Lecture 1: Introduction to OS

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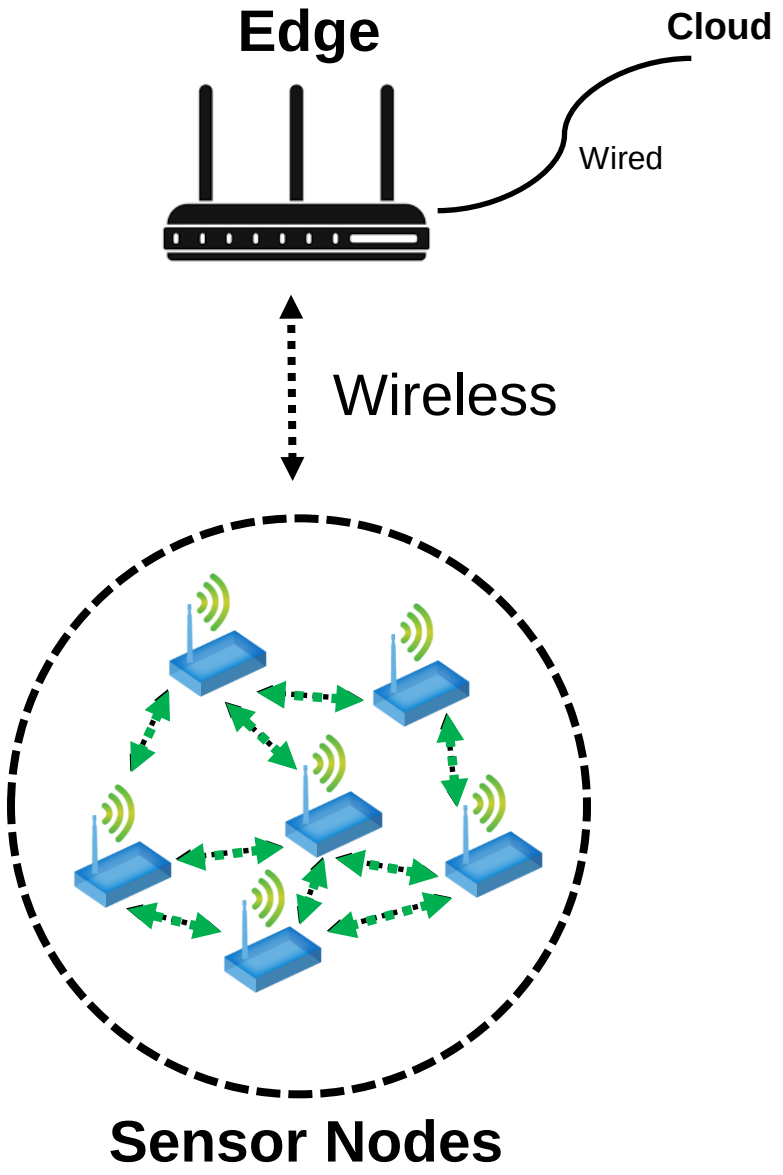
COP 4610 Operating Systems

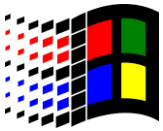
Who am I?

- Xin Liu
  - Assistant Professor in CS, FSU
  - PhD in CE, UMBC, 2022
  - Post-doctoral Research, OSU, 2 years
  - **Research Focus**
    Next generation of edge networks (6G and beyond)
  - **Experience**
    Over 10 years of embedded system development experience



First Operating System

Window 1
1985



Window 3.1
1992

Window 95
1995

Window XP
2001

Window Vista
2006

Window 7
2009

Window 8
2012

Window 10
2015

Window 11
2021

...

Which was the first version of Windows you ever used?

Key Factors of OS Reliability

Window 1
1985

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Window XP
2001

Window Vista
2006

Window 7
2009

Window 8
2012

Window 10
2015

Window 11
2021

...

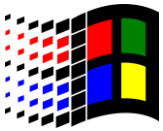
The most important aspect of an operating system is **reliability**, which is demonstrated in the following ways::

1. System Stability
2. Software Compatibility
3. Security
4. Data Integrity
5. Fault Recovery

...

