

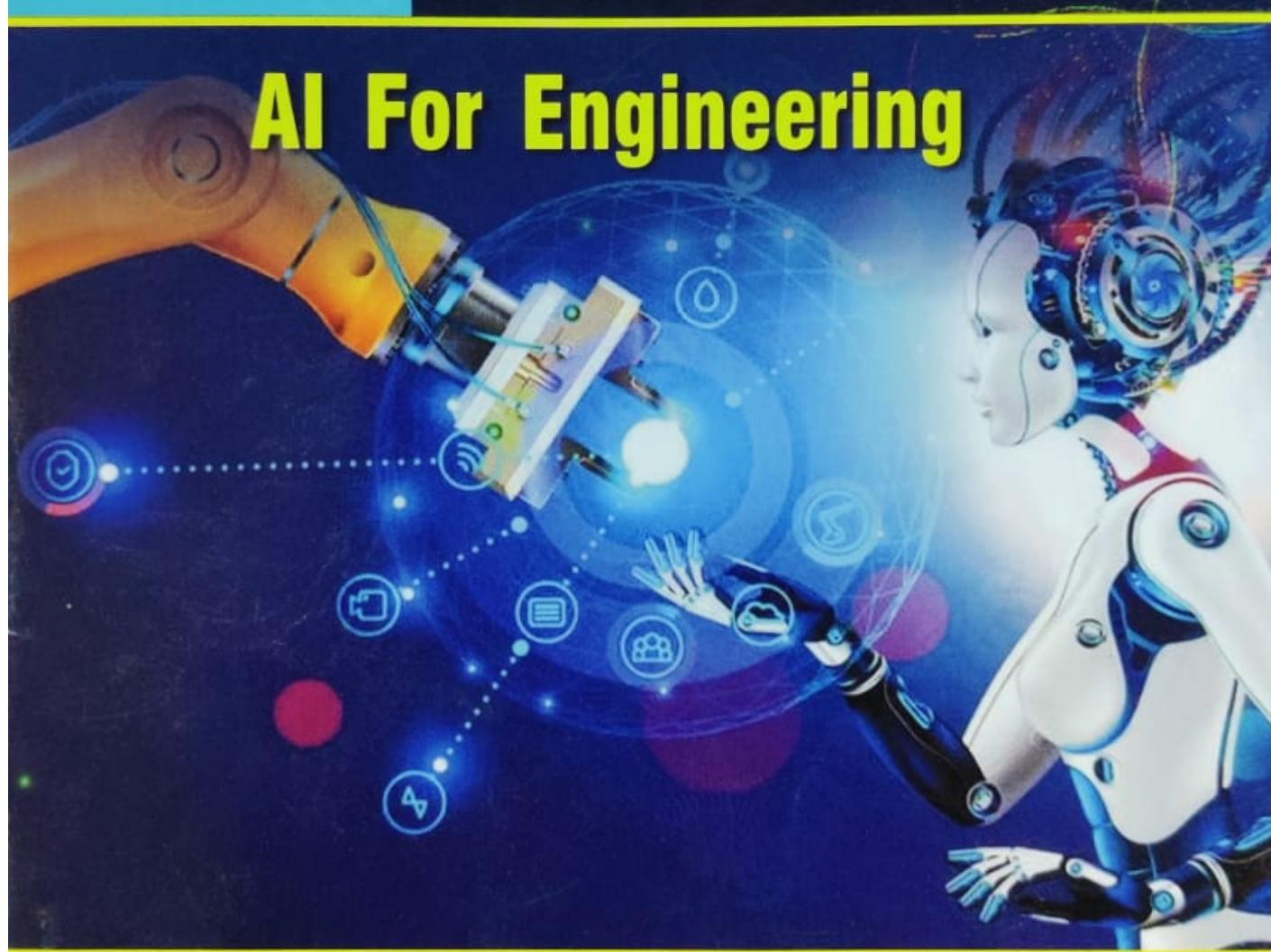


QUANTUM Series

B.Tech - 1st Year

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UNIT

An Overview to AI

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1-2 M (Sem-1 & 2)

An Overview to AI

PART-1

The Evolution of AI to the Present.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.1. What do you mean by artificial intelligence ? Define its goals.

Answer

1. Artificial Intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans.
2. AI has become an essential part of the technology industry.
3. Research associated with artificial intelligence is highly technical and specialized. The core problems of artificial intelligence include programming computers for certain traits such as:
 - i. Knowledge
 - ii. Reasoning
 - iii. Problem solving
 - iv. Perception
 - v. Learning
 - vi. Planning
 - vii. Ability to manipulate and move objects

Goals of AI :

1. **To create expert systems** : The systems which exhibit intelligent behaviour, learn, demonstrate, explain, and advice its users.
2. **To implement human intelligence in machines** : Creating systems that understand, think, learn, and behave like humans.

Que 1.2. What are the different branches of artificial intelligence ? Discuss some of the branches and progress made in their fields.

1-1 M (Sem-1 & 2)

Answer

Different branches of AI and progress made in these fields :

1. Machine Learning (ML) :

- i. ML is a method where the target is defined and the steps to reach that target are learned by the machine itself by training.
- ii. For example, to identify a simple object such as an apple or orange. The target is achieved by showing multiple pictures of object and thereby allowing the machine to define the steps to identify it like an apple or an orange.

2. Natural Language Processing (NLP) :

- i. NLP is defined as the automatic manipulation of natural language, like speech and text, by software.
- ii. For example, e-mail spam detection which has improved the mail system.

3. Vision : Machine vision captures and analyses visual information using a camera, analog-to-digital conversion, and digital signal processing.**4. Robotics :**

- i. Robotics is a field of engineering focused on the design and manufacturing of robots.
- ii. Robots are used where the tasks are difficult for humans to perform.
- iii. For example, car assembly lines, in hospitals, office cleaner, serving foods and preparing foods in hotels etc.

Que 1.3. Define the role of the machine intelligence in the human life.**Answer**

1. Machine intelligence is the intelligence provided to the particular machine to achieve the goals of the problems in AI.
2. It is defined as the embedding of intelligence in the machine so that the machine can behave like a human.
3. In human life, machine learning solves many problems of daily purpose of the human.
4. There are many problems which require intelligence such as complex arithmetic which is done by machine very easily.
5. Machine learning plays an important role in following areas :
 - i. **Learning :** Learning means to acquire new things from the set of given knowledge or experiences. It refers to the change in subject's behaviour to a given situation brought by repeated experiences in that situation.

- ii. **Reasoning :** Reasoning means to infer facts from given facts. Inferences are classified as either deductive or inductive and the reasoning is to draw inferences appropriate to the situation.

- iii. **Problem solving :** To solve problem means to move towards the goal. In this, set of rules are defined and a goal is also defined which is to be achieved by using these rules.

- iv. **Language understanding :** It means to understand natural language meaning. A language is a system of signs having meaning-by-convention. The meaning-by-convention is distinctive of language and is very different from natural meaning.

Que 1.4. Describe briefly the evolution of artificial intelligence.**Answer****Evolution of AI :**

1. **Beginning of AI (1943) :** The concept of AI began around 1943. AI is not limited to the computer sciences disciplines, but can be seen in various other areas.
2. **AI knowledge-based expert system (1970) :** An AI system often uses a rule-based system to capture knowledge in the form of if-then statements or as decision trees.
3. **Machine learning (1998) :** There are two types of machine learning :
 - i. **Formal :** The formal type of machine learning is a computer program that learns from experience in respect to some task and increases performance based on that experience.
 - ii. **Informal :** The informal involves giving computers the ability to learn without explicitly programming the capability.
4. **Supervised learning (2004) :** The supervised learning is based on giving the correct answers and having the computer mapping inputs to outputs. For example,
 - i. **Spam filters :** Software is trained to learn and distinguish between spam and non-spam messages (For example, e-mail filters).
 - ii. **Facial recognition :** It is used by cameras to focus and via photo editing software to tag persons (For example, Facebook).
5. **Unsupervised learning (2010) :** Unsupervised learning is the reverse of supervised learning where the correct answers are unknown. For example,
 - i. **Clustering algorithm :** Used to find patterns in datasets and then group that data into different coherent clusters.
 - ii. **Market segmentation :** Targeting customers based on regions, likes, dislikes, when the consumer makes purchases, etc. This is considered targeted marketing.

6. **Genetic programming (2010)** : Genetic programming is an idea that uses evolutionary process to improve algorithms.
7. **Future of AI (2019 onwards)** : There are many challenges in mimicking human intelligence. Humans acquire common senses that are intuitive but hard to reason rationally. For example, the colour of a blue car is blue.

PART-2*Various Approaches to AI.***Questions-Answers****Long Answer Type and Medium Answer Type Questions**

Que 1.5. What are the different approaches to AI ?

Answer

Different approaches to AI :

1. Artificial Intelligence (AI), as a broad field, encompasses many different approaches ranging from top-down knowledge representation to bottom-up machine learning.
2. There are three related concepts that have been frequently used in recent years: AI, machine learning, and deep learning.
3. In general, AI is the broadest concept, machine learning is a sub field in AI, and deep learning is a special type of machine learning.
4. Fig. 1.5.1 illustrates the relations among these three concepts.

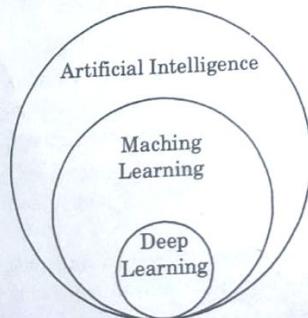


Fig. 1.5.1. Relations among AI, machine learning and deep learning.

5. While the broad field of AI includes many approaches, its popularity is largely due to the outstanding performances of machine learning and deep learning.

A. Machine learning :

- i. Machine learning is an application of Artificial Intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.
- ii. Machine learning focuses on the development of computer programs that can access data.
- iii. The primary aim is to allow the computers to learn automatically without human intervention or assistance and adjust actions accordingly.
- iv. Machine learning enables analysis of massive quantities of data.

B. Deep learning :

- i. Deep learning is the subfield of artificial intelligence that focuses on creating large neural network models that are capable of making accurate data-driven decisions.
- ii. Deep learning is used where the data is complex and has large datasets.
- iii. Facebook uses deep learning to analyze text in online conversations.
- iv. Google and Microsoft all use deep learning for image search and machine translation.

Que 1.6. What are the advantages and disadvantages of machine learning ?

Answer

Advantages of machine learning are :

1. **Easily identifies trends and patterns :**
 - a. Machine learning can review large volumes of data and discover specific trends and patterns that would not be apparent to humans.
 - b. For an e-commerce website like Flipkart, it serves to understand the browsing behaviour and purchase histories of its users to help cater to the right products, deals, and reminders relevant to them.
 - c. It uses the results to reveal relevant advertisements to them.
2. **No human intervention needed (automation) :** Machine learning does not require physical force i.e., no human intervention is needed.
3. **Continuous improvement :**
 - a. ML algorithms gain experience; they keep improving in accuracy and efficiency.

- b. As the amount of data keeps growing, algorithms learn to make accurate predictions faster.
- 4. Handling multi-dimensional and multi-variety data :**
- Machine learning algorithms are good at handling data that are multi-dimensional and multi-variety, and they can do this in dynamic or uncertain environments.
- Disadvantages of machine learning are :**
- Data acquisition :**
 - Machine learning requires massive data sets to train on, and these should be inclusive/unbiased, and of good quality. - Time and resources :**
 - ML needs enough time to let the algorithms learn and develop enough to fulfill their purpose with a considerable amount of accuracy and relevancy.
 - It also needs massive resources to function. - Interpretation of results :**
 - To accurately interpret results generated by the algorithms. We must carefully choose the algorithms for our purpose. - High error-susceptibility :**
 - Machine learning is autonomous but highly susceptible to errors.
 - It takes time to recognize the source of the issue, and even longer to correct it.

Que 1.7. Differentiate between machine learning and deep learning.

Answer

S.No.	Machine Learning	Deep Learning
1.	Works on small amount of dataset for accuracy.	Works on large amount of dataset.
2.	Dependent on low-end machine.	Heavily dependent on high-end machine.
3.	Divides the tasks into sub-tasks, solves them individually and finally combine the results.	Solves problem end to end.
4.	Takes less time to train.	Takes more time to train.
5.	More time to test the data.	Less time to test the data.

Que 1.8. What are the applications of deep learning ?

Answer

- Automatic text generation :**
 - Corpus of text is learned and from this model new text is generated, word-by-word, character-by-character.
 - Then this model is capable of learning how to spell, punctuate, form sentences, or it may even capture the style.
- Healthcare :** Helps in diagnosing various diseases and treating it.
- Automatic machine translation :** Certain words, sentences or phrases in one language is transformed into another language.
- Image recognition :** Recognizes and identifies peoples and objects in images as well as to understand content and context. This area is already being used in gaming, retail, tourism, etc.
- Predicting earthquakes :** Teaches a computer to perform viscoelastic computations which are used in predicting earthquakes.

Que 1.9. Describe the applications of artificial intelligence.

Answer

Applications of artificial intelligence :

- Gaming :** AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge.
- Natural language processing :** It is possible to interact with the computer that understands natural language spoken by humans.
- Expert systems :** There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.
- Vision systems :** These systems understand, interpret, and comprehend visual input on the computer.
- Speech recognition :** Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human's voice due to cold, etc.
- Handwriting recognition :** The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.

7. **Intelligent robots :** Robots are able to perform the tasks given by a human. They have sensors to detect physical data from the real world. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence.

PART-3*What should All Engineers Know About AI ?***Questions-Answers****Long Answer Type and Medium Answer Type Questions**

Que 1.10. What engineers need to know about Artificial Intelligence ?

Answer

1. Artificial intelligence (AI) systems by their nature are software-intensive. To create viable and trusted AI systems, engineers need technologies and standards.
2. Following are the key aspects and elements of AI that engineers must understand to work with emerging systems :

A. Introductory Concepts: AI, ML, and Deep Learning :

1. AI is define as :

... the ability of machines to perform tasks that normally require human intelligence - for example, recognizing patterns, learning from experience, drawing conclusions, making predictions, or taking action - whether digitally or as the smart software behind autonomous physical systems.

