It contributes to a sense of personal fulfilment and satisfaction as individuals align their actions with their values and passions, thus leading to better decision-making and reducing stress levels.

Ans 7. Developing a growth mindset helps in learning and improvement. It is essential to understand your strengths, weaknesses, values and beliefs. Knowing yourself well helps you make informed decisions that align with your true self.

Learn to negotiate and stand up for what you believe is right. It is always helpful to surround yourself with supportive and encouraging people who believe in you and your capabilities. Learn to bounce back from setbacks and keep going in the face of challenges. Resilience is a key trait for independence. Thus, a growth mindset helps an individual to approach challenges with a positive mindset and also aids in managing stress.

Ans 8. Becoming independent is a gradual process that involves developing various skills and adopting certain attitudes. It involves taking responsibility for one's actions, time and outcomes, demonstrating a high degree of autonomy and self-reliance.

Embracing self-reliance and independence cultivates confidence and autonomy. Working independently encourages continuous learning and personal growth. You seek out information, acquire new skills and develop a deeper understanding of your strengths and weaknesses.

Ans 9. The key traits that help one to become independent are:

(*i*) *Manage your Goals and Time:* Clearly define your short-term and long-term goals. Understand what matters most to you and what you want to achieve. Learn to manage your time effectively by setting realistic goals, creating schedules and prioritizing tasks. Avoid procrastination and stay organized.

(*ii*) *Take Responsibility:* Acknowledge that you are in control of your choices and actions. Avoid blaming others for your circumstances and take responsibility for your decisions.

(*iii*) *Develop Self-Awareness:* It is essential to understand your strengths, weaknesses, values and beliefs. Knowing yourself well helps you make informed decisions that align with your true self.

(*iv*) *Make Your Own Decisions:* Practice making decisions independently, starting with small choices and gradually tackling more significant ones. Consider the pros and cons before making a decision. Work on your critical thinking and problem-solving skills. Analyze situations, consider various solutions and take the time required in choosing the best ones.

(*v*) *Keep Learning:* Be curious and eager to learn. Read books, take courses, attend workshops and seek knowledge in areas that interest you. Develop a growth mindset that embraces learning and improvement.

(*vi*) *Learn to Advocate for Yourself:* Express your needs, opinions and desires assertively and respectfully. Learn to negotiate and stand up for what you believe is right. It is always helpful to surround yourself with supportive and encouraging people who believe in you and your capabilities. Learn to bounce back from setbacks and keep going in the face of challenges. Resilience is a key trait for independence.

Ans 10. Positive self-talk involves challenging yourself to face adversities, keeping in mind the bright side of things. This further fosters a growth mindset, for there is no growth without challenges. Growth mindset realizes the importance of hard work and dedication. Thus, both positive self-talk and growth mindset further promotes foster self-reliance and resilience.

CHAPTER 3: ICT Skills–II

Unsolved Questions

Ans 1. The role of an operating system in a computer is:

(*i*) *Managing Hardware:* The operating system ensures that all parts inside the computer, like the keyboard, screen and memory, work together smoothly.

(*ii*) *Running Programs:* OS helps us open and use software like games, word processors and web browsers.

(*iii*) *File Management:* It organizes and stores our files and folders, making it easy to find and use them.

(*iv*) *Memory Management:* OS decides which programs can use the computer's memory (RAM) and how much of it they can use.

(*v*) *User Interface:* OS provides an interface for us to interact with the computer via icons, buttons and windows.

(*vi*) *Security:* It helps protect our computer from viruses and makes sure that only authorized users can access it.

(*vii*) *Networking:* If we connect our computer to the internet, the OS manages the connection so that we can browse the web and send emails.

Ans 2. Single-user operating systems are designed to support only a single user at a time. For example, MS-DOS. On the other hand, multi-user operating systems allow multiple users to use the computer simultaneously. It ensures user isolation and resource sharing. Unix/Linux systems are known for multi-user capabilities, where multiple people can log in and use the computer concurrently.

Ans 3. Real-time Operating System (RTOS) is designed for systems where responses must be guaranteed within strict time constraints. It is common in embedded systems, robotics and industrial control.

Real-time operating systems (RTOS) like FreeRTOS and QNX are used in devices like robots and medical equipment.

Ans 4. The Recycle Bin is a virtual trash can for your computer. When you delete a file or folder, Windows does not immediately erase it. Instead, it sends it to the Recycle Bin. This provides a safety net in case you accidentally delete something important.

You can access the Recycle Bin from your desktop or from File Explorer. Inside the Recycle Bin, you can view, restore or permanently delete the files that you have previously deleted. Restoring a file from the Recycle Bin returns it to its original location, while permanently deleting it removes the file from your computer entirely. It is a useful feature for file management and recovery.

Ans 5. Copying and pasting files or folders is useful because it helps you keep a backup in case something goes wrong. Copying files might come in handy if you accidentally delete something.

It also helps organize different folders, thus making them easy to find. In addition, you may share these copies with friends by sending them through email or putting them on a USB drive.

There are three different methods to copy and paste files or folders in Windows: using keyboard shortcuts, using right-click context menu and using drag-and-drop method.

Ans 6. Temporary files are created by various applications and the operating system itself to store data temporarily or perform specific tasks. Temporary files may include cached web pages, log files, setup files and more. Temporary files can be regularly cleaned with a simple yet powerful tool in Windows called Disk Cleanup.

These files serve specific purposes but can accumulate over time, consuming disk space unnecessarily. Thus, regularly clearing temporary files is important to clear space and remove unwanted files.

Ans 7. A computer virus is a type of malicious software (malware) designed to replicate itself and spread from one computer to another. It can attach itself to installed programs or files. When these infected files are executed or opened, the virus activates, causing various harmful effects on the computer.

Detecting the presence of a virus on your computer is difficult. However, you have to keep observing unusual or unexpected behaviour since it can be harmful to your computer system. Some common signs of a virus infection include a sudden decrease in system performance, frequent crashes or freezes, unexpected pop-up ads, unexplained changes to system settings or files and unusual network activity.

Regularly scanning your computer with antivirus software and keeping your system updated can help you identify and address virus infections early.

Ans 8. Firewalls are essential for computer security as they help prevent unauthorized access. They act as a filter, allowing only legitimate and safe network traffic to pass through while blocking malicious or suspicious activity. They are particularly valuable for safeguarding sensitive data, preventing malware infections and maintaining the confidentiality and integrity of network communications.

Firewalls protect the system/network from hackers who take the help of viruses, phishing emails, spams and the like.

Ans 9. Internet cookies, often simply referred to as "cookies", are small pieces of data stored on your computer by the websites you visit. They are created by web servers to remember certain information about your interactions with the site, such as login credentials, site preferences and items in a shopping cart. Cookies typically store anonymous data or user preferences. They do not store sensitive personal information like Aadhaar numbers or credit card details.

Cookies serve various useful purposes in enhancing your online experience. They do so by helping websites access and gain insights into user preferences. Moreover, they facilitate seamless navigation and personalized interactions.

Ans 10. The components of Windows' user interface and their respective functions are:

(*i*) *Desktop:* The desktop is the primary screen that you see after logging into Windows. It serves as the main workspace where you can place icons, shortcuts and files. You can customize the desktop with wallpapers and arrange icons according to your preference.

(*ii*) *Icons and Shortcuts:* Icons represent files, folders, applications or other items on your desktop. Shortcuts are icons that point to programs or files, making them easily accessible.

(*iii*) *Start Button:* It is located on the lower-left corner of the desktop. Clicking the start button opens the Start Menu. The Start Menu in a Windows operating system acts as a host to essential elements for navigating and accessing various features and functions.

In most versions of Windows, the Start Menu houses the following buttons:

- *Search Box:* The search box allows you to quickly search for files, applications, settings or even web content.
- *Power Button:* The power button allows you to shut down, restart or put your computer to sleep.
- *User Account Picture/Name:* This button displays the currently logged-in user's account picture or name.

(*iv*) *Taskbar:* The taskbar runs along the bottom of the screen, offering easy access to running applications, the Start button, system notifications and the system tray (where you can find system icons like volume control and Wi-Fi status).

(*v*) *Notification Area:* Located on the right side of the taskbar, it displays icons for system notifications, such as updates, messages and alerts. You can also access quick settings like Wi-Fi and volume controls from here.

(*vi*) *Date/Time:* Displayed in the notification area, it provides the current time and date.

(*vii*) *Recycle Bin:* The Recycle Bin is a virtual trash can for your computer. When you delete a file or folder, Windows does not immediately erase it. Instead, it sends it to the Recycle Bin. This provides a safety net in case you accidentally delete something important.

Ans 11. Microsoft Windows is undoubtedly one of the most popular operating systems today. The earlier versions of Windows offered a user-friendly Graphical User Interface (GUI) that made computers more accessible to users, as opposed to the prevalent command-line interfaces.

Additionally, Microsoft's strategic partnership with computer manufacturers came in handy, ensuring Windows came pre-installed on many PCs. This further expanded its reach. Besides, continued improvement made Microsoft Windows a familiar and dependable choice for personal and business computing.

Key features and advantages of Windows OS are:

(*i*) User-friendly interface and easy to use

(*ii*) Compatible to all hardware

(*iii*) Supports Plug and Play feature

(*iv*) Provides software development support

Ans 12. The Start button is located on the lower-left corner of the desktop. Clicking the start button opens the Start Menu. The Start Menu in a Windows operating system acts as a host to essential elements for navigating and accessing various features and functions. In most versions of Windows, the Start Menu houses the following buttons, which further aid in computer navigation:

(*i*) *Search Box:* The search box allows you to quickly search for files, applications, settings or even web content. Simply type what you are looking for and Windows will provide relevant results.

(*ii*) *Power Button:* The power button allows you to shut down, restart or put your computer to sleep.

(*iii*) *User Account Picture/Name:* Displays the currently logged-in user's account picture or name. Clicking on this button can provide quick access to user-related settings and options, such as signing out or changing your account settings.

Ans 13. Proper maintenance extends the lifespan of devices in the same way human health requires maintenance. Preventive maintenance of computers and smartphones through regular updates, cleaning and optimizing their performance prevents technical issues and vulnerabilities. A well-maintained device operates efficiently. When devices run smoothly, they facilitate productivity as well.

The following are some examples of routine maintenance tasks:

(*i*) *Turn Off and Restart:* Start your computer fresh by shutting it down at the end of the day and restarting it in the morning to refresh system resources.

(*ii*) *Check for Updates:* Regularly check for and install operating system and software updates.

(*iii*) *Scan for Malware:* Run a quick antivirus or anti-malware scan to ensure your system is free of threats.

(*iv*) *Clear Unnecessary Files:* Delete temporary files, clear browser caches and empty the Recycle Bin to free up disk space and improve system performance.

(*v*) *Backup your Data:* If you work with important files daily, make sure they are backed up either to an external drive or cloud storage to protect against data loss.

(*vi*) *Clean the Physical Computer:* If you are using a desktop computer, dust off the exterior and clean the keyboard and screen when necessary.

(*vii*) *Password Management:* Be mindful of strong password practices and consider using a password manager to keep your online accounts secure.

(*viii*) *Close Unnecessary Programs:* Ensure that unnecessary programs or applications are closed to conserve system resources.

(*ix*) *Check Security Alerts:* Keep an eye on security alerts or notifications from your antivirus software and operating system for any immediate actions required.

Ans 14. An unmaintained computer may suffer from reduced performance, frequent crashes and hardware failure due to overheating or dust buildup. It is also vulnerable to a range of other threats. Over time, it accumulates digital clutter, outdated software and security weaknesses, making it an easy target for malware and cyberattacks. Viruses, spyware and ransomware can infiltrate and compromise an unattended system. This could potentially lead to data theft, loss or corruption.

Regular maintenance helps reduce these risks by extending the lifespan of devices in the same way human health requires maintenance. Preventive maintenance of computers and smartphones through regular updates, cleaning and optimizing their performance prevents technical issues and vulnerabilities. A well-maintained device operates efficiently. When devices run smoothly, they facilitate productivity as well.

Ans 15. Cleaning the external components of your computer, taking your keyboard, mouse, camera and storage media under the umbrella, is essential to maintain hygiene and functionality. The following are some cleaning tips for computers:

Cleaning the computer monitor/screen:

- Turn off the monitor before cleaning.
- Use a microfibre cloth and screen cleaning solution to gently clean the screen. Avoid using paper, towels or rough materials that can scratch the screen.
- Gently wipe the monitor screen in a straight, horizontal or vertical motion. Avoid applying excessive pressure.

Cleaning the keyboard and mouse:

- Turn off or unplug the keyboard or mouse before cleaning.
- Use compressed air and a small brush to remove dust and debris from the keyboard and mouse.
- Wipe down the surfaces with a damp, lint-free cloth to clean the keyboard and the mouse, including keys and buttons.

CHAPTER 4: Entrepreneurial Skills–II

Unsolved Questions

Ans 1. The significance of entrepreneurship is:

(*i*) *Economic Growth:* Entrepreneurship drives economic growth by creating new businesses, industries and jobs.

Example: N.R. Narayana Murthy co-founded Infosys, one of India's largest IT companies, which has contributed significantly to the growth of the IT sector in the country.

(*ii*) *Innovation:* Entrepreneurs develop new products, services and technologies that enhance our quality of life, solve problems and drive progress in various fields.

Example: Chetan Maini, the founder of Reva Electric Car Company, introduced electric vehicles to combat air pollution and reduce India's reliance on fossil fuels.

Ans 2. Some common myths associated with entrepreneurship are given below, along with why they can be misleading:

(*i*) *Entrepreneurs are born, not made:* This myth suggests that entrepreneurship is an inborn trait. This can be misleading because while some natural skills may help, entrepreneurship can be learned and developed through education, experience and mentorship.

(*ii*) *You need a brilliant idea to start:* Many believe they must come up with a ground-breaking, revolutionary idea to start a business. This is misleading because in reality, successful ventures often improve existing ideas or address common problems creatively.

(*iii*) *Only young people succeed:* Entrepreneurship is not limited by age. This is misleading since successful entrepreneurs come from various age groups and backgrounds, and experience can be an advantage in certain industries.

(*iv*) *Entrepreneurs are all tech geniuses:* Technology does play a significant role in some ventures. However, this is myth is misleading because not all entrepreneurs are tech experts. Many successful businesses operate in traditional industries.

(*v*) *Failure means the end:* Failure is a part of the entrepreneurial journey. It doesn't mean the end of your career but an opportunity to learn and pivot. Many successful entrepreneurs faced failures before achieving success.

(*vi*) *Entrepreneurship requires massive capital:* People often think they need substantial capital to start a business. This is misleading because many successful businesses began with minimal funds.

(*vii*) *Success happens overnight:* Entrepreneurship is often glamorized, making it seem like success happens quickly. However, in reality, most entrepreneurs face challenges and setbacks, navigating their way through them.

(*viii*) *It is a solo journey:* Entrepreneurship doesn't have to be a solitary endeavour. Successful entrepreneurs often collaborate with partners, teams, mentors and advisors to achieve their goals.

(*ix*) *It is all about money:* While financial success is a goal for many entrepreneurs, it is not the only motivation. Entrepreneurs often start ventures to pursue their passions, make a positive impact or address a personal mission.

(*x*) *You must have extensive experience:* While experience can be helpful, it is not a strict requirement. This myth can be misleading since entrepreneurship often thrives on fresh perspectives and innovative ideas from individuals with diverse backgrounds.

Ans 3. The following are some key qualities or skills that successful entrepreneurs possess:

- *Vision:* Successful entrepreneurs have a clear vision of what they want to achieve. They can see opportunities and possibilities that others may miss.
- *Risk-taking:* Entrepreneurs understand that not every venture will succeed but they are prepared to take risks, learn from failures and keep trying.
- *Problem-solving:* Entrepreneurs are problem-solvers. They are resourceful and creative in finding ways to overcome obstacles.
- *Decisiveness:* Entrepreneurs need to make important decisions quickly. They gather information, analyze it and then make confident decisions.
- *Leadership:* As leaders of their ventures, entrepreneurs must inspire and motivate their teams. Effective leadership is essential for the success of a business.
- *Continuous Learning:* Entrepreneurship is a journey of learning and growth. Successful entrepreneurs are curious and committed to continuous self-improvement.

Ans 4. The following are the roles that entrepreneurs often play in their ventures:

(*i*) *Innovator:* Entrepreneurs often introduce new ideas, products or services to the market.

(*ii*) *Visionary:* Entrepreneurs set the vision and long-term goals for their businesses.

(*iii*) *Marketer:* Entrepreneurs create marketing strategies, develop branding and promote their products or services to reach a wider audience.

(*iv*) *Financial Manager:* Entrepreneurs manage the financial aspects of their businesses. This includes budgeting, financial forecasting, securing funding and monitoring cash flow.

(*v*) *Adaptability:* The business world is constantly changing. Successful entrepreneurs are adaptable and can change strategy in the face of unexpected challenges. Thus, being adaptable forms the most essential role of an entrepreneur.

Ans 5. The various categories of entrepreneurs and their unique contributions are as follows:

(*ii*) *Social Entrepreneurs:* Social entrepreneurs are driven by a strong desire to address pressing social or environmental issues while also creating sustainable business models. They prioritize positive societal impact over profit. Example: Arunachalam Muruganantham, known as the "Padman" of India, created low-cost sanitary napkins for rural women, addressing menstrual hygiene issues and empowering women in rural areas.

(*ii*) *Women Entrepreneurs:* Women entrepreneurs are those who start and manage businesses, contributing not only to economic growth but also challenging gender stereotypes and promoting gender equality. Example: Kiran Mazumdar-Shaw founded Biocon, a biotechnology company that focuses on affordable healthcare solutions. She is a prominent female entrepreneur who has broken barriers in a male-dominated industry.

(*iii*) *Environmental Entrepreneurs (Ecopreneurs):* Ecopreneurs prioritize environmental sustainability in their businesses, working to reduce environmental impact. Example: Chetan Maini, the founder of Reva Electric Car Company, introduced electric vehicles to combat air pollution and reduce India's reliance on fossil fuels.

(*iv*) *Tech Entrepreneurs:* Tech entrepreneurs leverage technology to develop innovative solutions, products or services. They often contribute to economic growth and job creation by establishing tech startups. Example: N.R. Narayana Murthy co-founded Infosys, one of India's largest IT companies, which has contributed significantly to the growth of the IT sector in the country.

(*v*) *Rural Entrepreneurs:* Rural entrepreneurs establish businesses in rural areas, creating employment opportunities and preventing migration to urban centres. They often work with local resources and traditional practices. Example: Chetna Gala Sinha founded Mann Deshi Bank, which supports rural women entrepreneurs in Maharashtra.

(*vi*) *Youth Entrepreneurs:* Youth entrepreneurs are young individuals who start businesses at a relatively early age. They bring fresh perspectives, energy and creativity to entrepreneurship. Example: Ritesh Agarwal founded OYO Rooms, a tech-enabled budget accommodation platform, when he was just 19 years old.

Ans 6. Some significant impact of entrepreneurship on society include:

(*i*) *Job Creation:* When entrepreneurs start businesses, they often need help to run them. This is where job opportunities come in. An entrepreneur is a job creator as they provide work to many people, giving them a chance to earn a living, thus reducing unemployment.

(*ii*) *Innovation:* Entrepreneurs are problem-solvers. They come up with new ideas, inventions and services that can make life better. Innovation improves our quality of life and can even lead to exciting discoveries.

(*iii*) *Community Development:* Entrepreneurs often care about community development. They support local causes, sponsor events or help schools and charities, giving back to society and making the community stronger.

Ans 7. Although there are countless ways a society can benefit an entrepreneur, some key ones are listed below:

(*i*) *Infrastructure:* Entrepreneurs rely on the infrastructure that society builds and maintains. This includes roads, transportation systems, communication networks and utilities.

(*ii*) *Financial Resources:* Society often provides financial support to entrepreneurs through banks, investors, grants and subsidies.

(*iii*) *Market Opportunities:* Society provides entrepreneurs with a customer base for their products or services. Without consumers and businesses willing to buy what entrepreneurs offer, their ventures wouldn't succeed.

(*iv*) *Networking and Collaboration:* Entrepreneurs often collaborate with others in society, including suppliers, partners and other businesses. These relationships can lead to innovation and growth opportunities.

