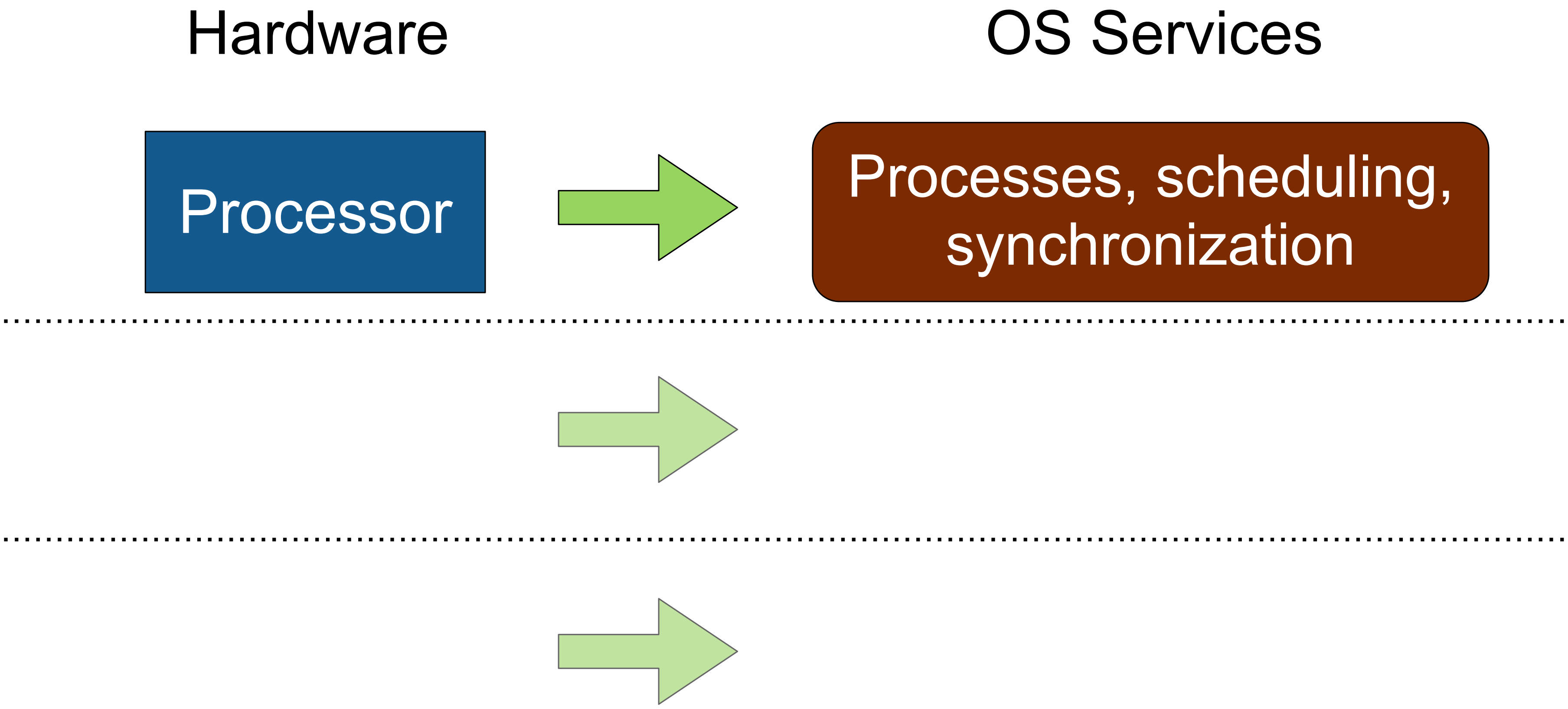
Processes



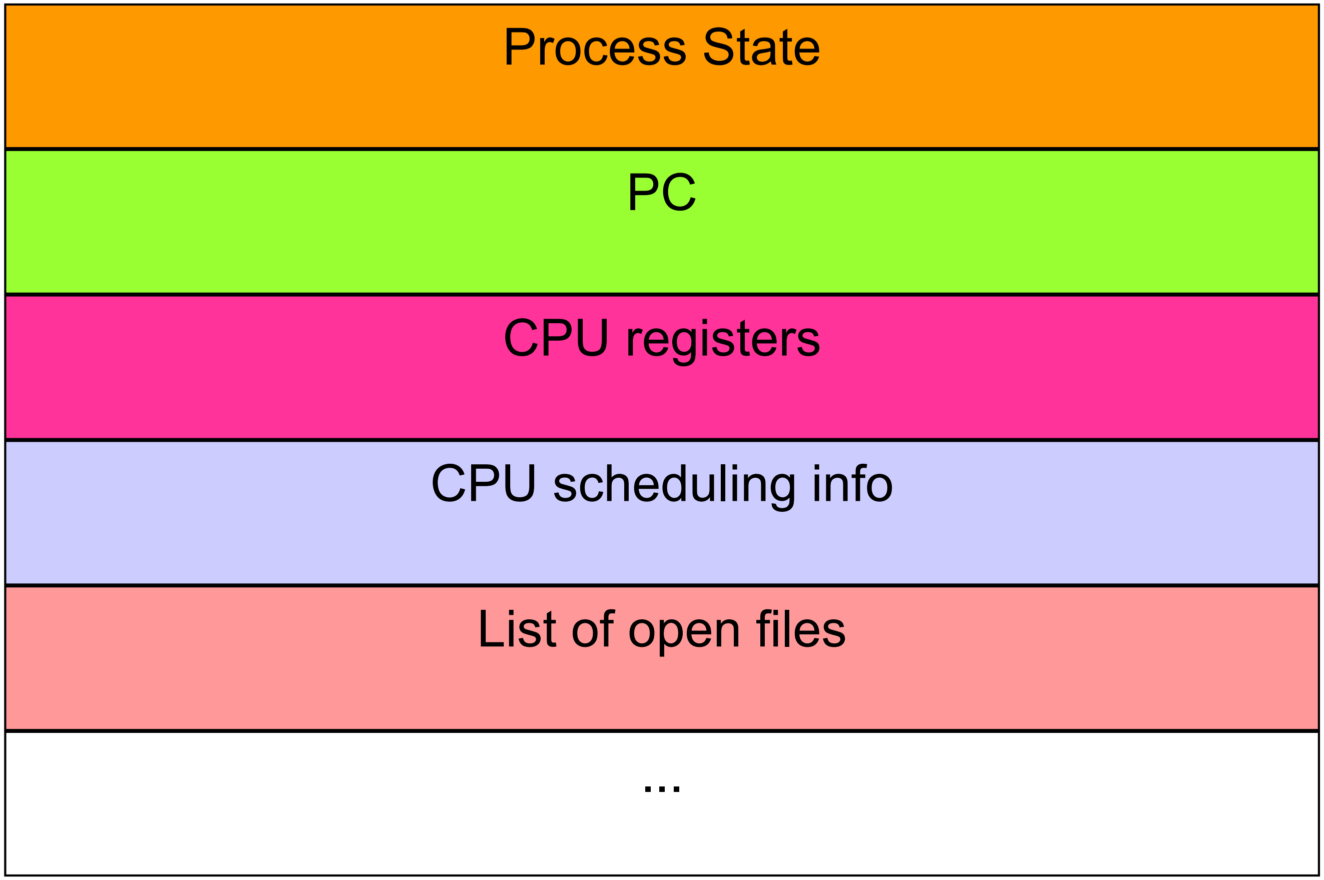
Hardware

OS Services

Processor

Processes, scheduling, synchronization

Process Control Block (PCB)



