The Process

How can a computer run so many programs?

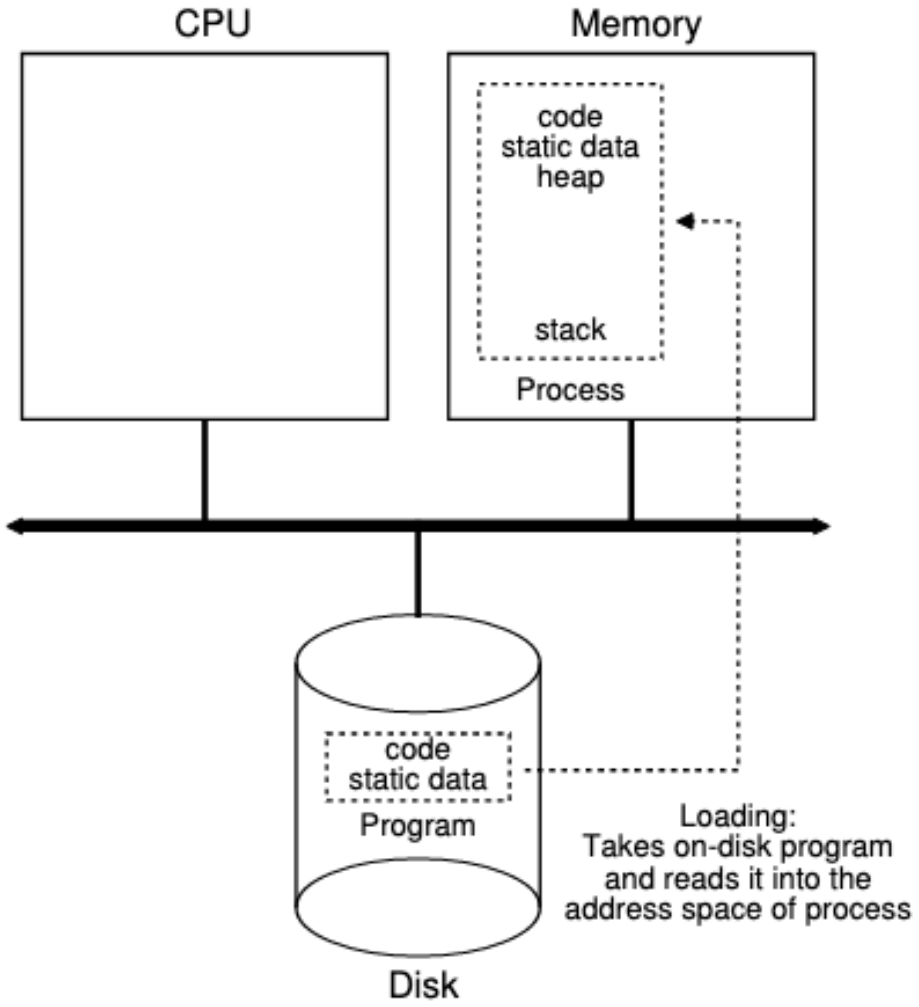
- We take this for granted daily
  - Do you think if your CPU is available to run a program?

- The OS ensures we don’t have to worry about these things
  - The CPU resource is **virtualized**
  - Each program is isolated from each other which gives the illusion that program is only running program

- A running program exists as an abstraction called a **process** in memory

How does the OS setup a process?

- OS allocates internal data structures
  - E.g. PID, process list entry
- OS allocates the program's **address space**
- Loads code and data from disk
- Creates runtime stack, heap, in the address space
- OS opens basic **file descriptors** for I/O
  - E.g. STDIN, STDOUT, STDERR
- OS initializes CPU registers

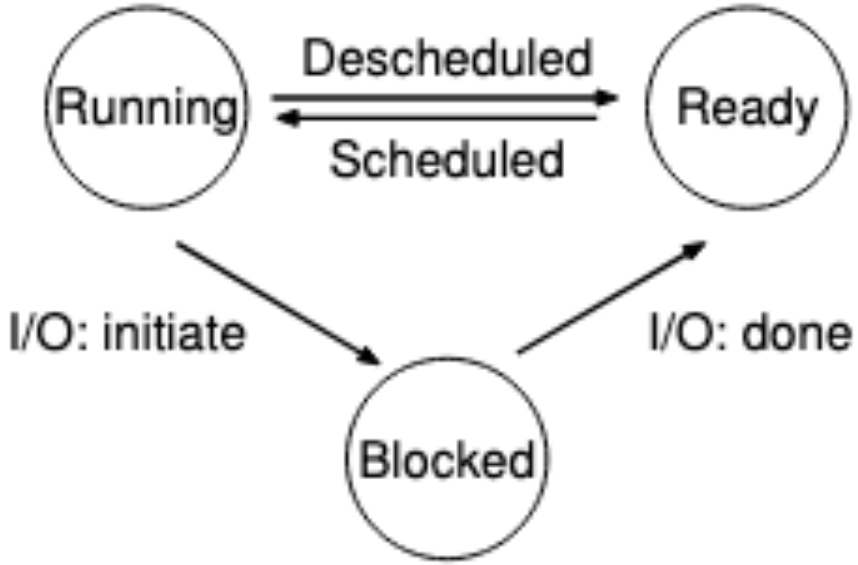


The Process List

- An internal data structure to keep track of all active processes
- Entries for each process are stored in a **Process Control Block (PCB)** or **process descriptor**
  - Process identifier
  - Process state
  - Pointers to other related processes (parent)
  - CPU context of the process (saved when the process is suspended)
  - Pointers to memory locations
  - Pointers to open files

Basic Process States

- **Running**
  - CPU is actively executing program instructions
- **Ready**
  - Process is ready to run on the CPU, but has not been selected to run
- **Blocked**
  - A process needs resources to run that have not yet been acquired so it yields to other processes until those resources are available
    - E.g I/O request



Running Processes on the CPU

- CPU resources are **time-shared** among the processes
- The OS has **mechanisms** (how?) to implement this, and a **scheduling policy** (why?) to make decisions on how time-sharing occurs

Time	$Process_0$	$Process_1$	Notes
1	Running	Ready	
2	Running	Ready	
3	Running	Ready	$Process_0$ initiates I/O
4	Blocked	Running	$Process_0$ is blocked,
5	Blocked	Running	so $Process_1$ runs
6	Blocked	Running	
7	Ready	Running	I/O done
8	Ready	Running	$Process_1$ now done
9	Running	–	
10	Running	–	$Process_0$ now done