2. Machine learning (ML), a part of AI, is define as :

A system that learns and improves its performance at some task by using data and experience.

3. Deep learning is define as :

a family of machine learning techniques whose models extract important features by iteratively transforming the data, "going deeper" toward meaningful patterns in the dataset with each transformation.

4. Unlike traditional machine learning methods, in which the creator of the model has to choose and encode features ahead of time, deep learning enables a model to automatically learn features that matter.

B. AI Engineering Concepts :**i. AI depends on the human element :**

1. AI augments, but does not replace, human knowledge and expertise.
2. This basic understanding affects engineers of AI systems in two dimensions : human-machine teaming and the probabilistic nature of AI "answers."
3. Engineers developing AI systems must account for the interactions between the system and the people who build and use it (human-machine teaming).
4. Often, the success of those interactions comes down to trust and transparency.
5. Further, AI will produce probabilistic answers.
6. How does the engineers of AI systems know when a prediction is bad ?

ii. AI depends on labeled and unlabeled data as well as the systems that store and access it :

1. The development in AI is due to the availability of data and the speed at which today's computers can process it.
2. AI systems can classify, categorize, and partition massive amounts of data to make the relevant information available for humans to analyze and make decisions.
3. Engineers must consider the data and the hardware and software systems that support that data.
4. Large amounts of data require a computing environment that has the capacity to handle it.
5. Managing data requires designing storage solutions around physical data constraints and types of queries desired.

iii. One AI, many algorithms :

1. When we talk about AI, ML, and deep learning, we are referring to many different algorithms, many different approaches, not all of which are neural-network based.

2. Many of the algorithms used in AI were generated in the 1950s, 1960s, or 1970s.
3. For example, the A* shortest path algorithm was conceived in the 1950s, and improved on in the 1960s.

iv. The insight is the benefit of AI :

1. Engineers know that it is impossible to test a system in every situation it will ever encounter.
2. An AI system can find an answer to never-seen-before situations that is insightful and has a very good probability of being correct.
3. However, it is not necessarily correct, but probabilistic.
4. Thus, gaining increased confidence in AI is hard for engineers who need to focus on creating and validating a system.

v. An AI system depends on the system under which it runs :

1. When building a system that does not incorporate AI, you can build and test it in isolation.
2. Then deploy it and be certain it is going to behave just as it did in the lab.
3. An AI system depends on the conditions under which the AI runs and what the AI system is sensing, and this context adds another level of complexity.

Que 1.11. What are the responsibilities of an AI Engineer ?

Answer

Responsibilities of an AI Engineer :

- 1 Convert the machine learning models into application program interfaces (APIs) so that other applications can use it.
- 2 Build AI models from scratch and help the different components of the organization (such as product managers and stakeholders) understand what results they gain from the model.
- 3 Build data ingestion and data transformation infrastructure.
- 4 Automate infrastructure that the data science team uses.
- 5 Perform statistical analysis and tune the results so that the organization can make better-informed decisions.
- 6 Set up and manage AI development and product infrastructure

- 7 Be a good team player.

PART-4

Other Emerging Technologies.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 1.12. What are the emerging technologies in artificial intelligence ?

Answer

Emerging technologies in artificial intelligence are :

1. AI-enhanced Analytics Solutions :

- i. This category helps to organize the customer journey and experience.
- ii. These systems can understand the customer, learn preferences, predict next best action/solution, and surface insights.
- iii. This is a top priority area for the contact center as AI-enhanced analytics solutions can deliver new and stronger business benefit.

2. Deep Learning (DL) :

- i. DL is a type of machine learning algorithm that has the ability to generate better predictions/insights, scale up with large data sets, and reduce the effort to build the model.
- ii. In the contact center, DL is used in conversational systems (speech recording, NLG, NLU, etc), Speech Analytics, and other areas.

3. Natural Language Generation (NLG) :

- i. NLG is a part of the tech stack in conversational systems.
- ii. NLG uses advanced AI algorithms to generate speech from text.
- iii. NLG is used to generate speech in Alexa, in Virtual Assistants and in a Natural Language IVR.
- iv. NLG is used as part of the SmartCare conversational platform that powers IVR and Chatbot channels.

4. Speech Analytics :

- i. Speech analytics uses AI technology to recognize speech, convert speech into text, and perform analytics on the text data set.
- ii. This technology is used in many contact centers to improve customer interactions, and agent performance.

5. AI for cyber-security applications :

- i. Artificial intelligence and machine learning technology is increasingly finding its way into cybersecurity systems for both corporate systems and home security.
- ii. AI and machine learning technology can be employed to help identify threats, including variants of earlier threats.
- iii. AI-powered cybersecurity tools can collect data from a company's transactional systems, communications networks, digital activity and websites, as well as from external public sources, and utilize AI algorithms to recognize patterns and identify threatening activity.
- iv. In home security AI system is integrated with consumer video cameras and intruder alarm systems integrated with a voice assistant.

6. AI/ML for IoT :

1. The Internet of Things has been a fast-growing area in recent years.
2. The use of AI/ML is increasingly intertwined with IoT.
3. AI, machine learning and deep learning are being employed to make IoT devices and services smarter and more secure.
4. In an industrial setting IoT networks throughout a manufacturing plant can collect operational and performance data.
5. It is then analyzed by AI systems to improve production system performance, boost efficiency and predict when machines will require maintenance.

7. AI and Machine Learning in Hyperautomation :

1. Hyperautomation is the idea that things within an organization that can be automated should be automated.
2. AI and machine learning are key components and major drivers of hyperautomation.
3. To be successful hyperautomation initiatives cannot rely on static packaged software.

4. Automated business processes must be able to adapt to changing circumstances and respond to unexpected situations.
5. That's where AI, machine learning models and deep learning technology come in.
6. Learning algorithms and models allow the system to automatically improve over time and respond to changing business processes and requirements.

8. Virtual agents :

1. Virtual agents have become valuable tools for instructional designers.
2. A virtual agent is a computer application that interacts with humans.
3. Web and mobile applications provide chatbots as their customer service agents to interact with humans to answer their queries.
4. Google Assistant helps to organize meetings, and Alexa from Amazon helps to make your shopping easy.
5. A virtual assistant also acts like a language assistant, which picks cues from your choice and preference.
6. Virtual agents act as software-as-a-service too.

PART-5*AI and Ethical Concerns.***Questions-Answers****Long Answer Type and Medium Answer Type Questions****Que 1.13. What do you understand by ethics of artificial intelligence ?****Answer**

1. The ethics of artificial intelligence is the branch of the ethics of technology specific to artificially intelligent systems.

2. It is sometimes divided into a concern with the moral behavior of humans as they design, make, use and treat artificially intelligent systems, and a concern with the behavior of machines, in machine ethics.
3. It also includes the issue of a possible singularity due to superintelligent AI.

Ques 1.14. What are the ethical problems in Artificial Intelligence ?

Answer

Following are some of the ethical problems that need to be dealt with in Artificial Intelligence :

A. Artificial Intelligence Bias :

1. Human beings are sometimes biased against other religions, genders, nationalities, etc.
2. This bias may unconsciously also enter into the Artificial Intelligence Systems that are developed by human beings.
3. The bias may also creep into the systems because of the flawed data that is generated by human beings.
4. For example, Amazon recently found out that their Machine Learning based recruiting algorithm was biased against women.
5. It is important that AI researchers specifically try to remove bias while developing and training the AI systems and selecting the data.
6. There are many companies that are working towards creating unbiased AI systems.
7. IBM scientists have created an independent bias rating system to calculate the fairness of an AI system.

B. Rights of Robots :

1. If robots become advanced enough emotionally, should they be given equal rights like humans or lesser rights ?
2. What if robots kill someone. Should it be considered murder or a machine malfunction ?
3. All these are ethical questions that need to be answered as Artificial Intelligence becomes and more intelligent.

C. Human Control on Artificial Intelligence :

1. Currently, human beings are the dominant species on Earth.

2. Human beings are dominant because of their intelligence.
3. So the critical question is, "What happens when Artificial Intelligence becomes *more* intelligent than Human Beings ?"
4. This would make AI the dominant species on Earth and lead to huge changes in human existence or even human extinction.
5. Humans need to prepare for this scenario and how to deal with it.

D. AI replacing human workers :

1. As Artificial Intelligence becomes more and more advanced, it will obviously take over jobs that were once performed by humans.
2. Around 800 million jobs could be lost worldwide because of automation by 2030.
3. Now the question arises "What about the humans that are left unemployed because of this?"
4. Some people believe that many jobs will also be created because of Artificial Intelligence and that may balance the scales a bit.
5. People could move from physical and repetitive jobs to jobs that actually require creative and strategic thinking.
6. But this is more likely to happen to people who are already educated and fall in the richer bracket.
7. This might increase the gap between the rich and poor even further.
8. A new societal setup will have to be generated so that all human beings are able to earn money even in this scenario.

E. Handling mistakes made by AI :

1. Artificial Intelligence may evolve into a super-intelligence in a few years but right now it is basic and so it makes mistakes.
2. Currently it makes mistakes that are relatively safe and can be easily handled.
3. But Artificial Intelligence may make complicated mistakes in the future.
4. Then what is to be done ? The question is about relativity.
5. Do Artificial Intelligence systems make lesser or more mistakes than humans ?
6. Do their mistakes lead to actually lose of life ?

7. And if there is a loss of life, is it more or less than when humans make mistakes?
8. All of these questions need to be taken into account when developing AI systems for different applications so that their mistakes are bearable and not catastrophic.

②③④

2

UNIT

Data & Algorithms

CONTENTS

Part-1 : History of Data	2-2M to 2-2M
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2-2 M (Sem-1 & 2)

Data & Algorithms

PART-1

History of Data.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

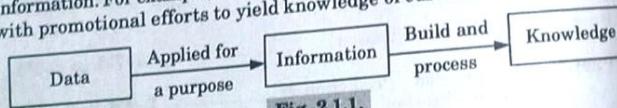
Que 2.1. Explain data, information and knowledge.

Answer

Data : Data are raw facts and figures that can be processed or stored by a computer. For example, text, numbers, symbols, etc.

Information : Information is data that has been processed into a form that gives it meaning. For example, analysis of retail of sale data can provide information on which products are selling.

Knowledge : Knowledge is the understanding of rules needed to interpret information. For example, information on retail market sales can be analyzed with promotional efforts to yield knowledge of customer behaviour.



PART-2

Data Storage and Importance of Data and its Acquisition.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 2.2. What is data storage ?

Answer

1. Data storage means that files and documents are recorded digitally and

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2. Storage systems may rely on electromagnetic, optical or other media to preserve and restore the data if needed.
3. Data storage makes it easy to back up files for safekeeping and quick recovery in the event of an unexpected computing crash or cyber attack.
4. Data storage can occur on physical hard drives, disk drives, USB drives or virtually in the cloud.

Que 2.3. Describe the types of data storage ?

Answer

Types of Data Storage :

1. Direct Attached Storage (DAS) :

- i. Direct attached storage (DAS) includes types of data storage that are physically connected to the computer.
- ii. This storage is generally accessible to only a single machine. Some common devices in this category include :
 1. Hard Drives
 2. CD/DVD Drives
 3. Flash Drives
- iii. DAS solutions are great for creating local backups and can be more affordable than NAS solutions, but sharing data between machines can be cumbersome

2. Network Attached Storage (NAS) :

- i. Network attached storage (NAS) allows for multiple machines to share storage over a network. This is accomplished with multiple hard drives or other storage devices in a RAID configuration.
- ii. The key benefits of NAS is the ability to centralize data and improve collaboration.
- iii. Data can be easily shared among connected machines, and permission levels can be set to control access.
- iv. While NAS solutions tend to be more costly than DAS solutions, they are still very affordable as storage technology has advanced significantly.

Que 2.4. Why is data important ?

Answer

Importance of data :

1. Data provides a deeper understanding of your market.
2. Data collection improves your consumer database.

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3. Consumer data improves your marketing strategies.
4. It allows for greater personalization.

Que 2.5. What do you mean by Data Acquisition ?**Answer**

1. Data acquisition is the process of measuring physical world conditions and phenomena such as electricity, sound, temperature and pressure.
2. This is done through the use of various sensors which sample the environment's analog signals and transform them to digital signals using an analog-to-digital converter.
3. The resulting digital numeric values can then be directly manipulated by a computer, allowing for the analysis, storage and presentation of these data.

Que 2.6. Discuss the types of Data Acquisition Systems.**Answer****Types of Data Acquisition Systems :**

1. **Analog Data Acquisition Systems :** The data acquisition systems, which can be operated with analog signals, are known as analog data acquisition systems. Following are the blocks of analog data acquisition systems :
 - i. **Transducer :** It converts physical quantities into electrical signals.
 - ii. **Signal conditioner :** It performs the functions like amplification and selection of desired portion of the signal.
 - iii. **Display device :** It displays the input signals for monitoring purpose.
 - iv. **Graphic recording instruments :** These can be used to make the record of input data permanently.
 - v. **Magnetic tape instrumentation :** It is used for acquiring, storing and reproducing input data.
2. **Digital Data Acquisition Systems :**
 - a. The data acquisition systems, which can be operated with digital signals, are known as digital data acquisition systems. They use digital components for storing or displaying the information.
 - b. The following operations take place in digital data acquisition :
 - i. Acquisition of analog signals
 - ii. Conversion of analog signals into digital signals or digital data
 - iii. Processing of digital signals or digital data

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- c. Following are the blocks of digital data acquisition systems :
 - i. **Transducer :** It converts physical quantities into electrical signals.
 - ii. **Signal conditioner :** It performs the functions like amplification and selection of desired portion of the signal.
 - iii. **Multiplexer :** Connects one of the multiple inputs to output. So, it acts as parallel to serial converter.
 - iv. **Analog to Digital Converter :** It converts the analog input into its equivalent digital output.
 - v. **Display device :** It displays the data in digital format.
 - vi. **Digital Recorder :** It is used to record the data in digital format.

PART-3

The Stages of Data Processing.