Process State

PC

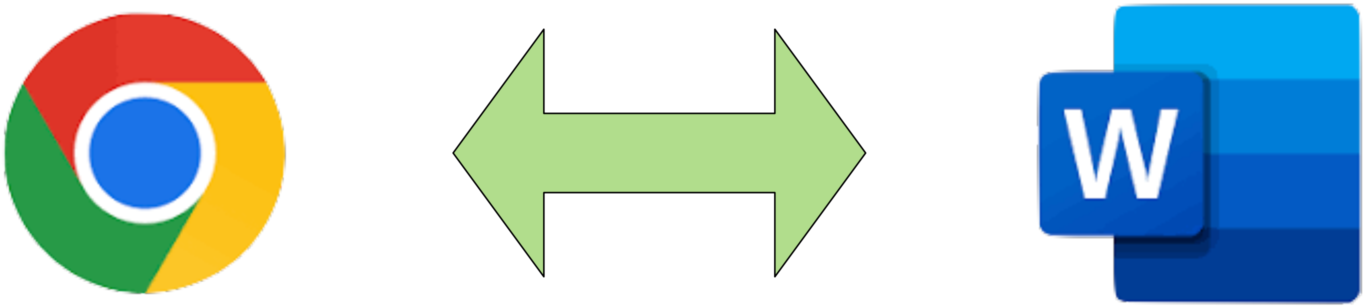
CPU registers

CPU scheduling info

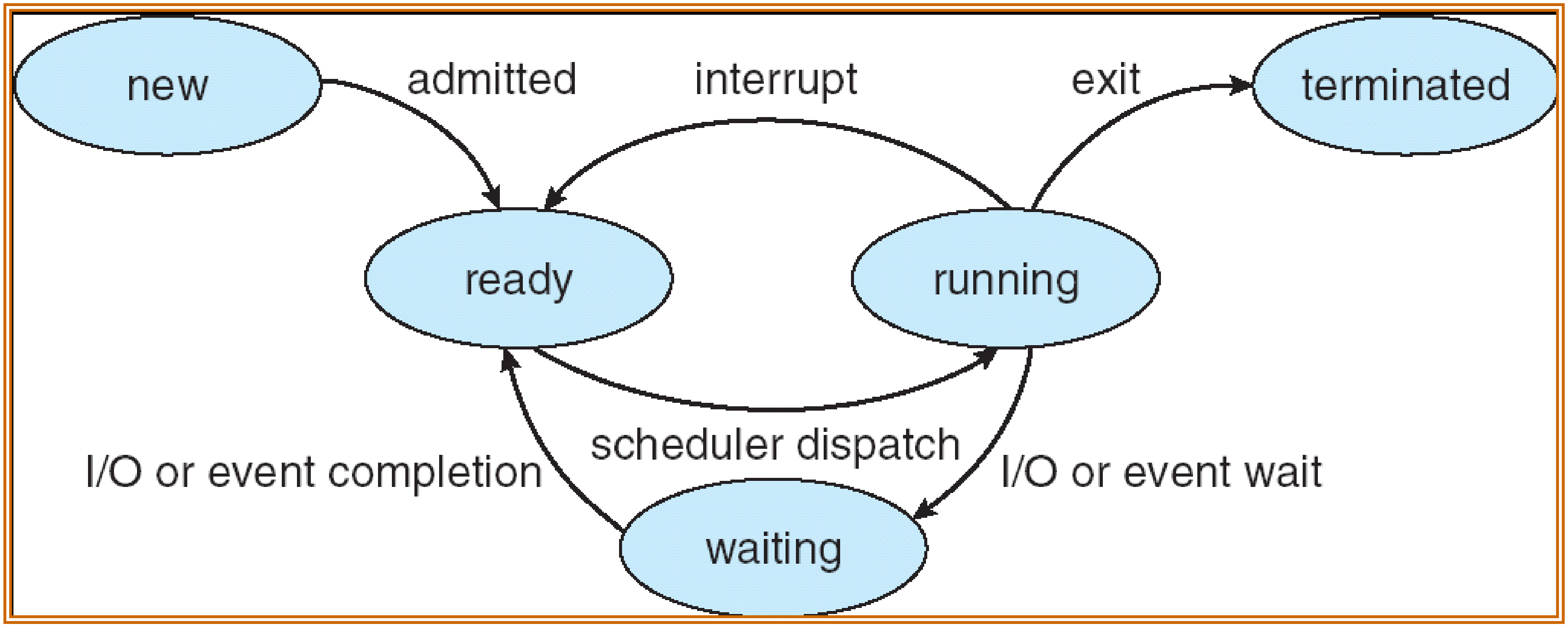
List of open files

...