Ans 8. Society benefits entrepreneurs in many ways. Society provides entrepreneurs with a customer base for their products or services. It often provides financial support to entrepreneurs through banks, investors, grants and subsidies, etc. Moreover, entrepreneurs rely on the infrastructure that the society builds and maintains including roads, transportation system, etc.

However, entrepreneurship is not a one-way traffic. While society benefits entrepreneurs, they also return the favour. They are the driving force that can bring about positive changes in society. They help in creating job opportunities, encourage and foster innovation, boost economic growth, support communities and inspire people to take action through social causes.

Ans 9. Entrepreneurship is not a new phenomenon. Even before it was named so, entrepreneurship has always played a role in human history but its significance has evolved over time.

- *Ancient Times:* Early entrepreneurs engaged in trade, agriculture and craftsmanship. They contributed to the growth of cities and civilizations through their economic activities.

- *Industrial Revolution (18th-19th centuries):* The Industrial Revolution marked a significant shift, with entrepreneurs leading innovations in manufacturing and technology. This period saw the rise of factories and modern industry.
- *20th Century:* The 20th century witnessed the emergence of entrepreneurship as a driver of economic growth. Innovations in transportation, communication and technology paved the way for new business opportunities.
- *21st Century:* In the digital age, entrepreneurship has gained unprecedented importance. Technology startups, social entrepreneurship and global connectivity have transformed the entrepreneurial landscape.

Ans 10. Several myths and misconceptions about entrepreneurship can deter people from pursuing their venture ideas. It is essential to understand these myths, debunk them and also create awareness to encourage more individuals to explore entrepreneurship.

Example: Many believe they must come up with a ground-breaking, revolutionary idea to start a business. However, believing in such myths can discourage potential entrepreneurs because in reality, successful ventures often improve existing ideas or address common problems creatively. For example, Mark Zuckerberg co-founded Facebook, which became a global phenomenon. While Facebook's concept was innovative, it wasn't entirely new. Social networking existed before Facebook but Zuckerberg executed the idea exceptionally well, emphasizing user experience and privacy, proving that execution matters as much as the idea.

Ans 11. The following are some challenges faced by entrepreneurs:

(*i*) *Success cannot happen overnight:* Entrepreneurship is often glamorized, making it seem like success happens quickly. However, in reality, most entrepreneurs face challenges and setbacks, navigating their way through them.

(*ii*) *Fear of failure:* Failure is a part of the entrepreneurial journey. It doesn't mean the end of your career but an opportunity to learn and pivot. Failure is an essential rung of the ladder that leads to success.

(*iii*) *Market competition:* Market competition is a significant challenge faced by entrepreneurs. With many businesses being started, the business environment has become highly competitive.

The challenges mentioned above can be overcome with resilience and adaptability. Resilience refers to the ability that entrepreneurs must possess to overcome challenges and setbacks. Resilience must be accompanied with patience and perseverance. Moreover, the business world is constantly changing. Thus, successful entrepreneurs are adaptable and can change strategy in the face of unexpected challenges.

Ans 12. Thomas Edison faced numerous failures while inventing the light bulb. He famously said, "I have not failed. I've just found 10,000 ways that won't work." His persistence and ability to learn from failures eventually led to success.

Colonel Sanders, the founder of Kentucky Fried Chicken (KFC), did not find success until later in life. He began franchising KFC at the age of 65, proving that entrepreneurship is not limited by age.

Ans 13. The following are the benefits of choosing entrepreneurship as a career:

(*i*) *Independence and flexibility:* Entrepreneurs have the freedom to be their bosses and make decisions independently. Entrepreneurs often have flexibility in terms of work hours and location.

(*ii*) *Potential for financial reward and personal growth:* While entrepreneurship involves risks, it also offers the potential for significant financial rewards. It can also lead to personal growth, resilience and increased self-confidence.

(*iii*) *Job creation and legacy building:* Entrepreneurs contribute to the economy by creating jobs and employment opportunities for others, thereby making a positive impact on their communities. They can leave behind a business or innovation that continues to benefit society long after they have moved on.

(*iv*) *Passion, purpose and creativity:* Most entrepreneurs are driven by a sense of purpose and passion for their ventures. They pursue what they love and believe in, which can lead to greater job satisfaction. Entrepreneurship also allows individuals to express their creativity and vision through their business ventures.

The following are the drawbacks of choosing entrepreneurship as a career:

(*i*) *Risk and uncertainty:* Entrepreneurship comes with its own set of risks. With the market overflowing with nascent businesses, it is apparent that entrepreneurship as a career is full of risks and uncertainties.

(*ii*) *Wavering income:* Entrepreneurship can be rewarding but not always. The initial stages are full of stress, long hours of work and irregular income.

CHAPTER 5: Green Skills–II

Unsolved Questions

Ans 1. Natural resources form the foundation of human sustainability. Nature has showered us with abundant gifts in the form of natural resources that are the building blocks of our existence. They encompass everything—from water, air and soil to minerals, forests and wildlife. These resources provide us with the essentials for survival, like food, water, shelter and energy. For centuries, humans have relied on these resources to meet their needs and build civilizations.

Our dependence on natural resources has remained a question of survival since the early civilizations. With extreme exploitation of natural resources over centuries, humankind has reached a situation that is threatening our own existence. Unfortunately, climate change, resource scarcity and ecological imbalances have turned into stark realities.

Ans 2. The term "sustainable development" gained widespread recognition following the publication of the Brundtland Report in 1987. Officially titled, "Report of the World Commission on Environment and Development," it was named after its chair, Gro Harlem Brundtland. His report defines Sustainable Development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The significance of sustainable development in addressing global environment and social challenges lies in its three major objectives:

(*i*) *Economic Sustainability:* This pillar focuses on continued economic growth and prosperity while ensuring that it is sustainable over the long term. We have come to recognize that economic development is essential for improving living standards, eradicating poverty and providing opportunities for all.

(*ii*) *Social Sustainability:* This pillar focuses on improving the well-being and quality of life for all individuals within the society. It recognizes that sustainable development should prioritize the welfare of people by addressing their basic needs such as health, education and social inclusion.

(*iii*) *Environmental Sustainability:* This pillar focuses on preserving and protecting the natural environment, including ecosystems, biodiversity and the climate. It recognizes that human well-being is intricately linked to a healthy planet and aims to ensure that development does not harm the environment.

Ans 3. The three major objectives of sustainable development, also known as the "three pillars" or "triple bottom line" are:

(*i*) *Economic Sustainability:* This pillar focuses on continued economic growth and prosperity while ensuring that it is sustainable over the long term. We have come to recognize that economic development is essential for improving living standards, eradicating poverty and providing opportunities for all.

Economic sustainability emphasizes responsible resource management and promotion of equitable economic systems, with the reduction of inequality as explained:

- *Responsible Resource Management:* Economic sustainability calls for the responsible use of natural resources, ensuring that resource extraction and consumption do not deplete or harm the environment beyond repair. This involves efficient resource utilization and minimizing waste.

(*ii*) *Social Sustainability:* This pillar focuses on improving the well-being and quality of life for all individuals within the society. It recognizes that sustainable development should prioritize the welfare of people by addressing their basic needs such as health, education and social inclusion.

- *Basic Needs:* Social sustainability aims to ensure that everyone has access to basic necessities such as clean water, food, shelter and healthcare. It also includes paying heed to issues like sanitation and hygiene.
- *Health and Education:* It promotes good health and quality education as fundamental rights. Ensuring access to healthcare and quality education eventually helps individuals lead productive and fulfilling lives.
- *Social Inclusion:* Social sustainability emphasizes creating inclusive societies wherein all individuals, regardless of their background, ethnicity, gender or other factors have equal opportunities and rights.

(*iii*) *Environmental Sustainability:* This pillar focuses on preserving and protecting the natural environment, including ecosystems, biodiversity and the climate. It recognizes that human well-being is intricately linked to a healthy planet and aims to ensure that development does not harm the environment.

- *Conservation of Ecosystems:* Environmental sustainability involves conserving ecosystems, including forests, wetlands, oceans and other habitats. This helps maintain biodiversity and preserves the services these ecosystems provide, such as clean air and water.
- *Mitigation of Climate Change:* It addresses the reduction of greenhouse gas emissions and the mitigation of climate change impacts. This includes transitioning to renewable energy sources and implementing strategies to adapt to changing climatic conditions.
- *Resource Efficiency:* Environmental sustainability promotes resource efficiency and the reduction of pollution and waste. This involves sustainable agriculture, responsible consumption patterns and the adoption of eco-friendly technologies.

Ans 4. One stark example showcasing the best practices of sustainable process implementation in Indian airports is the Cochin International Airport Limited (CIAL) in Kochi, Kerala. CIAL has gained international recognition for its sustainability initiatives, particularly in the area of environmental conservation and energy management.

Sustainable Practices at Cochin International Airport

(*i*) *Solar Power Generation:* CIAL houses one of the largest solar power plants at an airport in the world. It covers vast areas of airport land with solar panels, generating a significant portion of its energy needs from solar power. This initiative aligns with SDG 7 (Affordable and Clean Energy) by reducing the airport's carbon footprint and reliance on non-renewable energy sources.

(*ii*) *Waste Management:* The airport has implemented efficient waste management practices, including waste segregation and recycling. Organic waste is converted into biogas, which is used for cooking and power generation. Such practices align with SDG 12 (Responsible Consumption and Production), aiming to reduce waste and promote sustainable resource use.

(*iii*) *Biodiversity Conservation:* CIAL has undertaken initiatives to protect and enhance biodiversity on its premises. It has developed green zones, including a butterfly garden and a large area of mangrove forests. These efforts align with SDG 15 (Life on Land) by promoting the conservation and sustainable use of terrestrial and marine ecosystems.

(*iv*) *Water Conservation:* The airport has left no stone unturned while implementing rainwater harvesting and water recycling systems. This helps in reducing water consumption and dependence on external water sources. These practices align with SDG 6 (Clean Water and Sanitation) by promoting efficient water use.

(*v*) *Energy Efficiency:* CIAL has adopted energy-efficient technologies and practices, including LED lighting and energy-efficient air conditioning systems. These measures contribute to SDG 7 (Affordable and Clean Energy) by reducing energy consumption and emissions.

Ans 5. A green consumer, also known as an environmentally conscious or eco- conscious consumer, is an individual who makes purchasing decisions keeping in mind environmental and sustainability considerations. These consumers prioritize products and services that have a reduced impact on the environment and support sustainable practices. They play a significant role in driving demand for environmentally friendly products and services. Their choices can influence businesses to adopt more sustainable practices, leading to a more environmentally responsible economy.

Ans 6. Green skills are a set of knowledge, abilities and competencies that enable individuals to work in industries that prioritize environmental sustainability and address environmental challenges. These skills are essential for promoting eco-friendly practices, reducing environmental impact and supporting the transition to a greener and more sustainable economy. Green skills encompass a wide range of areas that describe their role in supporting eco-friendly professions:

(*i*) *Renewable Energy:* Skills related to the design, installation, maintenance and management of renewable energy systems such as solar, wind and hydropower.

(*ii*) *Energy Efficiency:* Abilities to improve energy efficiency in buildings, industrial processes and transportation systems, leading to reduced energy consumption and lower carbon emissions.

(*iii*) *Sustainable Agriculture:* Knowledge of sustainable farming practices, organic farming techniques and agroecology to minimize the environmental impact of agriculture while ensuring food security.

(*iv*) *Environmental Management:* Competencies in environmental assessment, conservation and compliance with environmental regulations in various industries.

(*v*) *Green Building and Design:* Skills in sustainable architecture and construction, including energy-efficient building design, use of eco-friendly materials and green building certifications.

(*vi*) *Waste Management:* Expertise in waste reduction, recycling and waste-to-energy technologies to minimize waste generation and promote recycling.

(*vii*) *Water Management:* Knowledge of water conservation, wastewater treatment and sustainable water usage practices for industries and municipalities.

(*viii*) *Sustainable Transportation:* Abilities to promote eco-friendly transportation options such as public transit, cycling, electric vehicles and the development of sustainable urban mobility solutions.

(*ix*) *Ecological Restoration:* Competencies in ecosystem restoration and biodiversity conservation to rehabilitate and protect natural habitats.

(*x*) *Climate Change Mitigation and Adaptation:* Knowledge and skills related to climate change science, adaptation strategies and emission reduction techniques.

These skills can be developed through education and experience as knowledge instils the desire to protect and save the environment—not only for oneself but also for future generations.

Ans 7. Ongoing professional development is crucial in the context of green skills and sustainability as it ensures professionals stay abreast of evolving practices, technologies, and regulations in environmentally-conscious fields. By continuously updating their knowledge and skills, individuals can effectively contribute to sustainable initiatives,

such as renewable energy, waste reduction, and eco-friendly practices. Additionally, ongoing development fosters innovation, enabling professionals to devise creative solutions to complex environmental challenges. Ultimately, prioritizing professional growth in green skills promotes the long-term health of the planet and facilitates the transition towards a more sustainable future.

Ans 8. The 4Rs and 1U are a set of principles that guide sustainable resource management and waste reduction. These are strategies that help in minimizing the environmental impact of unnecessary resource consumption and waste generation.

- *Reduce:* The first principle of the 4Rs is reduce. It involves minimizing the consumption of resources by using them less or only whenever required.
- *Refuse:* The second principle is refuse and it involves saying no to unnecessary or harmful products or practices that contribute to resource depletion or environmental degradation.
- *Reuse:* The third principle is reuse, which emphasizes finding creative ways to use items multiple times instead of discarding them after a single use. Reusing can include repurposing old furniture, donating clothing or using refillable containers instead of disposable ones.
- *Recycle:* The fourth principle is recycle and it focuses on collecting and processing recyclable materials like paper, glass, plastic and metals to create new products.
- *Upcycle:* Upcycle is the innovative addition to the 4Rs, denoting the process of repurposing discarded or unused materials into products of higher value or quality than the original. It encourages creative thinking and transforms waste into unique and valuable items. For example, turning old denim jeans into fashionable bags or using discarded wood to craft decorative furniture.

Ans 9. The United Nations Sustainable Development Goals (SDGs) are a set of 17 global objectives. Adopted in September 2015 by the United Nations General Assembly, they are designed to address a wide range of global challenges.

(*i*) *No Poverty:* End poverty in all its forms everywhere.

(*ii*) *Zero Hunger:* End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

(*iii*) *Good Health and Well-being:* Ensure healthy lives and promote well-being for all.

(*iv*) *Quality Education:* Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

The importance of SDG goals:

(*i*) They are universal and apply to all countries, regardless of their level of development.

(*ii*) They acknowledge the interdependence of social, economic and environmental issues, promoting a holistic approach to development.

(*iii*) They provide a long-term vision for addressing the world's most pressing issues by 2030, fostering a sense of urgency and commitment to action.

(*iv*) They hold governments and organizations accountable for their actions and commitment.

Ans 10. A green economy is an economic system that seeks to promote sustainable development by incorporating principles and practices that reduce environmental risks and ecological scarcities. It aims to enhance human well-being and social equity.

The essential components of a green economy include:

(*i*) *Renewable Energy:* The transition to renewable energy sources such as solar, wind, hydroelectric and geothermal power is the cornerstone of a green economy.

(*ii*) *Resource Efficiency:* Resource efficiency involves using resources such as water, energy and materials more effectively to minimize waste and reduce environmental impact.

(*iii*) *Clean Technologies:* The development and adoption of clean and eco-friendly technologies are crucial for reducing pollution and conserving resources. Examples include electric vehicles, energy-efficient appliances and sustainable building materials.

(*iv*) *Sustainable Agriculture:* A green economy promotes sustainable farming practices that minimize the use of harmful chemicals, conserve soil and water, and protect biodiversity.

(*v*) *Circular Economy:* The Circular Economy model focuses on reducing, reusing and recycling products and materials to minimize waste and extend the life cycle of products. It creates a closed-loop system where no one is unfamiliar with reusing and recycling resources.

(*vi*) *Biodiversity Conservation:* Protecting and preserving biodiversity is integral to a green economy. It safeguards ecosystems, wildlife and natural habitats to maintain ecological balance and ecosystem services.

Ans 11. Although sustainable development is crucial for addressing global challenges, it is not unaccompanied by problems and challenges in its implementation. Some of the key issues associated with sustainable development implementation are presented below:

(*i*) *Difficult to Balance:* Sustainable development involves a complex web of social, economic and environmental factors that are interconnected. Finding solutions that balance these elements can pose a challenge, as decisions in one area may have unintended consequences in others.

(*ii*) *Short-Term vs. Long-Term Goals:* There are trade-offs between short-term economic interests and long-term sustainability objectives. Policymakers and businesses may prioritize immediate gains over long-term environmental and social benefits.

(*iii*) *Resistance to Change:* Transitioning to more sustainable practices often faces resistance from vested interests and traditional industries due to unwillingness to change age-old prevalent systems. This can form a hurdle in the progress towards sustainable development.

(*iv*) *Trade-Offs and Conflicting Objectives:* Finding the right balance between economic growth, social equity and environmental protection can be challenging. Trade-offs may be necessary and different stakeholders may have conflicting priorities.

(*v*) *Global Cooperation:* Many sustainability challenges, such as climate change and biodiversity loss, require international cooperation. Disagreements and geopolitical tensions can hinder effective global collaboration.

(*vi*) *Technological and Financial Barriers:* Access to sustainable technologies and financial resources can be limited in many regions and poor nations, which restricts their ability to adopt and implement sustainable practices.

Potential solutions to address these problems include following the SDGs with the aim to develop the community. SDGs provide a global framework for addressing interconnected issues such as poverty, inequality, environmental degradation and climate change. Tackling these issues require global cooperation.

SUBJECT-SPECIFIC SKILLS

CHAPTER 1: AI Project Cycle

Unsolved Questions

Short Answer Type Questions

Ans 1. AI Project Cycle can be described as a systematic and sequential process that involves effective planning, organization, coordination and development of a project, starting from the initial planning phase and progressing through execution, completion and review.

AI Project Cycle plays a crucial role in breaking down the development of an AI project into different stages. This division simplifies the process, enhances clarity and makes each step precise. Achieving the project goals is the ultimate aim of a Project Cycle.

Ans 2. AI Project Cycle can be described as a systematic and sequential process from the planning phase till completion and the review phase.

There are 5 stages of AI Project Cycle.

(*i*) **Problem Scoping:** Problem scoping is the process of defining and understanding the specific boundaries and details of a problem before starting an AI project. It helps us clarify what needs to be solved and what is the best approach to solve our problem.

(*ii*) **Data Acquisition:** This stage involves gathering and collecting relevant data for the AI project. The sources of data are databases, web scraping, social media, sensors, surveys and APIs.

(*iii*) **Data Exploration:** Data exploration is a way to discover hidden patterns, interesting insights and useful information from collected data. Data exploration helps us make important decisions and find insights that can be used to improve things.

(*iv*) **Modelling:** AI modelling refers to the process of creating a mathematical or statistical representation of a problem. The process of AI modelling has three essential components—data, algorithms and training.

(*v*) **Evaluation and Deployment:** Evaluation helps to understand the performance and effectiveness of an AI model after which it is made available for real-world use.

Ans 3. Problem scoping is the process of defining and understanding the specific boundaries and details of a problem before starting an AI project.

The 4Ws Problem Canvas is a tool for identifying and organizing key elements related to a problem. The 4Ws stand for Who, What, Where and Why. For example, consider the case study 'Energy Management System' given in the chapter.

(*i*) **Who:** The 'Who' block focuses on identifying the stakeholders which include individuals, groups, organizations or communities. In the case study, Energy Management System will benefit every human being living or working in buildings and contribute to a cleaner planet.

(*ii*) **What:** This block focuses on identifying and defining the core problem. In the case study, there is a global problem of energy scarcity in the world and we want to create a smart system using AI to help save energy in buildings.

(*iii*) **Where:** This block helps in examining the context, situation and location related to a specific problem. In the case study, the entire world is struggling with a potential shortage of energy and the smart system will be helpful globally.

(*iv*) **Why:** This block focuses on why it is important to solve this problem and how it will benefit the stakeholders involved and the society in general. In the case study, it is important because saving energy is better for the environment and will also help people save money.

Ans 4. The 4Ws Problem Canvas is a tool for identifying and organizing key elements related to a problem. The 4Ws are as follows:

(*i*) **Who:** The 'Who' block focuses on identifying the stakeholders. These stakeholders are directly or indirectly impacted by the problem.