Questions-Answers**Long Answer Type and Medium Answer Type Questions****Que 2.7. What are the various stages of data processing ?****Answer**

There are six main stages in the data processing cycle :

1. **Data Collection :**
 - i. The collection of raw data is the first step of the data processing cycle.
 - ii. The type of raw data collected has a huge impact on the output produced.
 - iii. It is important that the raw data sources are trustworthy and well-built so the data collected is of the highest possible quality.
 - iv. Raw data can include monetary figures, website cookies, profit/loss statements of a company, user behavior, etc.
2. **Data preparation :**
 - i. Data preparation or data cleaning is the process of sorting and filtering the raw data to remove unnecessary and inaccurate data.
 - ii. Raw data is checked for errors and then transformed into a suitable form for further analysis and processing.

2-6 M (Sem-1 & 2)

Data & Algorithms

- iii. This is done to ensure that only the highest quality data is fed into the processing unit.
- 3. **Data input :**
 - i. In this step, the raw data is converted into machine readable form and fed into the processing unit.
 - ii. Data input is the first stage in which raw data begins to take the form of usable information.
 - iii. This can be in the form of data entry through a keyboard, scanner or any other input source.
- 4. **Data Processing :**
 - i. During this stage, the data inputted in the previous stage is actually processed for interpretation.
 - ii. The raw data is subjected to various data processing methods using machine learning and artificial intelligence algorithms to generate a desirable output.
 - iii. The process itself may vary slightly depending on the source of data being processed and its intended use.
- 5. **Data output/interpretation :**
 - i. The data is finally transmitted and displayed to the user in a readable form like graphs, tables, vector files, audio, video, documents, etc.
 - ii. This output can be stored and further processed in the next data processing cycle.
- 6. **Data storage :**
 - i. The final stage of data processing is storage. After all of the data is processed, it is then stored for future use.
 - ii. This allows for quick access and retrieval of information whenever needed, and also allows it to be used as input in the next data processing cycle directly.

Que 2.8. What are the different forms of data processing ?

Answer

Different forms of data processing are :

1. **Data cleaning :** Data cleaning is a process to remove the noisy data, clean the data by filling in the missing values and correct the inconsistencies in data.
2. **Data integration :** Data integration is a technique that combines the data from multiple heterogeneous data sources into a coherent data store. Data integration may involve inconsistent data and therefore needs data cleaning.

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3. **Data transformation :** In this step, data is transformed or consolidated into forms appropriate for mining, by performing summary or aggregation operations. It involves the following :
 - a. **Smoothing :** Smoothing is a process of removing noise from data.
 - b. **Aggregation :** Aggregation is a process where summary or aggregation operations are applied to the data.
 - c. **Generalization :** In generalization low-level data are replaced with high-level data by using concept hierarchies climbing.
 - d. **Normalization :** Normalization scaled attribute data so as to fall within a small specified range, such as 0.0 to 1.0. It is of two types :
 - i. **Min-max normalization :** It is a technique that helps to normalize data. It will scale the data between 0 and 1.
 - ii. **z-score normalization :** Transform the data by converting the values to a common scale with an average of zero and a standard deviation of one.
 - e. **Attribute/feature construction :** New attributes constructed from the given ones.
4. **Data reduction :** Data reduction is used to obtain reduced representation of data in small values by maintaining the integrity of original data.

PART-4

Data Visualization.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 2.9. Describe data visualization.

Answer

1. Data visualization is a set of data points and information that are represented graphically to make it easy and quick for user to understand.
2. Data visualization is good if it has a clear meaning, purpose, and is very easy to interpret, without requiring context.

3. Tools of data visualization provide an accessible way to see and understand trends, outliers, and patterns in data by using visual effects or elements such as a chart, graphs, and maps.

Que 2.10. Write down the Characteristics of data Visualization.

Answer

Characteristics of data Visualization :

1. It shows or visualizes data very clearly in an understandable manner.
2. It encourages viewers to compare different pieces of data.
3. It closely integrates statistical and verbal descriptions of data set.
4. It grabs our interest, focuses our mind, and keeps our eyes on message as human brain tends to focus on visual data more than written data.
5. It also helps in identifying area that needs more attention and improvement.
6. Using graphical representation, a story can be told more efficiently. Also, it requires less time to understand picture than it takes to understand textual data.

Que 2.11. Discuss the categories of Data Visualization.

Answer

Categories of Data Visualization :

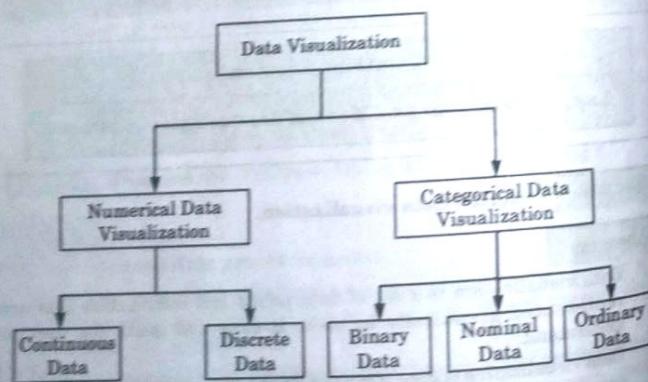


Fig. 2.11.1.

i. **Numerical Data :**

1. Numerical data is also known as quantitative data.
2. Numerical data is any data where data generally represents amount such as height, weight, age of a person, etc.
3. Numerical data visualization is easiest way to visualize data.
4. It is generally used for helping others to digest large data sets and raw numbers in a way that makes it easier to interpret into action.
5. The type of visualization techniques that are used to represent numerical data visualization is Charts and Numerical Values. Examples are Pie Charts, Bar Charts, Averages, Scorecards, etc.
6. Numerical data is categorized into two categories :
 - a. **Continuous Data :** It can be narrowed or categorized (Example: Height measurements).
 - b. **Discrete Data :** This type of data is not "continuous" (Example: Number of cars a household has).

ii. **Categorical Data :**

1. Categorical data is also known as qualitative data.
2. Categorical data is any data where data generally represents groups.
3. It simply consists of categorical variables that are used to represent characteristics such as a person's ranking, a person's gender, etc.
4. Categorical data visualization is all about depicting key themes, establishing connections, and lending context.
5. The type of visualization techniques that are used to represent categorical data is Graphics, Diagrams, and Flowcharts. Examples are Word clouds, Sentiment Mapping, Venn diagram, etc.
6. Categorical data is classified into three categories :
 - a. **Binary Data :** In this, classification is based on positioning (Example : Agrees or Disagrees).
 - b. **Nominal Data :** In this, classification is based on attributes (Example: Male or Female).
 - c. **Ordinal Data :** In this, classification is based on ordering of information (Example : Timeline or processes).

PART-5

Regression, Prediction & Classification.

Questions-Answers**Long Answer Type and Medium Answer Type Questions**

Que 2.12. Discuss about classification and its types.

Answer

1. Classification is a process of finding a function which helps in dividing the dataset into classes based on different parameters.
2. In Classification, a computer program is trained on the training dataset and based on that training, it categorizes the data into different classes.
3. The task of the classification algorithm is to find the mapping function to map the input(x) to the discrete output(y).
4. Classification algorithms can be divided into the following types:
 - i. Logistic Regression
 - ii. K-Nearest Neighbours
 - iii. Support Vector Machines
 - iv. Kernel SVM
 - v. Naive Bayes
 - vi. Decision Tree Classification
 - vii. Random Forest Classification

Que 2.13. Discuss about regression and its types.

Answer

1. Regression is a process of finding the correlations between dependent and independent variables.
2. It helps in predicting the continuous variables such as prediction of market trends, prediction of house prices, etc.
3. The task of the regression algorithm is to find the mapping function to map the input variable(x) to the continuous output variable(y).
4. Types of Regression Algorithm:

- i. Simple Linear Regression
- ii. Multiple Linear Regression
- iii. Polynomial Regression
- iv. Support Vector Regression
- v. Decision Tree Regression
- vi. Random Forest Regression

Que 2.14. Differentiate between regression and classification algorithm.

Answer

S. No.	Regression algorithm	Classification algorithm
1.	In Regression, the output variable must be of continuous nature or real value.	In Classification, the output variable must be a discrete value.
2.	The task of the regression algorithm is to map the input value(x) with the continuous output variable(y).	The task of the classification algorithm is to map the input value(x) with the discrete output variable(y).
3.	Regression algorithms are used with continuous data.	Classification algorithms are used with discrete data.
4.	In Regression, we try to find the best fit line, which can predict the output more accurately.	In Classification, we try to find the decision boundary, which can divide the dataset into different classes.
5.	Regression algorithms can be used to solve the regression problems such as Weather Prediction, House price prediction, etc.	Classification algorithms can be used to solve classification problems such as Identification of spam emails, Speech Recognition, Identification of cancer cells etc.
6.	The regression algorithm can be further divided into Linear and Non-linear Regression.	The classification algorithms can be divided into Binary Classifier and Multi-class Classifier.

Que 2.15. What is prediction in AI ?

Answer

1. Prediction refers to the output of an algorithm after it has been trained on a historical dataset and applied to new data when forecasting the likelihood of a particular outcome.
2. The algorithm will generate probable values for an unknown variable for each record in the new data.
3. This allows the data user to identify what that value will most likely be.
4. Machine learning model predictions allow businesses to make highly accurate guesses as to the likely outcomes of a question based on historical data.
5. These provide the business with insights that result in tangible business value.

PART-6

Clustering & Recommender Systems.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 2.16. What do you mean by clustering ? What are the different types of clustering ?

Answer

1. Clustering is the process of making a group of abstract objects into classes of similar objects.
2. While doing cluster analysis, we first partition the set of data into groups based on data similarity and then assign the labels to the groups.

3. Clustering methods can be classified into the following categories :

- i. Partitioning method
- ii. Hierarchical method
- iii. Density-based method
- iv. Grid-based method
- v. Model-based method

Que 2.17. Explain the different data types used in cluster analysis.

Answer

Data types used in cluster analysis are :

1. **Interval scaled variables :** Interval scaled variables are continuous measurements of roughly linear scale. Typical examples include weight and height, latitude and longitude coordinates, and weather temperature.
2. **Binary variables :** A binary variables has only two states : 0 and 1, where 0 means that the variable is absent, and 1 means that it is present. Given the variable smoker describing a patient, for instance, 1 indicates that the patient smokes, while 0 indicates that the patient does not.
3. **Categorical variables :** A categorical variable is a generation of the binary variable in that it can take on more than two states. For example, map colour is a categorical variable that may have, say, five states : red, yellow, green, pink and blue.
4. **Ordinal variables :** Ordinal variables are very useful for registering subjective assessments of qualities that cannot be measured objectively. For example, professional ranks are often enumerated in a sequential order.
5. **Ratio scaled variables :** A ratio scaled variable makes a positive measurement on a non-linear scale, such as an exponential scale, approximately following the formula :

$$Ae^{Bt} \text{ or } Ae^{-Bt}$$

where A and B are positive constant, and t typically represents time.

Common examples include the growth of a bacteria population or the decay of a radioactive element.

6. **Variables of mixed type :** Data sets may contain all types of variables such as : symmetric binary, asymmetric binary, nominal, ordinal, interval.

Ques 2.18. What is recommender system ?

Answer

1. A recommender system refers to a system that is capable of predicting the future preference of a set of items for a user, and recommends the top items.
2. We need a recommender system in modern society as people have too many options to choose from due to the prevalence of Internet. In the past, people used to shop in a physical store, in which the items available are limited.
3. For example, the number of movies that can be placed in a Blockbuster store depends on the size of that store. Netflix, for example, has an enormous collection of movies.
4. Although the amount of available information increased, a new problem arose as people had a hard time selecting the items they actually want to see. This is where the recommender system comes in.

Ques 2.19. Discuss the two methods to construct a recommender system.

Answer

Methods for building Recommender Systems :

1. **Content-based recommendation :**

- i. Recommendations through content-based filtering techniques are influenced by what the user has browsed earlier, or what he is currently browsing.
- ii. It is mostly dependent on keyword searching techniques and tries to follow the user's own browsing patterns by filtering items based on keywords to describe the items and make recommendations around it.

2. **Collaborative Filtering :**

- i. Unlike content-based filtering which only takes into account user-specific item interactions, collaborative filtering technique follows a more mature approach and finds out similar users based on user-item interactions.
- ii. For example : Consider two user browsing patterns. We can increase the confidence level of the two users being similar by comparing the number of common products they have browsed.





Natural Language Processing

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3-2 M (Sem-1 & 2)

Natural Language Processing

PART-1

Speech Recognition.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 3.1. Discuss the term speech recognition.

Answer

1. Speech recognition is the process that enables a computer to recognize and respond to spoken words and then convert them in a format that the machine understands. The machine may then convert it into another form of data depending on the end-goal.
2. Speech recognition is widely used in digital assistants, smart speakers, smart homes, and automation for a variety of services, products, and solutions.

Que 3.2. What are the most commonly used algorithms for speech recognition ?

Answer

1. Natural language processing (NLP) :
 - i. NLP is not a specific algorithm used in speech recognition; it is the area of artificial intelligence which focuses on the interaction between humans and machines through speech and text.
 - ii. Many mobile devices incorporate speech recognition into their systems to conduct voice search (example : Siri) or provide more accessibility around texting.
2. Hidden Markov models (HMM) :
 - i. Hidden Markov Models build on the Markov chain model, which stipulates that the probability of a given state hinges on the current state, not its prior states.
 - ii. While a Markov chain model is useful for observable events, such as text inputs, hidden Markov models allow us to incorporate hidden events, such as part-of-speech tags, into a probabilistic model.

- iii. They are utilized as sequence models within speech recognition, assigning labels to each unit i.e., words, syllables, sentences, etc., in the sequence.
 - iv. These labels create a mapping with the provided input, allowing it to determine the most appropriate label sequence.
- 3. Neural networks :**
- i. For deep learning algorithms, neural networks process training data by mimicking the interconnectivity of the human brain through layers of nodes.
 - ii. Each node is made up of inputs, weights, a bias (or threshold) and an output.
 - iii. If that output value exceeds a given threshold, it "fires" or activates the node, passing data to the next layer in the network.
 - iv. Neural networks learn the mapping function through supervised learning, adjusting based on the loss function through the process of gradient descent.
 - v. While neural networks tend to be more accurate and can accept more data, this comes at a performance efficiency cost as they tend to be slower to train compared to traditional language models.

