What is Operating System?

- **Modern Complex Computer System**
  - processor, memory, disk, printer, keyboard, monitor, network interface, other I/O devices.

- **Imagine**
  - If we need to consider all devices for writing a program, it is extremely hard.

- **Operating system** – protected software provides interface between hardware and software.
# A Computer System

<table>
<thead>
<tr>
<th>Banking system</th>
<th>Airline reservation</th>
<th>Web browser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compilers</td>
<td>Editors</td>
<td>Command interpreter</td>
</tr>
</tbody>
</table>

- **Application programs**
- **System programs**
- **Hardware**

- Operating system
- Machine language
- Microarchitecture
- Physical devices
Hardware

- **Physical devices** – IC chips (CPU, Memory ..), wires, power supplies, CRT (cathode ray tubes),
- **Micro-architecture** – physical devices are grouped together to form functional units.
- **Machine language** – There are typically 50 to 300 instructions in the system.
A Computer System

• The microprocessor’s main task is to execute instructions.
• The *instruction cycle* is therefore the heart of understanding the function and operation of the microprocessor.
Instruction Cycle

Fetch cycle

1. Reading the address of the instruction to be executed from the memory and
2. Loading it into the Instruction register (IR).
3. Program Counter register (PC) is modified to point at the next valid instruction.
Instruction Cycle

1. PC \rightarrow MAR
2. Address Bus \rightarrow MDR
3. Load Accumulator with M(A)
4. Data Bus
5. Load Accumulator with M(A)
6. Load Accumulator with M(A)
7. PC = PC + 1
Instruction Cycle

Execute cycle

- The contents of the IR are encoded and executed.
- The execution may result in a variety of actions depending on the type of instruction. It may be a self contained instruction, or it can involve interaction with memory and ALU.
What is an Operating System?

We can consider OS as

- an extended machine
  - Hides the messy details which must be performed.
  - Presents user with a virtual machine, easier to use.

- a resource manager
  - Each program gets time with the resource.
  - Each program gets space on the resource.
History of Operating Systems

The First Generation (1945 ~ 1955)

The First Generation (1945 ~ 1955) – vacuum tubes and plugboards

- Use vacuum tubes to build calculating engines.

- All programming was done in machine language, often by wiring up plugboards to control the machine’s basic functions.

- Need to sign up for a block of time, come down to the machine room, insert plugboards and wait for calculation
History of Operating Systems
The First Generation (1945 ~ 1955)
History of Operating Systems
The First Generation (1945 ~ 1955)

- IBM SSEC (1948)
- Speed: 50 multiplications/sec
- Input/output: cards, punched tape
- Memory type: punched tape, vacuum tubes, relays
- Technology: 20,000 relays, 12,500 vacuum tubes
- Floor space: 25 feet by 40 feet
History of Operating Systems

The Second Generation (1955 ~ 1965)

The Second Generation (1955 ~ 1965) – **Transistors and Batch system**

- **Transistor** was invented in the mid 1950s. Computer becomes more reliable since vacuum tubes are replaced by transistors – mainframes.

- To run a job
  1. Write the program on paper
  2. Punch it on cards
  3. Bring the card deck down to the input room and hand in to one of the operators
  4. Wait for output (normally drink coffee while waiting)
  5. If FORTRAN Compiler is needed, the operator would have to get the compiler from a file cabinet and read it in.
History of Operating Systems
The Second Generation (1955 ~ 1965)

- The figure shows one of the early 80 column IBM cards.
- Each card contains 12 rows of 80 columns, and each column is typically used to represent a single piece of data such as a character.

Punch Card
IBM’s 7000 series mainframes were the company’s first transistorized computers. Significantly faster and more dependable than vacuum tube machines.

IBM 7030 (1959)
History of Operating Systems
The Second Generation (1955 ~ 1965)

Batch System - to optimize the usage of expensive computer

- Collect a tray full of Jobs
- Bring cards to 1401 (cheap machine)
- Read cards to tape
- Put tape on 7094 which does computing (expensive)
- Put tape on 1401 which prints output
History of Operating Systems
The Second Generation (1955 ~ 1965)

Structure of a typical FMS (Fortran Monitor System) job
History of Operating Systems

The Third Generation (1965 ~ 1980)

The Third Generation (1965 ~ 1980)- IC and Multiprogramming

- Maintaining two completely different product lines (IBM 7094, IBM 1401) was an expensive proposition for the manufacturers.

- IBM introduced IBM System/360 – for scientific and commercial computing.

- The idea was that all software, including the operating system OS/360, had to work on all models – need very complex operating system with assembly code.
IBM announced the System/360, a family of six mutually compatible computers and 40 peripherals that could work together.

The initial investment of $5 billion was quickly returned as orders for the system climbed to 1,000 per month within two years.

At the time IBM released the System/360, the company was making a transition from discrete transistors to integrated circuits, and its major source of revenue moved from punched-card equipment to electronic computer systems.
History of Operating Systems

The Third Generation (1965 ~ 1980)

Major feature of the third generation operating system

- IBM System/360 was the first major computer to use IC (integrated circuit)
- Uses **multiprogramming** technique to save CPU time.
- Uses **spooling** (Simultaneous Peripheral Operation On Line) technique – The process in which information to be printed is stored temporarily in a file, the printing being carried out later. It is used to prevent a relatively slow printer from holding up the system at critical times, and to enable several computers or programs to share one printer.
- Uses **timesharing** system to share CPU time between users using terminal.
History of Operating Systems

The Third Generation (1965 ~ 1980)

- Multiprogramming system
- three jobs in memory – 3rd generation
History of Operating Systems

The Fourth Generation (1980 ~ Present)

The Fourth Generation (1980 ~ Present) – Personal Computer, LSI

- The development of LSI (Large Scale Integration) circuits (containing thousands of transistors) reduces the price of computer, which make it possible to build personal computer

- User type in commands from the keyboard
  - CP/M
  - DOS

- Graphic User Interface (GUI)
  - Apple with GUI
  - MS – Window95, 98, 2000, XP
The Operating System Zoo

- Mainframe operating systems
- Server operating systems
- Multiprocessor operating systems
- Personal computer operating systems
- Real-time operating systems
- Embedded operating systems
- Smart card operating systems