(*ii*) **What:** The 'What' block focuses on identifying problems. The goal is to gather specific details like relevant documents, reports, newspaper articles or expert opinion to provide evidence.

(*iii*) **Where:** The 'Where' block helps in examining the context, situation and locations related to a specific problem. It helps answer questions such as where the issue exists and whether it is confined to a specific area.

(*iv*) **Why:** The 'Why' block focuses on why it is important to solve this problem and how it will benefit the stakeholders involved and the society in general.

Ans 5. The data exploration stage is the third stage of AI Project Cycle and it is important for the following reasons:

(*i*) It is used to discover patterns and relationships within the data.

(*ii*) This stage involves summarizing the main characteristics of the data, identifying outliers, missing values and visualizing data.

(*iii*) It allows to identify biases in the data and select appropriate modelling techniques.

(*iv*) It is used for deriving meaningful conclusions and making informed decisions based on the data.

Ans 6. Data features refer to the type of data that represents a measurable property or characteristic of the object being analyzed. They can be numerical or categorical, depending on the nature of data.

Data features are crucial in the context of machine learning for the following reasons:

(*i*) Input to machine learning models

(*ii*) Model training and testing

(*iii*) Finding meaningful insights

(*iv*) Predictions and conclusions of a problem

Ans 7. AI modelling refers to the process of creating a mathematical or statistical representation of a real-world system or problem. Modelling plays an important role in capturing and understanding the relationships between input and output pairs for training the system.

The two approaches to AI modelling are:

Rule-based Approach	Learning-based Approach
It refers to AI modelling where the relationship or patterns in data are defined by the developer. The machine follows the rules or instructions mentioned by the developer and performs its task accordingly.	The relationship or patterns in data are not defined by the developer. In this approach, random data is fed into the machine and it is left to the machine to figure out patterns and trends from it.

Ans 8. Evaluation is important in AI because of the following reasons:

(*a*) It ensures the quality and reliability of AI models.

(*b*) It helps to identify biases and discrimination.

(*c*) It helps in the decision-making process.

The different metrics used for evaluation in AI are:

(*a*) **Accuracy:** This is the most commonly used metric which measures the percentage of correct predictions made by the system.

(*b*) **Precision:** This metric measures the percentage of true positives among all the positive predictions made by the system.

(*c*) **Recall:** This metric measures the percentage of true positives among all the actual positive cases.

(*d*) **F1 Score:** This is a combined metric that considers both precision and recall. It measures the harmonic mean of precision and recall.

Ans 9. Data authenticity ensures information is accurate, reliable and genuine, while relevance ensures the data matches the problem being solved. AI learns patterns from data, so poor-quality data leads to wrong decisions. Consequences include biased predictions, unfair outcomes, low accuracy, security risks and loss of user trust in AI systems.

Long Answer Type Questions

Ans 1. Here are some steps that can be taken to plan data acquisition for an AI project using the Energy Management System:

Step 1: Find the data sources: Figure out where we can get the data we need for our Energy Management System. This could be from things like energy meters, air conditioning systems or even manual readings.

Step 2: Decide how to collect data: Choose the best way to collect data, like using sensors or meters. We need to make sure it is accurate and reliable.

Step 3: Set data quality standards: Make rules on how good the data needs to be. We want it to be accurate, reliable and consistent. We might check the data to ensure that it is complete and makes sense.

Step 4: Manage the data: Make a plan on how to keep the data safe and organized. We might use a special database or storage system.

Step 5: Think about privacy and security: Consider how data collection might affect people's privacy and how to keep it safe. We have to follow the rules about privacy and make sure the data is secure.

Ans 2. Autonomy in bioethics respects an individual's right to make informed healthcare decisions. Applied to AI systems, patients must understand how AI functions in their diagnosis/treatment and how to access data driving decisions. Users of an AI algorithm should know how it functions and data should be reproducible and accessible to patients. This ensures patients retain control despite AI involvement. Challenges arise when algorithms operate as 'black boxes', making decisions without transparency, potentially undermining patient autonomy. Proper implementation requires balancing technological advancement with patients' right to informed consent.

Ans 3. AI systems pose two significant ethical challenges regarding data privacy and transparency.

(*i*) Healthcare algorithms require vast amounts of sensitive personal data, creating risk of unauthorized access, misuse or breach of confidential patient information.

(*ii*) Many AI systems operate as 'black boxes', making decisions through complex processes that remain opaque to users and patients.

For example, an AI diagnostic tool might flag certain patients for additional screening without explaining its reasoning or insurance algorithms might deny coverage based on obscure patterns in patient data, limiting accountability and patient understanding.

Ans 4. Justice in bioethics demands fair distribution of healthcare benefits and burdens across populations. In AI-driven healthcare, justice requires algorithms that don't amplify existing healthcare disparities. This means ensuring AI systems work equally well for all demographic groups and allocate resources equitably. Examples include telehealth AI deployed in underserved rural communities with limited broadband access and diagnostic algorithms trained on diverse datasets to ensure accuracy across ethnic groups. Without attention to justice, AI could worsen healthcare disparities by optimizing care for majority populations while overlooking unique needs of marginalized communities.

Ans 5. Transparency and explainability in AI systems are crucial because they enable users to understand how and why decisions are made. When healthcare professionals can comprehend AI recommendations, they can better evaluate their appropriateness for specific patients. Transparent AI allows for the identification of biases or errors in decision-making processes, facilitating improvement and preventing harm.

Additionally, explainable AI builds trust among patients and practitioners, encouraging adoption of beneficial technologies. Without transparency, users cannot meaningfully consent to AI-driven decisions or challenge potentially harmful outcomes, undermining autonomy and accountability.

Ans 6. Ethical frameworks in AI protect privacy and data security by establishing principles for responsible data collection, storage, processing and sharing. These frameworks require informed consent before gathering personal information, data minimization to collect only necessary information and robust security measures.

Without ethical considerations, AI systems risk exposing sensitive health information, using data for unauthorized purposes, creating detailed profiles without consent or perpetuating discrimination through biased algorithms. Ethical frameworks ensure patient data remains confidential, is used only for legitimate purposes and is protected from unauthorized access through encryption and secure storage protocols.

Ans 7. Accountability in AI development means creators take responsibility for the impacts of their systems and implement mechanisms to address problems. Ethical frameworks ensure accountability by requiring clear documentation of design choices, thorough testing for potential harms, ongoing monitoring after deployment and established procedures for addressing adverse outcomes. For example, healthcare AI developers should track how their algorithms perform across different patient populations and correct disparities. Without accountability measures, organizations might blame negative outcomes on 'the algorithm' rather than addressing root causes or prioritize efficiency over safety, resulting in harmful consequences without clear avenues for redress.

Ans 8. AI deployment raises ethical concerns around bias, privacy, job displacement, misuse and lack of human oversight. **Fairness** can be ensured by training models on diverse, balanced datasets and conducting regular bias audits. **Accountability** requires clearly-defined responsibility — developers and organizations must own the system's decisions and have redressal mechanisms. **Transparency** is achieved through explainable AI (XAI), open documentation of data sources, and informing users when AI is being used. Ethics committees and compliance with AI regulations further strengthen responsible deployment.

Case-Based/HOTS Questions

Ans 1. (*a*) **Two points in the AI Project Cycle where issues occurred:**

- **Data Acquisition** — Data only captured online metrics (participation, submissions) and ignored offline/in-person attendance, excluding rural realities.
- **Modelling/Evaluation** — The model was not tested across diverse student groups, so rural students with connectivity issues got unfairly flagged.

(*b*) **Two ways to make it fairer:**

- Include **multiple data sources** — offline attendance registers, teacher feedback and in-person participation — not just online metrics.
- Add a **contextual fairness check** that accounts for infrastructure disparities (*e.g.*, rural vs urban internet access), and allow manual review before any student is labelled "low commitment".

Ans 2. (*a*) **Stage needing revision:** Data Acquisition and Data Exploration — the training data used city-wide *averages*, ignoring household size and type (hostels, joint families, community homes). It also needs revision as it didn't normalize usage per person.

(*b*) **Two ways to make it fair and transparent:**

- Normalize water usage on a per-capita basis (litres per person per day) rather than per household, so that large families aren't penalized unfairly.
- Publish the criteria and thresholds used for alerts publicly, and provide an appeal/review mechanism for flagged households.

Ans 3. (*a*) **Two bioethical principles overlooked:**

- **Justice** — Equal treatment for all skin types was missing.
- **Non-maleficence** — Wrong diagnosis may harm patients.

(*b*) **Two ethical improvements:**

- Retrain the model using diverse local skin-tone datasets.
- Keep doctors in the loop, conduct clinical testing and government approval before full deployment.

Ans 4. (*a*) **Historical Bias** – Past employee data reflected old inequalities, favouring men and prestigious colleges.

(*b*) **Two ethical AI principles for redesign:**

- **Fairness** – Give equal opportunity to all applicants.
- **Inclusivity** – Include candidates from different genders, towns and colleges.

Ans 5. (*a*) It creates a **feedback loop** where strong students keep improving with harder tasks, while weak students remain limited to easy work and get fewer growth opportunities.

(*b*) **One ethical and one technical solution:**

- **Ethical**: Apply the principle of beneficence and fairness — the system's goal should be every learner's growth, not just matching difficulty to current ability. Design with inclusive learning outcomes in mind.
- **Technical**: Use an adaptive difficulty algorithm that gradually increases challenge based on progress (scaffolded learning), mixes difficulty levels, and sets personalized growth goals rather than static labels.

Ans 6. (*a*) The hospital should prioritize autonomy, ensuring patients have control over their medical data and consent to AI-based diagnoses. Beneficence must be upheld by improving healthcare outcomes while non-maleficence should ensure AI does not cause harm due to misdiagnosis. Justice should be maintained by providing equal access to reliable AI diagnostics for all patients.

(*b*) To address data bias, the hospital should enhance AI training with diverse datasets for accurate diagnoses. For autonomy, clear consent processes should be established, ensuring patients understand how their data is used and have control over their information.

Ans 7. A rule-based AI system for grading student exams offers both significant benefits and notable limitations.

Advantages:

- Provides consistent application of grading criteria across all exams
- Eliminates human bias, fatigue and inconsistency in evaluation
- Significantly reduces grading time, allowing faster feedback to students
- Offers transparent and explainable criteria that can be communicated to students
- Scales effectively for a large number of exams without quality degradation

Disadvantages:

- Lacks flexibility to recognize creative or unexpected but valid answers
- May fail to capture nuanced understanding that falls outside predefined rules
- Cannot adapt to new response patterns without manual reprogramming
- Might overlook valid alternative approaches to solving problems
- May perpetuate existing biases embedded in the rule design

Educational institutions implementing such systems should maintain human oversight and regularly review the rules to ensure fair assessment.

Ans 8. John's image recognition app experiences misidentification issues due to several technical limitations in the AI vision systems.

Main reasons for misidentification:

- Insufficient training data for certain objects or animal species
- Image quality problems including poor lighting, low resolution or motion blur
- Unusual viewing angles or partially obscured objects
- Visual similarity between different objects causing algorithmic confusion
- Environmental factors like shadows or reflections that alter apparent features

To improve the app's accuracy, John should provide feedback on incorrect identifications whenever possible, as this will help improve the app's learning. Taking clearer photos with good lighting and minimal background clutter will significantly improve results. Ensuring complete visibility of objects and updating the app regularly will also help. For critical identifications, John should verify results with multiple photos from different angles to increase confidence in the app's assessment.

Ans 9. The AI-based recommendation system enhances the music listening experience primarily by creating customized playlists based on user preferences (option *b*).

This personalization occurs through sophisticated data analysis; the system examines individual listening history, identifies patterns in user behaviour and leverages similarities with other users to discover relevant new content. Unlike options (*c*) and (*d*), which refer to technical features unrelated to AI recommendations, or option (*a*), which is just one aspect of the system's capabilities, option (*b*) captures the core function of the AI system.

The recommendation engine's key enhancements include:

- Analyzing past listening behaviour to understand individual taste profiles
- Identifying patterns that predict likely enjoyment of unfamiliar content
- Comparing data across similar users to discover relevant new artists and songs
- Adapting recommendations as user preferences evolve over time
- Considering contextual factors like time of day or activity

This personalization creates a more engaging listening experience tailored to each user's unique preferences while helping them discover new music aligned with their tastes.

Ans 10. The AI-powered virtual assistant to help students with homework offers several potential benefits. The most significant advantages are:

(*a*) **Quick and accurate answers:** The virtual assistant can instantly provide information without students needing to search through multiple sources, saving valuable study time.

(*b*) **Personalized study tips and guidance:** By analyzing a student's interaction patterns and learning needs, AI can offer customized suggestions that address individual knowledge gaps and learning styles.

These benefits enhance learning efficiency while still requiring students to engage with and understand the material, unlike option (*d*) which would undermine educational goals.

Ans 11. The stage of the AI project cycle that involves training a recommendation algorithm using historical user data is Model Development. During this stage, developers use the prepared dataset to train the algorithm to recognize patterns in user behaviour and product preferences. The system learns to make accurate predictions by analyzing past purchasing history, browsing patterns and user interactions. This stage includes selecting appropriate algorithms, tuning parameters and validating results to ensure the recommendations will be relevant to users of the e-commerce platform.

Ans 12. The stage of the AI project cycle that involves cleaning and preprocessing customer query data for chatbot training is Data Preparation. During this critical stage, raw customer inquiries and responses are cleaned by removing errors, standardizing formats and eliminating duplicates. The text data undergoes preprocessing steps like tokenization, removing stop words, and normalization. This prepared data becomes the foundation for effective chatbot training, ensuring that AI can recognize patterns and generate appropriate responses to customer inquiries.

Reasoning/Application-Based Questions

Ans 1. (*a*) **Optical Character Recognition (OCR)** – Extracts text from handwritten cheque images.

(*b*) **Recommendation System** – Suggests movies based on user preferences and behaviour.

(*c*) **Email Classification/Text Classification** – Sorts emails into categories.

(*d*) **Activity Recognition/Sensor-based AI** – Detects jogging or cycling automatically.

Ans 2. (*a*) **Computer Vision (DL – CNN)** – Detects traffic rule violations from camera images.

(*b*) **Regression/Predictive Analytics (ML)** – Estimates delivery time.

(*c*) **Speech Recognition (DL – RNN)** – Converts speech into text.

(*d*) **Time Series Forecasting/Predictive Analysis (ML)** – Predicts stock price changes.

Ans 3. (*a*) **Natural Language Processing (NLP)** – Understands and answers visitor questions in different languages.

(*b*) **NLP** – Detects misleading news.

(*c*) **Computer Vision** – Matches faces with stored records.

(*d*) **Machine Learning** – Predicts diabetes risk.

Ans 4. (*a*) **Supervised Learning** – Uses labelled handwriting examples.

(*b*) **Reinforcement Learning** – Improves using rewards and feedback.

(*c*) **Unsupervised Learning (Clustering)** – Groups customers without labels.

(*d*) **Unsupervised Learning (Anomaly Detection)** – Finds unusual account behaviour.

Image-Based Questions

Ans 1. Data Acquisition and Data Exploration: "Collect relevant data from reliable sources and explore it to understand patterns, quality and usefulness for the problem."

Develop Model: "Design and train the AI/ML model using the prepared data, selecting appropriate algorithms to solve the defined problem."

Ans 2. Yes, there is a clear ethical concern — AI Bias in Recruitment.

The image shows an AI recruiter system that has selected candidates (marked with red ticks) almost exclusively of one demographic — appearing to favour men of a particular ethnicity, while women and people from other ethnic backgrounds have largely been ignored.

Ethical issues observed:

(*a*) **Gender bias** — very few women are selected despite being present in the candidate pool.

(*b*) **Racial/ethnic bias** — the AI appears to favour one group over others.

(*c*) **Lack of fairness and inclusivity** — the model likely learned from historical hiring data where such biases already existed (similar to the TechVista case above).

How to fix it:

- Train the model on **balanced, diverse datasets** representing all genders, ethnicities and backgrounds.
- Conduct **regular bias audits** and apply **fairness constraints** during training.
- Follow principles of **Fairness, Accountability, Transparency** and **Inclusivity**.

Unsolved Questions

Short Answer Type Questions

Ans 1. Supervised learning involves training a model using labelled data, where each input is associated with a known output. The model learns from these labelled examples and makes predictions about new data. For example, in email classification, a supervised learning model is trained on emails labelled as 'spam' or 'not spam' to accurately classify future emails.

Unsupervised learning, on the other hand, works with unlabelled data and aims to find patterns or groupings. It is often used for clustering and anomaly detection. An example is customer segmentation in marketing, where a model groups customers with similar purchasing behaviour without predefined categories.

Ans 2. Classification models categorize data into distinct classes. Their goal is to predict discrete labels. For instance, a classification model can determine whether an image is of a cat or of a dog.

Regression models, however, predict continuous numerical values. Their goal is to estimate a dependent variable based on input features. For example, a regression model can predict house prices based on square footage, location and number of rooms.

Ans 3. Feature extraction is crucial in clustering. It transforms raw data into meaningful representations, ensuring that important patterns and relationships in the data are captured. This makes it easier for clustering algorithms to group similar items.

For example, in image clustering, pixel values, color histograms and edge detection help in identifying similar images. In text clustering, word embeddings and sentence structures assist in grouping similar documents. Without good feature extraction, clustering algorithms may fail to detect meaningful patterns.

Ans 4. Artificial Neural Networks (ANN) mimic the structure of the human brain by using layers of artificial neurons. Just as biological neurons receive signals, process them and pass them to other neurons, artificial neurons receive inputs, apply weights, sum them and pass the result through an activation function.

ANN consist of an input layer (receiving data), hidden layers (processing information), and an output layer (providing predictions). This layered architecture allows ANN to learn complex patterns, just as the human brain processes information to make decisions.

Long Answer Type Questions

Ans 1. A regression model predicts continuous values based on input features. In the case of housing price prediction, the process involves:

(*i*) **Data Collection:** Gather data on houses, including features like size, number of rooms and location.

(*ii*) **Data Preprocessing:** Clean and normalize data, handling missing values and removing outliers.

(*iii*) **Feature Selection:** Choose the most relevant factors influencing price, such as square footage and proximity to schools.

(*iv*) **Model Training:** Feed the data into a regression algorithm (*e.g.*, linear regression) to learn the relationship between input features and house prices.

(*v*) **Prediction:** When a new house's details are given, the model estimates its price based on learned patterns.

The model's accuracy is evaluated by comparing predicted prices with actual market prices.

Ans 2. Convolutional Neural Networks (CNN) are deep learning models specifically designed for image processing. Their architecture consists of:

(*i*) **Convolutional Layers:** Apply filters to detect patterns like edges and textures.

(*ii*) **Pooling Layers:** Reduce spatial dimensions to retain essential features while minimizing computational load.

(*iii*) **Fully Connected Layers:** Convert extracted features into final predictions.

CNN are widely used in image classification. For example, in a cat vs. dog classifier, CNN analyze pixel patterns to distinguish between the two animals, improving accuracy through multiple convolutional and pooling layers.

Ans 3. Unlike supervised learning, clustering models lack predefined labels, making evaluation difficult. Common challenges include:

- **Subjectivity:** Different clustering algorithms may produce varying results.
- **No clear ground truth:** There is no absolute way to validate clusters.

This problem can be resolved by using internal evaluation metrics and compare with domain knowledge.

Ans 4. Labelled data is essential in supervised learning as it provides the correct answers for the model to learn from. The quality of labelled data directly affects model accuracy, generalization and bias.

For instance, in a medical diagnosis AI, if training data contains mislabelled conditions, the model may misclassify diseases, leading to incorrect diagnoses. Poor labelling can introduce noise and reduce model effectiveness, whereas high-quality labelled data ensures reliable and precise predictions.

Ans 5. An activation function determines whether a neuron should be activated based on the weighted sum of its inputs. It introduces non-linearity, allowing neural networks to learn complex patterns.

For example, in an image recognition perceptron, a step activation function might decide if a pixel belongs to a cat's ear by outputting 1 (activated) or 0 (not activated). More advanced functions like ReLU help capture deeper patterns. Without activation functions, perceptrons would behave like linear regression models, limiting their capabilities.

Ans 6. Features are input variables that describe data while labels (or target variables) are the outputs AI models try to predict.