When Reliability Fails

Window 1
1985



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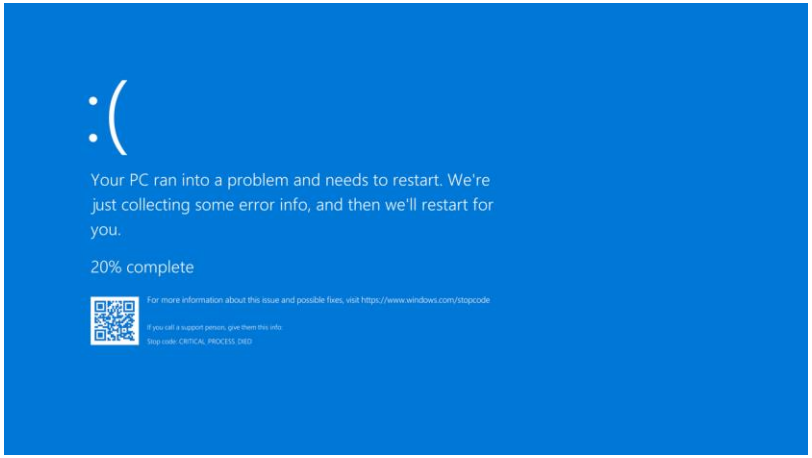

Blue Screen of Death

When Reliability Fails

Window 1
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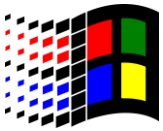

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Blue Screen of Death

On July 19, 2024, a large-scale IT system crash affected major global institutions, causing flight cancellations, media outages, and disruptions in various services, with Microsoft attributing the issue to a third-party software platform update.

Other Classic Operating Systems

macOS

Linux

Windows

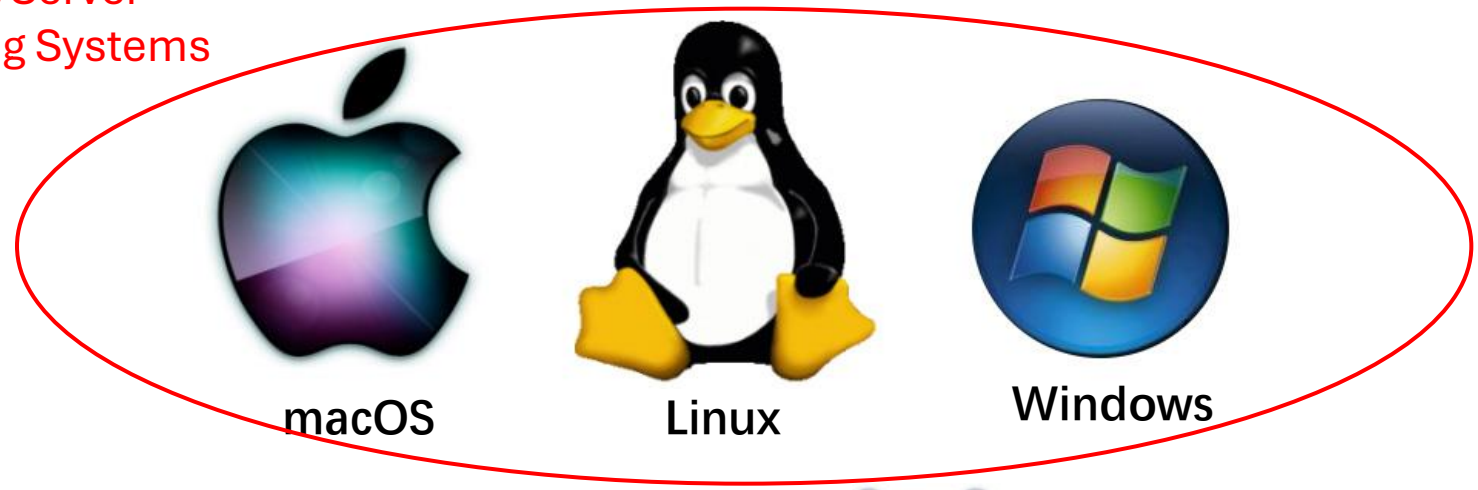
iOS

Android

Which operating systems are you using right now?

Other Classic Operating Systems

Desktop/Server
Operating Systems



macOS

Linux

Windows

iOS

Android

Which operating systems are you using right now?

Other Classic Operating Systems

Desktop/Server
Operating Systems

macOS

Linux

Windows

iOS

Android

Mobile Operating Systems

Which operating systems are you using right now?

More Operating Systems

Besides these, have you used any other operating systems?

What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware

- **Key Characteristics**:

  - **Program, Not Hardware**: The operating system is software that manages the hardware, not a physical component itself.

