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OPERATING SYSTEM CONCEPTS

Exercises

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Exercises 1.1

What are the three main purposes of an operating system?

Exercises 1.6

Which of the following instructions should be privileged?

1. Set value of timer.
2. Read the clock.
3. Clear memory.
4. Issue a trap instruction.
5. Turn off interrupts.
6. Modify entries in device-status table.
7. Switch from user to kernel mode.
8. Access I/O device.

Exercises 1.8

Some CPUs provide for more than two modes of operation. What are two possible uses of these multiple modes?

Exercises 1.15

Describe the differences between symmetric and asymmetric multiproccessing. What are three advantages and one disadvantage of multiproccessor systems?

Exercises 1.19

What is the purpose of interrupts? How does an interrupt differ from a trap? Can traps be generated intentionally by a user program? If so, for what purpose?

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Exercises 2.1

What is the purpose of system calls?

Exercises 2.13

Describe three general methods for passing parameters to the operating system.

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Exercises 3.5

When a process creates a new process using the *fork*() operation, which of the following states is shared between the parent process and the child process?

1. Stack
2. Heap
3. Shared memory segments

Exercises 3.8

Describe the differences among short-term, medium-term, and long-term scheduling.

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Exercises 4.2

What are two differences between user-level threads and kernel-level threads? Under what circumstances is one type better than the other?

Exercises 4.8

Which of the following components of program state are shared across threads in a multithreaded process?

1. Register values
2. Heap memory
3. Global variables
4. Stack memory

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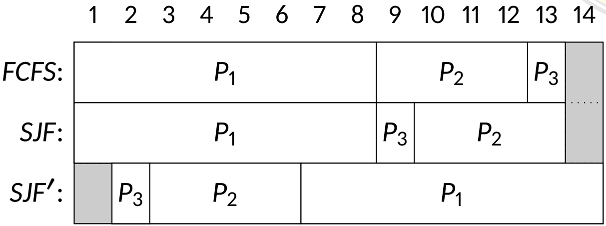
Exercises 6.3

Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the questions, use nonpreemptive scheduling, and base all decisions on the information you have at the time the decision must be made.

Process	**Arrival Time**	**Burst Time**
P1	0.0	8
P2	0.4	4
P3	1.0	1

1. What is the average turnaround time for these processes with the FCFS scheduling algorithm?
2. What is the average turnaround time for these processes with the SJF scheduling algorithm?
3. The SJF algorithm is supposed to improve performance, but notice that we chose to run process P1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes P1 and P2 are waiting during this idle time, so their waiting time may increase. This algorithm could be called future-knowledge scheduling.

Key to 6.3



1. $T_{turnaround} = \frac{8+(12-0.4)+(13-1)}{3} \approx 10.53$
2. $T_{turnaround} = \frac{8+(13-0.4)+(9-1)}{3} \approx 9.53$
3. $T_{turnaround} = \frac{14+(6-0.4)+(2-1)}{3} \approx 6.87$

Exercises 6.17

The following processes are being scheduled using a preemptive, roundrobin scheduling algorithm. Each process is assigned a numerical priority, with a higher number indicating a higher relative priority. In addition to the processes listed below, the system also has an idle task (which consumes no CPU resources and is identified as P_{idle}). This task has priority 0 and is scheduled whenever the system has no other available processes to run. The length of a time quantum is 10 units. If a process is preempted by a higher-priority process, the preempted process is placed at the end of the queue.

Thread	Priority	Burst	Arrival
P1	40	20	0
P2	30	25	25
P3	30	25	30
P4	35	15	60
P5	5	10	100
P6	10	10	105

1. Show the scheduling order of the processes using a Gantt chart.
2. What is the turnaround time for each process?
3. What is the waiting time for each process?
4. What is the CPU utilization rate?

Key to 6.17

1. Gantt chart:

5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120

RR:	P_1	P_{idle}	P_2	P_3	P_2	P_3	P_4	P_2	P_3	P_{idle}	P_5	P_6	P_5

2. $T_{turnaround} = T_{completion} - T_{arrival}$
3. $T_{waiting} = T_{turnaround} - T_{burst}$

	P_1	P_2	P_3	P_4	P_5	P_6
$T_{turnaround}$	20-0=20	80-25=55	90-30=60	75-60=15	120-100=20	115-105=10
$T_{waiting}$	20-20=0	55-25=30	60-25=35	15-15=0	20-10=10	10-10=0

4. $rate = \frac{105}{120} \approx 87.50\%$

Exercises 6.19

Which of the following scheduling algorithms could result in starvation?

1. First-come, first-served
2. Shortest job first
3. Round robin
4. Priority

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Exercises 5.3

What is the meaning of the term busy waiting? What other kinds of waiting are there in an operating system? Can busy waiting be avoided altogether? Explain your answer.

Exercises 5.4

Explain why spinlocks are not appropriate for single-processor systems yet are often used in multiprocessor systems.