Examples:

- **Tabular Data:** In a spam classifier, features include the presence of words like 'win' or 'free,' while labels are 'Spam' or 'Not Spam'.
- **Image Data:** In a cat vs. dog classifier, pixel values are features and the labels are 'Cat' or 'Dog'.
- **Text Data:** In sentiment analysis, word count and sentiment score are features while labels are 'Positive' or 'Negative'.

Features provide the necessary context for models to learn while labels guide them towards correct predictions.

Ans 7. Dimensionality reduction in machine learning is a technique used to simplify and represent complex data with fewer features or dimensions. Dimensionality reduction helps us focus on the most important aspects and makes it easier to understand.

By performing dimensionality reduction in machine learning, we simplify data representation by reducing the number of dimensions while retaining important information. It is a part of feature/column selection in Exploratory Data Analysis (EDA is a step in ML for data cleaning) to improve the performance of the model.

Ans 8.

Supervised Learning	Unsupervised Learning	Reinforcement Learning
(*i*) Uses labelled data	Uses unlabelled data	Based on feedback and experiences
(*ii*) Applicable in Regression and Classification problems	Applicable in Clustering and Association problems	Q-learning and SARSA are Reinforcement learning algorithms
(*iii*) *Example:* Identifying dogs based on labelled dog images	*Example:* Finding groups of similar images	*Example:* Super Mario video game

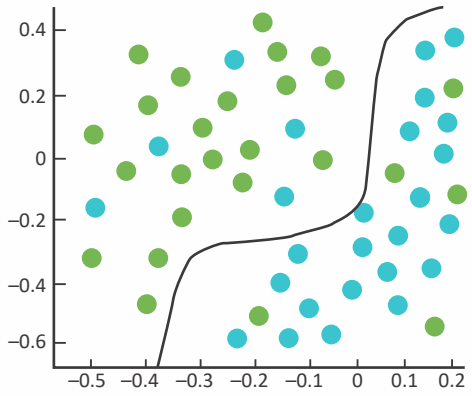
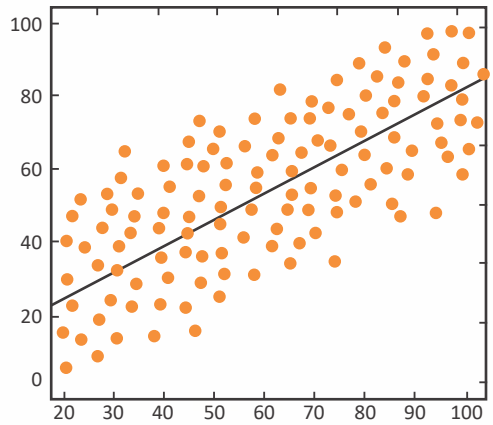
Ans 9. Artificial Neural Network primarily consists of three layers:

(*i*) **Input Layer:** The first layer is known as the input layer, responsible for receiving input data. It does not perform any processing but rather passes the data to the next layer.

(*ii*) **Hidden Layer:** The second layer, known as the hidden layer, is where the actual computation takes place. The output generated by each node in the hidden layer is then passed on to the next hidden layer, if present, or to the final layer.

(*iii*) **Output Layer:** The output layer provides the final processed result or prediction based on the computations performed in the hidden layer.

Ans 10.

Regression	Classification
(*i*) In Regression algorithm, the output variable is continuous type.	In Classification algorithm, the output variable is always categorical type.
(*ii*) It finds the best fit line which predicts the output more accurately.	Classification finds the decision boundary which divides the datasets into different classes.
(*iii*) Regression algorithm solves regression problems like predicting house price.	Classification algorithm solves classification problems like identifying spam emails.
(*iv*) Graph: 	Graph: 
(*v*) *Example:* Predicting house prices based on features such as the number of bedrooms, area and location.	*Example:* Identifying if an email is spam or not spam based on the email's content.

Ans 11. The importance of data in training a neural network is fundamental to its ability to generalize and make accurate predictions. Both the quantity and quality of data significantly impact the performance of a neural network as follows:

Importance of Data Quantity	Importance of Data Quality
(*i*) **Reduced overfitting:** A larger dataset helps in preventing overfitting.	**Accurate model learning:** High quality data ensures that the model learns the true underlying patterns.
(*ii*) **Robustness to variability:** A diverse dataset helps the neural network to become more robust to different scenarios, enabling it to perform well in real-world situations.	**Mitigation of bias:** The good quality of data mitigates biases and promotes fairness in model predictions.

Ans 12. Reinforcement learning is defined as a unique approach to machine learning that focuses on learning from feedback and experiences. The agent in reinforcement learning is the program, algorithm or model being trained to make decisions and take actions. Reinforcement learning is like learning by trial and error.

Consider the example of Super Mario video game. When the program does something good, it gets positive feedback or reward (points) and when it does something not-so-good, it might get negative feedback or penalty (losing a life).

Ans 13. **Rule-based AI** follows predefined 'if-then' rules written by programmers — it cannot learn from new data. *Example:* A traffic signal timer or a calculator app. It works best in **predictable, structured environments** with fixed rules (*e.g.*, tax calculation, chess with fixed rules).

Learning-based AI learns patterns from data and improves over time. *Example:* Netflix recommendations or spam filters. It works best in **dynamic, unpredictable environments** where rules can't be written manually (*e.g.*, speech recognition, self-driving cars, fraud detection where behaviour constantly evolves).

Ans 14. (*a*) **Self-driving cars (*e.g.*, Tesla Autopilot):** The AI agent gets **positive rewards** for smooth lane-keeping, safe distance and reaching destination; **negative rewards (penalties)** for collisions or sudden braking. Over millions of simulations, it learns optimal driving policies.

(*b*) **Game-playing AI (*e.g.*, AlphaGo, chess bots):** The model earns rewards for winning moves and penalties for losing positions. Through trial-and-error, it discovers winning strategies, even surpassing humans.

The reward system guides learning by reinforcing good actions and discouraging bad ones until the model maximizes long-term reward.

Ans 15. **Dimensionality reduction** is the process of reducing the number of input features (dimensions) in a dataset while preserving its essential information. It transforms high-dimensional data into a lower-dimensional form.

Large datasets with too many features cause the "*curse of dimensionality*" — slower training, higher memory use, overfitting and poor visualization. Reducing dimensions improves speed, accuracy and interpretability.

Example: **Principal Component Analysis (PCA)** converting a student dataset with 20 subject marks into 2 principal components for easy clustering and visualization.

Case-Based/HOTS Questions

Ans 1. (*a*) **Type of learning: Supervised Learning** — the model was trained on *labelled* student photographs (each image tagged with the student's identity).

(*b*) **Issue in data/modelling: Insufficient or non-diverse training data** — the dataset likely contained only clear, unobstructed faces. The model never learned to recognize features with occlusions (masks covering nose/mouth, spectacles altering eye region). This is a **data bias/lack of representative samples** problem.

(*c*) **One improvement: Retrain the model on an augmented dataset** that includes photos of students with *masks, spectacles, different lighting*, and *angles* (data augmentation).

Alternatively, use a model that focuses on *periocular features* (eye region) which remain visible even with masks.

Ans 2. (*a*) **Machine Learning type: Reinforcement Learning** — the robot learns through trial-and-error, receiving **rewards** for faster deliveries and fewer collisions.

(*b*) **Stage of AI Project Cycle demonstrated: Modelling (Develop Model)** and **Evaluation** — the robot is continuously learning and improving its policy based on feedback from the environment.

(*c*) **Real-world factors to monitor for safety & ethics:**

- **Safety:** Collision avoidance with human workers, emergency stop mechanisms, load stability, battery/sensor failures.
- **Ethics:** Job displacement of warehouse workers, data privacy if cameras are used, accountability if the robot causes an accident, and worker retraining programs.

Ans 3. (*a*) **ANN component handling feature transformation:** The **Hidden Layer(s)** — they apply weights, biases and activation functions to transform raw input features (past meter readings) into higher-level patterns useful for prediction.

(*b*) **Why poor performance on rural data:** The model was **trained mostly on urban consumption patterns** (stable supply, regular usage). Rural areas have **irregular supply, power cuts and seasonal farming loads**, which the model never saw — leading to **data bias and poor generalization**.

(*c*) SDG contribution:

- **SDG 7 — Affordable and Clean Energy** (efficient energy use)
- **SDG 11 — Sustainable Cities and Communities**
- **SDG 13 — Climate Action** (reduced wastage lowers carbon footprint)

Ans 4. (*a*) **Data processing concept applied: Dimensionality Reduction** — specifically **Principal Component Analysis (PCA)**, reducing 7 features to 2 principal components.

(*b*) **Why dimensionality reduction is useful here:**

- Enables **2D visualization** of student clusters (impossible with 7 dimensions).
- **Removes redundant/correlated features**, making clustering faster and clearer.
- Helps identify **dominant learning-behaviour patterns** that group similar students together.

(*c*) **One caution:** Reducing too many dimensions causes **information loss** — important subtle patterns may disappear, and the resulting clusters might oversimplify reality, leading to inaccurate grouping or misinterpretation of student behaviour.

Ans 5. (*a*) **Industry 4.0 concept applied: AI-driven Automation/Smart Manufacturing** — specifically **Automated Quality Inspection using Computer Vision** (a key pillar of Industry 4.0 along with IoT and cyber-physical systems).

(*b*) **One ethical/social concern:**

- **Job displacement** of manual quality-check workers,

OR

- **Data privacy violation** — factory cameras may capture workers' faces/ activities without their consent.

(*c*) **Sustainable solution ensuring fairness:** Adopt a **'Human-AI collaboration' model** — instead of replacing workers, **reskill and redeploy** them to supervise AI, handle edge cases, and maintain the system. Establish **clear data-privacy policies**, transparent camera usage, and **worker welfare programs** (training stipends, new role placements). This balances innovation with responsibility.

Ans 6. (*a*) Clustering algorithms can be used to group customers by analyzing their purchasing patterns and behaviours. Algorithms such as K-Means, DBSCAN and Hierarchical Clustering identify groups of customers with similar buying habits. For example, K-Means clustering assigns customers to different groups based on their transaction history, spending habits and product preferences. These clusters help businesses identify distinct customer segments, allowing them to tailor marketing strategies accordingly.

(*b*) The company might consider the following features for clustering:

- **Purchase frequency:** How often a customer makes a purchase
- **Average transaction value:** The amount spent on each transaction
- **Product categories purchased:** The types of products customers frequently buy
- **Customer demographics:** Age, gender, location and income level
- **Engagement level:** Interaction with advertisements, loyalty programs and discounts
- **Payment method:** Preferred payment modes like credit cards, digital wallets or cash

(*c*) The results of clustering can help the company improve its business strategy in several ways:

- **Personalized Marketing:** The company can send targeted promotions and advertisements based on customer preferences.
- **Product Recommendations:** By identifying what each segment frequently buys, businesses can suggest relevant products.
- **Customer Retention:** The company can develop loyalty programs for high-value customers to increase retention.
- **Inventory Optimization:** Understanding demand patterns allows better stock management.
- **Pricing Strategy:** Different pricing strategies can be applied to different customer groups based on their purchasing power.

Ans 7. (*a*) To train a regression model for stock price prediction, the following data would be collected:

- **Stock price history:** Open, close, high and low prices for a given period
- **Trading volume:** The number of shares traded per day
- **Company financials:** Revenue, earnings per share (EPS), profit margins and balance sheet details
- **Market indicators:** Indices like S&P 500, interest rates and economic indicators
- **News and sentiment analysis:** Impact of news articles, earnings reports and social media trends on stock prices
- **Macroeconomic factors:** Inflation rates, GDP growth and unemployment rates

(*b*) The steps to build a regression model for stock price prediction are as follows:

(*i*) **Data Collection:** Gather historical stock data from sources like Yahoo Finance or company reports.

(*ii*) **Data Preprocessing:** Handle missing values, remove outliers and normalize the dataset.

(*iii*) **Feature Engineering:** Identify key factors influencing stock prices such as moving averages or sentiment scores.

(*iv*) **Model Selection:** Choose a suitable regression model such as Linear Regression, Random Forest Regression or LSTM (Long Short-Term Memory) for time-series data.

(*v*) **Model Training:** Train the model on historical stock data using machine learning techniques.

(*vi*) **Prediction:** Use the trained model to forecast future stock prices.

(*vii*) **Evaluation and Fine-tuning:** Adjust hyperparameters and test the model with real-world stock movements.

(*c*) The performance of the regression model can be evaluated using the following metrics:

- **Mean Absolute Error (MAE):** Measures the average absolute difference between predicted and actual stock prices.
- **Mean Squared Error (MSE):** Penalizes larger errors more significantly by squaring the differences.
- **Root Mean Squared Error (RMSE):** The square root of MSE, which provides an interpretable error value.

Ans 8. (*a*) Deep learning models, particularly Convolutional Neural Networks (CNN), are widely used in medical imaging for disease diagnosis. CNN can analyze medical scans such as X-rays, MRIs and CT scans to detect abnormalities like tumours, fractures and infections. The process involves:

(*i*) **Feature Extraction:** CNNs automatically detect patterns such as edges, textures and shapes in medical images.

(*ii*) **Classification:** The model assigns probabilities to different medical conditions (*e.g.*, identifying whether a lung X-ray shows pneumonia).

(*iii*) **Diagnosis Support:** AI-assisted diagnostics help radiologists make faster and more accurate assessments, improving patient outcomes.

For example, CNN-based systems have been used to detect diabetic retinopathy in retinal images with accuracy comparable to human experts.

(*b*) Data privacy and security are significant challenges in deploying deep learning models in real-world healthcare. Medical images and patient records contain highly sensitive information. Sharing this data to train AI models raises ethical and legal concerns, as it must comply with prevalent laws. Additionally, obtaining large, labelled datasets is difficult due to strict privacy policies.

(*c*) Federated learning is a possible solution to overcome this challenge. This approach allows hospitals and medical institutions to train AI models collaboratively without sharing patient data. Instead of transferring raw medical data, hospitals only send model updates to a central server. This ensures privacy while still allowing the model to improve using data from multiple sources. Additionally, techniques like differential privacy and encryption can further enhance security when handling sensitive medical data.

Numerical Questions

Ans 1. Given: $x_1 = 2$, $x_2 = 3$, $w_1 = 0.4$, $w_2 = 0.2$, $b = -1$

Net input = $(w_1 \cdot x_1 + w_2 \cdot x_2 + b)$ = $(0.4 \times 2) + (0.2 \times 3) + (-1) = 0.8 + 0.6 - 1 =$ **0.4**

Since $0.4 \geq 0 \rightarrow$ **Output = 1** ☑ (Perceptron activates)

Ans 2. Given: $x = 5$, $w = 0.1$, $b = -1$

(*a*) **Net input = $(w \cdot x + b)$** = $(0.1 \times 5) + (-1) = 0.5 - 1 =$ **–0.5**

Since $-0.5 < 0 \rightarrow$ **Output = 0** (Perceptron does **not** activate)

(*b*) **Impact of bias:** Bias acts as an **adjustable threshold** that shifts the activation boundary. A negative bias makes it *harder* to activate; a positive bias makes it *easier*.

If bias = +1 instead of –1: Net input = $(0.1 \times 5) + 1 = 0.5 + 1 =$ **1.5**

Since $1.5 \geq 0 \rightarrow$ **Output = 1** ☑

Yes, the answer changes — the perceptron now activates. This shows that bias controls *when* a neuron fires, independent of the input values.

Ans 3. Given: $w_1 = 0.5$, $w_2 = 0.3$, $b = -3$, threshold = 0

Formula: Output = 1 if $(w_1 \cdot x_1 + w_2 \cdot x_2 + b) \geq 0$

(*a*) **Student A ($x_1 = 8$, $x_2 = 6$):** = $(0.5 \times 8) + (0.3 \times 6) + (-3) = 4 + 1.8 - 3 =$ **2.8** $\rightarrow 2.8 \geq 0 \rightarrow$ **Output = 1 (PASS)** ☑

(*b*) **Student B ($x_1 = 4$, $x_2 = 2$):** = $(0.5 \times 4) + (0.3 \times 2) + (-3) = 2 + 0.6 - 3 =$ **–0.4** $\rightarrow -0.4 < 0 \rightarrow$ **Output = 0 (FAIL)** ☒

Ans 4. (*a*) Rule: Output = 1 if $(w \cdot x + b) \geq 0$, else 0

Model A: $w = 0.2$, $b = -1$, $x = 7{,}000$ Net input = $(0.2 \times 7000) + (-1) = 1400 - 1 =$ **1399** $\rightarrow 1399 \geq 0 \rightarrow$ **Output = 1 (Active Day)** ☑

Model B: $w = 0.5$, $b = -800$, $x = 1{,}500$ Net input = $(0.5 \times 1500) + (-800) = 750 - 800 =$ **–50** $\rightarrow -50 < 0 \rightarrow$ **Output = 0 (Inactive Day)** ☒

Model	Net Input	Output	Classification
A	1399	1	**Active Day**
B	–50	0	**Inactive Day**

(*b*) Model A

(*c*) Model A has a **small negative bias (–1)** and receives a **very high input (7000 steps)**, so the weighted sum easily crosses the threshold. Model B has a **large negative bias (–800)** acting as a strict threshold — the person needs to walk much more than 1,500 steps (about 1,600+) for the model to classify it as active. This shows how **bias sets the "activation barrier"** — a larger negative bias makes the perceptron *harder to activate*, requiring stronger input evidence.

Image-Based Questions

Ans 1. The points significantly different from all other points are called 'outliers'.

Ans 2. (*a*) Input

(*b*) Hidden

(*c*) Output

Ans 3. (*a*) Diagrams are examples of supervised learning. This method involves training a model on labelled data, where the correct output is known.

(*b*) Image A shows regression, a category of supervised learning, used for predicting continuous values.

(*c*) Image B shows classification, a category of supervised learning, used for categorizing data into discrete classes.

CHAPTER 3: Evaluating Models

Unsolved Questions

Short Answer Type Questions

Ans 1. Splitting data into training and testing sets ensures that a machine learning model learns effectively while also being evaluated for its performance on unseen data. The training set trains the model, allowing it to recognize patterns, while the testing set assesses how well the model generalizes to new data. Without this split, the model might overfit, meaning it memorizes training data but performs poorly on real-world data. A typical split ratio is 70-80% for training and 20-30% for testing.

Ans 2. Accuracy and error are inversely related. Accuracy measures the proportion of correct predictions made by a model, while error represents the proportion of incorrect predictions. A high accuracy indicates a low error rate, meaning the model is making fewer mistakes. Conversely, if the error is high, accuracy will be low, indicating poor model performance. Evaluating both metrics helps in understanding the reliability and efficiency of a model.

Ans 3. Accuracy is calculated as:

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

Where:

- **TP (True Positives):** Correctly classified positive instances
- **TN (True Negatives):** Correctly classified negative instances
- **FP (False Positives):** Incorrectly classified positive instances
- **FN (False Negatives):** Incorrectly classified negative instances

Example: If a spam classification model detects 100 spam emails correctly (TP), 150 non-spam emails correctly (TN), misclassifies 20 emails as spam (FP) and misses 30 spam emails (FN), the accuracy is:

100 + 150/100 + 150 + 20 + 30 = 83.33%.

Ans 4. A high error rate means the model is making frequent incorrect predictions, reducing its reliability. This can lead to serious consequences, especially in critical applications like medical diagnosis or fraud detection.

Strategies to reduce error rate are:

(*a*) **Feature Engineering:** Selecting and refining input features can enhance model accuracy.

(*b*) **Increasing Training Data:** More diverse and representative data helps the model generalize better.

Ans 5. Evaluation of any AI system is important because of the following reasons:

(*i*) **Measure performance:** We evaluate AI systems to see how well they perform on specific tasks. This helps us know if they are accurate and ready for real-world use.

(*ii*) **Find areas to improve:** Evaluation helps us identify where the AI system is not doing well and needs to get better. We look for patterns in mistakes and find out where it struggles with certain inputs or situations.

(*iii*) **Check our assumptions:** Evaluation lets us check if our assumptions about the AI system and its data are correct. We want to make sure the data we used to train the system is like what it will face in the real world.

(*iv*) **Ensure ethical use:** Evaluation helps us make sure the AI system is used ethically and follows the laws. We look for biases or unintended effects and ensure the system is used fairly and responsibly.

Impact of model evaluation on the development and deployment of AI models:

(*i*) **Performance optimization:** Model evaluation guides the optimization of model performance during development.

