# Process

- **What is a Process?**
- **Process States and Life Cycle**
- **Process Scheduling**





# What is a Process?

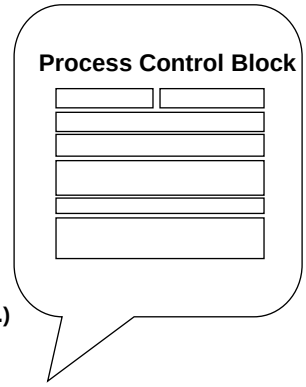
- **A process is a program in execution**
- **A process is not the same as "program"**
  - ♦ **A program is a passive text of executable codes resides in disk.**
  - ♦ **A process is an active entity ripe for execution (must have a program counter, stack and data section).**
  - ♦ **Multiple people can run the same program, each running a copy of the same program text, but each is a distinct process.**
- **Type (HP Unix):**

| | |
|---|---|
| **%ps** | **shows all my processed with little detail** |
| **%ps -fl** | **more detail** |
| **%ps -efl** | **all processed with full detail** |

- **User and OS processes**
  - ♦ **jobs (batch system), tasks (time shared system), process (generic)**

# Process (Continued..)

- **The process must have (at least):**
  - ♦ **ID**
  - ♦ **Code of the program**
  - ♦ **Program's static data**
  - ♦ **Program's dynamic data**
  - ♦ **Content of Program Counter (PC)**
  - ♦ **Content of Stack Pointer (SP)**
  - ♦ **Content of Program Status Word (PSW)**
  - ♦ **Content of general purpose registers**
  - ♦ **CPU scheduling information**
  - ♦ **Memory management info (memory limits etc.)**
  - ♦ **Accounting information**
  - ♦ **I/O status information**

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# Process Creation/ Termination

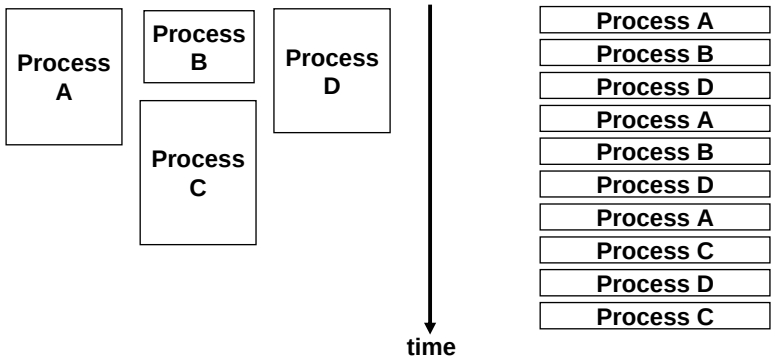
- **Reasons for process creation:**
  - ♦ **New batch job**
  - ♦ **user starts a program**
  - ♦ **OS creates process to provide a service**
  - ♦ **Program starts another process**

- **Reasons for process termination:**

| | | |
|---|---|---|
| **Normal completion** | **Exceed time limit** | **I/O failure** |
| **Memory unavailable** | **Bounds violation** | |
| **Protection error** | **Arithmetic error** | |
| **Privileged instruction** | **Invalid instruction** | |
| **Human intervention** | **Parent termination** | |
| **Parent request** | | |

# Process Execution

- **Conceptual model of Processes executing:**
- **Actual interleaved execution of the 4 processes:**



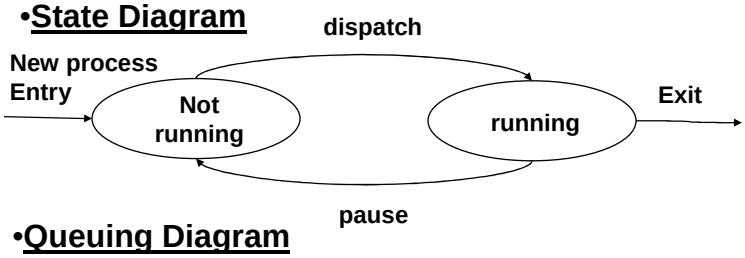




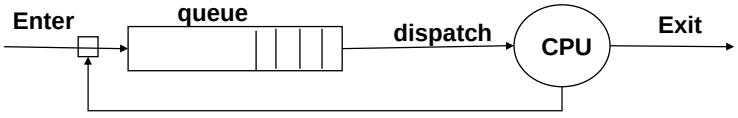

# A Two State Process Model

- **A Process is either "running" or "not running"**

**•State Diagram**




**•Queuing Diagram**



# Process Waiting …..

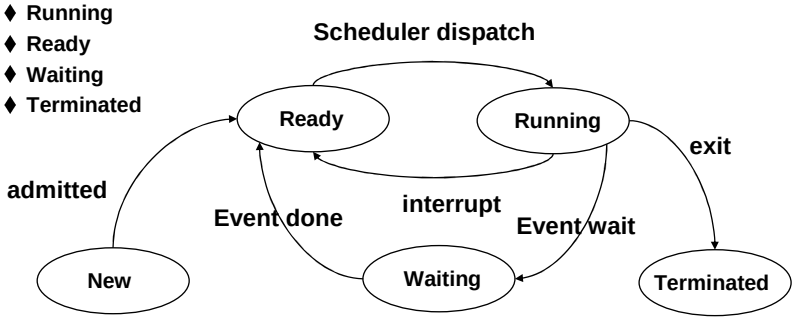
- **Some reasons why a process that might otherwise be running needs to wait:**
  - **Wait for user to type the next key**
  - **Wait for output to appear on the screen**
  - **program tried to read a file**
  - **Netscape tried to follow a link (URL)**
- **OS Must distinguish between:**
  - **Processes that are ready to run, and waiting for the time slice.**
  - **Processes that are waiting for something to happen.**





