Operating System (OS)

- **What is an Operating Systems (OS)?**
  - The *software layer* between user applications and hardware
  - Manages / Optimizes the hardware resources

- **Brief History of OS:**
  - **First generation:** 1945 - 1955
    - Vacuum tubes and plug boards
  - **Second generation:** 1955 - 1965
    - Transistors; Batch systems
  - **Third generation:** 1965 - 1980
    - Integrated circuits. Multiprogramming
Operating System (OS)

- Fourth generation: 1980 – present
  - Large scale integration. Personal computers.

- Next generation:
  - Systems connected by high-speed networks
  - Wide area resource management
First Generation (1945-1955): Direct Input

- Run one job at a time
  - Enter it into the computer (might require rewiring)
  - Run it
  - Record the results
- Programming languages were unheard of
- Assembly languages were not known
- No reason for an OS

Eniac, 1945

- Programs were written on paper in either FORTRAN or assembly
- Programs encoded on punched cards
- The card deck was taken down to the input room and handed to one of the operators
- Programmer would come back later for results
A first example of an OS for this generation is IBM’s OS/360

Considered a landmark operating system
Third Generation: Multiprogramming (1965-1980)

- Multiple jobs in memory
- Protected from one another
- Multiprogramming allowed several jobs to be active at one time

Diagram:

- Job 3
- Job 2
- Job 1
- Operating system

Memory partitions
Fourth Generation (1980-present) Personal Computers

- Personal computing changed the computing industry
- Intel came out with the 8080 in 1974
- Lots of companies produced complete systems
- The Control Program for Microcomputers (CP/M) from Digital Research was used

Altair 8080, 1975
256 bytes of memory
Fourth Generation (1980-present)

Personal Computers

- Now came the 16-bit systems with Intel’s 8086
- IBM designed the IBM PC
- IBM needed an OS for their PCs; CP/M behind schedule
- Who did they turn to?

IBM PC, 1981
Retailed at $2880
64 kilobytes of RAM
Single-sided 160K 5.25 floppy drive
Fourth Generation (1980-present) Personal Computers

- Bill Gates suggested to IBM that they should look at CP/M (one of the most successful OS for microcomputers at that time, by Gary Kindall)
- CP/M deal was not successful
Fourth Generation (1980-) Personal Computers

- IBM went back to Bill Gates
- Gates offered an OS called **DOS**
- DOS came from a company called Microsoft
- The new OS was renamed MS-DOS
Fourth Generation (1980-present) Personal Computers

- Up to this point all operating systems were command line
- Doug Englehart at Stanford invented the Graphical User Interface (GUI)
Fourth Generation (1980-present)  
Personal Computers

- Steve Jobs saw the possibility of a user-friendly PC
- This led to the Apple Macintosh in 1984
Fourth Generation (1980-present)

Personal Computers

- Used Motorola’s 16-bit 68000
- 64 KB of ROM
- Of course it had the first GUI
- BTW, Apple only started using Intel processors in 2006
What about UNIX?

- Let’s go back to the 60’s
- MULTICS was the first large timesharing system developed jointly between MIT, General Electric (computing division eventually sold to Honeywell) and Bell Labs
- But,... OS was written in a language called PL/1
- Not a lot of these got sold but they were very popular with those who bought
- Last one was put out of commission in 2000
  - It was owned by the Canadian Department of National Defence
MULTICS
What about UNIX?

- One of the computer scientists at Bell Labs who worked on MULTICS was Ken Thompson.
- He found a small PDP-7 minicomputer that no one was using.
- He decided to write a stripped-down, one-user version of MULTICS in the C programming language.
- This became UNIX.
- This was open source which led to other versions: System V (AT&T) and BSD (Berkeley Software Distribution).
What about MINIX?

- Eventually AT&T realized that UNIX was commercially viable.
- Unix, Version 7’s license prohibited the source code from being studied in courses.
- A computer scientist, Andrew Tanenbaum created a new OS (using the C programming language) from scratch that would be compatible with UNIX but completely different on the inside.
- This was MINIX or mini-Unix; released in 1987.
- Better structured than UNIX.
- MINIX-3 released in 2006.
After MINIX was released a newsgroup, comp.os.minix was formed.

Quickly had 40,000 subscribers who wanted to add stuff

One was a Finnish student named Linus Torvalds
LINUX

- Torvalds wanted to add features which led to other things
- Eventually this led to his own OS called Linux (August 1991)
- Linux is a notable success of the open source movement
Summary

- We have discussed what is an operating system
- We have looked at a brief history of operating systems
- Now it is time to learn more about the insides of an operating system