(*ii*) **Best model selection:** Model evaluation allows comparison of multiple models to select the one that performs optimally.

(*iii*) **Bias and fairness analysis:** This step contributes to ethical AI development.

(*iv*) **Decision to deploy:** The outcome of model evaluation influences the decision to deploy the model.

Ans 6. **Overfitting:** Overfitting occurs when the model becomes too complex and adapts too closely to the training data. As a result, it performs exceptionally well on the training data but poorly on the validation or test data. The model essentially memorizes the training examples but it struggles to generalize to new, unseen data.

Therefore, in case of Overfitting,

Training Performance: High

Validation/Test Performance: Poor

Underfitting: Underfitting means a model is too simplistic to capture the underlying patterns in the data. It performs poorly on both the training data and the validation or test data. In other words, it lacks the capacity to learn from the training data effectively and, as a result, struggles to make meaningful predictions. Underfitting often happens when the model is too basic or the data is too complex for the model to understand.

Therefore, in case of Underfitting,

Training Performance: Poor

Validation/Test Performance: Poor

Ans 7. Precision is a metric that measures the accuracy of positive predictions made by the model. It calculates the percentage of True Positives to the total number of predicted positives (both True Positives and False Positives).

Formula for Precision:

$$\text{Precision} = \frac{TP}{TP + FP}$$

Ans 8. The testing dataset must remain **unseen during training** to fairly evaluate how the model performs on **new, real-world data**. If mixed, the model simply memorizes answers (data leakage), giving falsely high accuracy. A separate test set reveals true **generalization ability** and prevents overfitting-based misleading results.

Ans 9. **Overfitting:** The model learns training data *too well*, including noise and outliers, so it performs excellently on training data but poorly on new/unseen data.

Underfitting: The model is too *simple* to capture underlying patterns, resulting in poor performance on both training and testing data.

Ans 10. **Precision** measures *how many predicted positives are actually correct* (quality), while **Recall** measures *how many actual positives were correctly identified* (coverage). Improving one often reduces the other — together they give a complete picture of a classifier's performance, balancing **false positives and false negatives**.

Ans 11. **High Precision important: Spam email filter** — wrongly marking an important email as spam (false positive) can prove costly; precision ensures only true spam is filtered.

High Recall important: Cancer/disease detection — missing a real patient (false negative) is dangerous; recall ensures every potential case is detected for further testing.

Ans 12. In imbalanced datasets (*e.g.*, 95% healthy, 5% sick), a model predicting 'healthy' for everyone gets 95% accuracy but detects **zero** sick patients. **F1 Score** is the harmonic mean of precision and recall — it stays low when either is poor, giving a truer measure of minority-class performance.

Long Answer Type Questions

Ans 1. Recall measures the ability of the model to find all the positive instances in the dataset. It calculates the ratio of True Positives to the total number of actual positives (both True Positives and False Negatives).

Formula for Recall:

$$\text{Recall} = \frac{TP}{TP + FN}$$

A high recall value ensures that most of the positive cases are detected by reducing false negatives, thus reducing the chances of critical errors.

Ans 2. F1 score is a metric that balances both Precision and Recall. It calculates the harmonic mean of Precision and Recall, giving us a single value that considers both false positives and false negatives.

Formula for F1 score:

$$F1 = \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}}$$

By combining Precision and Recall, the F1 score balances Precision and Recall.

Ans 3. A confusion matrix/error matrix is a table that allows us to assess the performance of a model by comparing its predicted results against the actual reality. It is primarily used for evaluating the performance of classification tasks.

It typically consists of four cells or entries—True Positive (TP), True Negative (TN), False Positive (FP), False Negative (FN).

Confusion Matrix is essential for evaluating AI model performance due to the following reasons:

(*i*) **Accuracy Assessment:** It calculates the overall correctness of the model's predictions, considering both True Positives and True Negatives.

(*ii*) **Precision and Recall Analysis:** It identifies the areas for improvement and involves assessing whether Precision or Recall is more critical for a specific task.

(*iii*) **F1 Score Calculations:** It is useful for finding the balance between false positives and false negatives.

(*iv*) **Model Comparison:** It facilitates an informed decision on which a model is better suited for the task.

(*v*) **Error Analysis:** It helps in understanding the nature of errors made by the model.

Ans 4.

Precision	Recall
Precision is a metric that measures the accuracy of positive predictions made by a model.	Recall measures the ability of a model to find all the positive instances in a dataset.
To minimize False Positives	To minimize False Negatives
Example: YouTube recommendation system	*Example:* Covid-19 detection

Example and explanation:

As regards YouTube recommendation system, what is most significant is reducing the number of false positives. Here, the term 'false positives' refers to YouTube recommending videos that the user does not prefer or like. Since YouTube recommendations should ideally show videos that the user is more likely to click on, false negatives are thus not as important as false positives.

When it comes to COVID-19 detection, avoiding false negatives as much as possible becomes imperative. There is no doubt that COVID-19 spreads easily and, thus, it is important to curb it in its initial stages. Here, a false negative case could prove to be detrimental since it indicates that a COVID-19 patient is assessed to not have the disease. Thus, it is obvious that false positives, *i.e.*, a healthy patient diagnosed as COVID-positive, do not hold as much significance as preventing a contagious patient from spreading the disease does. Recall forms an essential evaluation metric than precision in most high-risk disease detection cases (*e.g.*, cancer).

Ans 5. **Challenges associated with Accuracy:** In imbalanced datasets, accuracy can be misleading. When one class is much larger than the other, a high accuracy might not show the true performance of the model. It could be because the model is good at predicting the category containing majority data items but it may perform poorly on the category having a minimum number of cases. So, accuracy alone may not be a reliable measure in such cases.

Alternate metrics: When dealing with imbalanced datasets, Precision, Recall or F1 Score should be considered instead of Accuracy.

Ans 6. False Positive in Confusion Matrix indicates the misdiagnosis of a healthy patient as having a disease. To minimize False Positives, we should prioritize Precision.

On the other hand, False Negative denotes incorrect classification of a patient with a disease as healthy. To minimize False Negatives, we should prioritize Recall. Therefore, in such scenarios, there is a need to minimize both False Positives and False Negatives.

To achieve a balance between Precision and Recall and to minimize both the metrics, F1 Score is recommended. F1 Score provides a balanced relationship between Precision and Recall, making it a suitable metric for scenarios where both types of errors need to be minimized.

Ans 7. F1 Score is a metric that balances both Precision and Recall, whereas Accuracy is a metric that measures the overall correctness of the model's predictions by comparing the total number of predictions made.

Let us take the example of a credit card fraud detection model. Let us assume that 99% of the transactions are legitimate and only 1% are fraudulent.

Reality: (Dataset)

True Negatives: 99,000 transactions are legitimate.

True Positives: 1,000 transactions are fraudulent.

Model's Predictions:

Predicts all transactions as legitimate (no fraud) – 100,000 transactions.

Components of a Confusion Matrix:

- **Total transactions in the dataset (Total instances):** 100,000
- **True Positives (TP):** 0 (as the model predicts no fraudulent transaction)
- **True Negatives (TN):** 99,000
- **False Positives (FP):** 0 (as the model predicts no fraudulent transaction)
- **False Negatives (FN):** 1,000

On applying Accuracy formula, we get Accuracy = 0.99 (or 99%)

Here, the accuracy appears to be very high (99%) which might give the impression that the model is doing an excellent job as it is not detecting any fraudulent transactions; however, the model's accuracy is misleading. Therefore, in such scenarios we should prioritize Precision, Recall or F1 Score, depending on the need to minimize False Positives or False Negatives, or to provide a balance between Precision and Recall.

Ans 8. False Positives occur when the model incorrectly identifies a legitimate transaction as fraudulent. This could lead to inconvenience for users, potential delays or denial of legitimate transactions.

False Negatives happen when the model fails to detect an actual fraudulent transaction. This poses a severe risk as the choice between Precision and Recall depends on the specific goals and priorities of the fraud detection system.

If minimizing disruptions to legitimate users is a priority, Precision may be more relevant. If preventing financial losses due to undetected fraud is paramount, Recall becomes more relevant. F1 Score offers a comprehensive assessment when there is a need to balance both aspects effectively.

Ans 9. The significance of Confusion Matrix in evaluating AI model performance is explained below:

(*i*) **Accuracy Assessment:** It calculates the overall correctness of the model's predictions, considering both True Positives and True Negatives.

(*ii*) **Precision and Recall Analysis:** It identifies areas for improvement and involves assessing whether Precision or Recall is more critical for a specific task.

(*iii*) **F1 Score Calculations:** It is useful for finding the balance between false positives and false negatives.

(*iv*) **Model Comparison:** It facilitates an informed decision on which model is better suited for the task.

(*v*) **Error Analysis:** It helps in understanding the nature of errors made by the model.

Overall, Confusion Matrix provides insights into the model's behaviour, guiding refinement of algorithms and strategies to enhance overall performance.

Ans 10. When you try to improve either Precision or Recall, the other might actually get worse. This is known as the 'Precision-Recall Trade-off'.

- **High precision, low recall:** When we want to make sure that the model is being very careful in its positive predictions (high precision), it might become too cautious and miss some actual positive cases (lower recall).
- **High recall, low precision:** When we want the model to catch as many positive cases as possible (high recall), it might also include some false positive predictions (lower precision).

So, we need to find a balance that fits the situation. It all depends on what is more important for the specific task:

- For things like spam email detection or fraud detection, we can't mistakenly flag something important as spam or fraud (false positive), so we might prioritize high precision.
- But in medical diagnosis, missing a positive case (false negative) can be really bad, so we might prioritize high recall to make sure we catch most of the positive cases.

Ans 11. A single train-test split evaluates the model on just **one random partition**, which can give misleading results if the split happens to be lucky or unlucky. **Cross-validation (*e.g.*, k-fold)** divides data into k parts, trains on $k–1$ folds, and tests on the remaining fold — repeated k times. The final score is averaged across all folds, ensuring **every data point is used for both training and testing**. This reduces variance, detects overfitting, and gives a more **reliable and unbiased estimate** of real-world performance.

Ans 12. A **confusion matrix** tabulates True Positives (TP), True Negatives (TN), False Positives (FP) and False Negatives (FN).

Example — COVID test on 100 people: TP = 40, TN = 45, FP = 10, FN = 5

Derived metrics:

- **Accuracy** = (TP+TN)/Total = 85/100 = **85%**
- **Precision** = TP/(TP+FP) = 40/50 = **80%**
- **Recall** = TP/(TP+FN) = 40/45 = **88.9%**
- **F1 Score** = $2\cdot(P\cdot R)/(P+R) \approx$ **84.2%**

Thus, a single matrix yields a complete evaluation.

Ans 13. During evaluation, **bias** must be checked by testing the model across diverse demographic groups (gender, region, age) and auditing for disparate performance. **Transparency** requires documenting datasets, evaluation metrics and limitations openly (model cards, data sheets). **Accountability** means assigning clear responsibility — developers and organizations must own outcomes and provide redressal. **Fairness** demands balanced datasets, bias-mitigation algorithms and equal metric thresholds across groups. Independent audits, human-in-the-loop review, and compliance with AI ethics frameworks (like NITI Aayog's Responsible AI) ensure ethical evaluation.

Ans 14. Accuracy measures overall correctness but hides poor performance on minority classes in imbalanced datasets.

Example: A fraud detection system where only 2% of transactions are fraudulent. A model predicting '*not fraud*' for every transaction gets **98% accuracy** — yet it catches **zero frauds**, making it useless.

To truly evaluate, we need **Precision, Recall, F1 Score**, and **Confusion Matrix**, which expose how the model handles the critical minority class. Hence, accuracy must always be combined with other metrics for imbalanced problems.

Case-Based/HOTS Questions

Ans 1. (*a*) They can use Accuracy (how often the model is correct overall) and Recall (how many real traffic jams it actually detects). Together, these show both correct and missed predictions.

(*b*) Testing on **unseen roads** checks whether the model has truly **generalized** or just memorized training locations (overfitting). Real deployment involves new intersections with different layouts, so evaluation on fresh roads ensures city-wide reliability.

(*c*) Add more **training images from different times and situations** — late nights, construction zones, rainy days and festivals. This helps the model learn unusual conditions and make better predictions.

Ans 2. (*a*) **Overfitting** — the model has learned urban-specific patterns and fails on rural populations. It's also a **data bias/sampling bias** issue from non-representative training data.

(*b*) Developers can **test the model separately for each group** (urban vs rural, men vs women) and compare accuracy. If one group gets more wrong predictions, the model is unfair and needs fixing.

(*c*) Populations differ in **diet, genetics, climate, and lifestyle**. Varied regional data ensures the model is tested across real diversity, exposes hidden bias, and guarantees **equitable healthcare** — critical when wrong medical predictions can harm patients.

Ans 3. (*a*) **Accuracy = 85/100 × 100 = 85%**

(*b*) Both matter because both error types cost farmers:

- **False Positive** ("irrigate" but it rains) → water wastage, flooded crops → **Precision** handles this.
- **False Negative** ("don't irrigate" but it's dry) → crop loss → **Recall** handles this.

F1-Score balances both for a fair system.

(*c*) Test the model with **data from different seasons and weather conditions** (monsoon, dry days, unexpected rain) before deployment. Running a small **pilot test** with real farmers and collecting feedback also helps improve accuracy.

Ans 4. (*a*) The ethical concern is Bias and Unfairness — the AI is unfair to rural students. This happens because the training data mostly includes urban students, so the model wrongly favours them.

(*b*) Collect a balanced dataset with equal numbers of rural and urban students. Add fair features like school facilities and access to coaching. During evaluation, check selection rates separately for rural and urban students to ensure fairness.

(*c*) AI cannot understand real-life struggles like poverty, lack of internet or family hardships. Humans can review special cases, correct mistakes, and ensure deserving students aren't unfairly rejected. This is called Human-in-the-Loop — AI assists, humans decide.

Ans 5. (*a*) **Overfitting** — the model memorizes ideal daylight conditions and fails to generalize to rain, blur, or low light. Also reflects **lack of data diversity**.

(*b*) Add more training images taken in rainy, blurred, dark and cloudy conditions. A diverse dataset helps the model recognize waste in any situation, not just sunny days.

(*c*) Supports multiple SDGs:

- **SDG 11** — Cleaner, sustainable cities.
- **SDG 12** — Responsible consumption through better recycling.
- **SDG 13** — Climate action (less landfill methane).
- **SDG 3** — Safer waste-worker health.

Ans 6. (*a*) Given:

- TP = 150
- TN = 200
- FP = 50
- FN = 30

Using the accuracy formula:

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN} = \frac{150 + 200}{150 + 200 + 50 + 30}$$

$$= 81.39\%$$

Error Rate Calculation:

$$\text{Error Rate} = 1 - \text{Accuracy}$$
$$= 18.61\%$$

Thus, the model correctly classifies 81.39% of emails, while it misclassifies 18.61%.

(*b*) **True Positives (TP = 150):** These are actual spam emails correctly identified as spam. A high TP count indicates that the model effectively catches spam. **False Positives (FP = 50):** These are legitimate emails mistakenly classified as spam. A high FP count means important emails might be lost in the spam folder, causing inconvenience to users.

(*c*) **Reduce False Positives (FP):** Adjust the classification threshold to avoid misclassifying genuine emails as spam.

Improve Training Data: Increase the diversity of labelled spam and non-spam emails to improve learning.

Feature Engineering: Use better features such as email metadata, sender reputation and text structure analysis.

Ans 7. Case 1: Weather Prediction

Confusion Matrix:

	Predicted Rain	**Predicted No Rain**
Actual Rain	12 (TP)	1 (FN)
Actual No Rain	2 (FP)	15 (TN)

- **True Positives (TP):** 12 days predicted as rain and it actually rained.
- **True Negatives (TN):** 15 days predicted as no rain and it actually didn't rain.
- **False Positives (FP):** 2 days predicted as rain but it didn't rain.
- **False Negatives (FN):** 1 day predicted as no rain but it rained.

Case 2: Dog Breed Recognition

Confusion Matrix:

	Predicted Breed	**Predicted Not Breed**
Actual Breed	15 (TP)	2 (FN)
Actual Not Breed	3 (FP)	20 (TN)

- **True Positives (TP):** 15 images predicted as the breed and they are the breed.
- **True Negatives (TN):** 20 images predicted as not the breed and they are not the breed.
- **False Positives (FP):** 3 images predicted as the breed but they are not the breed.
- **False Negatives (FN):** 2 images predicted as not the breed but they are the breed.

Ans 8. (*a*) **Sentiment Analysis:** Use Precision and Recall to evaluate as false positives and false negatives can impact user experience.

(*b*) **Credit Card Fraud Detection:** Use Precision and Recall, focusing on minimizing false positives to avoid customer inconvenience.

(*c*) **Patient Readmission Prediction:** Use Recall to ensure high sensitivity in identifying potential readmissions.

(*d*) **Equipment Failure Prediction:** Use Precision and Recall to balance between false alarms and missed failures.

(*e*) **Manufacturing Defect Detection:** Use Precision to minimize false positives, avoiding unnecessary interventions.

(*f*) **Genetic Disease Risk Prediction:** Use Recall to ensure high sensitivity in identifying at-risk individuals.

Ans 9. TP: 80

- TN: 40
- FP: 10
- FN: 20

	Predicted Positive	**Predicted Negative**
Actual Positive	80	20
Actual Negative	10	40

Ans 10. TP: 40

- TN: 120
- FP: 30
- FN: 10

	Predicted Spam	**Predicted Not Spam**
Actual Spam	40	10
Actual Not Spam	30	120

Accuracy: (TP + TN)/Total = (40 + 120)/200 = 0.8

Precision: TP/(TP + FP) = 40/(40 + 30) = 0.57

Recall: TP/(TP + FN) = 40/(40 + 10) = 0.8

F1 Score: 2 * (Precision * Recall)/(Precision + Recall) = 0.67

Ans 11. TP: 15

- TN: 50
- FP: 10
- FN: 5

Accuracy: (TP + TN)/Total = (15 + 50)/80 = 0.81

Precision: TP/(TP + FP) = 15/(15 + 10) = 0.6

Recall: TP/(TP + FN) = 15/(15 + 5) = 0.75

F1 Score: 2 * (Precision * Recall)/(Precision + Recall) = 0.67

Image-Based Questions

Ans 1. Model Fit:

- The first image shows underfitting.
- The second image shows good fit.
- The third image shows overfitting.

Ans 2. Accuracy and Precision:

- **Accuracy:** (TP + TN)/Total = (16 + 144)/200 = 0.8
- **Precision:** TP/(TP + FP) = 16/(16 + 10) = 0.615

CHAPTER 4: Statistical Data

Unsolved Questions

Short Answer Type Questions

Ans 1. Statistical data refers to collected numerical or categorical information used for analysis, interpretation and decision-making. It is broadly classified into two types:

(*i*) **Qualitative Data (Categorical Data):** Describes qualities or characteristics

Types:

- **Nominal Data:** Categories with no inherent order (*e.g.*, gender, blood type)
- **Ordinal Data:** Categories with a meaningful order but unknown spacing (*e.g.*, satisfaction levels: poor, average, good)

(*ii*) **Quantitative Data (Numerical Data):** Represents numerical values with measurable characteristics

(*iii*) Types:

- **Discrete Data:** Countable numbers (*e.g.*, number of students in a classroom)
- **Continuous Data:** Infinite values within a range (*e.g.*, temperature readings)

Ans 2. The following table shows how the various AI tools differ from each other while working with statistical data.

	No-Code AI	Low-Code AI	High Code
(*i*)	Provides visual tools for analysis	Offers visual tools with coding for customization	Requires manual coding for statistical operations
(*ii*)	Model creation with drag-and-drop tools	Model creation with visual tools and code options	Code is required to create models
(*iii*)	Limited customization	Moderate level of customization with custom coding	Highest level of customization
(*iv*)	No programming knowledge required	Moderate programming knowledge required	High programming knowledge required

Ans 3. Statistical data plays a crucial role in healthcare for decision-making, diagnostics and research. It helps identify patterns, predict diseases and improve treatment outcomes.

Examples:

(*i*) **Disease Prediction:** Machine learning models use patient statistics (age, medical history, blood pressure) to predict diseases like diabetes or heart disease.

(*ii*) **Treatment Effectiveness:** Clinical trials analyze statistical data to measure how well a new drug works as compared to existing treatments.