Que 3.3. What are the applications of speech recognition ?**Answer**

1. **Automotive :** Speech recognizer improves driver safety by enabling voice-activated navigation systems and search capabilities in car radios.
2. **Technology :** Virtual assistants are increasingly becoming integrated within our daily lives, particularly on our mobile devices. We use voice commands to access them through our smartphones, such as through Google Assistant or Apple's Siri, for tasks, such as voice search, or through our speakers, via Amazon's Alexa or Microsoft's Cortana, to play music.
3. **Healthcare :** Doctors and nurses leverage dictation applications to capture and log patient diagnoses and treatment notes.
4. **Sales :** It can help a call center transcribe thousands of phone calls between customers and agents to identify common call patterns and issues. Cognitive bots can also talk to people via a webpage, answering common queries and solving basic requests without needing to wait for a contact center agent to be available. In both instances speech recognition systems help reduce time to resolution for consumer issues.

5. **Security :** As technology integrates into our daily lives, security protocols are an increasing priority. Voice-based authentication adds a viable level of security.

Que 3.4. What are the Techniques for Speech Recognition ?**Answer**

Techniques for Speech Recognition are :

1. Speech Analysis Technique :

- i. Speaker identity can be shown by a different type of information that is present in speech data.
- ii. This incorporates speaker-specific information due to the vocal tract, excitation source, and behavior feature.
- iii. This stage deals with a suitable frame size for segmenting speech signals for further analysis and extracting.

2. Feature Extraction Technique :

- i. The speech feature extraction technique is the process of placing words in groups or classes and decreasing the dimensionality of the input vector while maintaining the discriminating power of the signal.
- ii. From the basic formation of speaker identification and verification system, we know that the number of training and test vector needed for the classification problem grows with the dimension of the given input; therefore, we need feature extraction of the speech signal.

3. Modeling :

- i. The modeling technique aims to create speaker models using a speaker-specific feature vector. Further, Speaker recognition and Speaker identification are the parts of Modeling.
- ii. The speaker identification technique identifies by itself, who is speaking based on individual information integrated into a speech signal.

PART-2**Questions-Answers****Long Answer Type and Medium Answer Type Questions**

Que 3.5. What do you mean by natural language processing ?
Why it is needed ?

Answer

1. Natural Language Processing (NLP) studies the problems inherent in the processing and manipulation of natural language and to make computer understand statements written in human language.
2. NLP can be defined as the automatic processing of human language.
3. Natural language processing is a subfield of AI which deals with the methods of communicating with a computer in one's own natural language.
4. It is used for analyzing and representing naturally occurring texts at one or more levels of linguistic analysis for the purpose of achieving human-like language processing for a range of tasks or applications.
5. It is needed to bridge the gap between human and machine.
6. The goal of natural language is to enable people and computers to communicate in a natural language, such as English.
7. The field of NLP is divided into subfields :
 - a. **NLU (Natural Language Understanding)** : This investigates methods of allowing the computer to comprehend instructions given in English.
 - b. **NLG (Natural Language Generation)** : This strive that computer produce ordinary English language so that people can understand computers more easily.
8. The study of language generation falls into following three areas :
 - a. Determination of content.
 - b. Formulating and developing a text utterance plan.
 - c. Achieving a realization of the desired utterances.
9. A full NLU system would be able to :
 - a. Paraphrase an input text.
 - b. Translate the text into another language.
 - c. Answer questions about the contents of the text.
 - d. Draw inferences from the text.
10. Applications of NLP :
 - a. Natural language interfaces to databases.
 - b. Machine translation.

- c. Advanced word-processing tools.
- d. Explanation generation for expert systems.

Que 3.6. What do you mean by natural language understanding ?

Answer

- i. Natural language understanding (NLU) is a branch of natural language processing, which involves transforming human language into a machine-readable format.
- ii. Natural language understanding (NLU) uses the power of machine learning to convert speech to text and analyze its intent during any interaction.
- iii. NLU helps computers understand and interpret human language by breaking down the elemental pieces of speech.
- iv. While speech recognition captures spoken language in real-time, transcribes it, and returns text, NLU goes beyond recognition to determine a user's intent.
- v. In NLU, machine learning models improve over time as they learn to recognize syntax, context, language patterns, unique definitions, sentiment, and intent.

Que 3.7. Give some examples of natural language understanding ?

Answer

1. **Machine Translation (MT) :**
 - i. Accurately translating text or speech from one language to another is one of the toughest challenges of natural language processing and natural language understanding.
 - ii. Using complex algorithms that rely on linguistic rules and AI machine training, Google Translate, Microsoft Translator, and Facebook Translation have become leaders in the field of "generic" language translation.
 - iii. You can type text or upload whole documents and receive translations in dozens of languages using machine translation tools. Google Translate even includes optical character recognition (OCR) software, which allows machines to extract text from images, read and translate it.

2. Automated Reasoning :

- i. Automated reasoning is a subfield of cognitive science that is used to automatically prove mathematical theorems or make logical inferences about a medical diagnosis.
- ii. It gives machines a form of reasoning or logic, and allows them to infer new facts by deduction.
- iii. Using previously gathered and analyzed information, computer programs are able to generate conclusions. For example, in medicine, machines can infer a diagnosis based on previous diagnoses using IF-THEN deduction rules.

3. Automatic Ticket Routing :

- i. A useful business example of NLU is customer service automation, tech companies receive customer support inquiries per month. Using NLU technology, we can sort unstructured data (email, social media, live chat, etc.) by topic, sentiment, and urgency (among others).
- ii. These tickets can then be routed directly to the relevant agent and prioritized.

4. Question Answering :

- i. Question answering is a subfield of NLP and speech recognition that uses NLU to help computers automatically understand natural language questions.
- ii. For example, here's a common question to Google Assistant : "What's the weather like tomorrow ?"
- iii. NLP tools can split this question into topic (weather) and date (tomorrow), understand it and gather the most appropriate answer from unstructured collections of "natural language documents": online news reports, collected web pages, reference texts, etc
- iv. By default, virtual assistants tell you the weather for your current location, unless you specify a particular city.
- v. The goal of question answering is to give the user response in their natural language, rather than a list of text answers.

PART-3*Natural Language Generation.***Questions-Answers****Long Answer Type and Medium Answer Type Questions****Que 3.8.** Describe natural language generation.**Answer**

- i. Natural Language Generation (NLG) simply means producing text from computer data.
- ii. It acts as a translator and converts the computerized data into natural language representation.
- iii. In this, a conclusion or text is generated on the basis of collected data and input provided by the user.
- iv. It is the natural language processing task of generating natural language from a machine representation system.
- v. Natural Language Generation acts contrary to Natural language understanding.
- vi. In natural language understanding the system needs to disambiguate the input sentence to produce the machine representation language, whereas in Natural Language Generation the system needs to make decisions about how to put a concept into words.

Que 3.9. What are the typical stages of natural language generation ?**Answer**

Typical stages of natural language generation are :

- i. **Content determination :** Deciding the main content to be represented in a sentence or the information to mention in the text.
- ii. **Document structuring :** Deciding the structure or organization of the conveyed information.
- iii. **Aggregation :** Putting of similar sentences together to improve understanding and readability.
- iv. **Lexical choice :** Using appropriate words that convey the meaning clearly.
- v. **Referring expression generation :** Creating such referral expressions that help in identification of a particular object and region.
- vi. **Realisation :** Creating and optimizing the text that should be correct as per the rules of grammar.

Que 3.10. What are the three basic techniques for evaluating NLG systems ?

Answer

Three basic techniques for evaluating NLG systems are :

1. **Task-based evaluation** : It includes human-based evaluation, which assesses how well it helps him perform a task. For example, a system which generates summaries of medical data can be evaluated by giving these summaries to doctors and assessing whether the summaries help doctors make better decisions.
2. **Human ratings** : It assesses the generated text on the basis of ratings given by a person on the quality and usefulness of the text.
3. **Metrics** : It compares generated texts to texts written by professionals.

Que 3.11. What are the applications of natural language processing ?

Answer

Following are the applications of natural language processing :

i. Machine Translation :

1. As the amount of information available online is growing, the need to access it becomes increasingly important.
2. Due to this the value of natural language processing applications becomes clear.
3. Machine translation helps us in translating technical manuals, support content or catalogs at a significantly reduced cost.
4. The challenge with machine translation technologies is not in translating words, but in understanding the meaning of sentences to provide a true translation.

ii. Automatic summarization :

1. When we access a specific, important piece of information from a huge knowledge base; information overload can become a problem.
2. Automatic summarization is relevant for summarizing the meaning of documents and information.
3. Automatic summarization is helpful in understanding the emotional meanings inside the information, such as in collecting data from social media.

4. Automatic summarization is especially relevant when used to provide an overview of a news item or blog posts, while avoiding redundancy from multiple sources and maximizing the diversity of content obtained.

iii. Sentiment analysis :

1. The goal of sentiment analysis is to identify sentiment among several posts where emotion is not always explicitly expressed.
2. Companies use sentiment analysis, to identify opinions and sentiment online to help them understand what customers think about their products and services.
3. Sentiment analysis understands sentiment in context to help you better understand what's behind an expressed opinion, which can be extremely relevant in understanding and driving purchasing decisions.

iv. Text classification :

1. Text classification makes it possible to assign predefined categories to a document and organize it to help you find the information you need.
2. For example, an application of text categorization is spam filtering in email.

v. Question Answering :

1. Question-Answering (QA) is becoming popular due to applications such as Siri, OK Google, chat boxes and virtual assistants.
2. A QA application is a system capable of coherently answering a human request.
3. It may be used as a text-only interface or as a spoken dialog system.
4. While they offer great promise, they still have a long way to go.
5. Using natural language processing for creating a seamless and interactive interface between humans with machines will continue to be a top priority for various cognitive applications.

PART-4*Chatbots.***Questions-Answers****Long Answer Type and Medium Answer Type Questions**

Ques 3.12. What are chatbots? What are the models of chatbots?

Answer

Chatbots :

- a. A Chatbot known as a conversational agent is a service either powered by rules or artificial intelligence that we interact via a chat interface.
 - b. A well designed & built chatbot will :
 - i. Use existing conversation data to understand the type of questions people ask.
 - ii. Analyze correct answers to those questions through a 'training' period.
 - iii. Use machine learning and NLP to learn context, and continually get better at answering those questions in the future.
 - c. There are two main models for a chatbot :
1. **Retrieval-based model :**
 - i. This kind of chatbot uses a repository of predefined responses.
 - ii. The programmer chooses an appropriate response based on context following a given heuristic, which can be either something very simple or quite complex depending on the situation.
 2. **Generative model :**
 - i. A generative model chatbot does not use any predefined repository.
 - ii. This kind of chatbot is more advanced, because it learns from scratch using a process called deep learning.

Ques 3.13. What are the types of chatbots?

Answer

There are three types of chatbots :

A. Rules-Based Chatbots :

1. These chatbots follow pre-designed rules, often built using a graphical user interface where a bot builder will design paths using a decision tree.

2. Rules-based chatbot software executes pre-determined actions based on "playbooks" you set up on the back end of the user interface.
3. Rules-based chatbot technology act based on clicks actions, such as "Yes" vs. "No", or by recognizing a particular keyword or group of keywords.
4. For example, you could set up a rules-based chatbot to respond if someone selects "Red" or "Green" but also if they respond with "I want red shoes" and your target keyword is "red shoes".

B. AI Chatbots :

1. AI chatbots will automatically learn after an initial training period by a bot developer.
2. AI chatbots use artificial intelligence & natural language processing technology to understand sentences structure.
3. It then process that information & progressively get better at answering the question at hand.
4. Instead of relying on a pre-determined outcome designed by a human, AI chatbots first understand what your question is.
5. Then once they understand your intent, they deliver an answer that they think is the right answer based on existing data.
6. Over time by observing correct & incorrect answers, the machine gets better at understanding what the 'right' answer is.
7. AI chatbots require a training period and more effort to get started.

C. Live Chat :

1. These bots are primarily used by Sales & Sales Development teams.
2. They can also be used by Customer Support organizations, as live chat is a more simplistic chat option to answer questions in real-time.
3. Live Chat sits on your website or product and acts as a window to your team for your customer.
4. Live chat software has some routing capability to assign real-time conversations, but overall it's pretty simple.
5. When someone wants to talk and your team is online, live chat connects someone from your team to help address that person's issue.

Ques 3.14. How a chatbot works?

Answer

There are two different tasks at the core of a chatbot :

A. User request analysis :

1. This is the first task that a chatbot performs.
2. It analyzes the user's request to identify the user intent and to extract relevant entities.
3. If you are not able to correctly understand the user's request, you won't be able to provide the correct answer.

B. Returning the response :

1. Once the user's intent has been identified, the chatbot must provide the most appropriate response for the user's request.
2. The answer may be :
 - i. A generic and predefined text;
 - ii. A text retrieved from a knowledge base that contains different answers;
 - iii. A contextualized piece of information based on data the user has provided;
 - iv. Data stored in enterprise systems;
 - v. The result of an action that the chatbot performed by interacting with one or more backend application; or,
 - vi. A disambiguating question that helps the chatbot to correctly understand the user's request.

Que 3.15. What are the benefits of chatbots ?**Answer**

Following are the benefits of chatbots :

1. Increase website conversion rate :

- i. Marketers put a lot of work to drive traffic to their website.
- ii. The traffic conversion rate is anywhere between 0.25% - 1.0%.
- iii. Chatbots can help achieve higher traffic conversion rate.

2. Generate more qualified leads :

- i. It would be nice if we could talk to every lead and ensure they're a good fit before we schedule a meeting.
- ii. In reality, that's impossible for most organizations to do at scale.
- iii. Bots can help use advanced qualification logic to do lead qualification and improve sales acceleration.

3. Combat Customer Churn :

- i. Bots are a perfect answer to high-volume support inquiries, especially where customers become frustrated with standard knowledge bases that are hard to sift through.

Que 3.16. Mention the characteristics/features of a chatbot.**Answer**

Following are the characteristics/features of a chatbot :

1. Conversational Maturity :

- i. A chatbot has specific natural language processing (NLP) capabilities to understand the context of a conversation in multiple languages.
- ii. It can also identify the intent of a question to provide an accurate first response, and also propose options to confirm or clarify intent.
- iii. The chatbots have advanced conversational capabilities and can proactively seek out information, and can also ask clarifying questions, even if the conversation isn't linear.

