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**LECTURE- 5**  
Principles of  
Operating Systems

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**PROCESSES**

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# Outline

- Process Concept
  - Process Scheduling
  - Operations on Processes
  - Cooperating Processes
  - Threads
  - Interprocess Communication
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# Concept of Process

- An operating system executes a variety of programs
    - batch systems - jobs
    - time-shared systems - user programs or tasks
    - job and program used interchangeably
  - Process - a program in execution
    - process execution proceeds in a sequential fashion
  - A process contains
    - program counter, stack and data section
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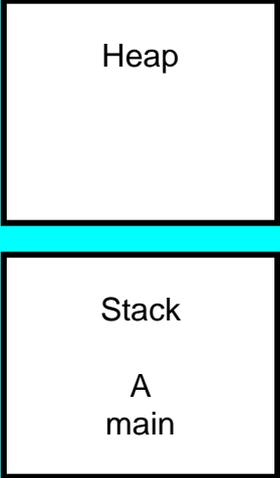
# Process =? Program

```
main ()
{
    ...;
}
A () {
    ...
}
```

Program

```
main ()
{
    ...;
}
A () {
    ...
}
```

Process

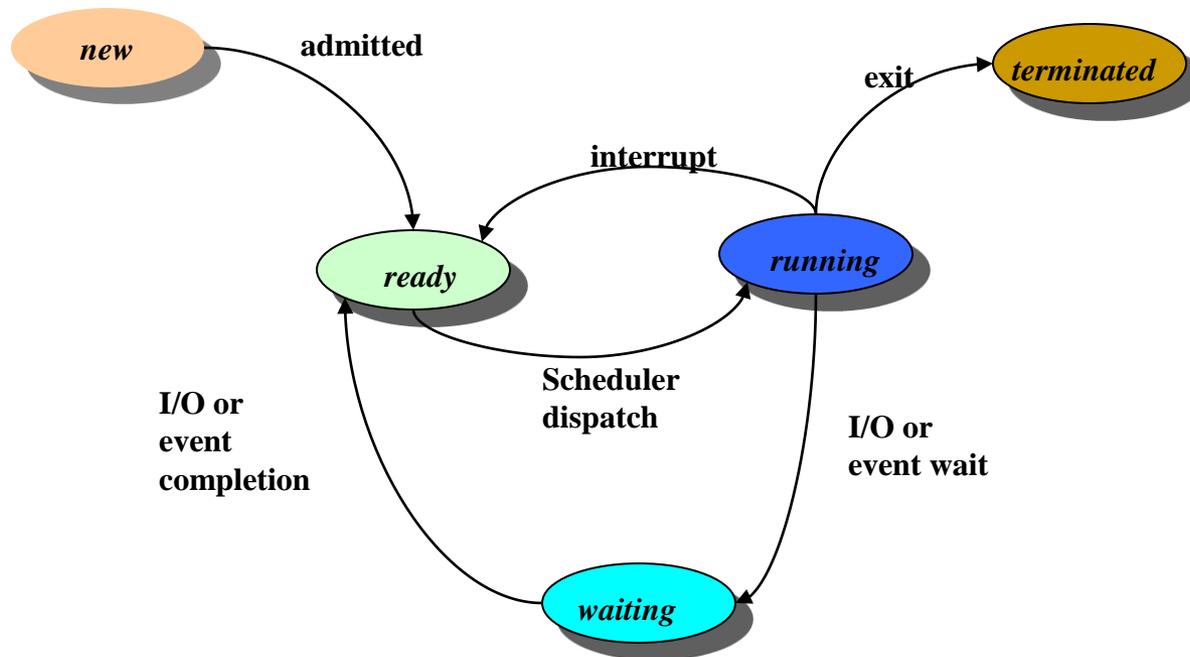


The diagram shows a vertical stack of memory regions. The top region is labeled 'Heap'. Below it is a region labeled 'Stack'. Inside the 'Stack' region, the labels 'A' and 'main' are listed vertically, indicating the call stack.

- More to a process than just a program:
  - Program is just part of the process state
  - I run emacs on lectures.txt, you run it on homework.java – Same program, different processes
- Less to a process than a program:
  - A program can invoke more than one process
  - cc starts up cpp, cc1, cc2, as, and ld

# Process State

- A process changes state as it executes.



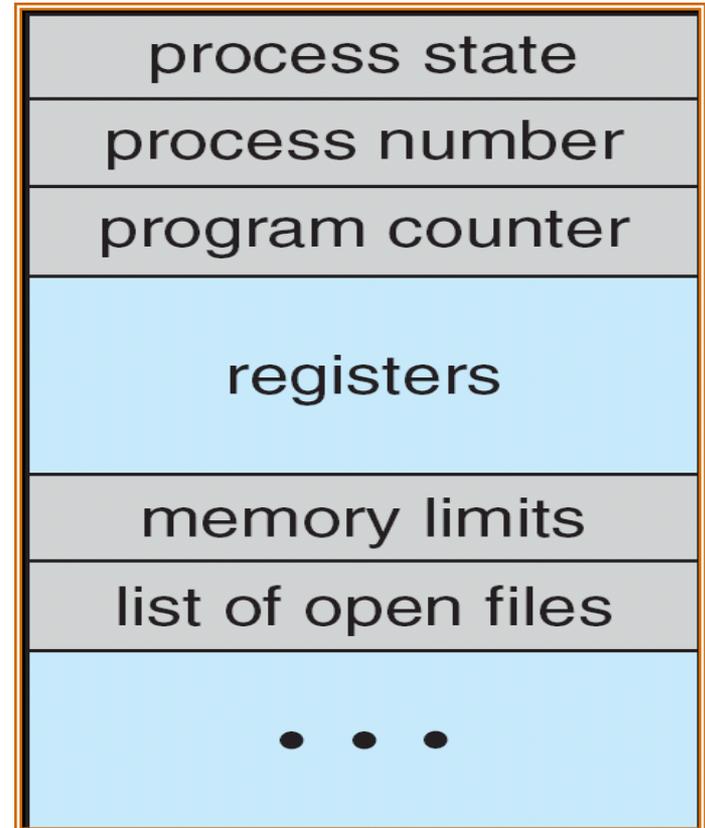
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# Process States

- New - The process is being created.
  - Running - Instructions are being executed.
  - Waiting - Waiting for some event to occur.
  - Ready - Waiting to be assigned to a processor.
  - Terminated - Process has finished execution.
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# Process Control Block

- Contains information associated with each process
  - Process State - e.g. new, ready, running etc.
  - Process Number – Process ID
  - Program Counter - address of next instruction to be executed
  - CPU registers - general purpose registers, stack pointer etc.
  - CPU scheduling information - process priority, pointer
  - Memory Management information - base/limit information
  - Accounting information - time limits, process number
    - I/O Status information - list of I/O devices allocated



Process  
Control  
Block