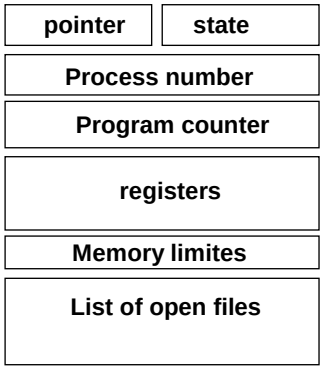
# Five State Process Model

- **States:**
  - **New**
  - **Running**
  - **Ready**
  - **Waiting**
  - **Terminated**



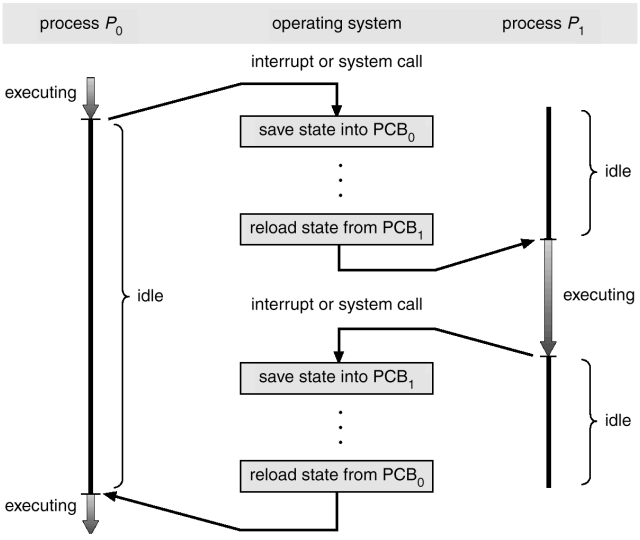
# Process Control Block

- **For Every process OS maintains a data structure that represents the process and its states**
- **Process ID**
  - **State**
  - **User IP owner**
  - **PC, SP, PSW and other registers**
  - **memory management info**
  - **list of open files**
  - **IO states**
  - **CPU scheduling (priority)**

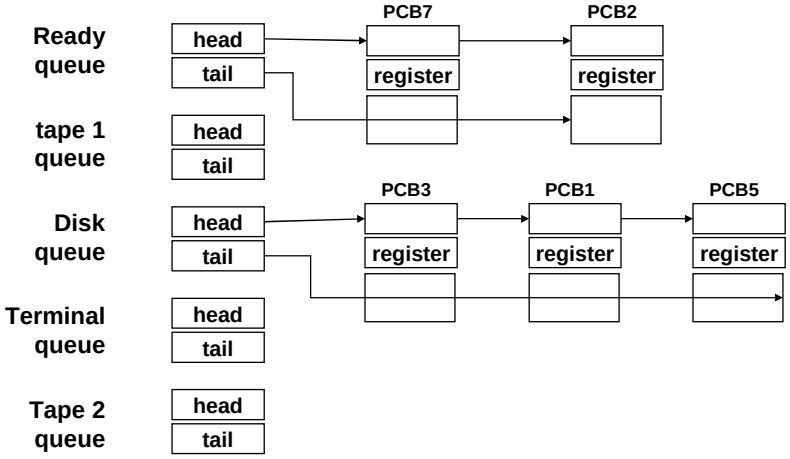






# Ready Queue and Other I/O Device Queues

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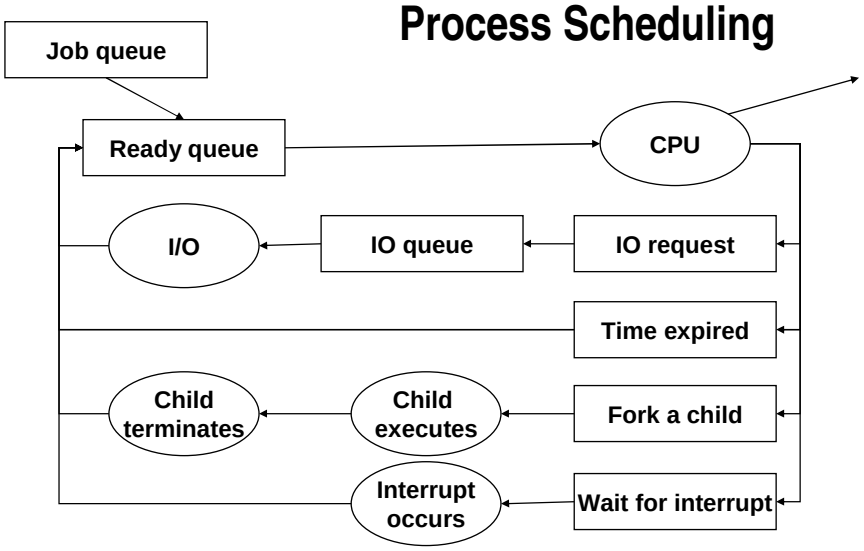
# Process Scheduling

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# Next Class..

- **Operation on processes**
- **Cooperating processes**
- **Process Communication**
- **Threads**