CS3.301 Operating Systems and Networks

Introduction and Course Overview

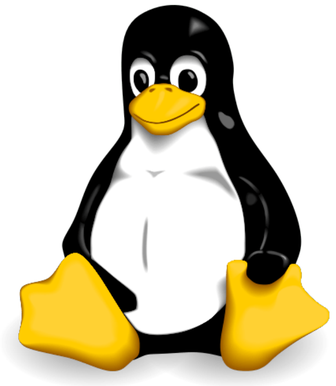
Karthik Vaidhyanathan

https://karthik.vaidhyanathan.com

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

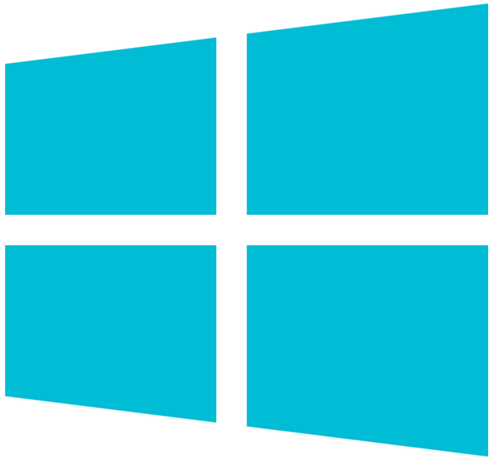
SERC
Software Engineering Research Centre

Which OS do you use?



Linux

ChromeOS



Windows

OSX

Wait! what is an OS anyway?

operating system

computing

Print Cite Share Feedback

Also known as: OS

Written by David Hemmendinger
Fact-checked by The Editors of Encyclopaedia Britannica
Last Updated: Article History

operating system (OS), program that manages a computer's resources, especially the allocation of those resources among other programs. Typical resources include

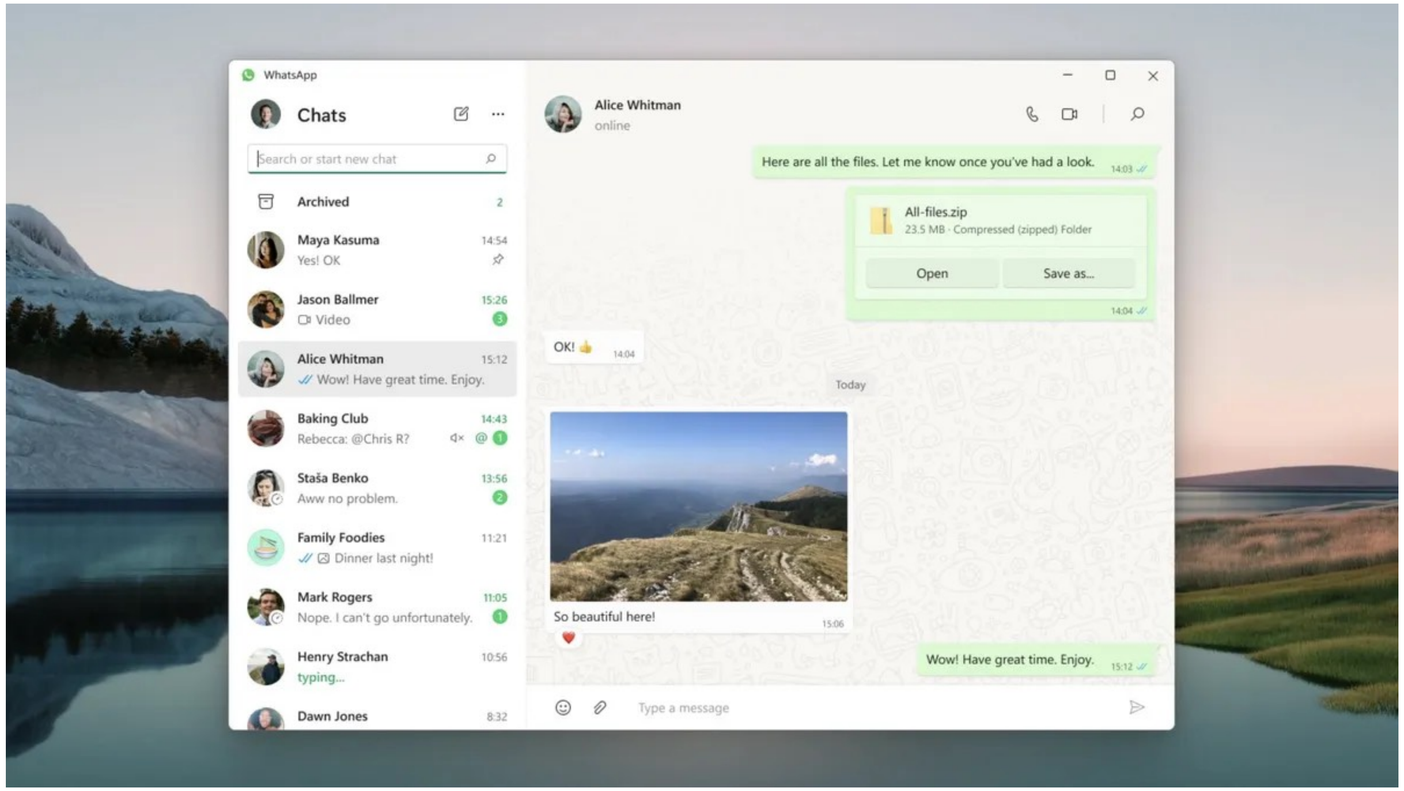
what is an operating system

An operating system (OS) is a type of system software that manages computer hardware, software resources, and provides various services for computer programs. It essentially acts as the intermediary between users and the computer hardware.

