IT308: Operating Systems

Exam 1

MCQ 1

For the following two questions, assume that there are 3 page frames, initially empty. Consider the reference string

2 1 4 3 1 2 4 3 2 1

Using the FIFO page replacement algorithm, what is the total number of page faults including compulsory faults, for the given reference string?

A. 4

B. 6

C. 8

D. 10

Solution

Access order: 2 1 4 3 1 2 4 3 2 1

Access	Hit/Miss?	Evict	Cache state
2	Miss		First-in $\rightarrow$ 2
1	Miss		First-in $\rightarrow$ 2, 1
4	Miss		First-in $\rightarrow$ 2, 1, 4
3	Miss	2	First-in $\rightarrow$ 1, 4, 3
1	Hit		First-in $\rightarrow$ 1, 4, 3
2	Miss	1	First-in $\rightarrow$ 4, 3, 2
4	Hit		First-in $\rightarrow$ 4, 3, 2
3	Hit		First-in $\rightarrow$ 4, 3, 2
2	Hit		First-in $\rightarrow$ 4, 3, 2
1	Miss	4	First-in $\rightarrow$ 3, 2, 1

A total of 6 misses

MCQ 2

For the following two questions, assume that there are 3 page frames, initially empty. Consider the reference string

2 1 4 3 1 2 4 3 2 1

Using the LRU page replacement algorithm, what is the total number of page faults including compulsory faults, for the given reference string?

A. 4

B. 6

C. 8

D. 10

Solution

Access order: 2 1 4 3 1 2 4 3 2 1

Access	Hit/Miss?	Evict	Cache state
2	Miss		LRU → 2
1	Miss		LRU → 2, 1
4	Miss		LRU → 2, 1, 4
3	Miss	2	LRU → 1, 4, 3
1	Hit		LRU → 4, 3, 1
2	Miss	4	LRU → 3, 1, 2
4	Miss	3	LRU → 1, 2, 4
3	Miss	1	LRU → 2, 4, 3
2	Hit		LRU → 4, 3, 2
1	Miss	4	LRU → 3, 2, 1

A total of 8 misses

MCQ 3

Segment	Base	Bounds
0	200	500
1	2000	50
2	100	90
3	1000	900

Assuming that the leading digit in a virtual address represents the segment, which one of the following virtual addresses is illegal? All numbers are given in hexadecimal.

A. 0400

B. 3100

C. 3900 Base + Offset $\not<$ Base + Bounds

D. 2089

MCQ 4

Assume, for the following jobs, a FIFO scheduler. Each job has a required runtime, which means the job needs that many time units on the CPU to complete.

Job A arrives at time = 0, required runtime = X time units
Job B arrives at time = 5, required runtime = Y time units
Job C arrives at time = 10, required runtime = Z time units

Assuming an average turnaround time between 10 and 20 time units (inclusive), which of the following run times for A, B, and C is possible?

A. A = 20, B = 20, C = 20
B. A = 30, B = 1, C = 1
C. A = 20, B = 30, C = 40
D. A = 22, B = 1, C = 1

Solution

We want run times for which average turnaround time is between 10 and 20 time units (inclusive).

A. A = 20, B = 20, C = 20 (not possible)

$((20 - 0) + (40 - 5) + (60 - 10))/3 = 35$

Solution

We want run times for which average turnaround time is between 10 and 20 time units (inclusive).

A. A = 20, B = 20, C = 20 (not possible)

$((20 - 0) + (40 - 5) + (60 - 10))/3 = 35$

B. A = 30, B = 1, C = 1 (not possible)

$((30 - 0) + (31 - 5) + (32 - 10))/3 = 26$

Solution

We want run times for which average turnaround time is between 10 and 20 time units (inclusive).