2. Omni-capable :

- i. The chatbot converses seamlessly across multiple digital channels and retains data and context for a seamless experience.
- ii. In some cases, even passing that information to a live agent if needed.

3. Integrates with CRM :

- i. The chatbot can be integrated with critical systems and organize workflows inside and outside of the CRM.
- ii. It can handle real-time action as routine as a password change, all the way through a complex multi-step workflow spanning multiple applications.

4. Emotionally Intelligent :

- i. The chatbot can infer customer personality traits and understand sentiment and tone during an interaction to deliver a personalized experience, or escalate to a live-agent when necessary.

5. Free to Explore :

- i. The chatbot can reach, consume, and process vast amounts of data to gather relevant data to solve customer issues quickly.

6. Autonomous Reasoning :

- i. The chatbot can perform complex reasoning without human intervention.
- ii. For example, a service chatbot should be able to infer solutions based on relevant case histories.

7. Pre-Trained :

- i. The chatbot is pre-trained to understand brand-specific or industry-specific knowledge and terms.
- ii. It's pre-configured to resolve common customer requests of a particular industry.

PART-5*Machine Translation.***Questions-Answers****Long Answer Type and Medium Answer Type Questions**

Que 3.17. What do you understand by machine translation? What are various types of machine translation systems?

Answer**Machine translation :**

1. Machine translation is the task of automatically converting source text in one language to text in another language.
2. In a machine translation task, the input already consists of a sequence of symbols in some language, and the computer program must convert this into a sequence of symbols in another language.

Types of Machine Translation Systems :

1. **Bilingual MT System :** Bilingual MT systems produce translations between two particular languages.
2. **Multilingual MT System :** Multilingual MT systems produce translations between any pair of languages. They may be either uni-directional or bi-directional in nature.

Que 3.18. What are the three major approaches of machine translation ?

Answer

Three major approaches are :

1. **Direct MT Approach :** It is less popular but the oldest approach of MT. The systems that use this approach are capable of translating SL (source language) directly to TL (target language). Such systems are bi-lingual and uni-directional in nature.

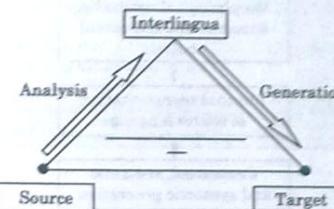


Fig. 3.18.1.

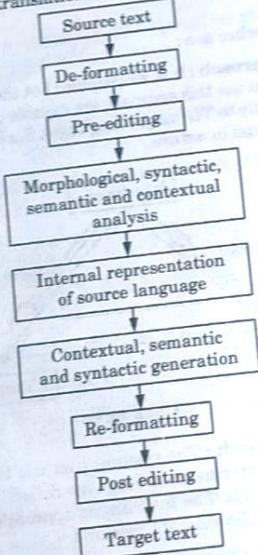
2. **Interlingua Approach :** The systems that use Interlingua approach translate SL to an intermediate language called Interlingua (IL) and then translate IL to TL. The Interlingua approach can be understood with the help of the following MT pyramid.
3. **Transfer Approach :** Three stages are involved with this approach :
 - a. In the first stage, source language (SL) texts are converted to abstract SL-oriented representations.
 - b. In the second stage, SL-oriented representations are converted into equivalent target language (TL)-oriented representations.
 - c. In the third stage, the final text is generated.

4. **Empirical MT Approach :** This is an emerging approach for MT. Basically, it uses large amount of raw data in the form of parallel corpora. The raw data consists of the text and their translations. Analogy-based, example-based, memory-based machine translation techniques use empirical MT approach.

Que 3.19. Design the process of machine translation with the help of flowchart.

Answer

Process of machine translation with the help of the following flowchart:

**4
UNIT****Artificial Neural Networks****CONTENTS**

Part-1 : Deep Learning	4-2M to 4-7M
Part-2 : Recurrent Neural Networks	4-7M to 4-10M
Part-3 : Convolutional Neural Networks	4-10M to 4-12M
Part-4 : The Universal Approximation Theorem	4-13M to 4-14M
Part-5 : Generative Adversarial Networks	4-14M to 4-16M

PART-1*Deep Learning.***Questions-Answers****Long Answer Type and Medium Answer Type Questions**

Que 4.1. Describe artificial neural network (ANN) ?

Answer

1. Neural network is a computing system made up of a number of simple highly interconnected processing elements, which process information by their dynamic state response to external inputs.
2. The idea of ANNs is based on the belief that working of human brain making the right connections can be imitated using silicon and wires living neurons and dendrites.

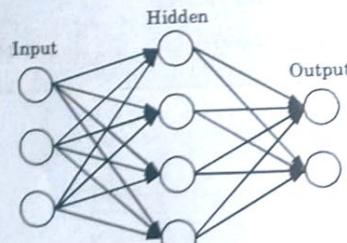


Fig. 4.2.1.

3. The human brain is composed of 86 billion nerve cells called neurons.
4. They are connected to other thousand cells by Axons.
5. Stimuli from external environment or inputs from sensory organs are accepted by dendrites.
6. These inputs create electric impulses, which quickly travel through neural network.
7. A neuron can then send the message to other neuron to handle issue or does not send it forward.

8. ANNs are composed of multiple nodes, which imitate biological neurons of human brain.
9. The neurons are connected by links and they interact with each other. The nodes can take input data and perform simple operations on the data. The result of these operations is passed to other neurons.
10. The output at each node is called its activation or node value.
11. Each link is associated with weight. ANNs are capable of learning, which takes place by altering weight values.

Que 4.2. What are the types of artificial neural network ?

Answer**Types of Artificial Neural Networks :**

1. **Feed Forward ANN :**
 - i. In this ANN, the information flow is unidirectional.
 - ii. A unit sends information to other unit from which it does not receive any information. There are no feedback loops.
 - iii. They are used in pattern generation/recognition/classification. They have fixed inputs and outputs.
2. **Feed Back ANN :**
 - i. In this ANN, feedback loops are allowed.
 - ii. They are used in content addressable memories.

Que 4.3. What do you understand by deep learning ?

Answer

1. Deep learning is the subfield of artificial intelligence that focuses on creating large neural network models that are capable of making accurate data-driven decisions.
2. Deep learning is used where the data is complex and has large datasets.
3. Facebook uses deep learning to analyze text in online conversations. Google and Microsoft all use deep learning for image search and machine translation.
4. All modern smart phones have deep learning systems running on them. For example, deep learning is the standard technology for speech recognition, and also for face detection on digital cameras.

5. In the healthcare sector, deep learning is used to process medical images (X-rays, CT, and MRI scans) and diagnose health conditions.
6. Deep learning is also at the core of self-driving cars, where it is used for localization and mapping, motion planning and steering, and environment perception, as well as tracking driver state.

Que 4.4. Explain the history of deep learning.

Answer

1. In 300 BC : Aristotle introduce associationism, started the history of human's attempt to understand brain.
2. In 1873 : Alexander Bain introduce neural groupings as the earliest models of neural network.
3. In 1913 : McCulloch and Pitts introduce MCP model, which is considered as the ancestor of artificial neural model.
4. In 1919 : Donald Hebb considered as the father of neural networks, introduced Hebbian Learning Rule, which lays the foundation of modern neural network.
5. In 1958 : Frank Rosenblatt introduce the first perceptron, which highly resembles modern perception.
6. In 1974 : Paul Werbos introduce backpropagation.
7. In 1980 : Tenvo Kohonen introduce self organizing map.
8. In 1980 : Kumihiko Fukushima introduce Neocognitron, which inspired convolutional neural network.
9. In 1982 : John Hopfield introduce Hopfield network.
10. In 1985 : Hilton and Sejnowski introduce Boltzmann machine.
11. In 1986 : Paul Smolensky introduce Harmonium, which is later known as restricted Boltzmann machine.
12. In 1986 : Michael I. Jordan defined and introduce recurrent neural network.
13. In 1990 : Yann LeCun introduce LeNet, showed the possibility of deep neural networks in practice.
14. In 1997 : Schuster and Paliwal introduce bidirectional recurrent neural network.
15. In 2006 : Geoffrey Hinton introduce deep belief networks, also introduce layer-wise pretraining technique, opened current deep learning era.

16. In 2009 : Salakhutdinov and Hinton introduce deep Boltzmann machines.
17. In 2012 : Geoffrey Hinton introduce Dropout, an efficient way of training neural networks.

Que 4.5. Discuss the algorithm used for deep learning.

Answer

Following are the algorithm used for deep learning :

1. **Feed forward neural networks :**
 - a. A feed forward neural network is an artificial neural network wherein connections between the nodes do not form a cycle.
 - b. Feedforward neural networks are used for supervised learning in cases where the data to be learned is neither sequential nor time dependent.
2. **Radial basis function neural network :**
 - a. A radial basis function network is an artificial neural network that uses radial basis functions as activation functions.
 - b. The output of the network is a linear combination of radial basis functions of the inputs and neuron parameters
3. **Multilayer perceptron :** The perceptrons which are arranged in layers are called multilayer perceptron. This model has three layers : an input layer, output layer and hidden layer.
4. **Unsupervised pre-trained network :**
 - a. Unsupervised pre-training initializes a discriminative neural network from one which was trained using an unsupervised criterion, such as a deep belief network or a deep autoencoder.
 - b. This method helps with both the optimization and the overfitting issues :
 - i. **Autoencoders :**
 - a. An autoencoder is a type of artificial neural network used to learn efficient data coding in an unsupervised manner.
 - b. The aim of an autoencoder is to learn a representation (encoding) for a set of data, typically for dimensionality reduction, by training the network to ignore signal noise.
 - ii. **Deep belief networks :**
 - a. A Deep Belief Network (DBN) is a generative graphical model composed of multiple layers of latent variables (hidden units), with

connections between the layers but not between units within each layer.

iii. Generative Adversarial Networks (GANs) :

- Generative Adversarial Networks (GANs) are a powerful class of neural networks that are used for unsupervised learning.
- GANs are basically made up of a system of two competing neural network models which compete with each other and are able to analyze, capture and copy the variations within a dataset.

5. Convolutional Neural Networks (CNNs) :

- ConvNets (CNNs) are the category of Neural Networks that have proven very effective in areas such as image recognition and classification.
- ConvNets have been successful in identifying faces, objects and traffic signs apart from powering vision in robots and self driving cars.

6. Recurrent neural network :

- A recurrent neural network (RNN) is a class of artificial neural networks where connections between nodes form a directed graph along a temporal sequence.
- This allows it to exhibit temporal dynamic behavior.
- Derived from feedforward neural networks, RNNs can use their internal state (memory) to process variable length sequences of inputs.

7. Recursive neural networks :

- A recursive neural network is a kind of deep neural network created by applying the same set of weights recursively over a structured input, to produce a structured prediction over variable-size input structures, or a scalar prediction on it, by traversing a given structure in topological order.

Que 4.6. What are the applications of deep learning ?

Answer

1. Automatic text generation :

- Corpus of text is learned and from this model new text is generated word-by-word, character-by-character.
- Then this model is capable of learning how to spell, punctuate, find sentences, or it may even capture the style.

- Healthcare** : Helps in diagnosing various diseases and treating it.
- Automatic machine translation** : Certain words, sentences or phrases in one language are transformed into another language.
- Image recognition** : Recognizes and identifies peoples and objects in images as well as to understand content and context. This area is already being used in gaming, retail, tourism, etc.
- Predicting earthquakes** : Teaches a computer to perform viscoelastic computations which are used in predicting earthquakes.

PART-2

Recurrent Neural Networks.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 4.7. What is recurrent neural network ?

Answer

- Recurrent Neural Network (RNN) is a type of neural network where the output from previous step are fed as input to the current step.
- In traditional neural networks, all the inputs and outputs are independent of each other, but in cases like when it is required to predict the next word of a sentence, the previous words are required and hence there is a need to remember the previous words.
- Thus RNN came into existence, which solved this issue with the help of a Hidden Layer.
- The main and most important feature of RNN is Hidden state, which remembers some information about a sequence.
- RNN has a "memory" which remembers all information about what has been calculated.
- It uses the same parameters for each input as it performs the same task on all the inputs or hidden layers to produce the output.
- This reduces the complexity of parameters, unlike other neural networks.

Que 4.8. What are the advantages and disadvantages of recurrent neural network ?

Answer**Advantages of Recurrent Neural Network :**

1. An RNN remembers each and every information through time. It is useful in time series prediction only because of the feature to remember previous inputs as well. This is called Long Short Term Memory.
2. Recurrent neural network are even used with convolutional layers to extend the effective pixel neighborhood.

Disadvantages of Recurrent Neural Network :

1. Gradient vanishing and exploding problems.
2. Training an RNN is a very difficult task.
3. It cannot process very long sequences if using tanh or relu as an activation function.

Que 4.9. Write down the Applications of Recurrent Neural Networks.

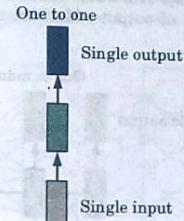
Answer**Applications of Recurrent Neural Networks :**

1. **Image Captioning :** RNNs are used to caption an image by analyzing the activities present.
2. **Time Series Prediction :** Any time series problem, like predicting the prices of stocks in a particular month, can be solved using an RNN.
3. **Natural Language Processing :** Text mining and Sentiment analysis can be carried out using an RNN for Natural Language Processing (NLP).
4. **Machine Translation :** Given an input in one language, RNNs can be used to translate the input into different languages as output.

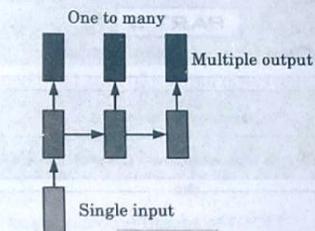
Que 4.10. What are the different types of Recurrent Neural Networks ?

Answer**There are four types of Recurrent Neural Networks :**

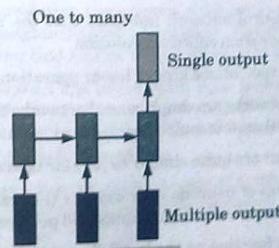
1. **One to One RNN :** This type of neural network is known as the Very Simple Recurrent Neural Network. It's used for general machine learning problems, as it has a single input and a single output.