Not bad!!

Caution: Use tools but be aware of the uncertainties they bring in!

Develop Whatsapp like Messaging System



- Users authentication
- Send and receive chats
- Send and receive media contents
- Make audio, video calls
- Record audio, video
- …..

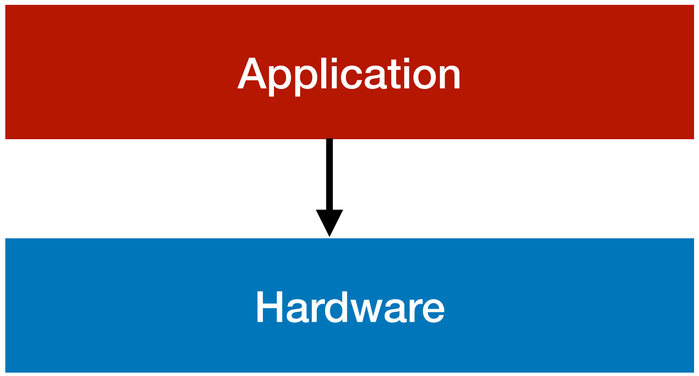
Source: cnet.com

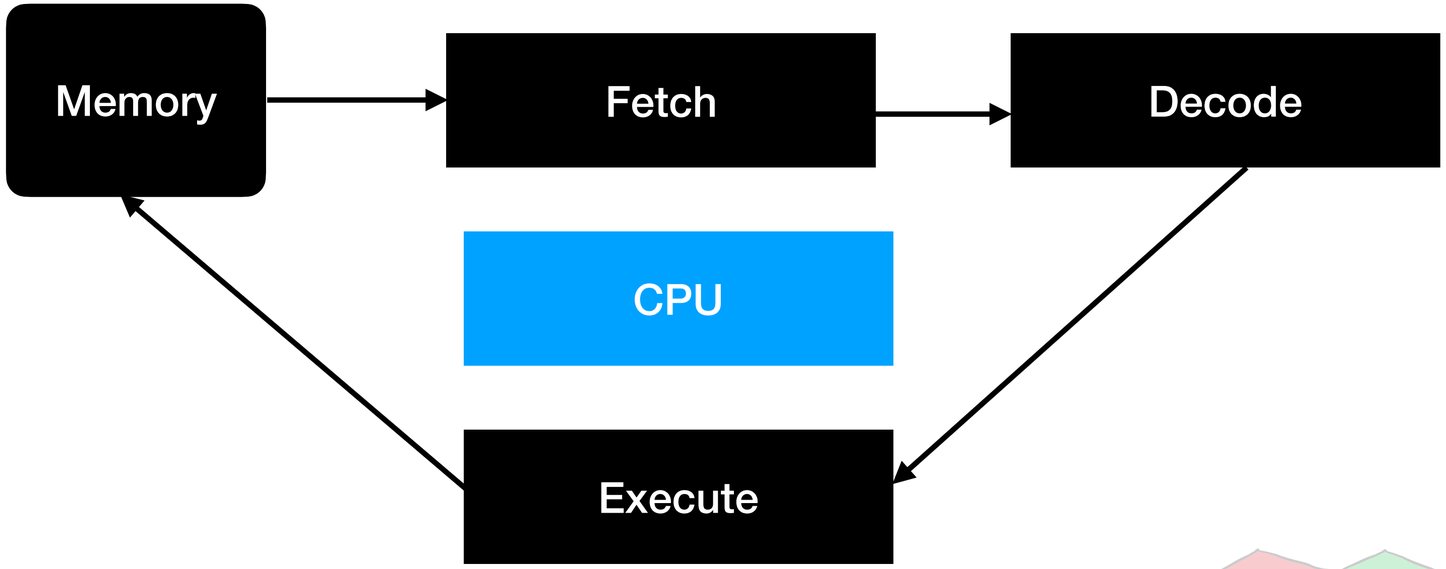
Any Program for that Matter!

- Once your app is build - Compiler comes into action (“c” -> “a.out”) to create the executable (“.dmg”, “.elf”, “.exe”)
- Executable contains: Instructions + data
- Instructions are run by the CPU
- CPU internally consists of registers
  - Program counter or PC
  - Operands of instructions, memory addresses