Long Answer Type Questions

Ans 1. AI project lifecycle of Predicting Diabetes using Statistical Data is as follows:

(*i*) **Problem Definition:** Identify the objective—predict whether a patient has diabetes based on health parameters.

(*ii*) **Data Collection:** Gather patient records, including glucose levels, BMI and age.

(*iii*) **Data Preprocessing:** Handle missing values and convert categorical data (*e.g.*, gender) into numerical form.

(*iv*) **Feature Engineering:** Select relevant features such as blood pressure and insulin levels.

(*v*) **Model Training:** Use classification algorithms like Decision Trees or Logistic Regression.

(*vi*) **Model Evaluation:** Measure accuracy using Precision-Recall and Confusion Matrix.

(*vii*) **Deployment:** Implement the model in a hospital system for automated diagnosis.

Ans 2. Advantages:

(*i*) No programming skills required

(*ii*) Quick model creation with visual workflows

(*iii*) Easy integration with existing data sources

Limitations:

(*i*) Limited flexibility for complex models

(*ii*) Performance depends on pre-built algorithms

(*iii*) Not suitable for highly customized AI applications

Ans 3. Most machine learning algorithms require numerical data to perform mathematical operations. Therefore, categorical data must be converted into numerical form for processing.

Example:

- **Problem:** A dataset contains 'Country' as a feature (USA, India, UK).
- **Issue:** Algorithms cannot process text directly.
- **Solution:** Convert categories into numbers.

Methods of Conversion:

(*i*) **One-Hot Encoding:** Converts categorical variables into binary columns.

Example:

Country	→	USA	India	UK
USA	→	1	0	0
India	→	0	1	0
UK	→	0	0	1

(*ii*) **Label Encoding:** Assigns unique numbers to each category.

Example:

USA → 0, India → 1, UK → 2

Ans 4. Random sampling ensures that every data point in the population has an **equal chance of being selected**, preventing systematic favoritism towards any group, region or pattern. This eliminates **sampling bias** — where the dataset over-represents one class and under-represents others — leading to more **generalizable and fair models**. For example, randomly sampling students from all sections rather than one class gives a truer picture of overall performance. Random sampling improves data reliability, reduces skewed predictions, and strengthens statistical validity of AI outcomes.

Ans 5. **Advantage:** No-code AI tools (like Orange Data Mining, Teachable Machine, Google AutoML) allow **non-programmers — students, teachers, analysts** — to build and analyze models through drag-and-drop interfaces. This democratizes AI, speeds up experimentation, and lets users focus on *data insights* rather than coding syntax.

Limitation: They offer **limited customization and flexibility** — users cannot fine-tune advanced algorithms, handle very large datasets efficiently, or implement custom logic. For complex, production-grade projects, traditional coding (Python, R) remains necessary for precision and scalability.

Ans 6. Evaluating **training data alone** misleads because the model has already 'seen' those examples — it may simply memorize patterns **(overfitting)**, showing high accuracy that doesn't reflect real-world performance. A **separate test set** contains *unseen* data, revealing how well the model **generalizes** to new situations. This exposes weaknesses like overfitting, bias, or poor feature selection. Without test-set evaluation, deployed models can fail unexpectedly on live data, causing wrong predictions, user distrust, and serious consequences in fields like healthcare or finance.

Case-Based/HOTS Questions

Ans 1. (*a*) **Categorical data** — specifically **nominal categorical**, as 'Property Area' contains discrete labels like *Rural, Semi-Urban, Urban* with no natural numerical order.

(*b*) **Data Acquisition and Data Exploration stage** — this is where biased or imbalanced data (*e.g.*, fewer rural approvals in historical records) must be identified, cleaned and balanced before it reaches the modelling stage.

(*c*) **Balance the training dataset** so that rural and urban applicants are represented equally, and apply **bias-mitigation techniques** (like reweighting or fairness constraints). Additionally, remove or audit features that act as proxies for location, and add **human-in-the-loop review** for flagged rural applications with good credit scores.

Ans 2. (*a*) **Standard Deviation (σ)** — it quantifies the **spread or dispersion** of data values around the mean. A related measure is **Variance** (σ^2), which is the square of standard deviation.

(*b*) It indicates that **PM2.5 levels fluctuate greatly** at traffic crossings — values swing widely above and below the mean. This reflects **unstable, inconsistent air quality** caused by varying traffic density, vehicle emissions, and time-of-day effects. In contrast, low SD in parks means stable, consistent readings.

(*c*) Data Exploration (part of Data Acquisition & Data Exploration stage) — students are visualizing, summarizing, and understanding patterns in data using histograms, box plots, mean and standard deviation before any modelling begins.

Ans 3. (*a*) **Stratified Sampling** — the population is divided into **strata (subgroups)** based on attendance categories (above 90%, 75–90%, below 75%), and samples are drawn proportionally from each stratum. This ensures no group is under- or over-represented.

(*b*) It suggests the data is **skewed** and contains **outliers** — extremely high or low scores pulling the mean away from the median. For example, a few students scoring very low can drag the mean down while the median stays stable. The median is then a more reliable measure of central tendency.

(*c*) • **Data Acquisition and Data Exploration** — collecting and grouping data, computing mean/median.

• **Modelling (Develop Model)** — applying regression in Orange to predict next term's marks.

Ans 4. (*a*) **Historical Bias** (also called **Gender Bias/Selection Bias**) — the training data reflects **past hiring inequalities**, where male candidates were historically preferred. The AI has simply learned and amplified this pre-existing societal bias.

(*b*) **Data Acquisition and Data Exploration stage** (primarily), and re-validated at the **Evaluation stage**. Biased historical data must be identified, rebalanced or features like *gender* removed/masked before modelling. Evaluation must include **fairness audits** across demographic groups.

(*c*) Follow the **Fairness and Non-Discrimination principle** — ensure the AI does not disadvantage any group based on gender, age, caste or region. Use **balanced datasets**, conduct **regular bias audits**, apply **blind screening** (removing sensitive attributes) and maintain **transparency and accountability** with human oversight in final hiring decisions.

Ans 5. (*a*) **Numerical (Continuous) variable** — temperature can take any real value within a range (*e.g.*, 28.5°C, 32.7°C) and is measured on a continuous scale.

(*b*) **Modelling (Develop Model) stage** — students are feeding the prepared dataset (temperature, strength, past usage) into a regression algorithm in Orange to learn patterns and make predictions.

(*c*) **Reduced water wastage through accurate demand prediction** — AI optimizes tank-filling schedules, preventing overflow and shortage. This supports **SDG 6 (Clean Water and Sanitation)** and **SDG 12 (Responsible Consumption and Production)**, promoting sustainability and lowering utility costs for the school.

Ans 6. (*a*) To predict sales, statistical data such as product category, store location, pricing and past sales, trends are analyzed. Data preprocessing involves handling missing values, normalizing numerical values and encoding categorical data. Feature engineering extracts key insights like the impact of discounts and store type. Machine learning models such as Linear Regression or Random Forest are trained on historical sales data. No-code AI tools like Orange Data Mining allow easy implementation, while low-code platforms like KNIME offer additional flexibility. The model is evaluated using performance metrics like RMSE and MAE. Continuous model monitoring improves prediction accuracy.

(*b*) Data preprocessing involves removing duplicates, handling missing values, standardizing numerical features and encoding categorical variables. Feature engineering focuses on creating meaningful variables such as seasonal trends, promotional effects and customer demographics. Model building includes

selecting appropriate regression algorithms, training the model on historical sales data and optimizing hyperparameters. The trained model is then evaluated using statistical metrics like MAE, RMSE and R^2 score. If performance is unsatisfactory, additional data cleaning, feature selection and model tuning are performed. Finally, the model is deployed for real-time sales forecasting and periodic updates that ensure better performance over time.

Ans 7. (*a*) Low-code AI offers faster fraud detection, allowing bank analysts to use pre-built AI models without extensive coding. It simplifies model deployment, reducing development time. Automated feature selection and continuous model updates enhance efficiency. However, the transition also presents challenges. Low-code AI may lack customization, making it harder to detect sophisticated fraud patterns. Performance constraints can limit detection accuracy and integration with legacy banking systems may be complex. Additionally, cloud-based low-code AI platforms raise security concerns. Despite these limitations, low-code AI improves fraud detection speed, enabling faster response to fraudulent activities.

(*b*) Low-code AI tools can maintain accuracy by providing adjustable parameters for fraud detection thresholds. Hybrid approaches allow integration with Python and SQL for complex data analysis. Automated retraining ensures the model adapts to evolving fraud patterns. AI explainability tools help analysts understand model decisions, improving transparency. Secure deployment, including on-premise low-code solutions, enhances data security. User-friendly dashboards enable analysts to modify risk thresholds and customize detection rules without extensive coding. By combining automation with human expertise, low-code AI can deliver effective fraud detection while maintaining flexibility, accuracy and security.

CHAPTER 5: Computer Vision

Unsolved Questions

Short Answer Type Questions

Ans 1. In computer vision, feature extraction involves identifying and isolating important parts of an image, such as edges, textures or shapes to simplify the image and make it easier for a model to process.

Embedding models transform images into lower-dimensional vectors (embeddings) that capture essential features. This helps in comparing images, clustering and improving the efficiency of machine learning models by focusing on relevant information.

Ans 2. **Autonomous Vehicles:**

- **Challenges:** Real-time processing, handling diverse and unpredictable environments and ensuring safety.

Medical Imaging:

- **Challenges:** High accuracy requirements, dealing with varied image quality and ensuring patient privacy and data security.

Ans 3. Workflow of building an Image Classification Model using Orange Data Mining is as follows:

(*i*) **Data Import:** Load image data into Orange.

(*ii*) **Preprocessing:** Use widgets to preprocess images, such as resizing or normalizing.

(*iii*) **Feature Extraction:** Apply feature extraction techniques to convert images into a format suitable for modelling.

(*iv*) **Model Building:** Use classification widgets to train a model on the extracted features.

(*v*) **Evaluation:** Assess model performance using evaluation widgets, such as confusion matrices or cross-validation.

(*vi*) **Deployment:** Use the model for predictions on new image data.

Ans 4. The visual system is composed of various components, all working together to capture, process and interpret visual information. The light captured by the photoreceptor cells in the retina is converted into electrical signals. These signals are then transmitted via the optic nerve to the visual cortex in the brain, which then enables us to perceive and understand the real world, whereas Computer Vision is a branch of AI that uses algorithms and scientific techniques which enable machines to acquire visual data to process and analyze.

Ans 5. AI is a broad field and computer vision is a domain of AI because it involves the use of algorithms and techniques to give machines the ability to perceive and understand visual information. Computer Vision uses machine learning algorithms to learn patterns from training data and make predictions on unseen data.

Ans 6. Object Detection combines the tasks of classification and localization, *i.e.*, it not only classifies but also provides their precise location within the image. Each detected object is associated with a bounding box that specifies its label or class, location and dimensions (width and height) within the image. On the other hand, Object Classification only classifies the image; it involves assigning a label to an image based on its content. This is achieved by using a classifier—a specialized algorithm or model trained on labelled images. The classifier analyzes the visual features of the input image and predicts the most appropriate label or category.

Ans 7. Some applications of CV are:

(*i*) **Self-Driving Vehicles:** Computer vision is vital for self-driving cars to perceive the environment and make decisions.

(*ii*) **Facial Recognition:** Facial recognition technology uses computer vision to identify and verify individuals based on their unique facial features.

(*iii*) **Augmented Reality (AR):** Computer vision enables immersive augmented reality experiences by overlaying digital content on the real world.

(*iv*) **Medical Imaging and Diagnostics:** Computer vision aids in medical imaging for accurate diagnostics. For instance, radiologists use computer vision algorithms to analyze medical scans, such as X-rays or MRIs, to detect abnormalities, identify diseases and assist in treatment planning.

Ans 8. **Image Classification** assigns a **single label** to an entire image (*e.g.*, 'cat' or 'dog') — it only answers *what* is in the image. **Object Detection** identifies **multiple objects within an image**, locates each with **bounding boxes**, and labels them — answering both *what* and *where* (*e.g.*, 3 cars and 2 people).

Ans 9. **Feature extraction** converts raw pixel data into meaningful patterns — edges, corners, textures, shapes, and colors — that the AI model can understand. It reduces data dimensionality, removes noise, and highlights important information. Without it, models struggle to recognize objects accurately, train slower, and produce poor predictions, especially with large, complex images.

Ans 10. No-code tools like **Orange Data Mining** and **Teachable Machine** provide **drag-and-drop visual workflows**, letting beginners import images, train classifiers and evaluate models **without writing code**. They lower the entry barrier, allow quick experimentation, and help students, teachers and non-programmers understand core AI concepts like training, testing and accuracy through **interactive visualization**.

Long Answer Type Questions

Ans 1. Machine learning is a technique within AI that helps computers learn patterns and make predictions using data. In computer vision, ML algorithms can be trained on large datasets of images or videos to recognize objects, classify images, detect and track objects and perform other visual tasks. By combining ML with computer vision, computers can understand images, recognize faces, find objects and even drive cars autonomously.

Pixels are the smallest unit of information in digital images. A pixel contains information that represents the color and intensity of a specific point in an image. Resolution is a measure of the number of pixels that make up the image. Higher-resolution images have more pixels, resulting in sharper and more detailed visuals.

Ans 2. Resolution is a count of the total number of pixels. Therefore,

Total number of Pixels = 1024 (pixels width) × 768 (pixels height)

= 7,86,432

Ans 3. Image features refer to distinctive and informative patterns or structures within an image that can be used for various tasks such as object recognition, image matching or image analysis. Image features are specific areas or regions within an image that possess unique characteristics, making them easily distinguishable from their surroundings.

Ans 4. An image kernel, also known as a filter, is a small matrix of numbers used in image processing and acts as a magnifying glass.

Ans 5. Convolution is a special mathematical operation that helps a computer analyze and understand images.

To examine different parts of an image, it uses filters (called Image Kernels) and sliding windows. The filters can be used to detect various patterns, like edges, shapes or even more complex objects.

Ans 6. Computer vision performs tasks that can be categorized into two main groups based on the number of objects involved.

(*i*) For single objects:

(*a*) **Classification:** In computer vision, classification is the process of identifying or categorizing objects or images into different classes or categories.

(*b*) **Classification + Localization:** Image classification and localization refers to the combined task of not only identifying the objects but also accurately determining the location and position of objects within an image.

(*ii*) For multiple objects:

(*a*) **Object Detection:** It combines the task of classification and localization by not only identifying objects but also providing their precise location within the image.

(*b*) **Image Segmentation:** It is the process of dividing an image into different regions or segments based on certain characteristics or criteria.

Ans 7. Convolutional Neural Network (CNN) is an advanced form of artificial intelligence algorithm, which works as the brain for computers to help them understand and analyze pictures. By using complex algorithms and learning from extensive training data, a CNN can recognize and interpret objects, patterns and features within an image.

The layers involved in a CNN are:

(*i*) **Convolutional Layer:** This layer finds important things in an image like edges, shapes or textures. It uses filters that slide across the image, looking for these patterns and highlighting them.

(*ii*) **Pooling Layer:** This layer makes the image smaller by keeping only the most important information. It does this by taking the highest values from certain areas and discarding the rest. This helps reduce the size of the image while keeping the important features. There are two types of pooling commonly performed on an image—Max Pooling and Average Pooling.

In Max Pooling, the pooling layer selects the highest number within each window and keeps only that number.

In Average Pooling, the image is divided into non-overlapping rectangular regions (often squares) and the average value within each region is calculated. This pooling technique reduces the spatial dimensions of the image while providing a smooth representation of the input.

(*iii*) **Fully connected layer:** It is like the part of the brain that connects different pieces of information together. It helps the network understand how different features relate to each other and make predictions based on that understanding.

(*iv*) **Output layer:** It is like the final decision-maker or the one that gives the ultimate answer. It takes all the information processed by the previous layers and provides the final prediction or classification result.

Ans 8. [(1×2 + 2×3 + 4×1 + 5×2) (2×2 + 3×3 + 5×1 + 6×2) (4×2 + 5×3 +7×1 +8×2) (5×2 + 6×3 +8×1 + 9×2)]

[(1×2 + 2×3 + 4×1 + 5×2) (4×2 + 5×3 + 7×1 + 8×2) (2×2 + 3×3 + 5×1 + 6×2) (5×2 + 6×3 + 8×1 + 9×2)]

= [(2 + 6 + 4 + 10) (4 + 9 + 5 + 12) (8 + 15 + 7 + 16) (10 + 18 + 8 + 18)] [(2 + 6 + 4 + 10) (8 + 15 + 7 + 16) (4 + 9 + 5 + 12) (10 + 18 + 8 + 18)]

= [22304054][22403054]

Case-Based/HOTS Questions

Ans 1. (*a*) Two main tasks:

- **Object Detection** — identifying and locating floating waste items on the river surface with bounding boxes.
- **Image Segmentation/Level Estimation** — measuring water levels by segmenting the water boundary against the safety mark on the bridge.

(*b*) • Apply **image preprocessing techniques**.

• Use **multi-camera angles** or **infrared/thermal sensors** to cross-verify detections before triggering alerts.

(*c*)
- **Cleaner rivers & healthier ecosystems** — prompt waste removal prevents pollution, protects aquatic life, and reduces disease.
- **Flood safety** — real-time water-level alerts help authorities evacuate citizens during monsoons.
- **Reduced manual labor & cost-efficiency** — cleaning teams are deployed only when needed.
- Supports **SDG 6 (Clean Water), SDG 11 (Sustainable Cities)**, and **SDG 13 (Climate Action)**.

Ans 2. (*a*) **Evaluation (Testing) stage** — the model has already been trained and students are now *testing it in real-world field conditions* and analyzing misclassifications (wet leaves being called diseased). This may also loop back to the **Modelling** and **Data Acquisition** stages for improvement.

(*b*) **Expand and diversify the training dataset** — include images of leaves under various real-world conditions: **wet, dry, shaded, sunny, dusty, morning dew and different growth stages**.

(*c*)
- **Early pest detection** reduces crop loss and protects farmer income.
- **Targeted pesticide use** — pesticides are sprayed only on infected plants, reducing chemical overuse, soil damage and water pollution.
- **Affordable & accessible** — a mobile-based no-code tool empowers small farmers without costly equipment.
- Supports **SDG 2 (Zero Hunger)** and **SDG 12 (Responsible Consumption and Production)**.

Ans 3. (*a*) **Facial Recognition** — a biometric CV task that involves:

- **Face Detection** — locating the face in the camera frame.
- **Feature Extraction** — identifying unique facial landmarks (eye distance, jaw shape, etc.).
- **Face Matching/Verification** — comparing extracted features with stored records in a database to confirm identity.

(*b*) **Data Privacy and Consent** — storing children's facial biometric data in the cloud without explicit parental consent violates **privacy rights** and data-protection laws (like India's **DPDP Act 2023**).

Other concerns: data security risks (leaks, misuse), **lack of transparency**, and potential **surveillance overreach**.

(*c*)
- Obtain **informed written consent** from parents and students before enrolment, with an **opt-out option** (manual attendance alternative).
- Store data in **encrypted, secure local servers**, not open cloud storage.
- Follow **data minimization** — keep only what's necessary and **auto-delete** after the academic year.
- Ensure **transparency** — publish a clear privacy policy, and appoint a **data protection officer** accountable for misuse or breaches.

Ans 4. (*a*) • **Object Detection** — identifying vehicles, riders and detecting whether a helmet is worn (and locating signal violations at red lights).
• **Optical Character Recognition (OCR)** — reading and extracting alphanumeric characters from vehicle number plates.

(*b*) High resolution ensures **number plate characters and helmet details are sharp and clearly visible**, especially in **poor light, rain, fog or high-speed motion**. Low-resolution or blurry images cause **OCR misreads**, wrong challans, and false violations — damaging public trust. Good resolution improves **accuracy, fairness and legal validity** of captured evidence.

(*c*) **Social Benefit: Improved road safety** — automated enforcement deters traffic violations (signal jumping, helmetless riding), reduces accidents, saves lives and ensures **fair, corruption-free challans** without human bias.

Possible Risk: Wrongful penalties due to misreads in poor conditions (rain, glare, dirty plates) — innocent drivers face unfair fines. Additional risks include **mass surveillance concerns, privacy issues**, and **accountability gaps** when contesting AI-issued challans.

