CS 3305A

Multiprogramming

Lecture 7

Sept 30th 2019

Multiprogramming

- Assume we have two processes p and q
- Process p has an instruction that requires a read/write from/to disk
- Reading from disk is slow
- Why not have instructions from q execute while p is waiting?

Multiprogramming

- Multiprogramming allows for the execution of multiple processes
- But only one process active at any time

Why Multiprogramming?

- Operating systems allow for interleaved execution
  - On a single-processor system, no more than one process ever runs.
  - However, one process's instructions may be executed before the completion of the instructions from another process
- The objective is to have some process running at all times in order to maximize CPU utilization.

Process Switching

- Current process executes an I/O operation
- OS needs to be able to suspend current process so that another process can execute
- This is referred to as context switching

Process Switching

- OS needs to be able to suspend current process
- OS captures information about a process
- Information captured must be sufficient to restore the hardware to the same configuration it was in when the process was switched out.

Characterizing a Process

- Each process is represented in the OS by a process control block (PCB) which contains all the state for a program in execution including (but not limited to):
  - Pointer to text, data etc. information
  - The program counter (PC) indicating the next instruction
  - Current values of the set of general-purpose registers
  - A set of operating system resources e.g., open files, network connections
  - Process identifier (PID)
  - Process priority (for scheduling purposes)
  - etc.

Process Execution States

- As a process executes, it changes execution state
- The execution state of a process is defined in part by the current activity of the process
- A process may be in one of the following execution states:
  - New: The process is being created
  - Ready: The process is waiting to be assigned to a processor
  - Running: Instructions are being executed
  - Waiting: The process is waiting for some event to occur (such as an I/O completion or reception of signal)
  - Exit: The process has finished executing
- Only one process can be running on any processor at any instant
- Many processes may be ready and waiting

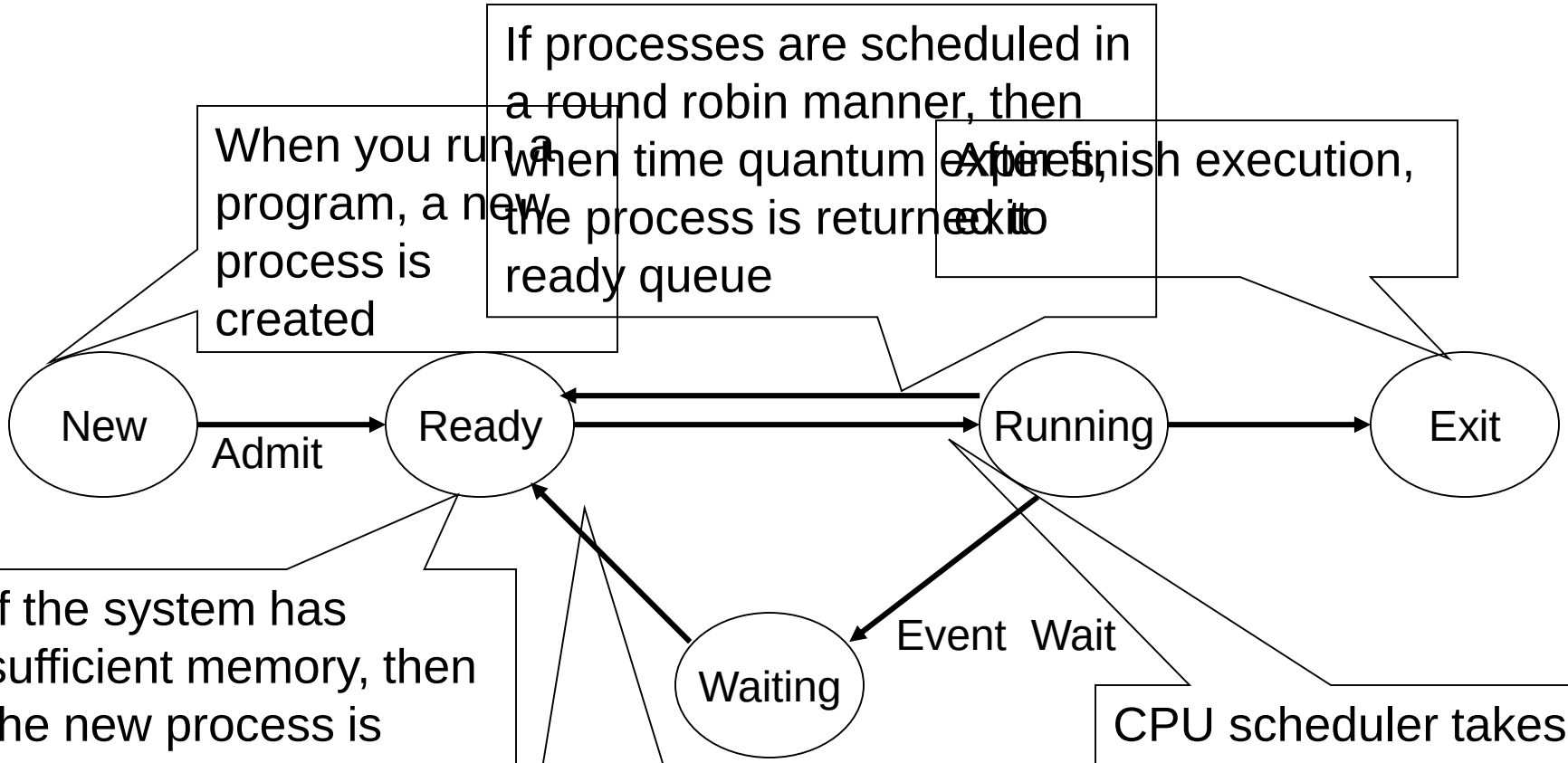
Scheduling

- The purpose of multiprogramming is to have a process running at all times
- The objective of time sharing is to switch the CPU among processes so frequently that users can interact with each process
- The process scheduler selects an available process
- There may be multiple processes to select from

Scheduling Queues

- As processes enter the system, they are put into a job queue, which consists of all processes in the system
- The processes that are residing in main memory and are ready and waiting to execute are kept on a list called the ready queue
- Queues are implemented using linked list

Process Execution States



If the system has sufficient memory, then the new process is loaded into memory and placed in **ready queue**

When the wait for I/O is over there is a return to the Ready state

CPU scheduler takes a process from the head of a ready queue to execute
(Sometimes, there may be multiple ready queues.)