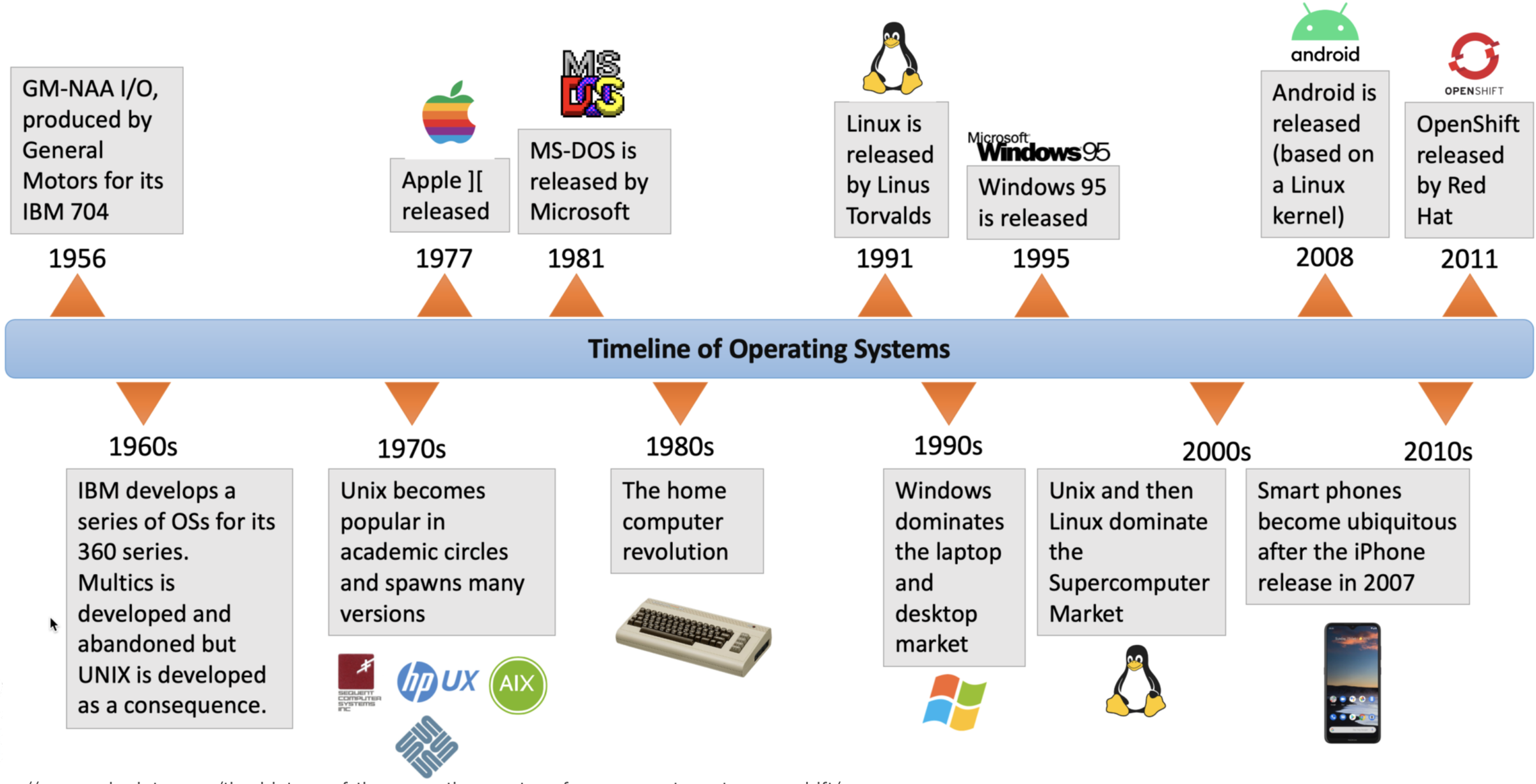
What if there were no OS?

- Application is a program: Processor will Fetch -> Decode -> Execute, Continue
- CPU will have the PC which points to the instructions in the memory



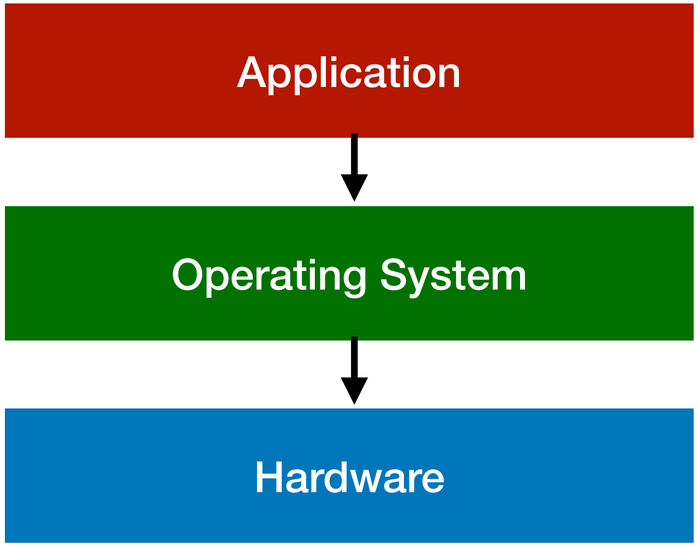


OS: A Brief History



Source: https://www.orb-data.com/the-history-of-the-operating-system-from-paper-tape-to-openshift/

Operating Systems: An Overview



- OS basically is a middleware between the hardware and the application/user program
- In charge of making sure that the system operates correctly and efficiently
- Does three key things:
  - Easy to execute programs
  - Manages memory
  - Handles the different I/O devices

Abstraction holds the key

Lets draw some parallels

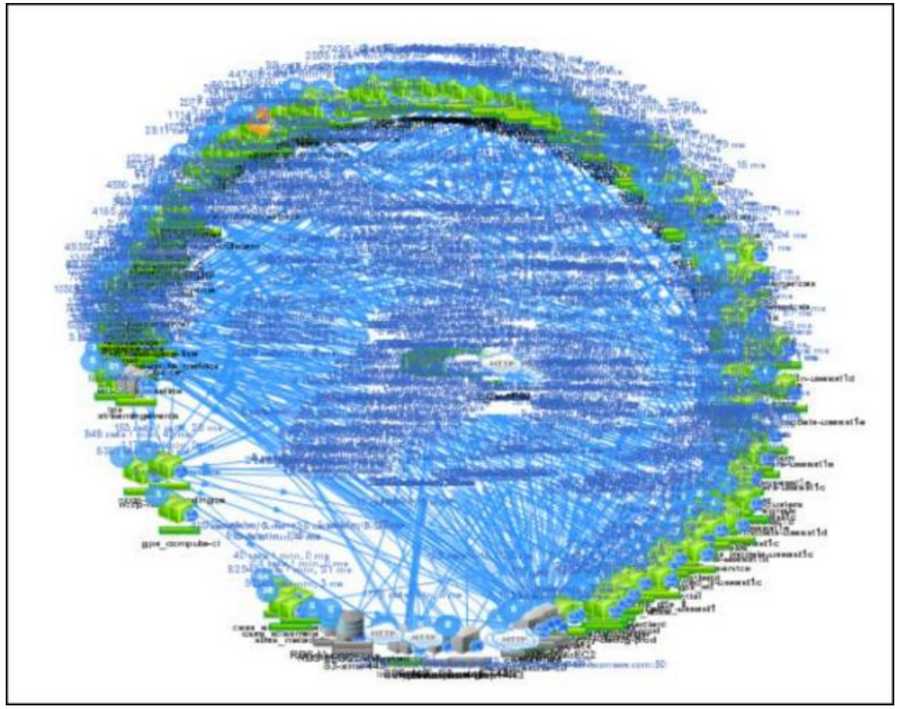
What you see as Netflix!