**Fig. 4.10.1.**

2. **One to Many RNN :** This type of neural network has a single input and multiple outputs. An example of this is the image caption.

**Fig. 4.10.2.**

3. **Many to One RNN :** This RNN takes a sequence of inputs and generates a single output. Sentiment analysis is a good example of this kind of network where a given sentence can be classified as expressing positive or negative sentiments.

**Fig. 4.10.3.**

4. **Many to Many RNN :** This RNN takes a sequence of inputs and generates a sequence of outputs. Machine translation is one of the examples.

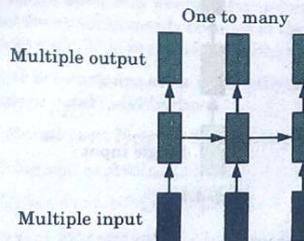


Fig. 4.10.4.

PART-3

Convolutional Neural Networks.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 4.11. Describe convolutional neural networks.

Answer

1. Convolutional networks also known as Convolutional Neural Networks (CNNs) are a specialized kind of neural network for processing data that has a known, grid-like topology.
2. Convolutional neural network indicates that the network employs a mathematical operation called convolution.
3. Convolution is a specialized kind of linear operation.
4. Convolutional networks are simply neural networks that use convolution in place of general matrix multiplication in at least one of their layers.
5. CNNs (ConvNets) are quite similar to regular neural networks.
6. They are made up of neurons with weights that can be learned from data. Each neuron receives some inputs and performs a dot product.
7. They have a loss function on the last fully connected layer.

8. They can use a non-linearity function a regular neural network receives input data as a single vector and passes through a series of hidden layers.

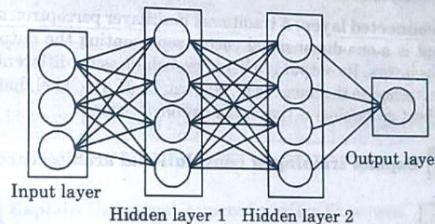


Fig. 4.11.1. A regular three layer neural network.

9. Every hidden layer consists of neurons, wherein every neuron is fully connected to all the other neurons in the previous layer.
10. Within a single layer, each neuron is completely independent and they do not share any connections.
11. The fully connected layer (the output layer) contains class scores in the case of an image classification problem.

Que 4.12. Explain the layers in a convolutional neural network.

OR

What are the basic building blocks of CNN ?

Answer

Layers in a Convolutional Neural Network:

1. **Convolution layer :** A "filter", sometimes called a "kernel", is passed over the image, viewing a few pixels at a time (for example, 3×3 or 5×5). The convolution operation is a dot product of the original pixel values with weights defined in the filter. The results are summed up into one number that represents all the pixels the filter observed.
2. **Activation layer :** The convolution layer generates a matrix that is much smaller in size than the original image. This matrix is run through an activation layer, which introduces non-linearity to allow the network to train itself via backpropagation.
3. **Pooling layer :** Pooling is the process of further downsampling and reducing the size of the matrix. A filter is passed over the results of the

previous layer and selects one number out of each group of values. This allows the network to train much faster, focusing on the most important information in each feature of the image.

4. **Fully connected layer:** A traditional multilayer perceptron structure. Its input is a one-dimensional vector representing the output of the previous layers. Its output is a list of probabilities for different possible labels attached to the image (e.g., dog, cat, bird). The label that receives the highest probability is the classification decision.

Que 4.13. Explain training of convolutional architecture.

Answer

1. During network training, the filter weights are adjusted, so as to improve the classification performance of the network.
2. This can be done using a method called backpropagation, where the gradient of an error function is computed with respect to all network weights, going all the way to the input connections of the network.
3. Network weights are updated by the following equation relating the step to the gradient and the learning rate, denoted by η .

$$W_{\text{new}} = W - \eta \frac{dE}{dW} \quad \dots(4.13.1)$$

4. An error function can be expressed as a sum of squared differences between the network's output and the correct output, over all discrete points in the output.
5. This sort of scoring function works for cases where the network output is a vector, matrix, or tensor of continuous real values.

$$E(W, b) = \frac{1}{N} \sum_{i=1}^n \frac{1}{2} \| hW, b(I^{(i)}) - y^{(i)} \|^2 \quad \dots(4.13.2)$$

6. The gradient of this scoring function would be taken in eq. (4.13.1).
7. For classification network, the scoring function is computed differently.
8. Because the output is a one-of-N vector, where the highest value component represents the network's best estimation of the image class (i.e., car, boat, airplane, etc), an error function for categorical output is needed.
9. This is called the categorical cross entropy.

PART-4

The Universal Approximation Theorem.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 4.14. Explain Universal Approximation Theorem.

Answer

1. Feedforward networks with hidden layers provide a universal approximation framework.
2. The universal approximation theorem states that a feedforward network with a linear output layer and at least one hidden layer with any "squashing" activation function can approximate any Borel measurable function from one finite-dimensional space to another with any desired non-zero amount of error, provided that the network is given enough hidden units.
3. The derivatives of the feedforward network can also approximate the derivatives of the function.
4. The concept of Borel states that for any continuous function on a closed and bounded subset of R^n is Borel measurable and therefore may be approximated by a neural network.
5. The universal approximation theorem means that a large MLP will be able to represent function.
6. Even if the MLP is able to represent the function, learning can fail for two different reasons:
 - a. Optimization algorithm used for training may not be able to find the value of the parameters that corresponds to the desired function.
 - b. Training algorithm might choose the wrong function due to overfitting.
7. Feedforward networks provide a universal system for representing functions, in the sense that, given a function, there exists a feedforward network that approximates the function.
8. There is no universal procedure for examining a training set of specific examples and choosing a function that will generalize to points not in the training set.

9. The universal approximation theorem says that there exists a network large enough to achieve any degree of accuracy we desire, but the theorem does not say how large this network will be.
10. Scientists provide some bounds on the size of a single-layer network needed to approximate a broad class of functions. In the worse case, an exponential number of hidden units.
11. This is easiest to see in the binary case : the number of possible binary functions on vectors $V \in \{0, 1\}^n$ is 2^{2^n} and selecting one such function requires 2^n bits, which will in general require $O(2^n)$ degrees of freedom.
12. A feedforward network with a single layer is sufficient to represent any function, but the layer may be infeasibly large and may fail to learn and generalize correctly.

PART-5
Generative Adversarial Networks.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 4.15. Discuss Generative Adversarial Network (GAN).

Answer

1. Generative Adversarial Networks (GANs) are a powerful class of neural networks that are used for unsupervised learning.
2. GANs are made up of a system of two competing neural network models which compete with each other and are able to analyze, capture and copy the variations within a dataset.
3. Generative Adversarial Networks (GANs) can be broken down into three parts :
 - a. **Generative** : To learn a generative model, which describe how data is generated in terms of a probabilistic model.
 - b. **Adversarial** : The training of a model is done in an adversarial setting.
 - c. **Networks** : Use deep neural networks as the Artificial Intelligence (AI) algorithms for training purpose.
4. In GANs, there is a generator and a discriminator. The Generator generates fake samples of data and tries to distract the discriminator.

5. The Discriminator tries to distinguish between the real and fake samples. The Generator and the Discriminator are both Neural Networks and they both run in competition with each other in the training phase as shown in Fig. 4.15.1.
6. Here, the generative model captures the distribution of data and is trained in such a manner that it tries to maximize the probability of the Discriminator in making a mistake.
7. The Discriminator is based on a model that estimates the probability that the sample that it got is received from the training data and not from the Generator.
8. The GANs are formulated as a minimax game, where the Discriminator is trying to minimize its reward $V(D, G)$ and the Generator is trying to minimize the Discriminator's reward or in other words, maximize its loss.

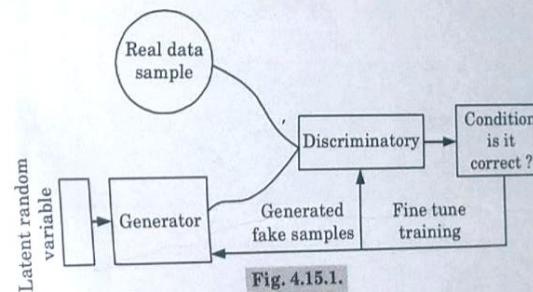


Fig. 4.15.1.

Que 4.16. What are the advantages and disadvantages of GAN ?

Also give the application of GAN.

Answer

Advantages of GAN :

1. Better modeling of data distribution (images sharper and clearer).
2. GANs can train any kind of generator network. Other frameworks require generator networks to have some specific form of functionality, such as the output layer being Gaussian.
3. GANs go into details of data and can easily interpret into different versions so it is helpful in doing machine learning work.

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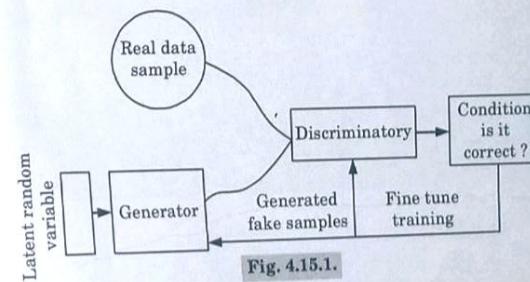
PART-5*Generative Adversarial Networks.***Questions-Answers****Long Answer Type and Medium Answer Type Questions**

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3. GANs go into details of data and can easily interpret into different versions so it is helpful in doing machine learning work.

Disadvantages of GAN :

1. Hard to train, unstable. Good synchronization is required between the generator and the discriminator.
2. Mode collapse issue. The learning process of GANs may have a missing pattern, the generator begins to degenerate, and the same sample points are always generated, and the learning cannot be continued.

Applications of GAN :

1. GANs are helpful in marketing, advertisements, e-commerce, games, hospitals, etc.
2. We can generate images for novels and other story writing stuff.
3. GANs are mostly used in generating images and videos.

**Applications****CONTENTS**

Part-1 :	Image and Face Recognition	5-2M to 5-7M
Part-2 :	Object Recognition	5-8M to 5-9M
Part-3 :	Speech Recognition	5-10M to 5-13M besides Computer Vision
Part-4 :	Robots	5-13M to 5-16M
Part-5 :	Applications	5-17M to 5-18M

PART-1*Image and Face Recognition.***Questions-Answers****Long Answer Type and Medium Answer Type Questions****Que 5.1.** What is image recognition ?**Answer**

1. Image recognition is a computer vision task that works to identify and categorize various elements of images and/or videos.
2. Image recognition models are trained to take an image as input and output one or more labels describing the image.
3. The set of possible output labels are referred to as target classes.
4. Along with a predicted class, image recognition models may also output a confidence score related to how certain the model is that an image belongs to a class.

Que 5.2. How image recognition actually works ?**Answer**

Major steps in image recognition process :

1. Gather and Organize Data :

- i. The human eye perceives an image as a set of signals which are processed by the visual cortex in the brain.
- ii. This results in a vivid experience of a scene, associated with concepts and objects recorded in one's memory. Image recognition tries to mimic this process.
- iii. Computer perceives an image as either a raster or a vector image.
- iv. To analyze images the geometric encoding is transformed into constructs depicting physical features and objects. These constructs can then be logically analyzed by the computer.
- v. Organizing data involves classification and feature extraction.

- vi. The first step in image classification is to simplify the image by extracting important information and leaving out the rest.

2. Build a Predictive Model :

- i. To build a predictive model we need neural networks. The neural network is a system of hardware and software similar to our brain to estimate functions that depend on the huge amount of unknown inputs.
- ii. A neural network is an interconnected group of nodes.
- iii. Each processing node has its own small sphere of knowledge, including what it has seen and any rules it was originally programmed with or developed for itself.
- iv. The neural network would require one learning algorithm. There are numerous algorithms for image classification in recognizing images such as support vector machines (SVM), face landmark estimation (for face recognition), K-nearest neighbors (KNN), logistic regression etc.

3. Recognize Images :

- i. The image data, both training and test are organized.
- ii. Training data is different from test data, which also means we remove duplicates (or near duplicates) between them.
- iii. This data is fed into the model to recognize images.
- iv. We have to find the image of an object in our database of known images which has the closest measurements to our test image.
- v. We need to train a classifier that can take the measurements from a new test image and tells us about the closest match with a object. Running this classifier takes milliseconds. The result of the classifier is the 'object' or 'Non-object'.

Que 5.3. What are the uses of AI image recognition ?**Answer**

Uses of AI image recognition :

- 1. Image Recognition AI used in visual search :**
 - i. Visual search is a novel technology, powered by AI that allows the user to perform an online search by employing real-world images as a substitute for text.
 - ii. Google lens is one of the examples of image recognition applications.

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Applications

2. **Image recognition AI can be used to organize the images :**
 - i. Image recognition AI technology helps to arrange the captured photos and videos into categories that lead to enhanced accessibility later.
 - ii. When the content is organized properly, the users not only get the added benefit of enhanced search and discovery of those pictures and videos, but they can also effortlessly share the content with others.
 - iii. For example, Google Photos allows users to store unlimited pictures (up to 16 megapixels) and videos (up to 1080p resolution).
3. **Image recognition used for content moderation :**
 - i. Image recognition powered with AI helps in automated content moderation, so that the content shared is safe, meets the community guidelines, and serves the main objective of the platform.

Que 5.4. Discuss face recognition in deep learning.

Answer

1. Face recognition is a method of identifying or verifying the identity of an individual using their face. Face recognition systems can be used to identify people in photos, video, or in real-time.
2. Face recognition systems use computer algorithms to pick out specific, distinctive details about a person's face.
3. These details, such as distance between the eyes or shape of the chin, are then converted into a mathematical representation and compared to data on other faces collected in a face recognition database.
4. The data about a particular face is often called a face template and it is designed to only include certain details that can be used to distinguish one face from another.
5. Face recognition is often described as a process that first involves four steps :
 - a. **Face detection :** Locate one or more faces in the image and mark with a bounding box.
 - b. **Face alignment :** Normalize the face to be consistent with the database, such as geometry and photometrics.
 - c. **Feature extraction :** Extract features from the face that can be used for the recognition task.

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- d. **Face recognition :** Perform matching of the face against one or more known faces in a prepared database.

