Assignment

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Assignment - 2.

Que-1 Write a short note on following computing paradigm focusing the difference between them:

1. Distributed Computing

• Description:- Distributed computing involves a network of independent computers that work together to solve a task by dividing it into smaller subtasks. Each computer (or node) in the network performs part of the overall task & the results are combined to achieve the final outcome.

Key features:-

- Tasks are distributed across multiple machines.
- Nodes may be geographically dispersed.
- Key: Improves fault tolerance and scalability.

Differences:- Unlike parallel computing, which typically involves multiple processors within a single system working on different parts of a task simultaneously. distributed computing spreads the computation across multiple autonomous systems that communicate through a network. The focus is on task distribution rather than simultaneous execution.

2. Parallel Computing

- Description:- Parallel computing is a type of computing where multiple processors execute or process multiple tasks simultaneously. The main goal is to perform complex computations more quickly by dividing a task into smaller subtasks and processing them concurrently on different processors.

- Key features:-
  - Multiple processors working simultaneously.
  - Tasks are split and executed in parallel.
  - Reduces computation time for large-scale problems

- Difference:- In parallel computing, the focus is on concurrent execution of tasks within a single machi or tightly-coupled systems. Unlike distributed computi which spreads tasks across different systems or netwo parallel computing typically operates within one system with multiple processors working together in parallel.

3. Cluster Computing

Description:- Cluster computing involves a group of connected computers (called nodes) working together as a single system to perform tasks. These nodes are usually located in close proximity and connected through a local area network (LAN) to enhance performance, reliability and scalability.

Key features:-

- Comprised of multiple computers (nodes) that work together.
- Nodes are tightly coupled and often homogeneous.
- Improves the fault tolerance and redundancy.

Difference:-

Unlike distributed computing, which involves geographically dispersed systems, cluster computing involves physically close system that work in tandem. Cluster computing also leads to focus more on performance and redundancy, while distributed computing emphasizes task distribution over a broader network.

4. Grid Computing :-

Description :- Grid computing is a form of distributed computing where geographically dispersed and often heterogeneous resources are pooled together to work on a common task. It allows for the sharing of computational power, data storage and other resources across multiple organisation and location.

Key features :-

(a) focuses on resources sharing & collaboration.
(b) Resources can be heterogeneous.
(c) often used for large scale scientific research, simultaneous, and data analysis.

Difference : Unlike cluster computing, where nodes are typically homogenous and located in the same physical spaces, grid computing involves heterogenous system that are geographically dispersed. Grid computing also emphasizes resource sharing across independent entities whereas cluster computing is typically centralised and owned by a single organisation.

5. Utility Computing

Description:- Utility computing is a model in which computing resources are provided to users on-demand and charged based on usage, much like traditional utilities such as electricity or water. This model is designed to provide scalable, flexible and cost-effective computing services.

Key features:-

- On-demand access to computing resources.
- Pay-per-use pricing model.
- Scalable resources that adjust to the user's needs.

Difference:

Unlike traditional computing models where organisations invest in and maintain their own infrastructure, utility computing allows users to rent resources as needed. It differs from grid and cluster computing in that it focuses more on a service-oriented approach, with a business model similar to utilities. While grid and cluster computing emphasize distributed processing power.

6. Edge Computing

Description:- Edge computing refers to the practice of processing data closer to the source where it is generated (the "edge" of the network) rather than sending it to a centralised cloud or data center for processing. This approach reduces latency, improves response time, and decreases the load on network bandwidth

Key features:-

- Data is processed near the device or sensor generating it.
- Reduces latency and improves real-time data processing.
- Enhances data security by minimising transmission of sensitive information.
- Difference:- Unlike traditional cloud computing, where data is sent to distant data centers for processing, edge computing processes data locally at the "edge" of the network. This results in faster response times and less dependence on centralised infrastructure. Edge computing also differs from fog computing, which creates a middle layer between the cloud and the edge, while edge computing happens directly at the source.

7. fog Computing

Description: fog computing is an extension of cloud computing that provides services and resources closer to the edge of the network, but not directly at the devices themselves. It creates an intermediary layer between the edge devices and the centralised cloud, distributing, storage and networking services more efficiently.

