Distributed and Cloud Computing

Lecture 01 - Introduction

2

Course Info

- Course name – **Distributed and Cloud Computing**
- Course code – **CIS22012**
- Core course
- Methodology
  - 30 hours of lectures
  - 30 hours of practical
  - 75 hours of independent learning
- Evaluations
  - Continuous Assessments – 40%
  - Final Assessments – 60%

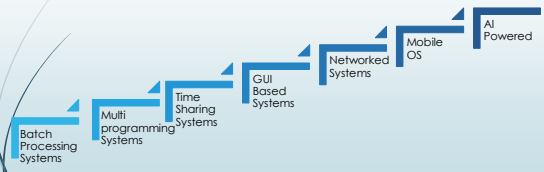
3

How you can reach me,

Janotheepan.m@uwu.ac.lk
0777820899

4

Computer Systems – Year wise Evolution



5

Mainframe Systems

- **Reduce setup time** by batching similar jobs
- **Automatic job sequencing**
  - Automatically transfers control from one job to another.
  - First rudimentary operating system.
- **Resident monitor**
  - initial control in monitor
  - control transfers to job
  - when job completes control transfers back to monitor

6

Time Sharing Systems

- The **CPU is multiplexed among several jobs** that are kept in memory and on disk (the CPU is allocated to a job only if the job is in memory).
- A job **swapped in and out of memory** to the disk.

7

Time Sharing Systems Cont…

- **On-line communication** between the user and the system is provided
  - When the operating system finishes the execution of one command, it seeks the next "control statement" from the user's keyboard.

8

Desktop Systems

- **Personal computers** – computer system is **dedicated to a single user**.
- **I/O devices** – keyboards, mice, display screens, small printers.
- User convenience and responsiveness.
- Can adopt technology developed for larger operating system' often individuals have sole use of computer and do not need advanced CPU utilization of protection features.
- May run several different types of operating systems (Windows, MacOS, UNIX, Linux)

9

Parallel Systems

- **Multiprocessor systems with more than one CPU in close communication.**
- Tightly coupled system – processors share memory and a clock; communication usually takes place through the shared memory.
- Advantages of parallel system:
  - **Increased throughput**
  - **Economical**
  - **Increased reliability**
    - graceful degradation
    - fail-soft systems

10

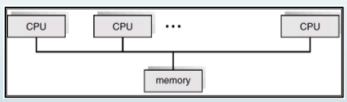
Parallel Systems Cont…

- **Symmetric multiprocessing (SMP)**
  - Peer to peer
  - No performance deterioration.
  - Most modern operating systems support SMP
- **Asymmetric multiprocessing**
  - Each processor is assigned a specific task; master processor schedules and allocated work to slave processors.
  - More common in extremely large systems

11

Parallel Systems Cont…

- Symmetric Multiprocessing Architecture



12

Distributed Systems

- **Distribute the computation among several physical processors.**
- Loosely coupled system
  - Each processor has its own local memory
  - Processors communicate with one another through various communications lines, such as high-speed buses or telephone lines.

13

Distributed Systems Cont…

- Requires **networking infrastructure**.
- Local area networks (LAN) or Wide area networks (WAN)
- May be either client-server or peer-to-peer systems

14

Distributed Systems Cont…

- Advantages of distributed systems.
  - **Resources Sharing**
  - **Computation speed up** – load sharing
  - **Reliability**
  - **Communications**

15

Clustered Systems

- Clustering allows **two or more systems to share storage**.
- Provides **high reliability**.
- Asymmetric clustering: one server runs the application while other servers standby.
- Symmetric clustering: all N hosts are running the application.

16

Real-Time Systems

- Often used as a control device in a dedicated application such as controlling scientific experiments, medical imaging systems, industrial control systems, and some display systems.
- Well-defined fixed-time constraints.
- Real-Time systems may be either hard or soft real-time.

17

Real-Time Systems Cont…

- **Hard real-time**
  - Secondary storage limited or absent, data stored in short term memory, or read-only memory (ROM)
  - Conflicts with time-sharing systems, not supported by general purpose operating systems.
- **Soft real-time**
  - Limited utility in industrial control of robotics
  - Useful in applications (multimedia, virtual reality) requiring advanced operating-system features.

18

Handheld Systems

- Personal Digital Assistants (PDAs)
- **Cellular telephones**
- **Issues**:
  - Limited memory
  - Slow processors
  - Small display screens.

19

AI Powered Systems

- In today's time, **Artificial Intelligence** is dominating every aspects of computers including Operating Systems.
- Siri, Google Assistant, Alexa and many other AI based assistant softwares which can even understand the voice commands and can perform any operation that a user needs to perform.

20

Computing Paradigm Distinctions

- **Centralized Computing**
- **Parallel Computing**
- **Distributed Computing**
- **Cloud Computing**

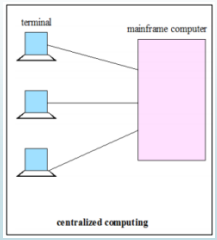
21

Centralized Computing

- Early computing was performed on a single processor
- Uni-processor computing can be called as "**Centralized Computing**"
- All computer **resources are centralized in one physical system**.
- All resources(processors, memory, and storage) are fully shared and tightly coupled within one integrated OS.

22

Centralized Computing Cont…



23

Centralized Computing Cont…

- Characteristics of Centralized Systems
  - **Multiple users share the resource** of a centralized system at all times.
  - Centralized systems are often **built using homogeneous technology**.
  - Centralized systems have a **single point of control and of failure**.

