

Chapter 11

Advances in Computing

Distributed Computing

It is a method of computing in which large problems are divided into many small problems and these are distributed to many computers in a network. Later, the small results are assembled to get the final solution.

Advantages: Economical, Speed, Reliability, Scalability.

Disadvantages: Complexity, Lack of security

Types of distributed computing

1. Parallel Computing

A problem is divided among various CPUs. The calculations are carried out simultaneously. The memory is shared by all the CPUs.

Advantages: Fault tolerance; Sharing of computing power and resources; Load sharing.

Disadvantages: More complex; Portability issues.

Serial Computing V/s Parallel Computing

Serial Computing	Parallel Computing
(a) Single processor is used.	(a) Multiple processors with shared memory.
(b) Instructions are executed sequentially.	(b) Instructions are executed concurrently.

2. Grid Computing

It is a world in which computational power (resources, services, data) are readily available which we can access as required. Grid computing is mainly used in disaster management, weather forecasting, market forecasting, bio-informatics etc.

Advantages: Solves larger complex problems in short time; Better use of existing hardware; Easy to increase computing power by adding desktops or servers.

Disadvantages: Slower processing speed; Licensing issues.

3. Cluster Computing

It is a form of computing in which a group of personal computers, storage devices, etc. are linked together through a LAN so that they can work like single computer. It is a low cost form of parallel processing. Linux is the widely used OS for cluster computing.

Advantages: Reduces cost of processing; Failure of one system will not affect the processing; More components can be added.

Disadvantages: Programmability issues; Difficulty in fault finding.

4. Cloud Computing

It refers to the use of computing resources that reside on a remote machine and are delivered to the end user as a service over a network. It uses Internet and central remote servers to maintain data and applications. E-mail is an example.

Cloud services are grouped into three – Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).



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SaaS gives access to both resources and applications. Google Docs, Office365, facebook.com are examples.

PaaS gives access to the components that we require to develop and operate applications on Internet. LAMP, ASP.NET, Google's App Engine are some examples.

IaaS provides basic storage and computing capabilities. Servers, networking equipments, data centre space etc. will be available as infrastructure where we can set up our software. Amazon Web Services, AT&T are some examples.

Advantages: Cost savings; Flexibility; Reliability; Mobile accessibility.

Disadvantages: Security and privacy; Lack of standard.



Artificial Intelligence (AI)

The first definition of AI was established by Alan Turing. AI can be defined as developing computer programs to solve complex problems by applications of processes that are similar to human reasoning processes. Alan Turing proposed Turing Test, which is considered as the ultimate test a machine must pass in order to be called as intelligent.

Computational Intelligence

The study of human-machine interaction to solve real life problems led to the development of **Cybernetics**. It is defined as the study of control and communication between man and machines.

Computation Intelligence (CI) (commonly referred to as AI) is the study of adaptive mechanisms (algorithms) to facilitate intelligent behavior in complex and changing environment so as to solve real life problems. The four main paradigms (*paradigm means a pattern or model in the study of a complex subject*) of Computational Intelligence are Artificial Neural Networks (ANN), Evolutionary Computation (EC), Swarm Intelligence (SI) and Fuzzy Systems (FS).

Artificial Neural Networks (ANN) is the research in algorithmic modeling of biological neural system. It focuses on human brain that has the ability to perform tasks such as pattern matching, perception and body movements, and also the ability to learn, memorise, generalize etc.

Evolutionary Computation (EC) has its objective to mimic processes from natural evolution. It focuses on the survival of the fittest and death of the weak. EC is used in data mining, fault diagnosis etc.

Swarm Intelligence (SI) is originated from the study of colonies or swarms of social organisms. Choreography of bird flocks and foraging behavior of ants led to different optimization algorithms.

Fussy Systems (FS) allows reasoning with uncertain facts to infer new facts. In a sense, fuzzy logic allows the modeling of common sense. Fuzzy systems have been applied in gear transmission in vehicles, controlling traffic signals etc.

Applications of Computational Intelligence

1. **Biometrics:** It refers to the measurements (metrics) related to human characteristics. It is used in identification of individual in terms of finger print, palm veins, face, hand geometry, iris, retina and odour.

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2. **Robotics:** It is the scientific study associated with the design, fabrication, theory and application of robots. Robot is an electromechanical device which is capable of reacting to its environment and take autonomous decisions or actions to achieve a specific task. They are used in vehicle manufacturing industry, exploration of outer space, military, agriculture etc.
3. **Computer vision:** It is the construction of meaningful description of the structure and properties of the 3-dimensional world from 2-dimensional images. Mars rover – Curiosity uses computer vision to explore the planet Mars.
4. **Natural Language Processing (NLP):** It is branch of computer science that focuses on developing systems which allow computers to communicate with people using human languages such as English, Malayalam etc.
5. **Automatic Speech Recognition (ASR):** It refers to the AI methods of communicating with a computer in a spoken language like Malayalam. The mobile application Siri of Apple iOS, Cortana of Microsoft and Google Now of Android are examples.
6. **Optical Character Recognition (OCR) and Handwritten Character Recognition (HCR):** The task of OCR and HCR are integral parts of pattern recognition. The software converts scanned images of printed text or the text written on the screen into computer processable format (ASCII or Unicode).
7. **Bio-informatics:** It is the application of computer technology to the management of biological information. Computers are used to gather, store, analyze and integrate biological and genetic information which can be applied to gene-based drug discovery and development.
8. **Geometric Information System (GIS):** It is a computer system for capturing, storing, checking, and displaying data related to various positions on earth's surface. GIS can be applied in areas like soil mapping, agricultural mapping, forest mapping, e-Governance, water resource management, natural disaster assessment etc.

Questions from Previous Years' Question Papers (Computer Science)

1. (a) The computing technology in which a problem is broken into pieces and solved concurrently is called _____. (1)
(b) Categorise the cloud service models. (3) (March 2016)
2. Define Robotics. (1) (SAY 2016)
3. Give any three advantages and disadvantages of grid computing. (3) (SAY 2016)
4. (a) A widely used operating system for cluster computers is _____. (1)
(b) Discuss advantages of grid computing, cluster computing and cloud computing. (3) (March 2017)
5. NLP is _____.
(a) National Level Programming (b) Natural Language Processing
(c) Neural Level Programming (d) None of the above (1) (SAY 2017)
6. What is ANN? (3) (SAY 2017)