Context Switching

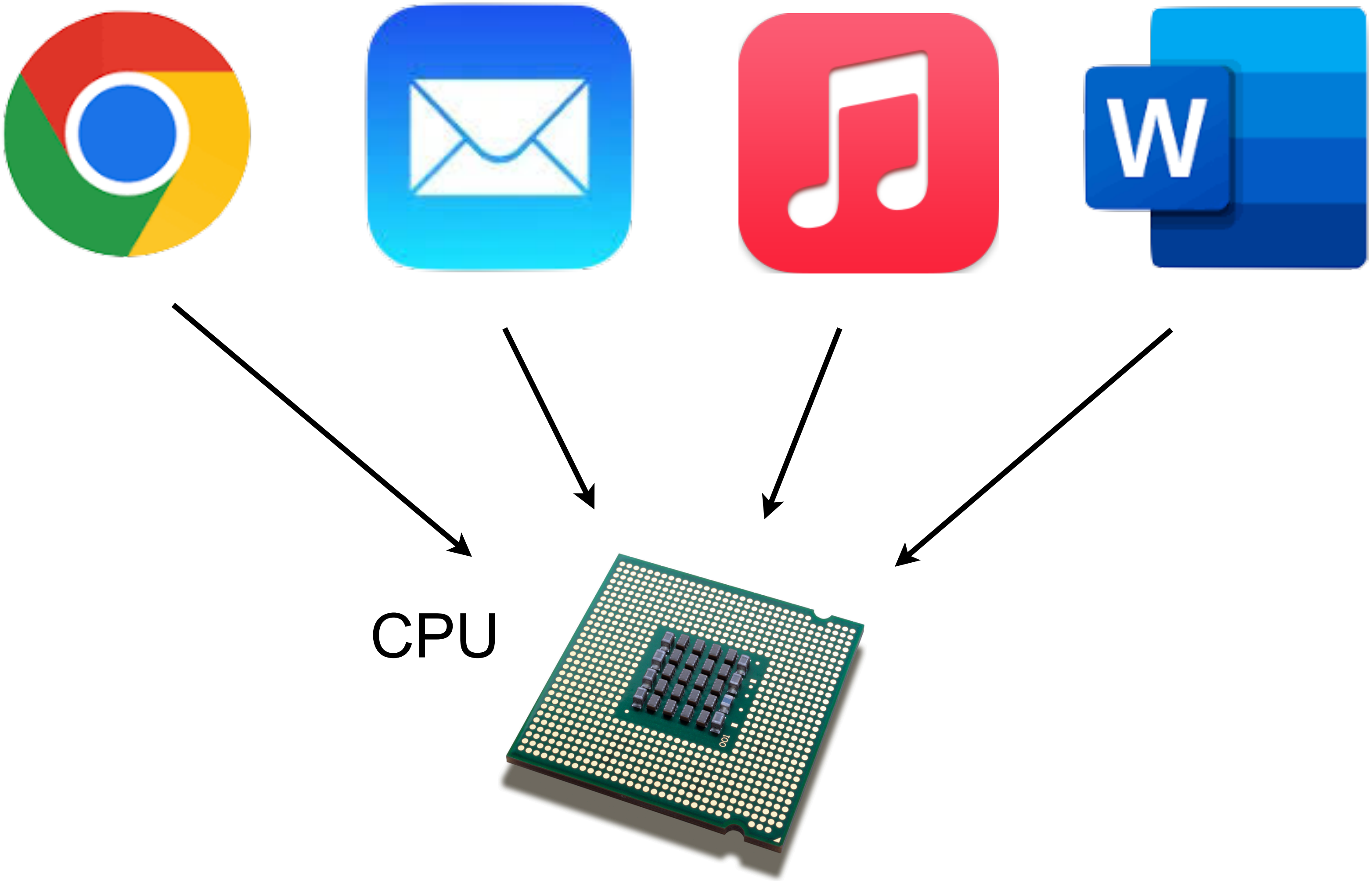


Process Execution States



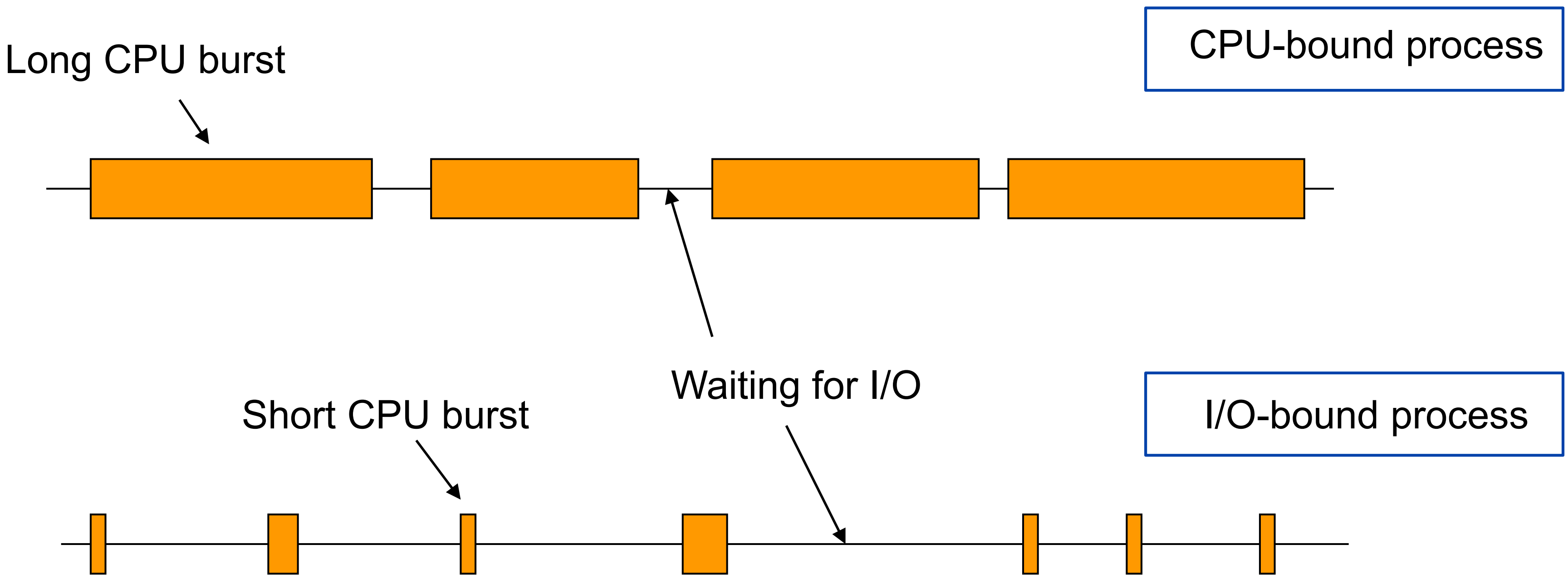
CPU Scheduling

Processes



CPU

CPU and I/O Bursts