Source: netflix.com

- One of the key principles in system design - Try to keep things simple
- Abstraction and decomposition - Two main principles in Software Engineering
- Think of libraries in programming languages
  - Provides abstraction in terms of functions
  - All you need to know is functions to be called - Not how they work

Abstraction holds the key

Lets draw some parallels



Behind the scenes!

Source: netflix.com

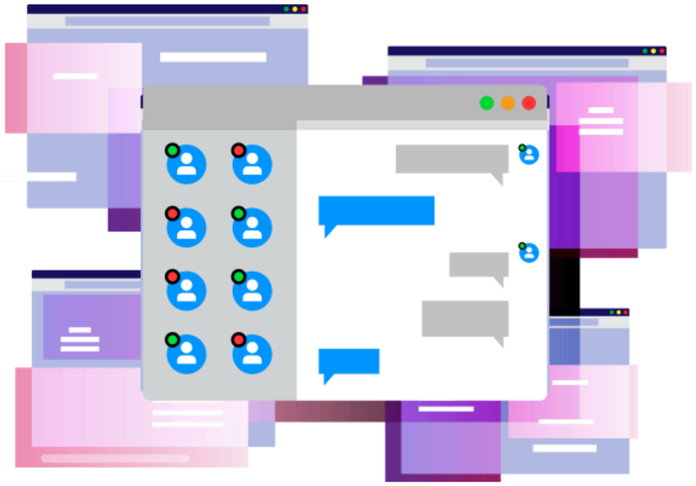
- One of the key principles in system design - Try to keep things simple
- Abstraction and decomposition - Two main principles in Software Engineering
- Think of libraries in programming languages
  - Provides abstraction in terms of functions
  - All you need to know is functions to be called - Not how they work

OS can be also thought of as a black box!

What does an OS abstract?

Think about the messaging system that needs to be developed

- The messaging application runs on the CPU
- It requires RAM to run but it feels that it has infinite RAM
- There are also other application that needs to run simultaneously
- The application also needs to store data -> images, videos, documents…
- Application also have to interact with devices (Camera, USB,…)



The Three Pillars of Operating Systems

Virtualization (Process and Memory)

1. OS gives every process a feeling that it has own CPU
2. Every process feels that its enough memory

Concurrency

1. Multiple process can run at the same time without resulting in problems
2. OS Provides mechanisms to make them work together

Persistance

1. Disk is an I/O device. It needs to be managed and handled.
2. OS handles interactions with the disk and performs storage management

Process Virtualization

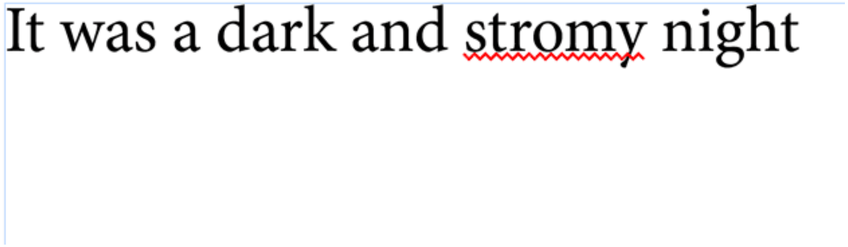
- How many CPU does your computer have?
- Is the number of process equal to the number of CPU your computer have?
- Lets look into a simple example…

Memory Virtualization

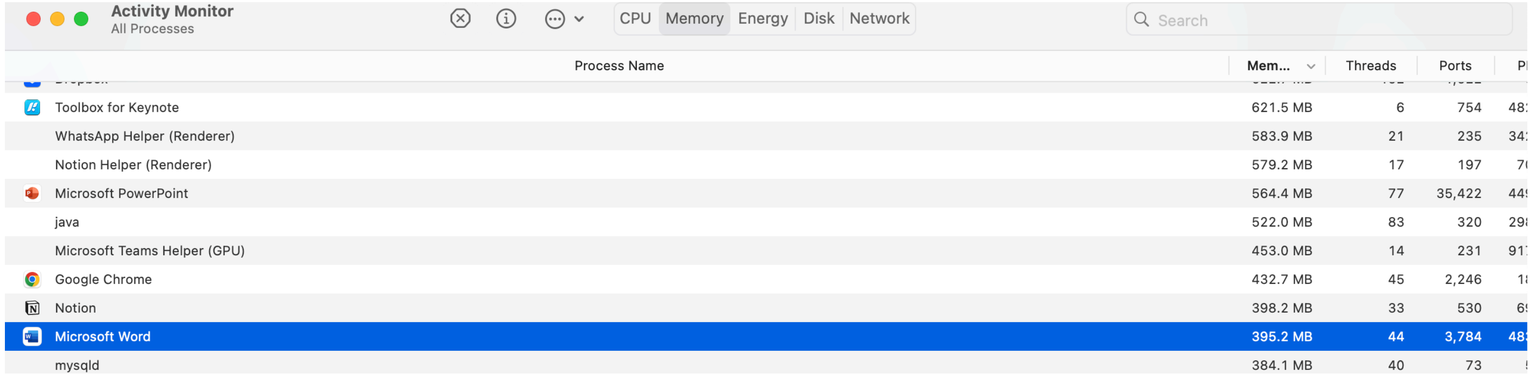
- Every process requires memory to run
- How many processes are active in your system?
- What’s the total memory they require?
- How’s CPU managing this?