Key features:

- Acts as a middle layer between cloud and edge computing.
- Reduces latency by processing data closer to the data source.
- Supports real-time processing and decision making.

Difference: Unlike edge computing, which processes data directly on or near the devices generating it, fog computing provides a middle layer that handles data processing before it reaches the cloud. While edge computing occurs at the device level, fog computing and the power of cloud computing.

8. Mist Computing

• Description:- Mist computing is an ultra-lightweight form of computing that extends the concept of edge and fog computing by processing data directly on very small, resource-constrained devices like sensors or embedded systems. It pushes computation to the "mist computing", which is the layer even closer to the data source than edge computing.

Key features:-

- Operates on micro-level devices such as sensors & actuators.
- Extremely low power and minimal resource requirements
- Enables real-time, localised data processing and decision making.

Difference: Mist computing is more lightweight and operates on smaller, lower-powered devices compared to edge and fog computing. While edge computing processes data at or near the device, and fog computing introduces an intermediary layer, mist computing happens directly on the smallest, more resource-limited devices, providing ultra-local data processing.

9. Quantum Computing

Description. Quantum Computing uses principles of quantum mechanics to performs computations at exponentially faster rates than classical computers. It leverages quantum bit (qubits) that can exist in multiple states simultaneously (superposition) and can be entangled with each other, & allowing for massive parallelism in computation.

Key features:

- Uses qubits instead of classical bits (which are either 0 or 1).
- Exploits phenomena like superposition and entanglement.
- Used in fields like cryptography, drug discovery, and material science.

Difference:- Quantum computing differs fundamentally from classical computing which is based on binary logic and deterministic processing. Classical computers process one state at a time, while quantum computer can process multiple states simultaneously, leading to a potential exponential speed up for specific tasks. It represents a shift in computing models rather than just an advancement in hardware.

10 Cognitive Computing

Description: Cognitive computing aims to create system that mimic human thought processes using AI & ML. These systems are designed to understand, reason, and learn from data enabling them to handle complex, unstructured information and make decisions or provide insights that would typically require human intelligence.

Key features:-

- Utilizes AI, natural language processing and ML.
- Handles unstructured data and complex patterns

Difference: Cognitive computing focuses on simulating human cognitive abilities and understanding whereas traditional computing models emphasize processing data based on pre-defined rules and algorithms

11. Mobile Computing

Description:- Mobile computing refers to the ability to use computing devices such as smartphones, tablets and laptops while moving around. It involves wireless communication, portable hardware, and applications designed to work seamlessly across various environments and conditions.

Key features

- Allows for computing and data access from portable devices.
- Supports application that adapt to different contexts and user locations.

Difference:-

Mobile computing differs from other paradigms by its emphasize on portability and the ability to operate in various physical locations, as opposed to fixed computing environments like desktops or servers. It focuses on providing continuous access and functionality despite the user's movement, while paradigms like cloud computing or edge computing focus more on where and how data is processed rather than the mobility of the user.

12. Nano Computing

- Description: Nano computing involves the use of nanotechnology to build extremely small computing devices ors components. This paradigm focuses on leveraging the principles of nanotechnology to create computing elements at the nanoscale, which is typically on the order of nanometers

Key features:

- Utilizes nanotechnology to develop tiny computing devices or components
- Can involve manipulating materials at the atomic or molecular level.

Difference:

Nano computing differs from traditional computing paradigms in its scale and technological focus. while classical computing involves relatively larger and more conventional components, nano computing operates at a much smaller scale, potentially enhancing performance and miniaturizing devices.

13. Optical Computing

• Description:- Optical computing uses light (photons) instead of electrical signals (electrons) to perform computation. This approach leverages optical devices and components, such as lasers, lenses and waveguides. to process and transmit data at extremely high speeds and with potentially greater bandwidth than traditional electronic computing.

• Key features
  • Uses photons for data processing and transmission.
  • Promises faster data transfer and processing speeds due to the high velocity of light.

• Difference
Optical computing differs from traditional electronic computing in its use of light for processing & transmission rather than electrical signals. While conventional computing relies on electronic components and has limitations in speed and bandwidth due to electronic constraints, optical computing aims to overcome these limitations by harnessing the properties of light.