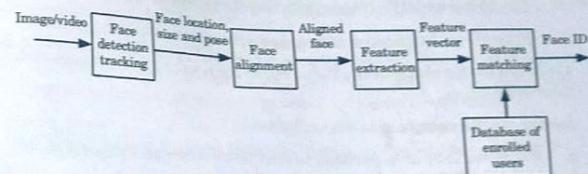


Fig. 5.4.1. Face recognition processing flow.

Que 5.5. Explain the steps used in face recognition.

Answer

Following are the steps used in face recognition :

Step 1 : A picture of our face is captured from a photo or video. Our face might appear alone or in a crowd. Our image may show us looking straight ahead or nearly in profile.

Step 2 : Facial recognition software reads the geometry of our face. Key factors include the distance between our eyes and the distance from forehead to chin. The software identifies facial landmarks that are keys to distinguishing our face. The result: our facial signature.

Step 3 : Our facial signature a mathematical formula is compared to a database of known faces.

Step 4 : A determination is made. Our faceprint may match that of an image in a facial recognition system database.

Que 5.6. Discuss the application of face (facial) recognition.

Answer

Application of facial recognition :

1. **At airports :**
 - a. Facial recognition systems can monitor people coming and going in airports.
 - b. The technology is used to identify people who have overstayed their visas or may be under criminal investigation.

2. **Mobile phone makers in products :**
 - a. Apple first used facial recognition to unlock its iPhone X, and continues with the iPhone XS.
 - b. Face ID authenticates and makes sure we are accessing phone.
3. **Colleges in the classroom :** Facial recognition software can, in essence, take attendance.
4. **Social media companies on websites :**
 - a. Facebook uses an algorithm to spot faces when we upload a photo to its platform.
 - b. The social media company asks if want to tag people in our photos. If we say yes, it creates a link to their profiles.
 - c. Facebook can recognize faces with 98 percent accuracy.
5. **Businesses at entrances and restricted areas :** Some companies have traded in security badges for facial recognition systems.
6. **Religious groups at places of worship :** Churches have used facial recognition to scan their congregations to see who's present.
7. **Retailers in stores :** Retailers can combine surveillance cameras and facial recognition to scan the faces of shoppers. One goal is to identifying suspicious characters and potential shoplifters.
8. **Airlines at departure gates :** When the fliers board the flight the airline scans the flier face.

Que 5.7. What are the issues related with face recognition ?

Answer

Issues related with face recognition :

1. **Security :** Our facial data can be collected and stored, often without our permission. It is possible that hackers could access and steal that data.
2. **Prevalence :** Facial recognition technology is becoming more widespread. That means our facial signature could end up in a lot of places. We probably would not know who has access to it.
3. **Ownership :** We own our face but our digital images are different. We may have given up our right to ownership when we signed up on a social media network.
4. **Safety :** Facial recognition could lead to online harassment and stalking. For example, someone takes our picture on a subway or some other

public place and uses facial recognition software to find out exactly who we are.

5. **Mistaken identity :** Facial recognition systems may not be 100 percent accurate.
6. **Basic freedoms :** Government agencies and others could have the ability to track us. What we do and where we go might no longer be private. It could become impossible to remain anonymous.

Que 5.8. How is deep learning used in facial recognition ?

Answer

1. Deep learning networks are loosely based on the structure of the human brain, and enable us to train machines to learn by example.
2. This means that once the deep learning algorithms have been trained for long enough using datasets that are both sufficiently large and diverse, they can apply what they have learned to make predictions or produce results in response to new data.
3. Deep learning uses Convolutional Neural Networks (CNNs) to perform facial recognition.
4. A CNN is a type of Deep Neural Network (DNN) that is optimized for complex tasks such as image processing, which is required for facial recognition.
5. CNNs consist of multiple layers of connected neurons. There is an input layer, an output layer, and multiple layers between these two.
6. With facial recognition, the input is an image, which the CNN processes as groups of pixels. These groups are scanned as matrices, and the values within the matrices are multiplied, with the results of this multiplication being fed into the next layer.
7. This process continues through all the layers, until it reaches the output layer, where the network produces an output in the form of an array of 2048 numbers. This array is referred to as a faceprint.
8. The computed faceprint can then be compared to another faceprint (1 : 1 matching), or to a database of faceprints (1 : N matching), to determine whether or not there is a match.
9. If two or more faceprints are similar enough, based on the chosen confidence thresholds, they will be recorded as a match.

PART-2*Object Recognition.***Questions-Answers****Long Answer Type and Medium Answer Type Questions****Que 5.9.** What is Object Recognition ?**Answer**

1. Object recognition is a computer vision technique for identifying objects in images or videos.
2. Object recognition is a key output of deep learning and machine learning algorithms.
3. When humans look at a photograph or watch a video, we can readily spot people, objects, scenes, and visual details.
4. The goal is to teach a computer to do what comes naturally to humans: to gain a level of understanding of what an image contains.
5. Object recognition is a key technology behind driverless cars, enabling them to recognize a stop sign or to distinguish a pedestrian from a lamppost.
6. It is also useful in a variety of applications such as disease identification in bioimaging, industrial inspection, and robotic vision.

Que 5.10. What are the two approaches to perform object recognition using deep learning ?**Answer**

Following are two approaches to perform object recognition using deep learning :

1. **Training a model from scratch :** To train a deep network from scratch, you gather a very large labeled dataset and design a network architecture that will learn the features and build the model. The results can be impressive, but this approach requires a large amount of training data, and you need to set up the layers and weights in the CNN.

2. **Using a pretrained deep learning model :** Most deep learning applications use the transfer learning approach, a process that involves fine-tuning a pretrained model. You start with an existing network and feed in new data containing previously unknown classes. This method is less time-consuming and can provide a faster outcome because the model has already been trained on thousands or millions of images.

Que 5.11. What are the four main tasks of object recognition ?**Answer**

The four main tasks of object recognition are :

1. Classification.
2. Tagging.
3. Detection.
4. Segmentation.

A. Classification and tagging :

- i. The mechanism of this task is straightforward.
- ii. It starts with the definition of the ontology, i.e., the class of objects to detect.
- iii. Then, both classification and tagging identify what is in the image and the associated level of confidence.
- iv. While classification recognizes only one class of objects, tagging can recognize multiple ones for a given image in tagging; it will try to return all the best classes corresponding to the image.

B. Detection and segmentation :

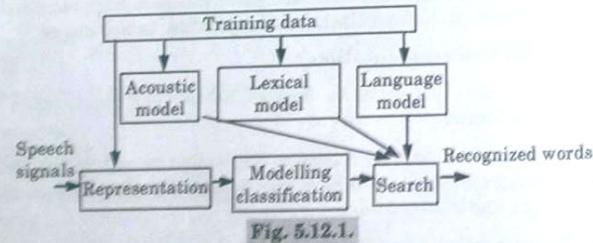
- i. There are two ways to locate the objects : detection and segmentation.
- ii. Detection outputs a rectangle, also called bounding box, where the objects are. It is a very robust technology, prone to minor errors and imprecisions.
- iii. Segmentation identifies the objects for each pixel in the image, resulting in a very precise map.
- iv. However, the accuracy of segmentation depends on an extensive and often time-consuming training of the neural network.

PART-3*Speech Recognition besides Computer Vision.***Questions-Answers****Long Answer Type and Medium Answer Type Questions**

Que 5.12. Explain speech recognition in detail. Write its application.

Answer**Speech recognition :**

1. Speech recognition is the process of converting an acoustic signal, captured by a microphone or a telephone, to a set of words.
2. The recognized words can be the final results, as for applications such as commands and control, data entry and document preparation.
3. Speech recognition is a difficult problem, because of the many sources of variability associated with the signal.
4. Fig. 5.12.1 shows the major components of a typical speech recognition system.



5. The speech signal is first transformed into a set of useful measurements or features at a fixed rate, typically once every 10-20 msec.
6. These measurements are then used to search for the most likely word candidate, making use of constraints imposed by the acoustic, lexical, and language models.

Applications of speech recognition :

1. **In the workplace :** Speech recognition technology in the workplace has evolved into incorporating simple tasks to increase efficiency, as well as beyond tasks that have traditionally needed humans to be performed. For example,
 - i. Search for reports or documents on your computer
 - ii. Start video conferences
 - iii. Schedule meetings
 - iv. Record minutes
2. **In banking :** The aim of the banking and financial industry for speech recognition is to reduce friction for the customer. Voice-activated banking could largely reduce the need for human customer service. For example,
 - i. Request information regarding your balance, transactions, and spending habits.
 - ii. Make payments.
3. **In healthcare :** In healthcare, immediate access to information can have a significantly positive impact on patient safety and medical efficiency. For example,
 - i. Quickly finding information from medical records.
 - ii. Nurses can be reminded of processes or given specific instructions.
 - iii. Nurses can ask for administrative information, such as the number of patients on a floor and the number of available units.

Que 5.13. Write a short note on speech processing.

Answer

1. Speech processing is the process by which speech signals are interpreted, understood, and acted upon.
2. It specifically refers to the processing of human speech by computerized systems, as in voice recognition software or voice-to-text programs.
3. Speech processing is important to both theoretical and practical uses, ranging from voice activation and control in phones to development of functional artificial intelligence in computer science.
4. Interpretation and production of coherent speech are both important in the processing of speech; some concerns do favour one over the other, however, as the application needs of speech processing are very diverse.

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5. Speech recognition is one of the most important aspects of speech processing because the overall aim of processing speech is to comprehend and to act on spoken language.
6. One commonly used application of speech recognition is simple speech-to-text conversion, which is used in many word processing programs.
7. Another component of speech processing is voice recognition, which is essentially a combination of speech and speaker recognition.
8. Voice recognition occurs when speech recognition programs process the speech of a known speaker; such programs can generally interpret the speech of a known speaker with much greater accuracy than that of a random speaker.
9. Voice analysis differs from other topics in speech processing because it is not really concerned with the linguistic content of speech.
10. It is primarily concerned with speech patterns and sounds. Voice analysis could be used to diagnose problems with the vocal cords or other organs related to speech by noting sounds that are indicative of disease or damage.
11. Sound and stress patterns could also be used to determine if an individual is telling the truth, though this use of voice analysis is highly controversial.

Que 5.14. What is computer vision ? What are the types of computer vision ?

Answer

1. Computer vision is a field of artificial intelligence that trains computers to interpret and understand the visual world.
2. Using digital images from cameras and videos and deep learning models, machines can accurately identify and classify objects and then react to what they see.

Different types of computer vision :

1. **Image segmentation** : It partitions an image into multiple regions or pieces to be examined separately.
2. **Object detection** : It identifies a specific object in an image. Advanced object detection recognizes many objects in a single image; a football field, an offensive player, a defensive player, a ball and so on. These models use an X, Y coordinate to create a bounding box and identify everything inside the box.
3. **Facial recognition** : It is an advanced type of object detection that not only recognizes a human face in an image, but identifies a specific individual.

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4. **Edge detection** : It is a technique used to identify the outside edge of an object or landscape to better identify what is in the image.
5. **Pattern detection** : It is a process of recognizing repeated shapes, colors and other visual indicators in images.
6. **Image classification** : It groups images into different categories.
7. **Feature matching** : It is a type of pattern detection that matches similarities in images to help classify them.

Que 5.15. What are the tasks of computer vision ?

Answer

Tasks of computer vision are :

1. **OCR** : Optical Character Reader is a software to convert scanned documents into editable text, which accompanies a scanner.
2. **Face Detection** : Many state-of-the-art cameras come with this feature, which enables to read the face and take the picture of that perfect expression. It is used to let a user access the software on correct match.
3. **Object Recognition** : They are installed in supermarkets, cameras, high-end cars.
4. **Estimating Position** : It is estimating position of an object with respect to camera.

PART-4

Robots.

Questions-Answers**Long Answer Type and Medium Answer Type Questions**

Que 5.16. What are Robots ? What is Robotics ?

Answer

Robots :

- i. Robots are the artificial agents acting in real world environment.
- ii. Robots are aimed at manipulating the objects by perceiving, picking, moving, modifying the physical properties of object, destroying it, or to

have an effect thereby freeing manpower from doing repetitive functions without getting bored, distracted, or exhausted.

Robotics :

- Robotics is a branch of AI, which is composed of Electrical Engineering, Mechanical Engineering, and Computer Science for designing, construction, and application of robots.
- The robots have mechanical construction, form, or shape designed to accomplish a particular task.
- They have electrical components which power and control the machinery.
- They contain some level of computer program that determines what, when and how a robot does something.

Que 5.17. Difference between AI program and Robot System ?
Answer

S. No.	AI programs	Robots
1.	They usually operate in computer-stimulated worlds.	They operate in real physical world.
2.	The input to an AI program is in symbols and rules.	Input to robots is analog signal in the form of speech waveform or images.
3.	They need general purpose computers to operate on.	They need special hardware with sensors and effectors.

Que 5.18. How do Robots and Artificial Intelligence work together ?
Answer

- Artificial Intelligence gives robots a computer vision to navigate, sense and calculate their reaction accordingly.
- Robots learn to perform their tasks from humans through machine learning which again is a part of computer programming and AI.
- AI has the power to give life to robots and empower them to take their decisions on their own.
- Depending on the use and the tasks that the robot has to perform different types of AI is used. They are as follows:

1. Weak Artificial Intelligence :

- This type of AI is used to create a simulation of human thought and interaction. The robots have predefined commands and responses.
- The robots do not understand the commands they do only the work of retrieving the appropriate response when the suitable command is given.
- The example of this is Siri and Alexa. The AI in these devices only executes the tasks as demanded by the owner.

2. Strong Artificial Intelligence :

- This type of AI is used in those robots that perform their tasks on their own. They do not need any kind of supervision once they are programmed to do the task correctly.
- This type of AI is widely used in automated things and the examples are self-driving cars and internet cars.
- This type of AI is also used in humanoid robots which can sense their environment quite well and interact with their surroundings.
- Also, robotic surgeons are becoming popular day by day as there is no human intervention required at all.

3. Specialized Artificial Intelligence :

- This type of AI is used when the robot needs to perform only specified special tasks. It is restricted only to limited tasks.
- This includes mainly **industrial robots** which perform specified and repetitive tasks like painting, tightening, etc.