Long CPU burst

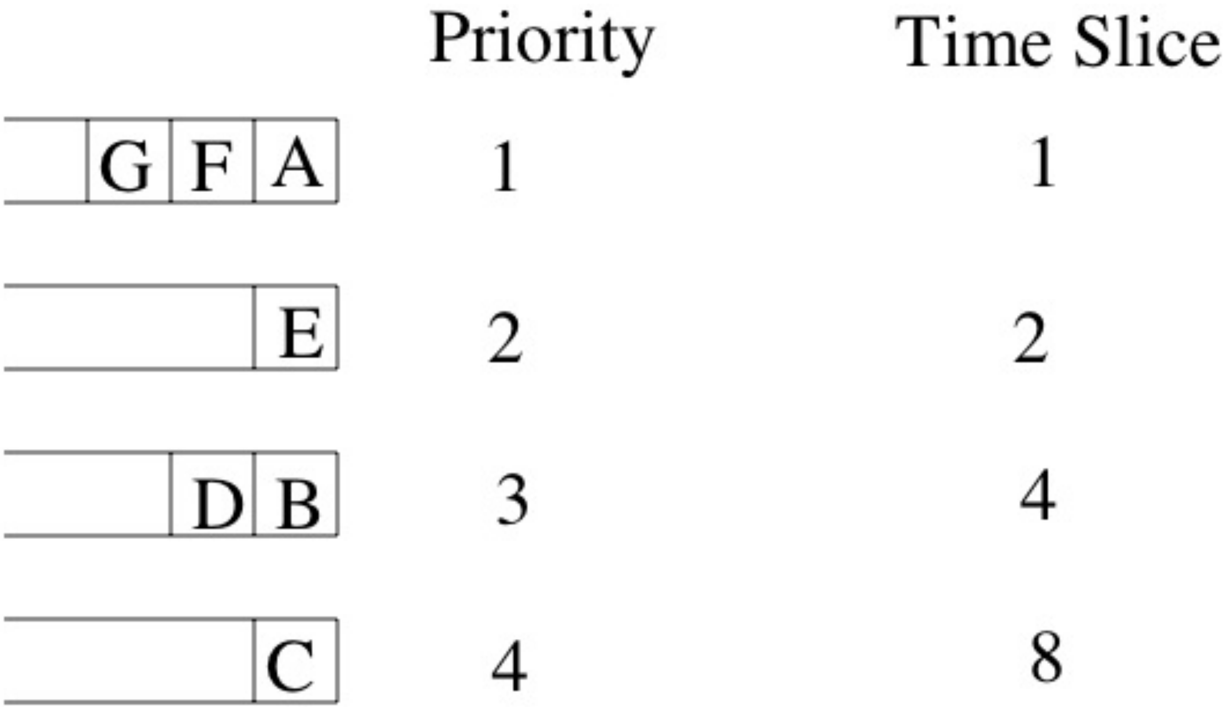
CPU-bound process

Waiting for I/O

Short CPU burst

I/O-bound process

Multilevel Feedback Queues



	Priority	Time Slice
G F A	1	1
E	2	2