Concurrency

- OS has to juggle between multiple processes
- Heard of multi-threaded programs? But wait heard of threads?



Spell check in Microsoft Word



How many threads are active in Microsoft Word?

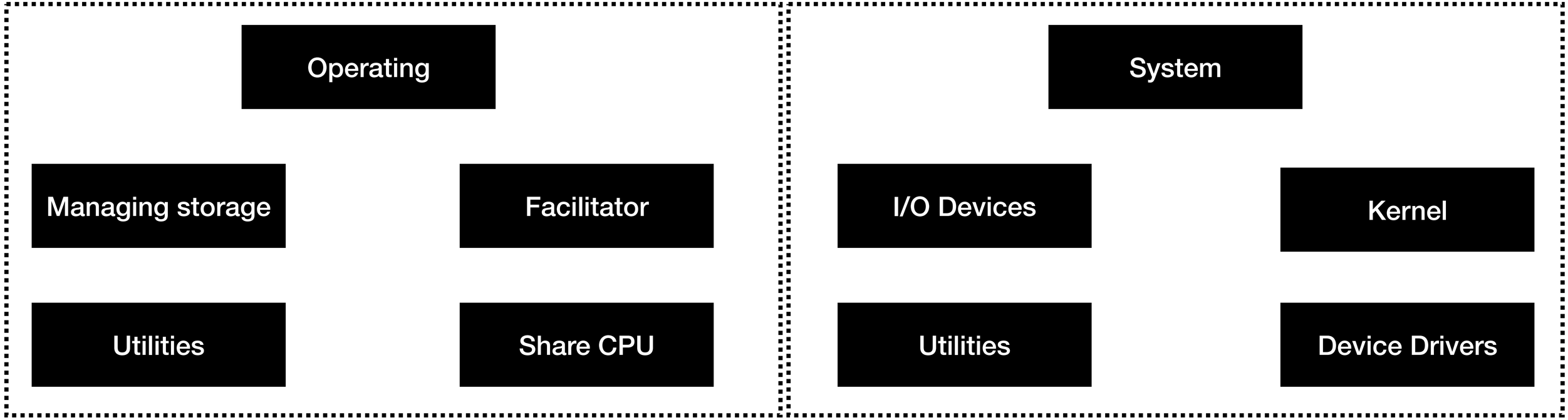
Spell check image source: https://creativepro.com/check-spelling-dynamically/

Persistence

- RAM is Volatile
- Hardware and software are needed to store data persistently
  - Hardware: I/O devices such as hard drive, SSDs, etc.
  - Software:
    - File system manages the disk
    - File system is responsible for any files that the user creates
    - Read, writes are handled by file system which interacts with low level device drivers

“Operating System” - Dual Roles

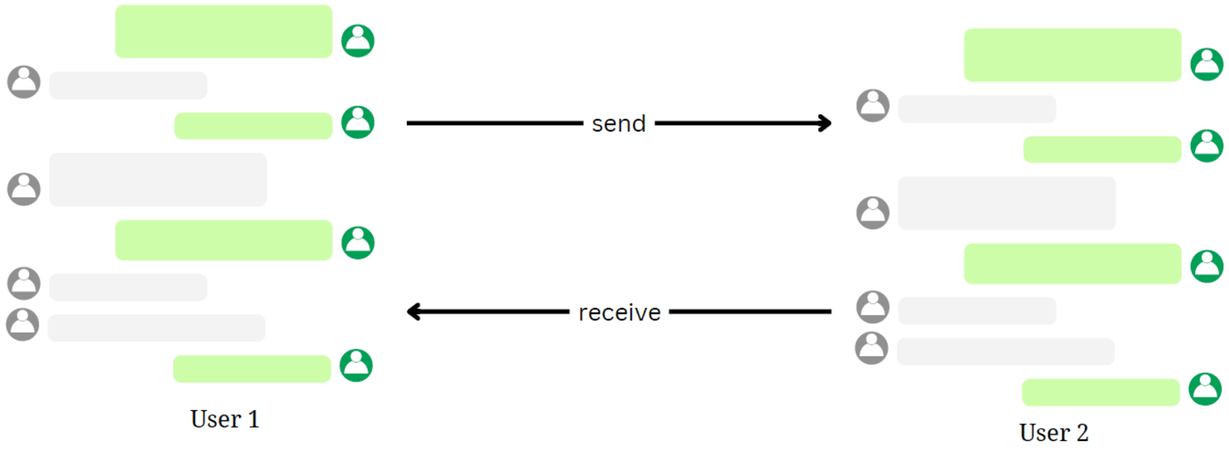
Resource Management and Hardware Abstraction



