What is Concurrent Programming?

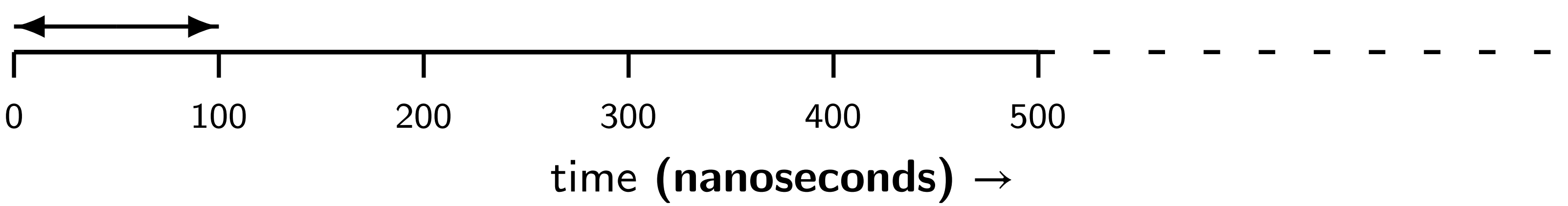
M. Ben-Ari

Principles of Concurrent and Distributed Programming

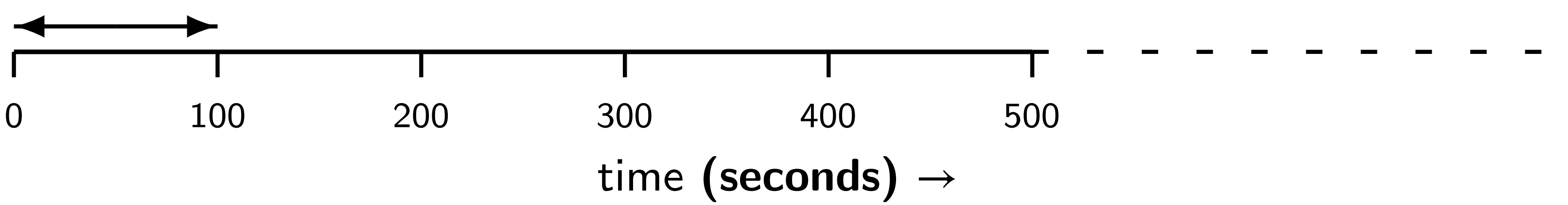
Second Edition

Addison-Wesley, 2006

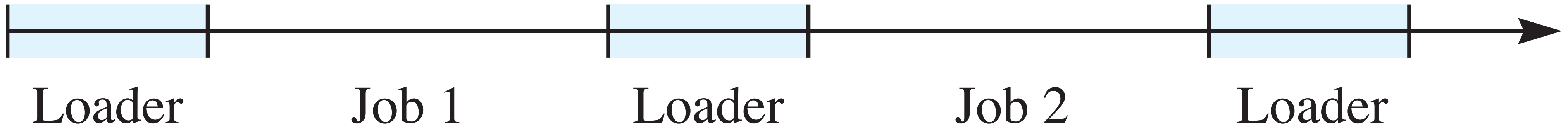
Computer Time



Human Time



Primitive, one-job-at-a-time system



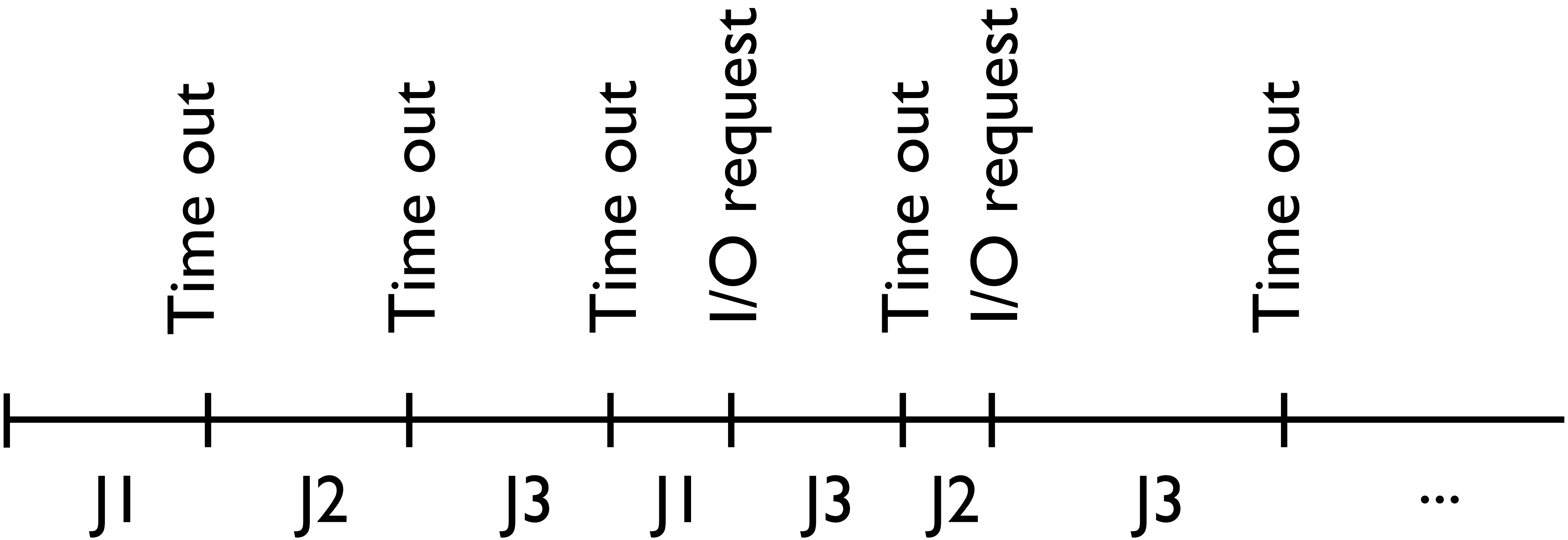
Multiprogramming

- An operating system that can switch back and forth between processes to keep the CPU busy is called a *multiprogramming system*
- It maintains a queue of process control blocks (PCBs)