D B	3	4
C	4	8

CPU Scheduling Algorithms

First Come First Serve (FCFS)

Shortest Job First (SJF)

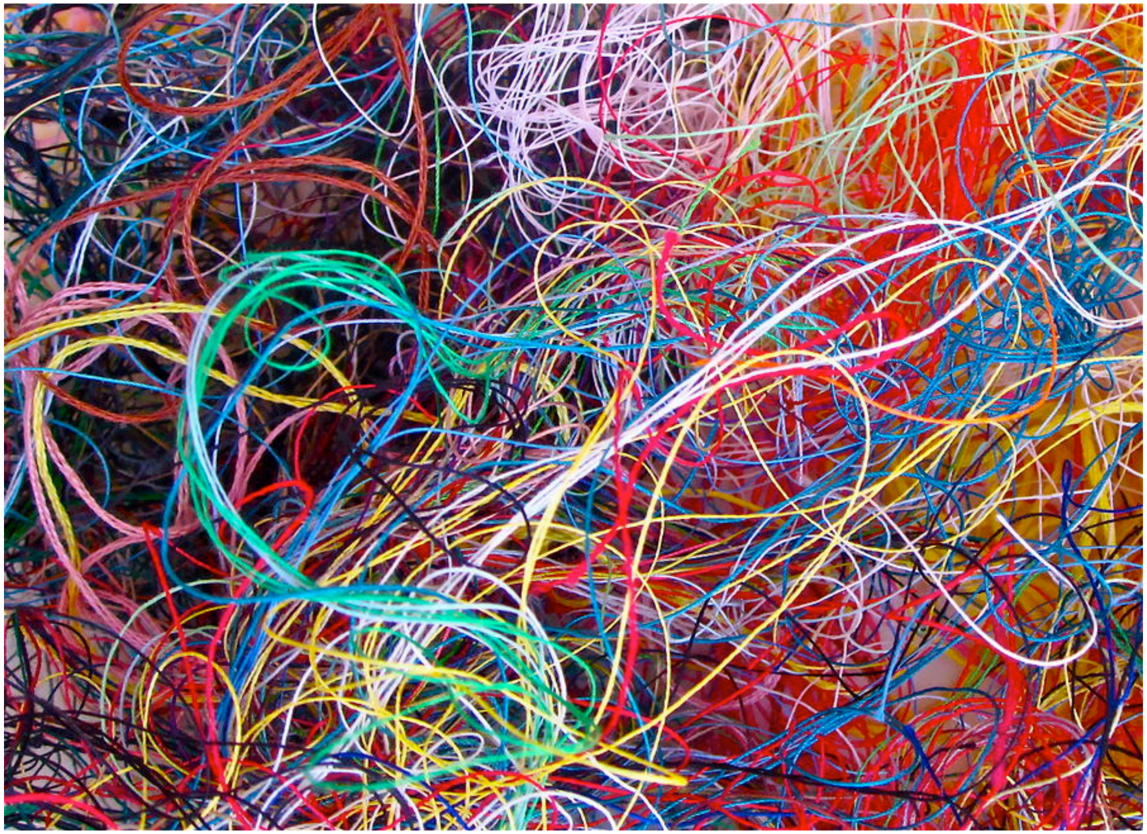
Shortest Remaining Time First (SRTF)

Round-Robin (RR)