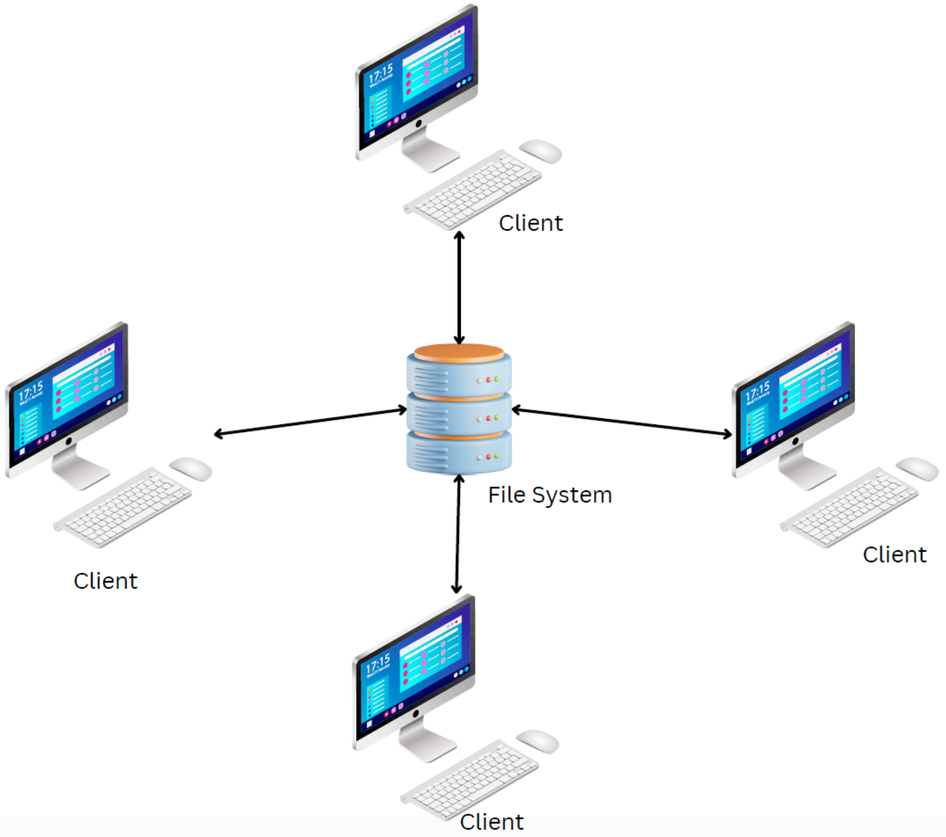
Key Design Goals Of OS

- **Abstraction**: Convenience and easy to use
- **High Performance**: Minimize overhead, Virtualisation should be done but minimise overhead
- **Reliability:** OS must continously run without crashing
- **Other attributes**: Energy efficiency, Security, Mobility
- **Remember:** OS itself is a massively complex software (Softwares rely on OS to function correctly!!)

But how does multiple systems interact?