Asynchronous interrupts

- Time outs
- I/O completions

A multiprocessing system



Observation

It is impossible for the programmer to predict the statements in the program where the process will be interrupted by the operating system.

Process

A process is a program during execution.
The state of the process is specified by:

- the program listing
- the values of all the variables
- the next instruction to execute
  program counter (PC)

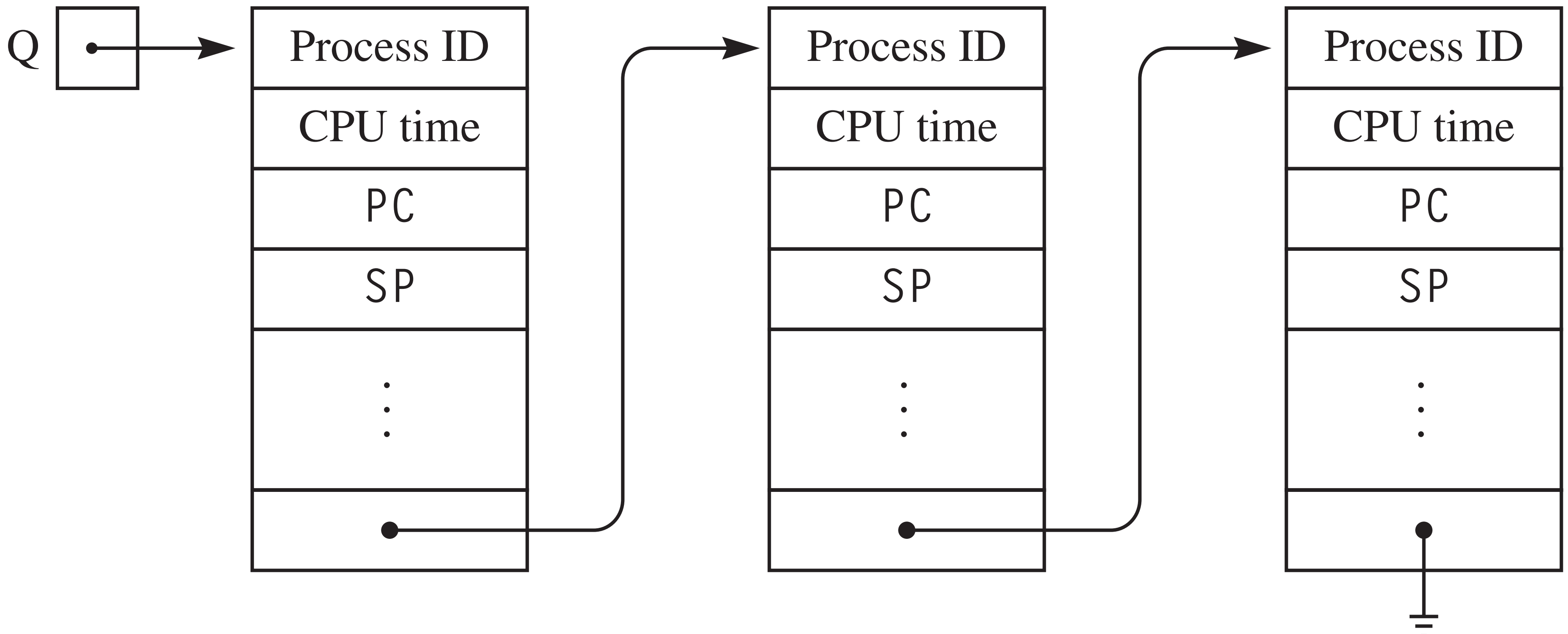
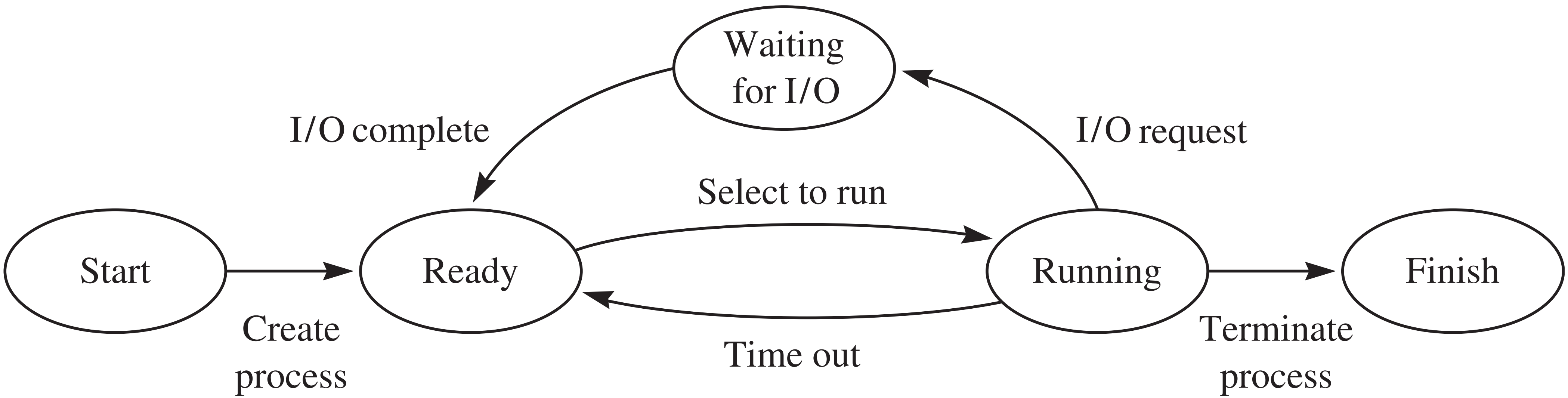