Ans 5. (*a*) **Image Segmentation** (specifically **semantic/pixel-level segmentation**) — the image is divided into regions based on **pixel color intensity, texture and saturation**, isolating faded or damaged patches from intact areas. Supporting concepts include **feature extraction** (edges, color histograms) and **pixel-wise analysis**.

(*b*) **SDG 11 Target 11.4** calls for **"strengthening efforts to protect and safeguard the world's cultural and natural heritage."** This AI system:
• **Preserves heritage non-invasively** — no physical contact with fragile artwork.
• Creates **digital archives** accessible to future generations and global researchers.
• Enables **accurate, data-driven restoration**, extending the life of cultural treasures.
• Promotes **cultural tourism** and pride in community heritage.

(*c*) • **Consent & ownership rights** — obtain permission from museums, artists' descendants, or indigenous communities; respect cultural sensitivities.
• **Data security** — protect high-resolution images from unauthorized use, forgery or illegal reproduction.
• **Authenticity & integrity** — AI recommendations must be reviewed by **human art experts and conservators** before any physical restoration; AI should *assist*, not *replace*, traditional expertise.
• **Transparency** — clearly document what was restored digitally vs physically, and credit original creators to preserve historical authenticity.

Image-Based Questions

Ans 1. The technique shown is **Object Detection**. It involves identifying and locating objects within an image, such as pedestrians, cars and traffic lights.

Ans 2. The technique shown is **Semantic Segmentation**. It involves classifying each pixel in the image into a category, like road, car or person.

Ans 3. First image shows **Semantic Segmentation**, where each object is labelled with a different color. The second image shows **Object Detection**, where objects are identified and enclosed in bounding boxes.

CHAPTER 6: Natural Language Processing

Unsolved Questions

Short Answer Type Questions

Ans 1. Lexical analysis breaks text into tokens, like words or phrases, to understand structure. For example: 'The cat sat' becomes tokens 'The', 'cat', 'sat'.

Ans 2. NLP analyzes email content for spam patterns using text classification, filtering unwanted emails by identifying keywords and linguistic features associated with spam.

Ans 3. Semantic analysis focuses on word meaning, like 'bank' as a financial institution. Pragmatic analysis considers context, interpreting 'Can you pass the salt?' as a request.

Ans 4. Sentiment analysis gauges review sentiment; machine translation converts languages; chatbots understand queries for support; speech recognition turns speech into text in virtual assistants.

Ans 5. Tokenization splits text into smaller units, like words, enabling parsing and analysis. It is crucial for understanding and processing language in NLP tasks.

Ans 6.

Scripted Chatbots	Smart Chatbots
(*i*) Based on pre-written instructions	NLP-based technique
(*ii*) Easy to create	Difficult to create
(*iii*) Limited functionalities	Wide functionalities
(*iv*) *Example:* Interactive voice response system used in customer care services	*Example:* Google Assistant, Siri, Alexa, etc.

Ans 7. The challenges faced by computers in understanding human language are mentioned below:

(*i*) There are thousands of languages.

(*ii*) There are multiple meanings of words. For example, 'bat' could indicate a cricket bat or a flying bat.

(*iii*) Sometimes, there is perfect syntax but no meaning, *e.g.*, 'The purple elephant flew over the rainbow and ate a shoe.'

(*iv*) It is difficult to understand idioms and phrases, *e.g.*, 'raining cats and dogs' does not mean animals are falling from the sky.

(*v*) No standard arrangement of words and meanings. In English, the word order is typically subject-verb-object (SVO). For example, 'The cat chased the mouse', but in Japanese, the word order is subject-object-verb (SOV), so the same sentence would be 'The cat the mouse chased.'

Ans 8. A few examples of popular NLP applications in our daily lives are:

(*i*) **Sentiment Analysis:** It is used to analyze sentiments in social media posts, customer reviews or feedback.

(*ii*) **Voice Assistants:** Voice assistants like Siri, Alexa, Cortana or Google Assistant rely heavily on NLP to understand and respond to our voice commands.

(*iii*) **Email Spam Filtering:** NLP plays a crucial role in email services by identifying and filtering out spam messages.

(*iv*) **Language Translation:** It is used to translate an English (one language) sentence like 'Hello, how are you?' into Spanish (or any other language).

(*v*) **Text Summarization:** For example, news aggregation websites often use NLP- based summarization to provide brief overviews of news articles.

Ans 9. The steps involved in text normalization are:

(*i*) Sentence Segmentation
(*ii*) Tokenization
(*iii*) Removal of Punctuation
(*iv*) Stop words removal
(*v*) Lowercasing
(*vi*) Lemmatization and Stemming
(*vii*) Part-of-Speech
(*viii*) Named Entity Recognition (NER)
(*ix*) Sentiment Analysis
(*x*) Bag of Words

Ans 10. (*i*) **Corpus:** A corpus is a structured and organized dataset that contains a wide variety of written texts from different sources and genres, such as books, articles, websites, social media posts, news articles and more.

(*ii*) **Tokens:** Tokens are individual words obtained after the breaking down of sentence during the tokenization process.

(*iii*) **Stopwords:** Stopwords are commonly used words which occur very frequently and do not contribute much to the overall meaning of a text, such as 'a', 'the', 'is', etc.

Ans 11.

	Lemmatization	**Stemming**
(*i*)	Lemmatization converts words to their dictionary form (lemma) by removing affixes.	Stemming involves the removal of affixes (word endings) to create a root form.
(*ii*)	Results in a meaningful and valid word in the language.	The resulting root form may or may not be a meaningful word.
(*iii*)	Uses lemmatize() method.	Uses stem() method.
(*iv*)	Example: 'Natural' remains 'Natural'.	Example: 'Natural' becomes 'Natur'.

Ans 12. Tokenization is done with the help of tokenize().

Numeric Character: Numeric characters, such as digits or numbers, can be removed or replaced with a placeholder.

Special Character: Symbols or non-alphanumeric characters are removed or replaced. This step eliminates unwanted symbols that may not contribute to the overall meaning or analysis of the text.

Ans 13. Bag of Words is an approach in NLP in which a document is treated as an unordered collection or 'bag' of words, disregarding grammar and word order but maintaining information about word frequency.

To understand how Bag of Words simplifies text data, consider the following two sentences:

'I love ice cream.'

'Ice cream is delicious.'

For the Bag of Words representation, we put all the unique words in these sentences into a bag, without paying attention to their order:

Bag of Words: ['I', 'love', 'ice', 'cream', 'is', 'delicious']

Now, we represent each sentence as a list of 0s and 1s, where 1 indicates the presence of a word in the sentence and 0 indicates its absence:

'I love ice cream.' → [1, 1, 1, 1, 0, 0]

'Ice cream is delicious.' → [0, 0, 1, 1, 1, 1]

Ans 14. TF-IDF stands for Term Frequency-Inverse Document Frequency. TF-IDF process includes calculating the significance of a term in a document compared to a collection of documents (corpus). This process involves transforming words in a text document into important values using text vectorization. Also, TF-IDF assigns a score to a word by multiplying its Term Frequency (TF) with the Inverse Document Frequency (IDF).

Term Frequency (TF) measures how frequently a term appears in a document relative to the total number of words in that document.

$$TF = \frac{\text{Number of times the term appears in a document}}{\text{Total number of words in the document}}$$

Document Frequency (IDF) is a metric that shows how many documents in the corpus contain a particular term. Words that are rare and found in only a small portion of documents receive higher importance values compared to words that are common and present in all documents (like 'a', 'the' and 'and').

$$IDF = \log \frac{\text{(Total number of documents in the corpus)}}{\text{Number of documents in the corpus containing the term}}$$

The TF-IDF of a term is calculated by multiplying TF and IDF scores.

TF-IDF = TF * IDF

Ans 15. NLTK is a popular Python library for NLP that provides a wide range of tools and functionalities to aid in data processing. NLTK simplifies and automates many tedious and complex tasks involved in NLP, making it easier for developers and researchers to work with text data. Some commonly used features of NLTK library include sentiment analysis, named entity recognition, tokenization, part-of-speech, text normalization, corpora and resources.

Ans 16. Modern AI assistants like **Gemini 1.5** and **ChatGPT-4o** use **Computer Vision** to understand images (objects, text, scenes) and **NLP** to understand the user's written or spoken question. They combine both to give smart answers. *Example:* Upload a plant photo and ask "*Is it healthy?*" — the assistant sees the leaves and replies in simple language.

Long Answer Type Questions

Ans 1. Part-of-Speech (POS) tagging is a process in NLP that labels each word in a sentence with its grammatical category or part of speech, such as noun, verb, adjective, etc. This helps computers understand the function of each word in the context of the sentence.

Example sentence: 'The quick brown fox jumps over the lazy dog.'

Output: [('The', 'DT'), ('quick', 'JJ'), ('brown', 'NN'), ('fox', 'NN'), ('jumps', 'VBZ'), ('over', 'IN'), ('the', 'DT'), ('lazy', 'JJ'), ('dog', 'NN'), ('.', '.')]

Explanation of POS tags:

'The' is a determiner (DT), 'quick' is an adjective (JJ), 'brown' is a noun (NN), 'fox' is a noun (NN), 'jumps' is a verb (VBZ), 'over' is a preposition (IN), 'the' is a determiner (DT), 'lazy' is an adjective (JJ), 'dog' is a noun (NN).

'.' is a punctuation mark indicating the end of the sentence.

Ans 2. NER stands for Named Entity Recognition. It is an NLP technique used to identify and classify named entities in the text, such as names of people, organizations, locations, dates and other specific entities. NER helps computers understand the important entities mentioned in a text and extract meaningful information from it.

For recognizing name, NER uses tokenization, Parts-of-Speech (POS) and categorization techniques.

Example sentence: 'Narendra Modi, the Prime Minister of India, addressed the nation on Independence Day, which is celebrated on August 15 every year.' Now, if we write the code using Python, it will give the output as shown below:

Output:

(PERSON Narendra/NNP) (GPE Modi/NNP)

(GPE India/NNP)

(GPE Independence/NNP)

Ans 3. NLP is used to analyze sentiment in social media posts, customer reviews or feedback. Companies often employ sentiment analysis to understand public opinion about their products or services. Thus, the importance of sentiment analysis lies in its ability to classify text as positive, negative or neutral, indicating the writer's feelings or opinions about a particular subject.

For instance, if someone tweets, 'I love this new video game! The graphics are amazing,' sentiment analysis algorithms can recognize the positive sentiment and help companies to see how people feel about their products.

The Sentiment Intensity Analyzer analyzes the sentiment behind the text by calculating a sentiment score ranging from –1 (very negative) to +1 (very positive). For example, if the sentiment score is 0.9152, it indicates a positive sentiment. The 'Sentiment Label' is then set to 'Positive' because the sentiment score is greater than or equal to 0.05.

Ans 4. TF-IDF is a valuable tool in search engine algorithms, allowing them to weigh the importance of terms within documents and across the entire corpus. This helps to improve the relevance of search results by prioritizing documents that contain terms that are both frequently used within a document and unique or rare across the entire collection.

Ans 5. Inverse Document Frequency (IDF) addresses the issue of common terms that appear frequently across many documents, helping to highlight words that are distinctive and informative. The impact of IDF on word importance is given below:

(*i*) **Addressing common terms:** IDF assigns lower scores to common words like 'and', 'the', 'is', etc.

(*ii*) **Sealing down impact:** By sealing down the impact of high term frequency, IDF helps to emphasize the importance of terms that are rare across the document.

(*iii*) **Enhancing relevance:** TF-IDF helps to identify documents that are more likely to be pertinent to a user's information needs.

Ans 6. To calculate the TF-IDF, the below-given steps are to be followed:

Step 1: Term Frequency (TF)

We count how often each word appears in each document, as shown below:

Document	I	love	to	read	books	are	a	great	source	of	knowledge	reading	is	my	favourite	hobby
1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	0
3	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	1
Total	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1

Step 2: Inverse Document Frequency (IDF)

We calculate the uniqueness of each word across all documents. The formula for IDF (Inverse Document Frequency) is calculated as follows:

$$IDF = \log_{10}\left(\frac{N}{DF}\right)$$

Where,

N is the total number of documents in the collection.

DF is the number of documents that contain a specific word (term).

In the given example, N=3.

Let us calculate IDF.

Only the term 'book' appears thrice in all the three documents. Therefore,

IDF = log10(3/3) = 0

Rest of the terms appear once.

Therefore, IDF = log10(3/1) = 0.48 (approximately)

Step 3: TF-IDF

Finally, we combine TF and IDF to get the TF-IDF score for each word in each document.

For Document 1:

TF-IDF for 'I' = 1 * 0.18 = 0.18

TF-IDF for 'love' = 1 * 0.48 = 0.48

TF-IDF for 'to' = 1 * 0.48 = 0.48

TF-IDF for 'read' = 1 * 0.48 = 0.48

TF-IDF for 'books' = 3 * 0 = 0

For Document 2:

TF-IDF for 'books' = 3 * 0 = 0

TF-IDF for 'are' = 1 * 0.48 = 0.48

TF-IDF for 'a' = 1 * 0.48 = 0.48

TF-IDF for 'great' = 1 * 0.48 = 0.48

TF-IDF for 'source' = 1 * 0.48 = 0.48

TF-IDF for 'of' = 1 * 0.48 = 0.48

TF-IDF for 'knowledge' = 1 * 0.48 = 0.48

For Document 3:

TF-IDF for 'reading' = 1 * 0.48 = 0.48

TF-IDF for 'books' = 1 * 0 = 0

TF-IDF for 'is' = 1 * 0.48 = 0.48

TF-IDF for 'my' = 1 * 0.48 = 0.48

TF-IDF for 'favourite' = 1 * 0.48 = 0.48

TF-IDF for 'hobby' = 1 * 0.48 = 0.48

A lower TF-IDF score suggests that the term 'books' may not be unique or important in the document because it is common or frequently occurring.

Ans 7. The Word Cloud widget in Orange Data Mining is a visualization tool that helps analyze text data by displaying the most frequently occurring words in a dataset. Large words indicate higher frequency, making it easier to identify key terms and themes in a text corpus. This widget is useful for exploring unstructured text data,

understanding topic trends and performing preliminary analysis before deeper NLP tasks. For example, when analyzing customer reviews, Word Cloud may highlight words like 'great', 'poor' or 'service', giving quick insights into the overall sentiment and recurring discussion points.

Ans 8. Performing sentiment analysis in Orange Data Mining involves the following steps:

(*i*) **Data Import:** Load the dataset containing tweets using the Corpus widget.

(*ii*) **Preprocessing:** Use Text Preprocessing to remove stop words, lowercase text, and filter unnecessary symbols.

(*iii*) **Feature Extraction:** Convert text into numerical representations using TF-IDF or Word Embeddings.

(*iv*) **Model Selection:** Use classification models such as Naïve Bayes, Logistic Regression or Neural Networks to classify sentiment.

(*v*) **Evaluation:** Assess model performance using Confusion Matrix and metrics like accuracy and F1 Score.

(*vi*) **Visualization:** Use Word Cloud and Sentiment Distribution graphs to interpret results.

This process helps classify tweets as positive, negative or neutral, providing insights into public opinion.

Ans 9. No-Code NLP Tools vs Code-based NLP Libraries

Feature	No-Code Tools (*e.g.*, Orange Data Mining)	Code-based Libraries (*e.g.*, spaCy, NLTK)
(*i*) Ease of Use	Drag-and-drop interface does not require programming knowledge	Requires coding skills (Python), setup and scripting
(*ii*) Flexibility	Limited customization, mainly pre-built components	Highly customizable with deep control over NLP tasks
(*iii*) Speed and Performance	User-friendly but may prove slower for large datasets	Faster processing with optimized algorithms, especially in spaCy
(*iv*) Supported Tasks	Basic NLP tasks like tokenization, sentiment analysis and word clouds.	Advanced NLP tasks such as named entity recognition (NER), dependency parsing and custom model training
(*v*) Machine Learning Integration	Provides built-in models but limited fine-tuning	Allows full control over training custom ML models for NLP
(*vi*) Use Case Suitability	Ideal for beginners, educators and quick exploratory analysis	Preferred for research, industry applications and production-level NLP systems

Case-Based/HOTS Questions

Ans 1. (*a*) **VADER (Valence Aware Dictionary and Sentiment Reasoner)** is a **rule-based, lexicon-driven** sentiment analyzer — it scores words based on a predefined positivity/negativity dictionary (*e.g.*, "loved" = +positive). It doesn't understand **context, tone or intent**. Since VADER lacks **contextual understanding** and cannot detect tonal cues, it misreads sarcasm as genuine praise.

(*b*) • **Supplement VADER with a context-aware ML model** like **BERT, RoBERTa, or a fine-tuned transformer** trained specifically on **sarcastic and ironic text**.
- Build a **labelled sarcasm dataset** with local student expressions (Hinglish, school slang) for retraining.
- Use **ensemble models** combining rule-based VADER with deep-learning classifiers for better accuracy.

(*c*) • **Evaluation metrics** — accuracy, precision, recall and **F1-score** on a separate test set (not seen during training).
- **Bias and fairness audit** — ensure the model works equally well across genders, grades, and Hinglish variations.
- **Confusion matrix analysis** to verify sarcasm is now correctly classified.
- **Real-world pilot testing** with fresh student feedback before full rollout.
- **Data privacy check** — anonymize student identities to protect feedback confidentiality.

Ans 2. (*a*) **Linguistic Bias/Language Inequity** — the chatbot provides **unequal quality of service** based on the user's language. This violates core ethical principles of **fairness, inclusivity and accessibility**. Rural Hindi-speaking students (often from less privileged backgrounds) receive inferior career guidance, which can worsen the **digital and opportunity divide**. It also reflects **data bias** — the training dataset had far more English content than Hindi.

(*b*) • **Expand the Hindi training dataset** — include high-quality, detailed career-guidance content in Hindi (translated and natively written).
- Use **multilingual models**.
- Employ **bilingual domain experts** to review and enrich Hindi responses for depth and accuracy.
- **Regular fairness audits** — test response quality parity between languages.
- Add **Hinglish support** to match real rural communication patterns.

(*c*) Primarily **SDG 4 — Quality Education** (ensuring inclusive, equitable education and lifelong learning opportunities for all).

Also supports:
- **SDG 10 — Reduced Inequalities** (bridging the rural-urban and linguistic divide).
- **SDG 8 — Decent Work and Economic Growth** (equal career access).

Ans 3. (*a*) NLP helps the chatbot send **friendly, human-like reminders** to switch off lights and fans. It also **rephrases motivational messages every week** so that they stay fresh and engaging. This encourages employees to save energy every day, leading to a **15% drop in energy use** — supporting **SDG 7 (Clean Energy)** and **SDG 13 (Climate Action)**.

(*b*) • **Transparency & Consent:** Publish a clear **privacy policy** explaining what data is collected, how it is used, and who has access. Obtain **informed employee consent**.
- **Data Minimization:** Collect only what's necessary for energy reminders (*e.g.*, work hours), **not personal message content**.
- **Anonymization & Encryption** of any logged data.
- **Opt-out option** for employees who decline.
- Establish an **accountability mechanism** (designated privacy officer, grievance redressal).

(*c*) Ethical and privacy checks span **multiple stages**, but most prominently:

- **Problem Scoping** — defining ethical boundaries and stakeholder impact.
- **Evaluation stage** — auditing the system for bias, privacy compliance and fairness before deployment.
- **Deployment stage** — implementing consent mechanisms, privacy policies and monitoring frameworks in production.

Ans 4. (*a*) **Code-mixing and inconsistent tokenization** — Hinglish blends two languages (*e.g., 'Paani nahi aaya today morning, please fix karo'*), and common preprocessing tasks break down:

- **Spelling inconsistencies** — "paani/pani", "nahi/nhi/nai".
- **No standard grammar or dictionary** — traditional tokenizers, stemmers and stop word lists fail.
- **Script mixing** — some words in Roman, others in Devanagari.
- **Morphological variations** — same word has many forms. This makes **feature extraction and vectorization (TF-IDF, embeddings)** unreliable.

(*b*)
- **Use Hinglish-specific NLP libraries**.
- Apply **transliteration normalization** — convert variants ("nahi", "nhi", "nai") to a standard form.
- **Train on a local Hinglish dataset** with labelled community messages.
- Use **multilingual embeddings**.
- Add **spell-correction and custom tokenizers** during preprocessing.