Que 5.19. What are the Components of a Robot ?
Answer

Robots are constructed with the following :

- Power Supply :** The robots are powered by batteries, solar power, hydraulic, or pneumatic power sources.
- Actuators :** They convert energy into movement.
- Electric motors (AC/DC) :** They are required for rotational movement.
- Pneumatic Air Muscles :** They contract almost 40% when air is sucked in them.
- Muscle Wires :** They contract by 5% when electric current is passed through them.
- Piezo Motors and Ultrasonic Motors :** Best for industrial robots.
- Sensors :** They provide knowledge of real time information on the task environment. Robots are equipped with vision sensors to compute the

depth in the environment. A tactile sensor imitates the mechanical properties of touch receptors of human fingertips.

Que 5.20. Describe robot locomotion. What are types of locomotion ?

Answer

Locomotion is the mechanism that makes a robot capable of moving in its environment. There are various types of locomotion :

1. Legged Locomotion :

- i. This type of locomotion consumes more power while demonstrating walk, jump, trot, hop, climb up or down, etc.
- ii. It requires more number of motors to accomplish a movement. It is suited for rough as well as smooth terrain where irregular or too smooth surface makes it consume more power for a wheeled locomotion. It is little difficult to implement because of stability issues.
- iii. It comes with the variety of one, two, four, and six legs. If a robot has multiple legs then leg coordination is necessary for locomotion.

2. Wheeled Locomotion :

- i. It requires fewer numbers of motors to accomplish a movement.
- ii. It is little easy to implement as there are less stability issues in case of more number of wheels. It is power efficient as compared to legged locomotion.
 - a. **Standard wheel** : Rotates around the wheel axle and around the contact.
 - b. **Castor wheel** : Rotates around the wheel axle and the offset steering joint.
 - c. **Swedish 45° and Swedish 90° wheels** : Omni-wheel, rotates around the contact point, around the wheel axle, and around the rollers.
 - d. **Ball or spherical wheel** : Omnidirectional wheel, technically difficult to implement.

3. Slip/Skid Locomotion :

- i. In this type, the vehicles use tracks as in a tank.
- ii. The robot is steered by moving the tracks with different speeds in the same or opposite direction. It offers stability because of large contact area of track and ground.

PART-5

Questions-Answers

Long Answer Type and Medium Answer Type Questions

Que 5.21. Discuss the robotic applications that use Artificial Intelligence ?

Answer

Ways in which AI is deployed are :

1. Assembly :

- i. AI is a highly useful tool in robotic assembly applications.
- ii. When combined with advanced vision systems, AI can help with real-time course correction, which is particularly useful in complex manufacturing sectors like aerospace.
- iii. AI can also be used to help a robot learn on its own which paths are best for certain processes while it's in operation.

2. Packaging :

- i. Robotic packaging uses forms of AI frequently for quicker, lower cost and more accurate packaging.
- ii. AI helps save certain motions a robotic system makes, while constantly refining them, which makes installing and moving robotic systems easy enough for anybody to do.

3. Customer Service :

- i. Robots are now used in a customer service capacity in retail stores and hotels around the world.
- ii. Most of these robots leverage AI natural language processing abilities to interact with customers in a more humane way. Often, the more these systems can interact with humans, the more they learn.

4. Open Source Robotics :

- i. Few of the robotic systems are now being sold as open source systems with AI capability.
- ii. Users can teach their robots to do custom tasks based on their specific application.

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PART-5

Applications.

Questions-Answers

Long Answer Type and Medium Answer Type Questions

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4. Open Source Robotics :

- Few of the robotic systems are now being sold as open source systems with AI capability.
- Users can teach their robots to do custom tasks based on their specific application.

- iii. The convergence of open source robotics and AI could be a huge trend in the future of AI robots.
- iv. When working together, robots are smarter, more accurate and more profitable. AI has yet to come close to reaching its full potential, but as it advances, so will robotics.

Que 5.22. What are the various domains of applications of Robotics ?

Answer

The robotics has been instrumental in the various domains such as :

1. **Industries** : Robots are used for handling material, cutting, welding, color coating, drilling, polishing, etc.
2. **Military** : Autonomous robots can reach inaccessible and hazardous zones during war.
3. **Medicine** : The robots are capable of carrying out hundreds of clinical tests simultaneously, rehabilitating permanently disabled people, and performing complex surgeries such as brain tumors.
4. **Exploration** : The robot rock climbers used for space exploration, underwater drones used for ocean exploration are to name a few.
5. **Entertainment** : Disney's engineers have created hundreds of robots for movie making.



An Overview to AI (2 Marks Questions)

- 1.1. Define artificial intelligence ?**

Ans: Artificial Intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and reacts like humans.

- 1.2. What are the goals of AI ?**

Ans: Goals of AI :

1. To create expert systems.
2. To implement human intelligence in machines.

- 1.3. Define machine learning.**

Ans: Machine learning is an application of Artificial Intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

- 1.4. Define deep learning.**

Ans: Deep learning is the subfield of artificial intelligence that focuses on creating large neural network models that are capable of making accurate data-driven decisions.

- 1.5. What are the responsibilities of an AI Engineer ?**

Ans: Responsibilities of an AI Engineer :

1. Build data ingestion and data transformation infrastructure.
2. Automate infrastructure that the data science team uses.
3. Set up and manage AI development and product infrastructure.
4. Be a good team player.

- 1.6. What are the emerging technologies in artificial intelligence ?**

Ans: Emerging technologies in artificial intelligence are :

1. AI-enhanced Analytics Solutions
2. Deep Learning (DL)
3. Natural Language Generation (NLG)
4. Speech Analytics

1.7. What is speech analytics ?

Ans: Speech analytics uses AI technology to recognize speech, convert speech into text, and perform analytics on the text data set. This technology is used in many contact centers to improve customer interactions, and agent performance.

1.8. Discuss the applications of artificial intelligence.

Ans: Applications of artificial intelligence :

1. Gaming
2. Natural language processing
3. Expert systems
4. Vision systems
5. Speech recognition

1.9. Write down the applications of deep learning.

- Ans:**
1. Automatic text generation.
 2. Healthcare.
 3. Automatic machine translation.
 4. Image recognition.
 5. Predicting earthquakes.

**Data & Algorithms
(2 Marks Questions)****2.1. Define data.**

Ans: Data are raw facts and figures that can be processed or stored by a computer. For example, text, numbers, symbols, etc.

2.2. What is data storage ?

Ans: Data storage means that files and documents are recorded digitally and saved in a storage system for future use.

2.3. Define data acquisition.

Ans: Data acquisition is the process of measuring physical world conditions and phenomena such as electricity, sound, temperature and pressure.

2.4. Define data cleaning.

Ans: Data cleaning is a process to remove the noisy data, clean the data by filling in the missing values and correct the inconsistencies in data.

2.5. Define data integration.

Ans: Data integration is a technique that combines the data from multiple heterogeneous data sources into a coherent data store. Data integration may involve inconsistent data and therefore needs data cleaning.

2.6. What is data visualization ?

Ans: Data visualization is a set of data points and information that are represented graphically to make it easy and quick for user to understand.

2.7. What are the categories of data visualization ?

- Ans:** Following are the categories of data visualization :
1. Numerical Data visualization
 2. Categorical Data visualization

2.8. Define classification.

Ans. Classification is a process of finding a function which helps in dividing the dataset into classes based on different parameters.

2.9. What is clustering ?

Ans. Clustering is the process of making a group of abstract objects into classes of similar objects.

2.10. Define recommender system.

Ans. A Recommender System refers to a system that is capable of predicting the future preference of a set of items for a user, and recommends the top items.

2.11. Write down the types of data storage.

Ans. Types of Data Storage :

1. Direct Attached Storage (DAS)
2. Network Attached Storage (NAS)



3

UNIT

Natural Language Processing (2 Marks Questions)

3.1. Define speech recognition.

Ans. Speech recognition is the process that enables a computer to recognize and respond to spoken words and then convert them in a format that the machine understands. The machine may then convert it into another form of data depending on the end-goal.

3.2. Define natural language processing.

Ans. Natural Language Processing (NLP) studies the problems inherent in the processing and manipulation of natural language and to make computer understand statements written in human language.

3.3. What are the applications of speech recognition ?

- Ans.**
1. Automotive
 2. Technology
 3. Healthcare
 4. Sales

3.4. Define Feature Extraction Technique.

Ans. The speech feature extraction technique is the process of placing words in groups or classes and decreasing the dimensionality of the input vector while maintaining the discriminating power of the signal.

3.5. Define Natural Language Understanding (NLU).

Ans. NLU investigates methods of allowing the computer to comprehend instructions given in English.

3.6. Define Natural Language Generation (NLG).

Ans. NLG strive that computer produce ordinary English language so that people can understand computers more easily.

3.7. Write down the applications of NLP.

Ans. Applications of NLP:

SQ-6 M (Sem-1 & 2)**2 Marks Questions**

- a. Natural language interfaces to databases.
- b. Machine translation.
- c. Advanced word-processing tools.
- d. Explanation generation for expert systems.

3.8. What are chatbots ?

Ans: A Chatbot known as a conversational agent is a service either powered by rules or artificial intelligence that we interact via a chat interface.

3.9. What are the two main models for a chatbot ?

- Ans:**
- 1. Retrieval-based model
 - 2. Generative model

3.10. What are the benefits of chatbots ?

- Ans:** Following are the benefits of chatbots :
- 1. Increase website conversion rate
 - 2. Generate more qualified leads
 - 3. Combat Customer Churn

3.11. Define Machine translation.

Ans: Machine translation is the task of automatically converting source text in one language to text in another language.

3.12. What are the types of translation system ?

- Ans:** Types of Machine Translation Systems :
- 1. **Bilingual MT System :** Bilingual MT systems produce translations between two particular languages.
 - 2. **Multilingual MT System :** Multilingual MT systems produce translations between any pair of languages. They may be either unidirectional or bi-directional in nature.

**Artificial Intelligence For Engineering****SQ-7 M (Sem-1 & 2)****Artificial Neural Networks
(2 Marks Questions)****4.1. What are the types of artificial neural network ?**

- Ans:** Types of Artificial Neural Networks :
- 1. FeedForward ANN
 - 2. FeedBack ANN

4.2. What are the algorithms used for deep learning ?

- Ans:** Following are the algorithms used for deep learning :
- 1. Feed forward neural networks.
 - 2. Radial basis function neural network.
 - 3. Multilayer perceptron.
 - 4. Unsupervised pre-trained network.

4.3. Define recurrent neural network.

Ans: A recurrent neural network (RNN) is a class of artificial neural networks where connections between nodes form a directed graph along a temporal sequence.

4.4. What is Convolutional Neural Networks (CNNs).

Ans: ConvNets (CNNs) are the category of Neural Networks that have proven very effective in areas such as image recognition and classification.

4.5. What is Generative Adversarial Networks (GANs) ?

Ans: Generative Adversarial Networks (GANs) are a powerful class of neural networks that are used for unsupervised learning.

4.6. Write down the disadvantages of recurrent neural network ?

- Ans:** Disadvantages of recurrent neural network :
- 1. Gradient vanishing and exploding problems.
 - 2. Training an RNN is a very difficult task.
 - 3. It cannot process very long sequences if using tanh or relu as an activation function.

4.7. Write down the applications of recurrent neural network.

- Ans:** Applications of Recurrent Neural Networks :
1. Image Captioning.
 2. Time Series Prediction.
 3. Natural Language Processing.
 4. Machine Translation.

4.8. What are the Types of Recurrent Neural Networks ?

- Ans:** There are four types of Recurrent Neural Networks :
1. One to One RNN
 2. One to Many RNN
 3. Many to One RNN
 4. Many to Many RNN

4.9. Write down the Layers in a Convolutional Neural Network (CNN).

- Ans:** Layers in CNN are :
1. Convolution layer
 2. Activation layer
 3. Pooling layer
 4. Fully connected layer

4.10. What are the advantages of GAN ?

- Ans:** Advantages of GAN :
1. Better modeling of data distribution.
 2. GANs can train any kind of generator network.

4.11. What are the disadvantages of GAN ?

- Ans:** Disadvantages of GAN :
1. Hard to train, unstable. Good synchronization is required between the generator and the discriminator.
 2. Mode collapse issue.



Applications (2 Marks Questions)

5.1. What is image recognition ?

- Ans:** Image recognition is a computer vision task that works to identify and categorize various elements of images and/or videos

5.2. Write down the steps in image recognition process.

- Ans:** Major steps in image recognition process :
1. Gather and Organize Data
 2. Build a Predictive Model
 3. Recognize Images

5.3. Define face recognition.

- Ans:** Face recognition is a method of identifying or verifying the identity of an individual using their face. Face recognition systems can be used to identify people in photos, video, or in real-time.

5.4. What is object recognition ?

- Ans:** Object recognition is a computer vision technique for identifying objects in images or videos.

5.5. What are the main tasks of object recognition ?

- Ans:** In this process, the four main tasks are :
1. Classification
 2. Tagging
 3. Detection
 4. Segmentation

5.6. What is computer vision ?

- Ans:** Computer vision is a field of artificial intelligence that trains computers to interpret and understand the visual world. Using digital images from cameras and videos and deep learning models, machines can accurately identify and classify objects and then react to what they see.

5.7. What are Robots ?

SQ-10 M (Sem-1 & 2)

2 Marks Questions

Ans. Robots are the artificial agents acting in real world environment. Robots are aimed at manipulating the objects by perceiving, picking, moving, modifying the physical properties of object, destroying it, or to have an effect thereby freeing manpower from doing repetitive functions without getting bored, distracted, or exhausted.

5.8. What are types of locomotion ?

Ans. There are various types of locomotions :

1. Legged Locomotion
2. Wheeled Locomotion
3. Slip/Skid Locomotion

5.9. Define robot locomotion.

Ans. Locomotion is the mechanism that makes a robot capable of moving in its environment.

5.10. What are the tasks of computer vision ?

Ans. Tasks of computer vision are :

1. OCR
2. Face Detection
3. Object Recognition
4. Estimating Position

5.11. Define speech recognition.

Ans. Speech recognition is the process of converting an acoustic signal, captured by a microphone or a telephone, to a set of words.