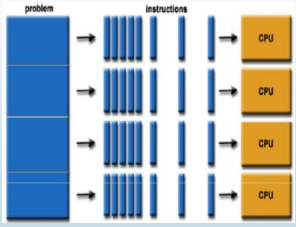
24

Parallel Computing

- Parallel computing is a type of computing architecture in which **several processors simultaneously execute multiple, smaller calculations broken down from an overall larger, complex problem**.
- All processors are either **tightly coupled** with centralized shared memory or **loosely coupled** with distributed memory.
- Inter-processor communication is accomplished through shared memory or via message passing.

25

Parallel Computing Cont…



26

Cloud Computing

- Cloud computing is the **delivery of different services through the Internet**. These resources include tools and applications like data storage, servers, databases, networking, and software.
- An Internet cloud of resources can be either a centralized or a distributed computing system.

27

Cloud Computing

- The cloud applies parallel or distributed computing, or both.
- **Clouds can be built with physical or virtualized resources** overlarge data centers that are centralized or distributed.

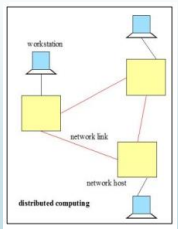
28

Distributed Computing

- A distributed system is a **collection of independent computers, interconnected via a network**, capable of collaborating on a task.
- Distributed computing is the computing performed in a distributed system.
- Distributed computing has **become increasingly common due to advances that have made** both machines and networks cheaper and faster.

29

Distributed Computing Cont…



30

Distributed Systems

- **Hardware and software components, located at remote networked computers, coordinate and communicate their actions only by passing messages**. Any distance may separate computers in the network.
- **Sharing of resources is the main motivation of distributed systems**. Resources may be managed by servers and accessed by clients, or they may be encapsulated as objects and accessed by client objects.

31

Distributed Systems Cont…

- A distributed operating system runs on multiple independent computers, connected through communication network, **but appears to its users as a single virtual machine and runs its own OS**.

32

Distributed Systems in Experts' View

Leslie Lamport:

"A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable."

Coulouris, et al.

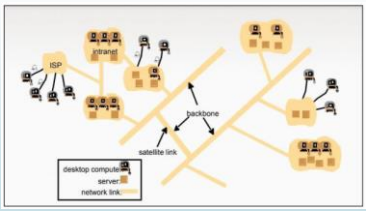
"A distributed system is one in which components located at networked computers communicate and coordinate their actions only by passing messages"

van Steen, Tanenbaum:

"A distributed system is a collection of autonomous computing elements that appears to its users as a single coherent system"

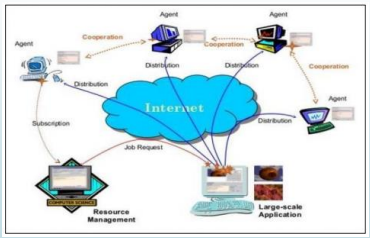
33

Typical Distributed Systems



34

Typical Distributed Systems



35

Characteristics of Distributed Systems

- **Have Concurrency**:
  - How to handle the sharing of resources between clients? **Execution of concurrent programs share resources**: e.g. web pages, files, etc.
- **No global clock**:
  - In a distributed system, computers are connected through network and have their own clocks. **Communication between programs is only through messages and their coordination depends on time**.

36

Characteristics of Distributed Systems Cont…

- **Independent Failure**:
  - Distributed systems should be planned for the consequences of possible failures of its components. How to handle a failure in the network or in a particular client?
  - Other clients might not be immediately aware of a failure. Each component of the distributed system can fail independently leaving others still running. Faults in the network results in isolation of the failed component only, but system continue running.

37

Distributed Systems Cont…

- It consists of several independent computers connected through communication network
- The **computers communicate with each other by exchanging message** over a communication network.
- Each computer has its own memory, clock and runs its own operating system.
- Each computer has its own resources, called local resources
- Remote resources are accessed through the network

38

Distributed Systems for,

- **Efficient and effective**
  - Resource combination and sharing
- **Transparent**
  - Hiding their (internal) complexity
  - Which makes them easier to understand and use
- **Scalable**
  - Coping with growth
- **Open**
  - Allowing usage by, extension with, integration into and built from 3rd party components and systems.

39

Why Distributed Systems

- The prime motivation of distributed systems is to **share resources**.
- A resource is an entity that can be usefully shared among users.
- Any hardware or software entity is a resource.
- We use shared resources all the time.

40

Resources are managed by a **service**. A service is managed by one or more **servers**, which provide access to a set of resources to **clients** via a set of well-defined operations (an **interface**).

41

The Motivation behind the Distributed Systems Development

- Users desire to have **computational power at low cost**.
- **Need of the people** working in a group to communicate with each other
- **Sharing of information** (data)
- Sharing of expensive computer resources

42

Advantages of Distributed Systems

- Resource Sharing
- Enhance Performance
- Improved reliability and availability
- Modular expandability

43

Limitations of Distributed Systems

- **Lack of common memory**
  - Without a shared memory, up-to-date information about the state of the system is not available to every process.
  - The state information must therefore be collected only through communication.

44

Limitations of Distributed Systems Cont…

- **Lack of System wide common clock**
  - It becomes difficult to talk about temporal order of events in the absence of global time.
  - The combination of unpredictable communication delays and the lack of global time in a distributed system make it difficult to know how up-to-date collected state information really is.

45

Application Domains

- Financial applications
- Manufacturing
- Reservation
- Transportation / Traffic
- Telecom
- Multimedia
- Social media
- Health care
- Surveillance
- Smart environments
- Automotive / Aviation

46

Examples of Distributed Systems

- Internet (The World Wide Web)
- Intranet/workgroups
- ATM (bank) machines
- Distributed manufacturing systems
- Network of branch office computers
- Mobile and Ubiquitous Computing
- Telecommunication networks

47

Thank You!

M. Janotheepan