(*c*) Primarily **SDG 6 — Clean Water and Sanitation** (ensuring accessible, responsive water services for all).

Also supports:

- **SDG 11 — Sustainable Cities and Communities** (citizen-government engagement for better municipal services).
- **SDG 16 — Peace, Justice & Strong Institutions** (transparent, accountable public governance through AI-assisted feedback systems).

Ans 5. Sentiment analysis should be used. It classifies text as positive, negative or neutral by analyzing words and phrases to gauge public opinion on the product.

Ans 6. Challenges include understanding accents and context.

Solutions: Train on diverse datasets for accents and use context-aware models to improve comprehension.

Image-Based Questions

Ans 1. Tokens: 'We', 'love', 'NLP', '!'

Ans 2. POS tagging: 'I' (pronoun), 'want' (verb), 'an' (article), 'early' (adjective), 'upgrade' (noun). POS tagging helps understand sentence structure and meaning by identifying grammatical roles.

CHAPTER 7: Advanced Python

Unsolved Questions

Short Answer Type Questions

Ans 1. Jupyter Notebook is an open-source, web-based interactive computing platform that helps us write, run and understand Python code in an interactive and visual way. It is like having a virtual notebook where we can write our code, annotate it with explanatory text, execute it and analyze the results all in one place.

Jupyter Notebook facilitates interactive platform and data analysis. The features are as follows:

(i) It allows us to break down our code into smaller parts called 'cells', where codes can be written, run and tested separately.

(ii) It gives the output of the codes written in each cell right away, which allows us to see if our code is working as expected or if we need to fix something.

(iii) It offers popular libraries and frameworks used in AI such as NumPy, Pandas, Matplotlib and TensorFlow. These libraries help us perform complex data manipulations, visualize data and implement advanced machine learning algorithms.

(iv) Jupyter Notebook enables us to easily analyze and visualize data by creating graphs and charts to understand patterns and trends in data. This helps us gain insights and make better decisions based on the information we have.

Ans 2. Comments are lines of code that are ignored by the Python interpreter. They are used to add explanations or notes to the code, also known as code documentation for better understanding by humans. Comments play a crucial role in improving code readability, making it easier for programmers to understand and maintain the code over time.

There are two ways to write comments in Python code:

Single-line comments: Single-line comments are used to comment on a single line of code. Anything written after the '#' symbol on the same line is considered a comment and is not executed by the interpreter.

Multi-line comments: Multi-line comments are used to comment on multiple lines of code. They are enclosed between triple quotation marks (either single or double quotes) and can span across multiple lines.

Ans 3. The input() function in Python is used to accept input from the user. It displays a prompt or message to the user, waits for the user to enter data from the keyboard and then returns the entered data as a string. The entered data can be stored in a variable for further processing or can be used directly in the program.

The print() function is used to display output or results to the user. It takes one or more arguments, which can be strings, variables or expressions, and prints them to the console or standard output. The output can include text, values of variables or any other information that needs to be shown to the user. The print() function in Python can combine different data types.

Ans 4. In Python, a variable is a named location in memory that stores a value. It acts as a container that allows us to store and manipulate data during the execution of a program. Variables are dynamic, meaning their contents can change during program execution.

Examples of different data types are:

```
# integer
Adm_num = 1123
# string
```

```
Name="Aarav Nandwani"
# float
Ageinyears = 5.10
# dictionary
Height_Weight = {"Height":110.6, "Weight": 17.5}
# tuple
Subjects=("Maths", "English", "Hindi", "E.V.S", "Arts")
# list
Terms_marks=[94, 97, 91.5, 99, "A+"]
# boolean
Resultstatus = True
```

Ans 5. Mutable data types are those that can be changed or modified after they are created. The memory location of the object remains the same and only its internal contents are changed. Examples: lists, sets and dictionaries.

Immutable data types are those that cannot be changed once they are created. When you want to modify an immutable object in Python, you create a new object with a different memory location. Examples: int, float, complex, str and tuple.

Ans 6. Arithmetic operators are used to perform mathematical operations on numeric values.

Python offers seven arithmetic operators for performing all kinds of calculations. For the given example, consider two variables x = 5 and y = 2.

Operation	Result	Description
(*i*) Addition (x + y)	x + y # 7	Returns the sum of x and y
(*ii*) Subtraction (x – y)	x – y # 3	Returns the difference between x and y
(*iii*) Multiplication (x * y)	x * y # 10	Returns the product of x and y
(*iv*) Division (x / y)	x / y # 2.5	Returns the quotient of x divided by y
(*v*) Modulus (x % y)	x % y # 1	Returns the remainder of x divided by y
(*vi*) Exponentiation (x ** y)	x ** y # 25	Returns x raised to the power of y
(*vii*) Floor Division (x // y)	x // y # 2	Returns the integer part of the division of x by y

Ans 7. A variable is a named location in memory that stores a value. It acts as a container that allows us to store and manipulate data during the execution of a program.

Example:

```
Weight = 58.5
Age = 20
```

In the above example, the variable 'Weight' is float type whereas the variable 'Age' is integer type.

Ans 8. In Python, the id() function is used to find the unique identifier of an object and the type() function is used to determine the data type of the variable.

Ans 9. Type conversion, also known as type casting, is the process of changing the data type of the value stored in a variable from one type to another.

There are two kinds of type conversions in Python as explained below:

(*i*) **Implicit Type Conversion (Automatic Conversion)**

This type of conversion happens automatically when Python can figure out how to convert one type to another. For example, if we add an integer and a float, Python automatically converts the integer to a float before doing the addition.

```
x = 5
y = 2.5 # see that x is integer but y is a float
z = x + y # Implicitly converts x to a float before addition print(z)
# Output: 7.5 which is float
```

(*ii*) **Explicit Type Conversion (Type Casting)**

This type of conversion is performed explicitly by the programmer using predefined functions. It allows us to convert one data type to another as per our requirement. In type casting, we intentionally tell Python to convert a value from one type to another using specific functions or techniques. For example, we can convert a number into a string using the str() function. Consider the code snippet below as an illustration:

```
x = 10
y = float(x) # Converts x to a float
z = int(y) # Converts y to an integer print(x, y, z)
10 10.0 10
```

Ans 10. Here are certain rules for naming identifiers:

(*i*) Identifiers can contain letters (both lowercase and uppercase), digits (1,2,3…) and underscores (_). However, they must start with a letter or an underscore. Special characters and spaces are not allowed.

(*ii*) Python is a case-sensitive language so if two identifiers differ only in case, they are considered different. For example, 'myVar' and 'myvar' are distinct identifiers.

(*iii*) Identifiers cannot have the same names as Python keywords as they are already predefined and have special meanings in the language.

(*iv*) Identifiers can be of any length but it is always better to keep them short and meaningful.

Ans 11.

List	Tuple
(*i*) Lists are mutable and allow modification of their elements.	Tuples are immutable, which means their elements cannot be changed after creation.
(*ii*) Lists are defined using square brackets '[]'.	Tuples are defined using parentheses '()'.
(*iii*) Lists take more memory space as the size is not fixed.	Tuples take less memory space as the size is fixed.
(*iv*) Example: Subjects = ('Quantum Physics', 'Classical Mechanics', 'Astrophysics'). Here, subjects are fixed and cannot be changed.	Example: Subjects = ['Physics', 'Maths', 'Electronics', 'Optional']. Here, optional subject can be changed.

Ans 12. Python offers the following list functions:

(*i*) **list():** to create an empty list

(*ii*) **append():** to add a new element at the end of the list

(*iii*) **extend():** to add a new list at the end of the existing list

(*iv*) **insert():** to add a new element at a specific index of the list

(*v*) **pop():** to remove an element from a specific index in the list

(*vi*) **len():** to return the number of elements in a sequence

Long Answer Type Questions

Ans 1. The slicing operation allows us to extract a portion of a list by specifying a range of indices. The syntax for slicing a list is:

list[start:end:step]

Where,

- start is the index to start slicing (inclusive)
- end is the index to end slicing (exclusive)
- step is the increment between indices (optional)

Consider the code snippet below:

```
fruits = ['kiwi', 'pineapple', 'pear', 'mango']
# Slicing a list
print(fruits[1:3])'''It extracts a portion of the list of fruits starting from index 1 (inclusive) up to index 3 (exclusive) ''' print(fruits[:2]) '''the starting index is missing, so by default, the slice starts from the beginning of the list and goes up to index
2 (exclusive)'''
print(fruits[2:]) '''slicing starts from index 2 and includes all the remaining elements till the end of the list'''
['pineapple', 'pear']
['kiwi', 'pineapple']
['pear', 'mango']
```

Ans 2. The range() function is used to iterate over a sequence of numbers.

Here is an example of using the range() function with a tuple in a *for* loop:

```
colors = ('red', 'blue', 'green')
for i in range(len(colors)):
print(colours[i]) red
blue
green
```

Ans 3. Conditional Statements allow the program to make decisions and choose different paths of execution based on the evaluation of these conditions.

In Python, there are three common selection control flow structures: *if, if-else* and *if-elif-else*.

```
Syntax:
if condition1:
# code block executed if condition1 is true elif
condition2:
# code block executed if condition2 is true and condition1 is false
else
# code block executed if both condition1 and condition2 are false
```

For example,

```
if num>0
    print("positive number")
elif num==0:
    print("zero")
else:
    print("negative number")
```

Ans 4. Iteration is a process of repeating a set of instructions or a block of code multiple times. Iteration is useful when we want to process a large amount of data, perform repetitive tasks or work with patterns.

In programming, iteration is achieved using loops. Loops provide a way to repeatedly execute a block of code until a specific condition is met. By controlling the loop condition and the statements within the loop, we can control the flow of execution and repeat the desired set of instructions.

In Python, there are *for* loop and *while* loop.

(*i*) `for` loop — `for` loop in Python is used to iterate over a sequence of elements, such as a list, tuple, string or range. It allows us to perform a set of instructions for each item in the sequence.

Example:

```
numbers = (1, 2, 3, 4, 5)
for i in numbers:
    print (i)
1
2
3
4
5
```

(*ii*) `while` loop — `while` loop is useful when we want to repeat a block of code until a specific condition becomes false. It allows us to create loops with more flexible termination conditions compared to `for` loops, which are based on iterating over a predefined sequence.

`while` loops are particularly useful when the exact number of iterations is not known beforehand and depends on certain conditions or input values.

Example:

```
count = 0
while count < 5:
    print("Count:", count)
    count =+ 1
Count: 0
Count: 1
Count: 2
Count: 3
Count: 4
```

Ans 5. The importance of libraries and packages in Python are given below:

(*i*) Libraries and packages save time and effort. Instead of writing all the code from scratch, we can use the existing libraries and packages to solve common problems.

(*ii*) They make it easier to manage big projects with lots of code.

(*iii*) They also help us work together and share our code with others.

A few popular libraries that are used for data analysis, machine learning and web development are:

(*i*) NumPy

(*ii*) Pandas

(*iii*) NLTK

(*iv*) Matplotlib

(*v*) OpenCV

Ans 6. NumPy is a fundamental package for scientific computing in Python. It provides powerful array objects, mathematical functions, linear algebra operations and tools for working with large datasets and, hence, NumPy is widely used in fields such as data analysis, machine learning and numerical computations.

Ans 7. Pandas is a Python library that helps us work with data easily. Pandas library in Python is used for the following:

(*i*) Reading, writing and transforming data

(*ii*) Finding patterns from large volumes of data

(*iii*) Creating visualization for better insights

Ans 8. Matplotlib is a plotting library that enables the creation of various types of visualizations in Python. It provides a wide range of plotting functions and options to create line plots, scatter plots, bar plots, histograms and more. Matplotlib is highly customizable, allowing users to create visually appealing and informative plots for data exploration and presentation.

Write the output of the following codes:

Ans 1.
```
print(3 + 2)
```
Output: `5`

Ans 2.
```
print("Hello" + "World")
```
Output: `HelloWorld`

Ans 3.
```
print(5 / 2)
```
Output: `2.5`

Ans 4.
```
print(10 // 3)
```
Output: `3`

Ans 5.
```
print(2 ** 3)
```
Output: `8`

Ans 6.
```
print(7 % 3)
```
Output: `1`

Ans 7.
```
name = "John"
print("Hello, " + name + "!")
```
Output: `Hello, John!`

Ans 8.
```
numbers = [1, 2, 3]
print(numbers[1])
```
Output: `2`

Ans 9.
```
languages = ["Python", "Java", "C++"]
languages.append("JavaScript")
print(languages)
```
Output: `['Python', 'Java', 'C++', 'JavaScript']`

Ans 10.
```
languages = ["Python", "Java", "C++", "JavaScript"]
del languages [2]
print(languages)
```
Output: `['Python', 'Java', 'JavaScript']`

Lab Activity

Ans 1.
```
# Program 1: Personalized Greeting
name = input("Enter your name: ")
age = int(input("Enter your age: "))
print(f"\nHello {name}! ")
print(f"Welcome! You are {age} years old.")
print(f"It's great to meet you, {name}. Wishing you a wonderful
day ahead!")
```

Ans 2.
```
num1 = float(input("Enter first number: "))
num2 = float(input("Enter second number: "))
print("\nChoose Operation:")
print("1. Addition 2. Subtraction 3. Multiplication 4. Division ")
choice = input("Enter your choice (1/2/3/4): ")
if choice == '1':
  print("Result =", num1 + num2)
elif choice == '2':
  print("Result =", num1 - num2)
elif choice == '3':
  print("Result =", num1 * num2)
elif choice == '4':
  if num2 != 0:
    print("Result =", num1 / num2)
  else:
    print("Error: Division by zero is not allowed.")
else:
  print("Invalid Choice!")
```

Ans 3.
```
print("=== Temperature Converter ===")
print("1. Celsius to Fahrenheit")
print("2. Fahrenheit to Celsius")
choice = int(input("\nEnter your choice (1 or 2): "))
temp = float(input("Enter the temperature value: "))
if choice == 1:
  fahrenheit = (temp * 9/5) + 32
  print(f"\n{temp}°C = {fahrenheit:.2f}°F")
elif choice == 2:
  celsius = (temp - 32) * 5/9
  print(f"\n{temp}°F = {celsius:.2f}°C")
else:
  print("Invalid choice! Please enter 1 or 2.")
```

Ans 4.
```
n = int(input("How many numbers do you want to enter? "))
numbers = []
for i in range(n):
  num = float(input(f"Enter number {i+1}: "))
  numbers.append(num)
```

```
# Method 1: Using built-in max() function
largest = max(numbers)
print(f"\nList entered: {numbers}")
print(f"Largest element (using max): {largest}")
# Method 2: Using a loop (manual approach)
largest_manual = numbers[0]
for num in numbers:
  if num > largest_manual:
    largest_manual = num
print(f"Largest element (using loop): {largest_manual}")
```

Ans 5.
```
n = int(input("Enter the number of rows for the pyramid: "))
print("\nPyramid Pattern:\n")
for i in range(1, n + 1):
  # Print spaces for alignment
  print(" " * (n - i), end="")
  # Print asterisks (2i - 1 stars in row i)
  print("* " * i)
```

Python Programs for Self-Assessment:

Ans 1. Program to calculate the area of a rectangle.

Code:
```
# area of rectangle
length= int(input("Enter length of rectangle"))
breadth= int(input("Enter breadth of rectangle"))
area= length * breadth
print("Area of rectangle: ", area, sq unit)
```

Ans 2. Program to find the sum of all elements in a list.

Code:
```
List= [1,3,5,5,6]
Sum= sum(List)
print("Sum of all elements of the List: ",Sum)
```

Ans 3. Program to check if a number is prime or not.

Code:
```
num= int(input("Enter a number that is to be checked "))
# If given number is greater than 1
if num > 1:
# Iterate from 2 to n / 2
     for I in range(2, int(num/2)+1):
# If num is divisible by any number between
# 2 and n / 2, it is not prime
         if (num % i) == 0:
             print(num,"is not a prime number")
             break
         else:
             print(num,"is a prime number")
else:
      print(num,"is not a prime number")
```

Ans 4. Program to convert Celsius to Fahrenheit.

Code:
```
C=float(input("Enter temperature in Celsius: "))
# formula to calculate temperature in Fahrenheit
F = (9/5 * C) + 32
print("Temperature in Fahrenheit: ", F)
```

Ans 5. Program to calculate the factorial of a number.

Code:
```
num=int(input("Enter a number"))
factorial=1
for i in range(1, num+1):
   factorial=factorial * i
print("Factorial of the entered number: ", factorial)
```

Ans 6. Program to generate Fibonacci series.

Code:
```
n=int(input("Enter a number"))
a, b = 0, 1
for i in range(n):
   print(a)
   a, b = b, a + b
```

Ans 7. Program to count the number of vowels in a string.

Code:
```
s=input("Enter a sentence or a string: ")
c=0
for i in s:
   if i=="a" or i=="e" or i=="i" or i=="o" or i=="u" or
      i=="A" or i=="I" or i=="E" or i=="O" or i=="U":
      c=c+1
print("The number of vowels in the sentence: ", c)
```

Ans 8. Program to check if a year is a leap year or not.

Code:
```
year=int(input("Enter Year: "))
if year%4==0:
   print("Entered year is a Leap Year")
else:
   print("Entered year is not a Leap Year")
```

Ans 9. Program to find the largest and smallest elements in a list.

Code:
```
l=[1,2,3,4,55,111]
print("largest element: ",max(l))
print("smallest element: ",min(l))
```

Ans 10. An Armstrong number is a number that is equal to the sum of its own digits, each raised to the power of the number of digits. Write a Python program to check whether a number is an Armstrong number or not.

Code:
```
number = 371
n = number
digit, sum = 0, 0
length = len(str(n))
for i in range(length):
```

```
        digit = int(num%10)
        n = n/10
        sum += pow(digit,length)
    if sum==number:
        print("Armstrong")
    else:
        print("Not Armstrong")
```

Ans 11. Write a Python program to add the contents of two lists.

Code:
```
'''Adding the contents of lists containing two different data types
i.e., string and integers'''
place=["Goa", "Odisha", "Maharashtra"]
clientcode=[22, 66, 38]
s=place+clientcode
print(s)
```

Code Correction Problems:

Correct the following codes and mention the reason(s) for the code being incorrect.

1.
```
for = 10
print(for)
```

Sol. **Reason:** for is a reserved keyword and cannot be used as a variable.
```
f = 10
print(f)
```

2.
```
x = 5
y = '10'
result = x + y
print(result)
```

Sol. **Reason:** Quotes on an integer convert integer into string and string cannot be added to integers.
```
x = 5
y = 10
result = x + y
print(result)
```

3.
```
name = input('Enter your name:')
print('Hello' + name)
```

Sol. no error

Output:
```
Enter your name:sneha
Hellosneha
```

4.
```
my_list = [1, 2, 3]
print(my_list[3])
```

Sol. **Reason:** List index starts from 0 and, hence, this code gives error as index is out of range.
```
my_list = [1, 2, 3]
print(my_list[2])
```

5.
```
my_tuple = (1, 2, 3)
my_tuple[1] = 5
print(my_tuple)
```

Sol. **Reason:** Tuples are immutable. Hence, this code generates error. If we need to reassign or modify the elements, we may use list instead.
```
my_list = [1, 2, 3]
my_list[1] = 5
print(my_list)
```

6.
```
my_dict = {'name': 'John', 'age': 25}
print(my_dict['gender'])
```

Sol. **Reason:** There is no key name "gender" in a given dictionary.
```
my_dict = {'name': 'John', 'age': 25}
print(my_dict['age'])
```

7.
```
x = 10
if x > 5:
print('x is greater than 5')
```

Sol. **Reason:** If body requires indented block of codes.
```
x = 10
if x > 5:
print('x is greater than 5')
```

8.
```
for i in range(5):
print(i)
```

Sol. **Reason:** If body requires indented block of codes.
```
for i in range(5):
        print(i)
```

9.
```
x = 0
while x < 5:
print(x)
```

Sol. **Reason:** Infinite loop. It should terminate by giving condition or using "break" keyword.
```
x = 0
while x < 5:
print(x) break
```

10.
```
numbers = [1, 2, 3, 4, 5]
for num in numbers:
if num == 3:
break
print(num)
```

Sol. **Reason:** Missing indentation. Also to get output, the control statement "break" should be after print().
```
numbers = [1, 2, 3, 4, 5]
for num in numbers:
    if num == 3:
        break
        print(num)
```