  - **Acts as an Intermediary**: It serves as a bridge between the user and the computer hardware, facilitating communication and resource management.

Computer System Structure

- Computer system can be divided into four components:

1. **Hardware** – provides basic computing resources
   - CPU, memory, I/O devices

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3. **Application programs**
   - Define the ways in which the system resources are used to solve the computing problems of the users
   - Word processors, compilers, web browsers, database systems, video games

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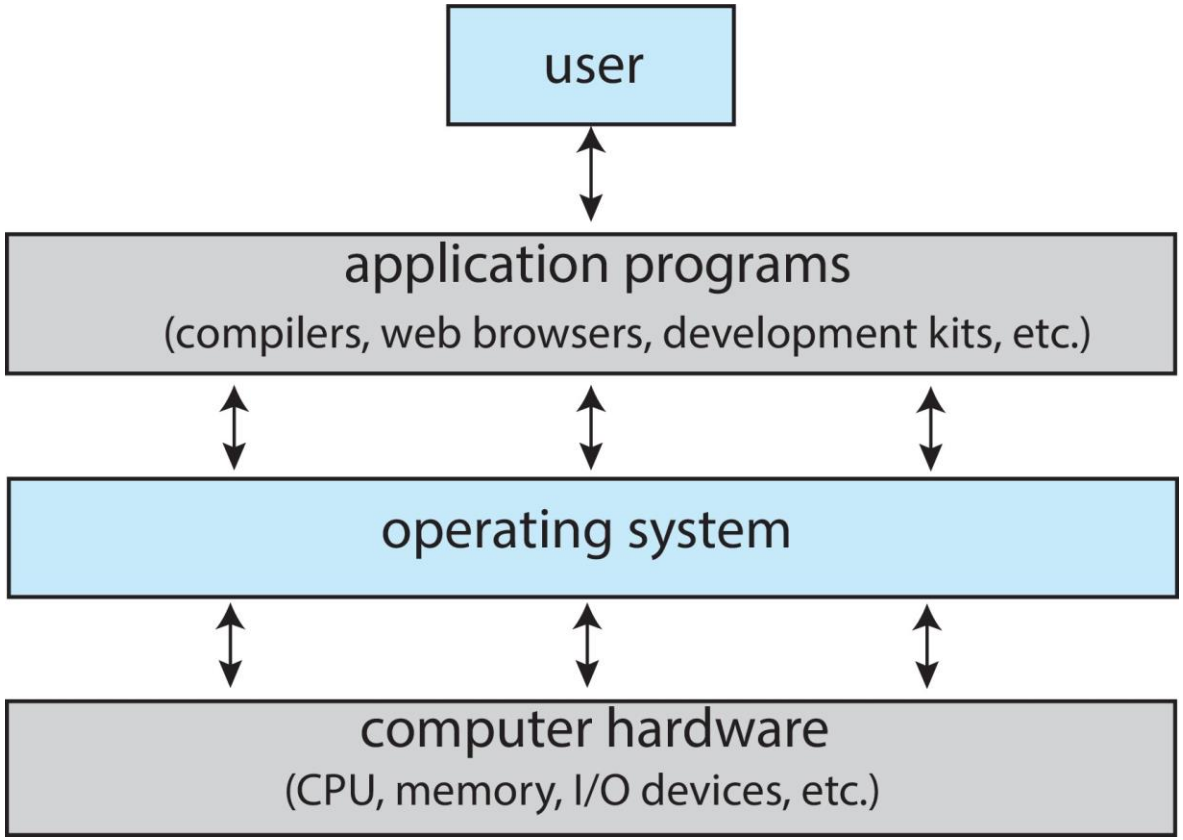
4. **Users**
   - People, machines, other computers

Abstract View of Components of Computer



Operating system goals:

- Execute user programs and make solving user problems easier
- Make the computer system convenient to use
- Use the computer hardware in an efficient manner

History Phase I: Hardware Expensive, Humans Cheap

- Hardware: mainframes
- OS: human operators
  - Handle one ***job*** (a unit of processing) at a time
  - Computer time wasted while operators walk around the machine room

IBM System/360

OS Design Goal

- Efficient use of the hardware
  - ***Batch system***: collects a batch of jobs before processing them and printing out results
    - Job collection, job processing, and printing out results can occur concurrently
  - ***Multiprogramming***: multiple programs can run concurrently
    - Example: I/O-bound jobs and CPU-bound jobs