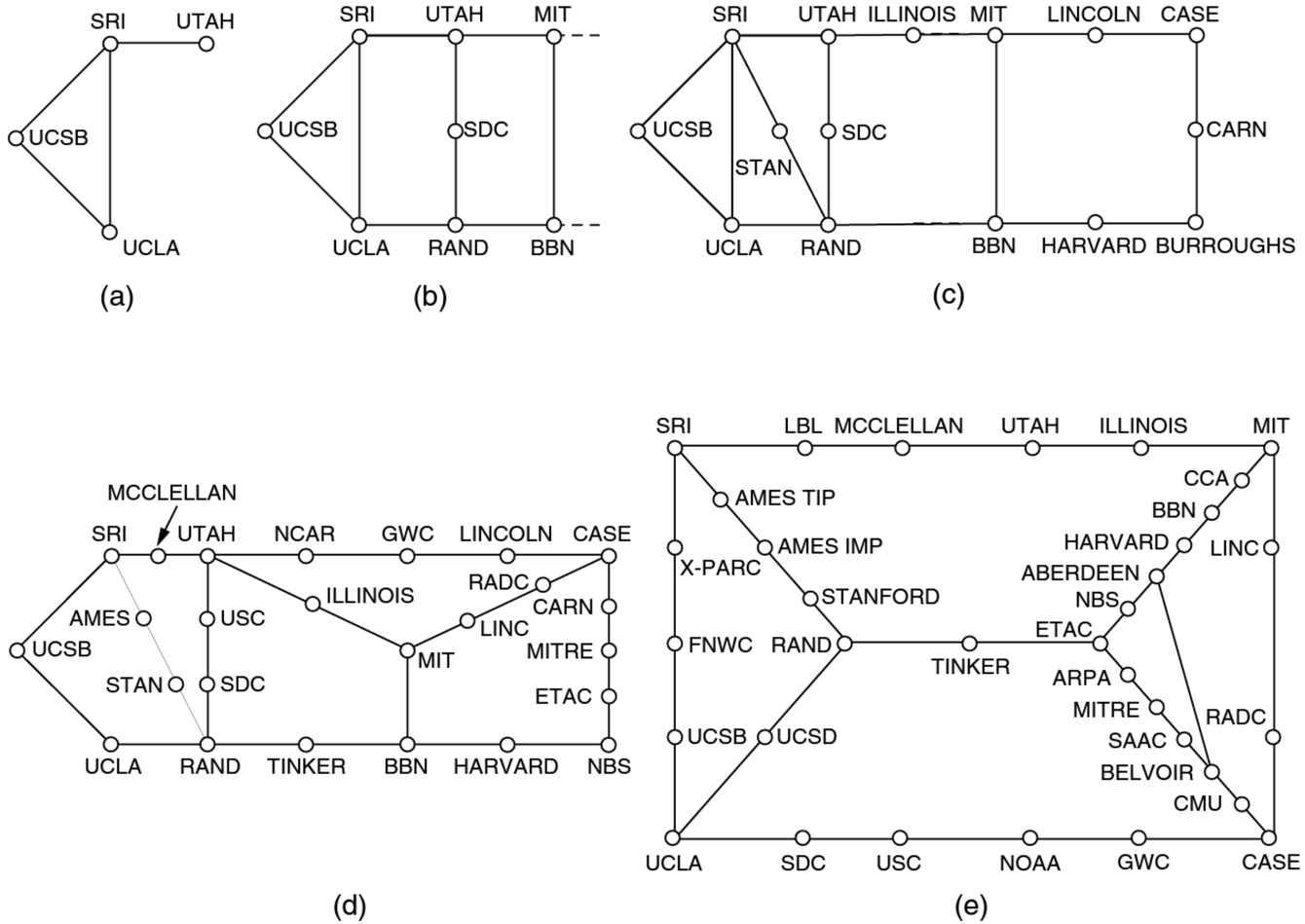


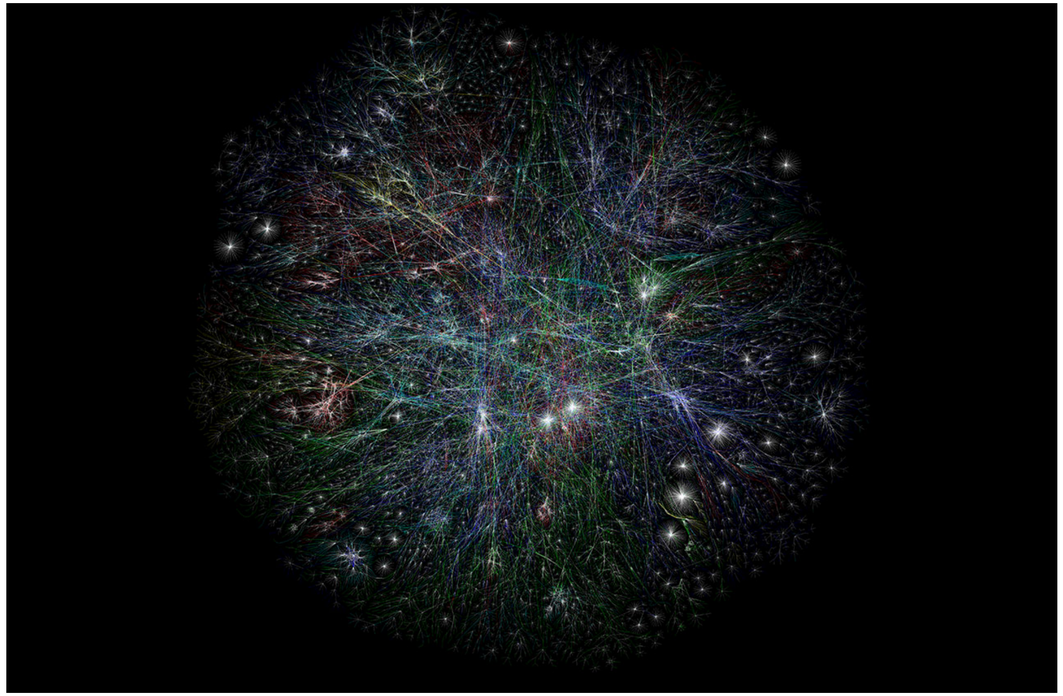
Whatsapp Chat example



Network File System

Any Guess on this?

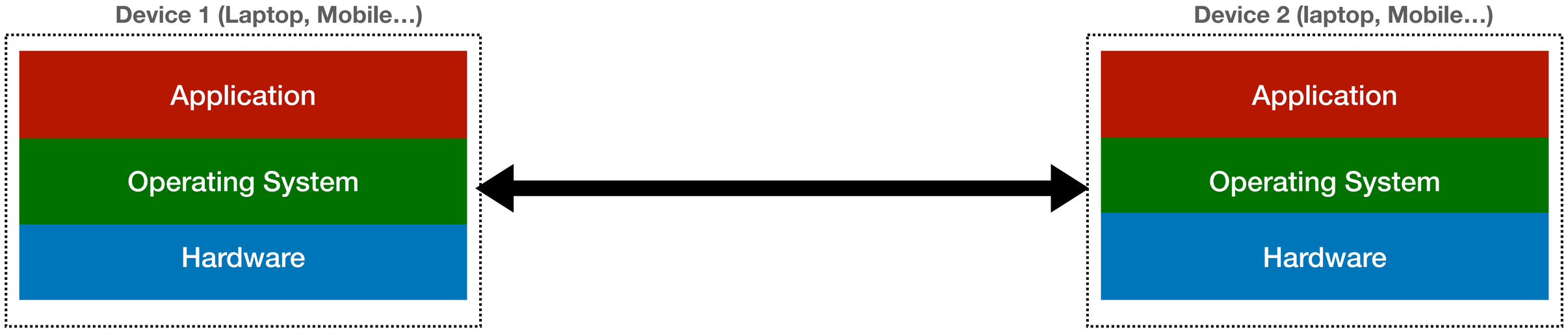




A Map of the internet (as of 2012)

Growth of ARPANET, source: Computer Networks, 5e, Tannenbaum and Weatherall

Computer Networks: The horizontal



- How can application from device 1 and 2 communicate?
- How to ensure the data/information reaches reliably?
- What if multiple applications are running and are communicating?