A. A = 20, B = 20, C = 20 (not possible)

$((20 - 0) + (40 - 5) + (60 - 10))/3 = 35$

B. A = 30, B = 1, C = 1 (not possible)

$((30 - 0) + (31 - 5) + (32 - 10))/3 = 26$

C. A = 20, B = 30, C = 40 (not possible)

$((20 - 0) + (50 - 5) + (90 - 10))/3 = 48.33$

Solution

We want run times for which average turnaround time is between 10 and 20 time units (inclusive).

A. A = 20, B = 20, C = 20 (not possible)

$((20 - 0) + (40 - 5) + (60 - 10))/3 = 35$

B. A = 30, B = 1, C = 1 (not possible)

$((30 - 0) + (31 - 5) + (32 - 10))/3 = 26$

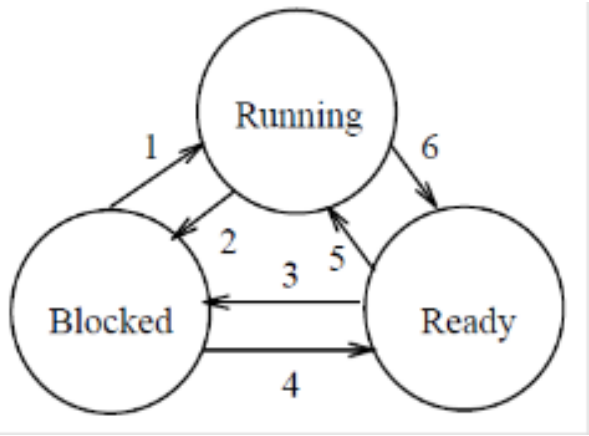
C. A = 20, B = 30, C = 40 (not possible)

$((20 - 0) + (50 - 5) + (90 - 10))/3 = 48.33$

D. A = 22, B = 1, C = 1 (possible)

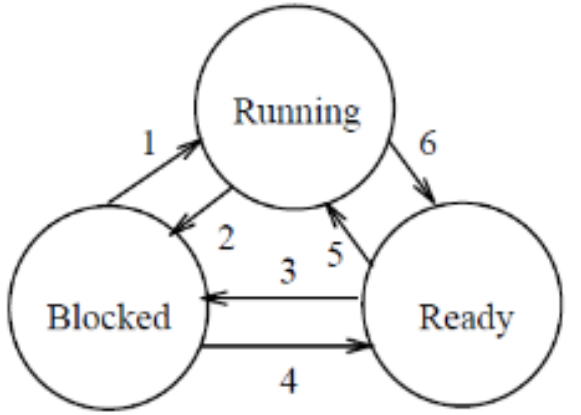
$((22 - 0) + (23 - 5) + (24 - 10))/3 = 18$

Problem 2



(a) Transition 3: Ready $\rightarrow$ Blocked

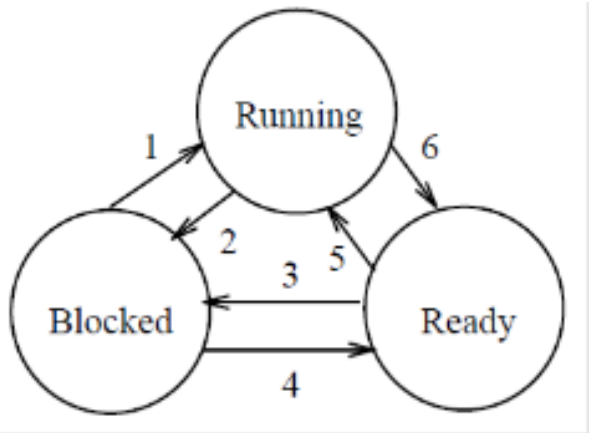
Problem 2



(a) Transition 3: Ready $\rightarrow$ Blocked

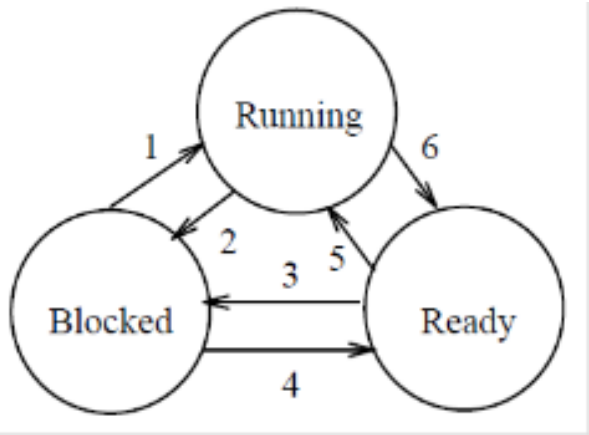
Not legal. A process cannot execute any statements when still in the ready queue.