History Phase II: Hardware Cheap, Humans Expensive

- Hardware: terminals

- OS design goal: more efficient use of human resources
  - ***Timesharing systems***: each user can afford to own terminals to interact with machines
  - The operating system could support multiple users simultaneously, each with their own terminal
  - Each user had an efficient and responsive experience, without the need for dedicated machines for each person

History Phase III: Hardware Very Cheap, Humans Very Expensive

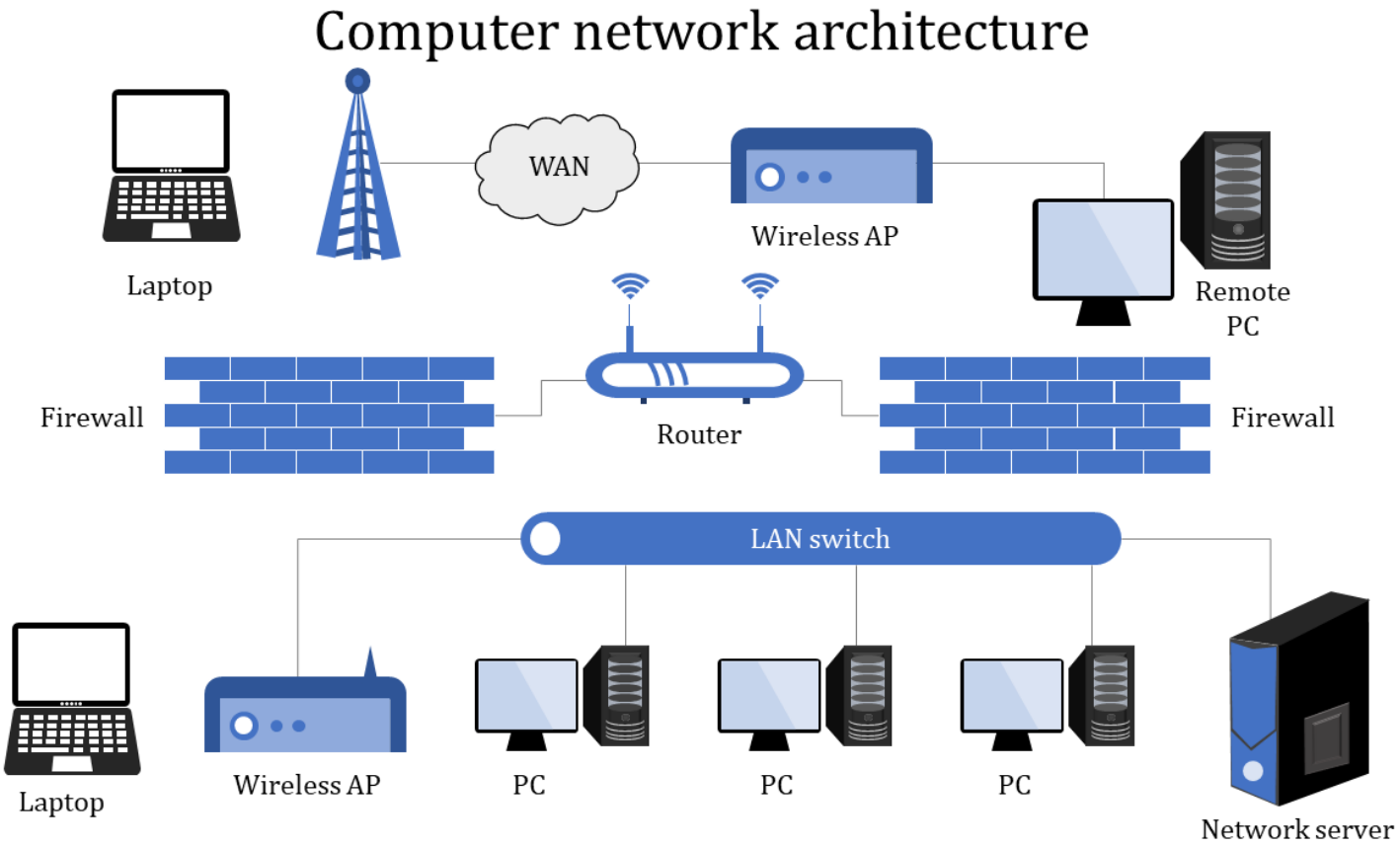
- Hardware: personal computers

- OS design goal: allowing a user to perform many tasks at the same time
  - ***Multitasking***: a single user can run multiple programs on the same machine at the same time