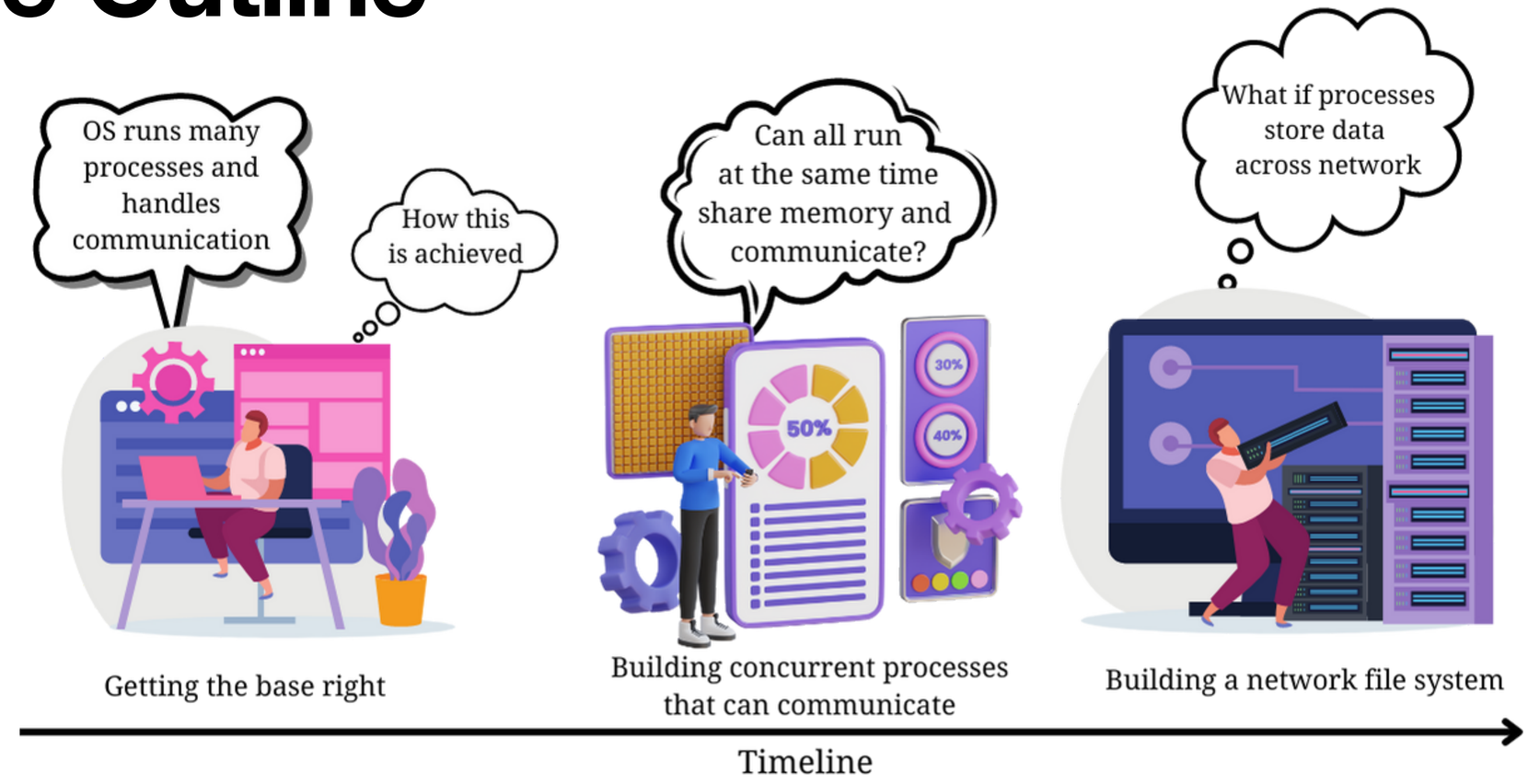
Networks - Different Components

- Different types of network - PAN, MAN, LAN, WAN,..
- Some terminologies - subnets, hosts, routers, switches, transmission lines, interconnected networks (internet) not Internet
- **internet** - formed when distinct networks are interconnected (network of networks)
- Subnets - collection of communication lines and routers owned by network operators
- Protocol - Agreement between communicating parties on how the communication needs to proceed

The Different Pieces of Networks

- As more and more networks started joining ARPANET, need for common protocol arise
  - Invention of TCP/IP model
- Implementing TCP/IP on different platforms was encouraged
  - Sockets - 4.2BSD Release of Berkeley Unix
  - Using networks with sockets proved effective and efficient
- As scale increased, difficult to remember the address of the system
  - Domain Name System (DNS)
  - How to find route from one point to another?

Course Outline



This Course

Process and Memory Virtualization	Concurrency	Persistence
Networking intro	Addressing and Routing	Network file Systems

Grade Distribution

Component	Weightage
Final Exam	30%
Mid-term Exam	15%
Quizzes	10%
4 Mini projects	30%
In-class activities/Bonus	5%
Project/OSN Hack day	10%

Note: The instructor reserves the right to make any changes based on the course progress

Course Logistics

- Course announcements and management - Moodle
- Assignments and projects - Github Classroom
- All resources, information and materials -
- https://karthikv1392.github.io/cs3301_osn/
- At any point, feel free to contact the instructor or TA
- Instructor office hours - Friday 11:00 AM to 12:00 PM
- TA office hours would be listed on the website
- Feedbacks are always welcome!

Meet the Team!

Ashna Dua

Divij D

Hitesh Goel

Jhalak Akhilesh Banzal

Karthik Vaidhyanathan

Prince Varshney

Roja Lakshmi Sahoo

Samruddhi Shastri

Swayam Agrawal

Vineeth Bhat

VJS Pranavasri

Vyom Goyal

Special Mention:

1. Shrikara A
2. Adyansh Kakrn
3. Rohan Kumar

Thank you

Course site: karthikv1392.github.io/cs3301_osn
Email: karthik.vaidhyanathan@iiit.ac.in
Twitter: @karthi_ishere