Problem 2



(b) Transition 1: Blocked $\rightarrow$ Running

Problem 2



(b) Transition 1: Blocked $\rightarrow$ Running

Not legal. A blocked process must first be placed in the ready queue before it can be selected to run.

Problem 3: (a)

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True

Problem 3: (b)

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False

Problem 3: (c)

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False

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Given a constant number of bits in a virtual address, the size of a page table decreases with larger pages.

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Within a given virtual memory system, pages of varying sizes are used to avoid wasting space within partially-filled pages.

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Problem 4

(a) Under what conditions does FIFO scheduling result in the shortest possible average response time?

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if the jobs happen to arrive in the ready queue with the shortest completion times first (or, as a special case, if all jobs have the same completion time).

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(b) Under what conditions does round robin scheduling behave identically to FIFO in terms of turnaround time?

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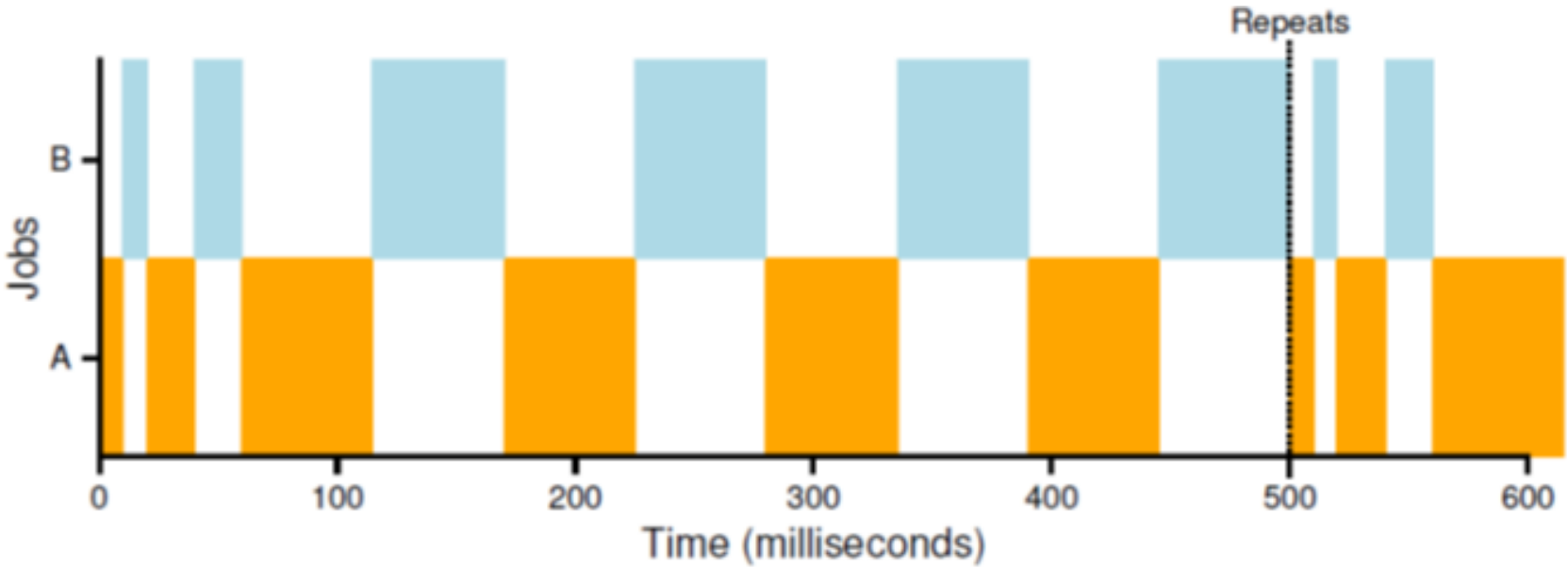
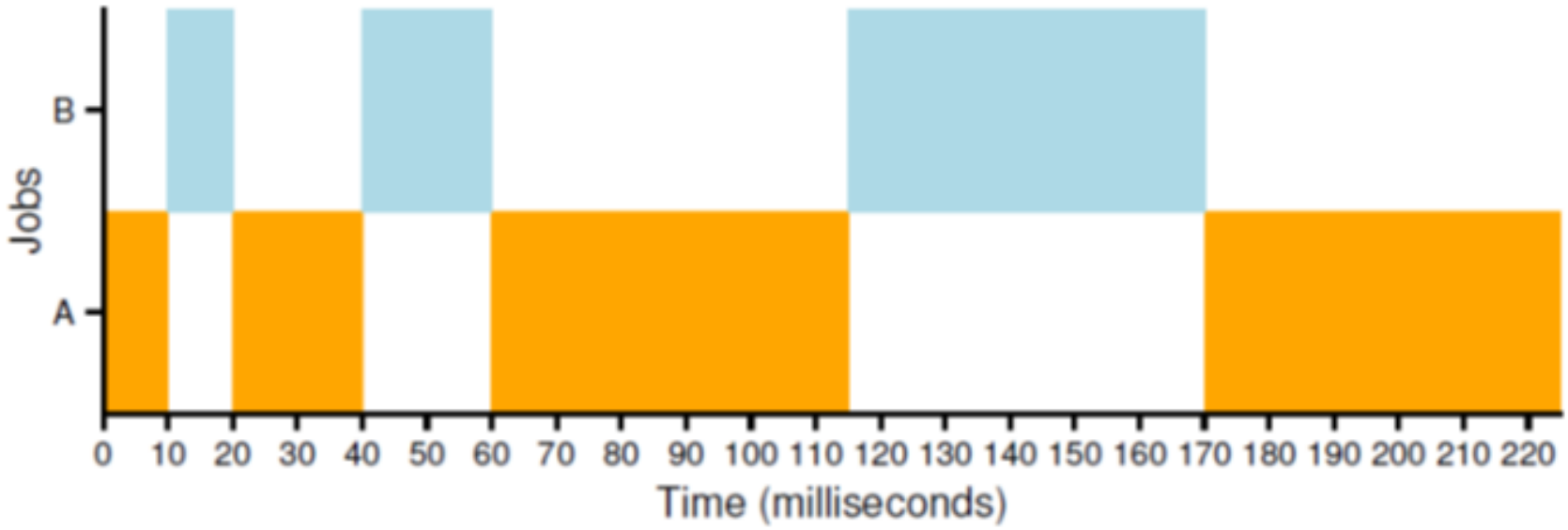
if the job lengths are no longer than the length of the time slice.

Problem 5


Repeats
Jobs
B
A
0
100
200
300
400
500
600
Time (milliseconds)


Jobs
B
A
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
Time (milliseconds)

Solution

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10 ms. (it's the first time slice shown.)

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Three queues. You will see three distinct time slices being used: 10 ms, 20 ms, 30 ms

(b) How long is the time slice at the top-most (high priority) queue?

10 ms. (it's the first time slice shown.)

(c) How long is the time slice at the bottom-most (low priority) queue?

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(a) How many queues do you think there are in this MLFQ scheduler?

Three queues. You will see three distinct time slices being used: 10 ms, 20 ms, 30 ms

(b) How long is the time slice at the top-most (high priority) queue?

10 ms. (it's the first time slice shown.)

(c) How long is the time slice at the bottom-most (low priority) queue?

30 ms. (it's the longest time slice shown.)