Q
Process ID
CPU time
PC
SP
Process ID
CPU time
PC
SP
Process ID
CPU time
PC
SP

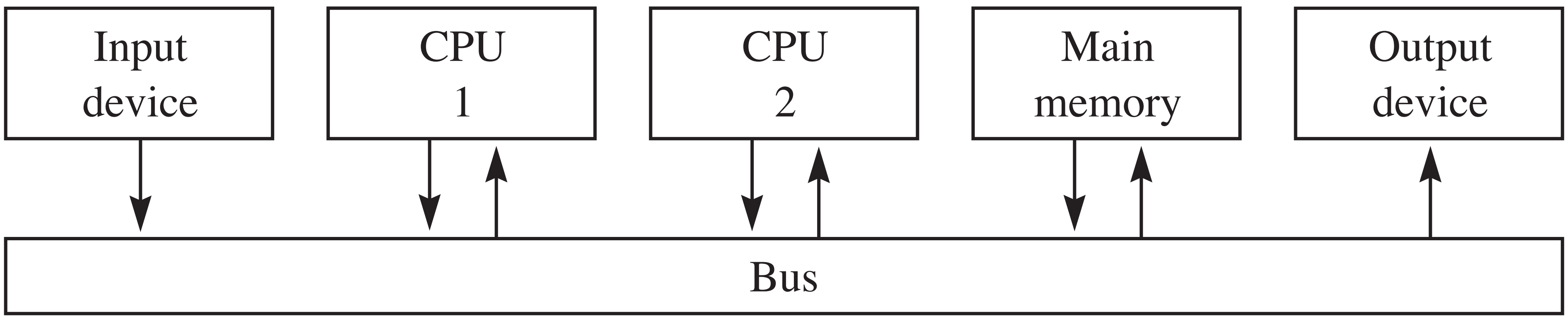
Figure 8.19


Waiting for I/O
I/O complete
I/O request
Select to run
Start
Ready
Running
Finish
Create process
Time out
Terminate process

Multiprocessing

- A computer system with more than one physical CPU
- Also maintains a queue of PCBs, but more than one process can be running at the same time

Figure 8.20



The Concurrency Theorem

Multiprogramming and multiprocessing
are logically equivalent.