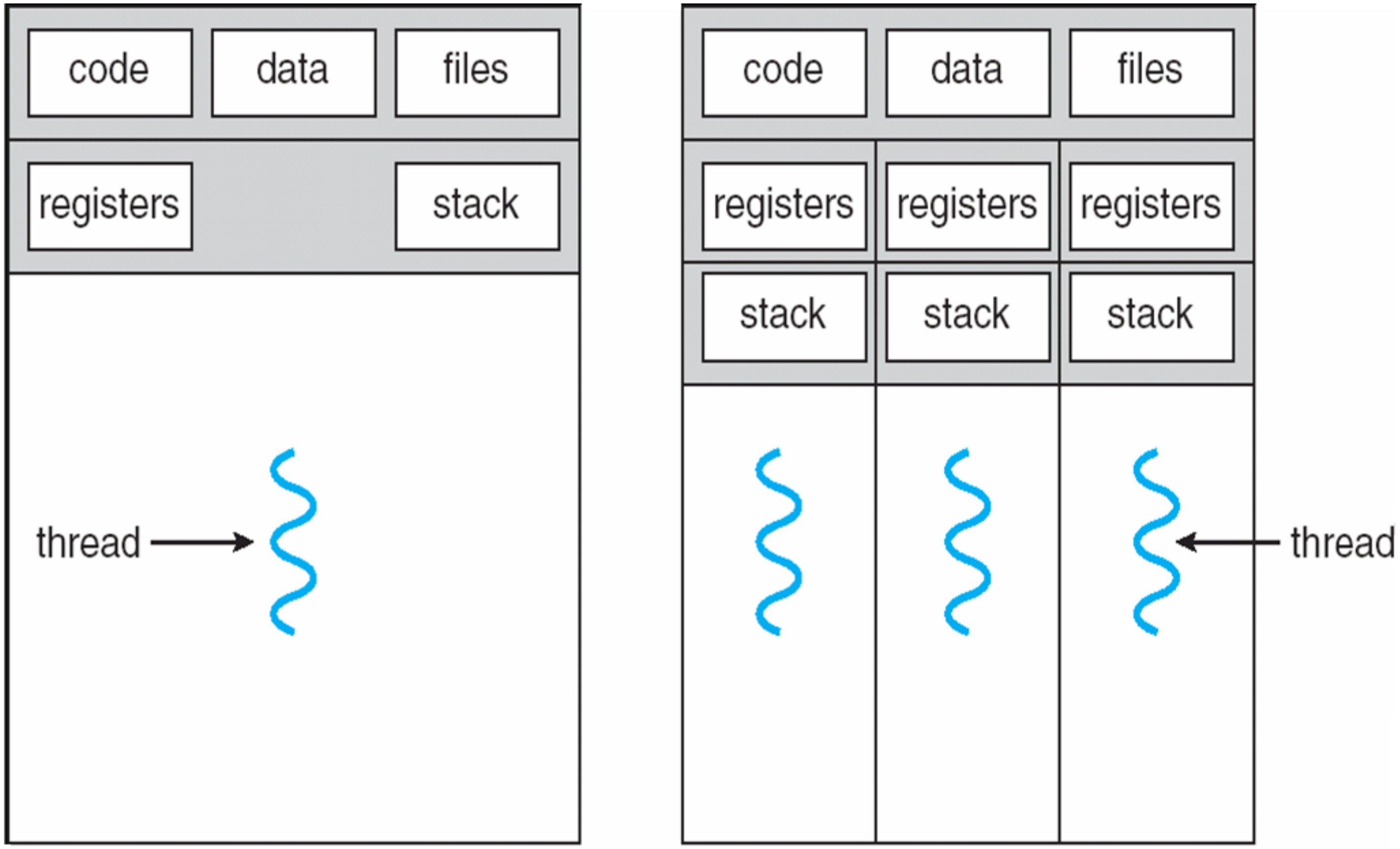
Multilevel Feedback Queues (MLFQ)

... more advanced schedulers ...