  - ***Multiprocessing***: the ability to use multiple processors on the same machine

History Phase IV: Distributed Systems

- Hardware: computers with networks
- OS design goal: ease of resource sharing among machines
  - Cloud Computing



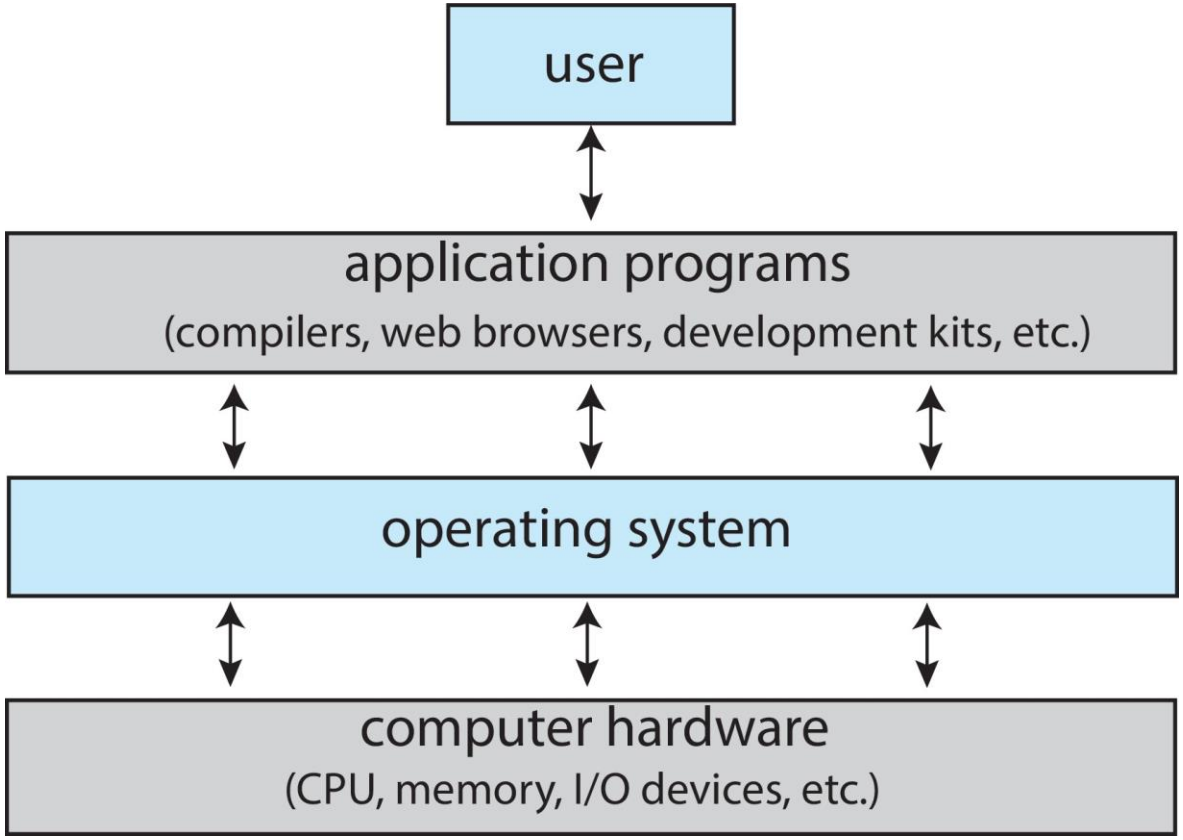
History Phase V, VI, VII?

- AI As Operating System?

History of OS: Change!

		1980	2020	Factor
Speed	CPU	1 MIPS	88K MIPS	8.8×10^4
	Memory	500 ns	0.6 ns	8.3×10^2
	Storage	18 ms	300 ns	1.8×10^5
	Network	300 bits/sec	100 Gb/s	3.6×10^8
Capacity	Memory	64 Kbytes	3 TB	5.0×10^7
	Disk	1 Mbytes	16 TB	1.6×10^7
Cost	Per MIP	$100K/MIP	$0.0066/MIP	1.4×10^7
Other	Address bits	8	64	8
	Users/CPU	10s	0.01	1.0×10^{-3}

Simplifying Hardware for Developers



Hides the complexity and limitations of hardware from application programmers

Takeaways

- OS is a program that acts as an intermediary between a user of a computer and the computer hardware

- OS hides the complexity and limitations of hardware from application programmers