Threads



Multithreaded Processes



single-threaded process

multithreaded process

Thread APIs

POSIX Threads (pthreads):

```
 pthread_create(&tid, NULL, my_fun, &param); // thread runs my_fun
```

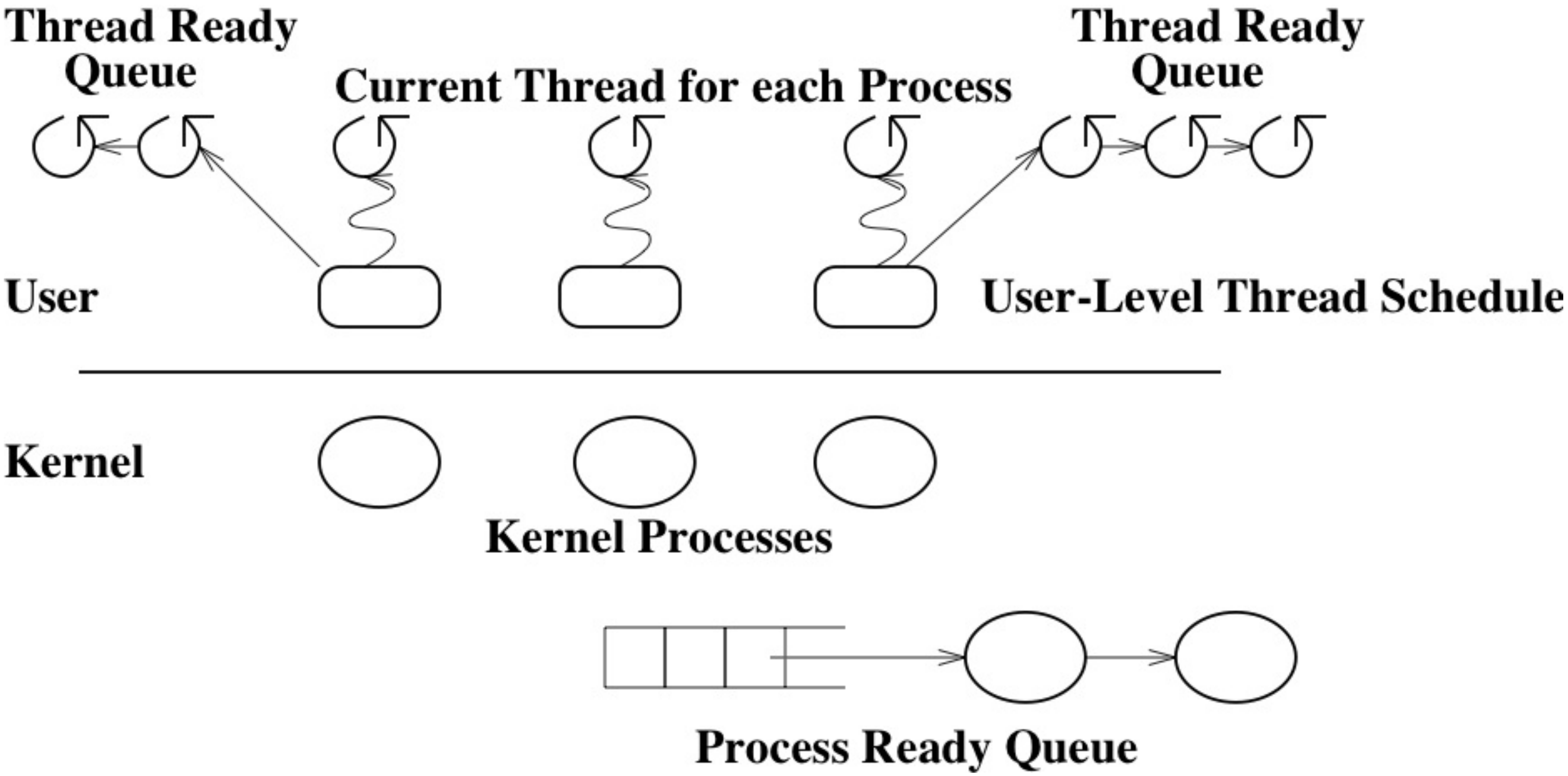
Windows Threads:

```
ThreadHandle = CreateThread(NULL, 0, MyFun, &Param, 0, &ThreadID);
```

Java Threads:

```
Thread t = new Thread(new MyRunnable(param));
t.start();  // start the thread running MyRunnable.run()
```

User-Level Threads


Thread Ready Queue
Current Thread for each Process
Thread Ready Queue
User
User-Level Thread Schedule
Kernel
Kernel Processes
Process Ready Queue