

COP4610 / CGS5765 Operating Systems Homework 3 Deadlock, Main Memory, and Virtual Memory (50 pts)

Deadlock (20 pts)

1. (Exercise 7.4) A possible method for preventing deadlocking is to have a single, higher-order re- source... (5 pts)

It is not a good solution because it yields too large a scope. It is better to define a locking policy with the most possible narrow scope.

2. (Exercise 7.8) Consider the following resource-allocation policy... (5 pts)

a. Deadlock cannot occur because preemption exists.

b. Yes. A process may never acquire all the resources it needs if they are continuously preempted by a series of requests such as those of process C.

3. (Exercise 7.23) Consider the following snapshot of a system ... (10 pts)

a. P1 P3 P4 P2 P0

b. Yes

c. No

Main Memory (15 pts)

1. (Exercise 8.11) Given six memory partitions of 300KB, 600KB, 350KB...(5pts)

a. First-fit:

b. 115 KB is put in 300 KB partition, leaving (185 KB, 600 KB, 350 KB, 200 KB, 750 KB, 125 KB)

c. 500 KB is put in 600 KB partition, leaving (185 KB, 100 KB, 350 KB, 200 KB, 750 KB, 125 KB)

- d. 358 KB is put in 750 KB partition, leaving (185 KB, 100 KB, 350 KB, 200 KB, 392 KB, 125 KB)
- e. 200 KB is put in 350 KB partition, leaving (185 KB, 100 KB, 150 KB, 200 KB, 392 KB, 125 KB)
- f. 375 KB is put in 392 KB partition, leaving (185 KB, 100 KB, 150 KB, 200 KB, 17 KB, 125 KB)
- g. Best-fit:
- h. 115 KB is put in 125 KB partition, leaving (300 KB, 600 KB, 350 KB, 200 KB, 750 KB, 10 KB)
- i. 500 KB is put in 600 KB partition, leaving (300 KB, 100 KB, 350 KB, 200 KB, 750 KB, 10 KB)
- j. 358 KB is put in 750 KB partition, leaving (300 KB, 100 KB, 350 KB, 200 KB, 392 KB, 10 KB)
- k. 200 KB is put in 200 KB partition, leaving (300 KB, 100 KB, 350 KB, 0 KB, 392 KB, 10 KB)
- l. 375 KB is put in 392 KB partition, leaving (300 KB, 100 KB, 350 KB, 0 KB, 17 KB, 10 KB)
- m. Worst-fit:
- n. 115 KB is put in 750 KB partition, leaving (300 KB, 600 KB, 350 KB, 200 KB, 635 KB, 125 KB)
- o. 500 KB is put in 635 KB partition, leaving (300 KB, 600 KB, 350 KB, 200 KB, 135 KB, 125 KB)
- p. 358 KB is put in 600 KB partition, leaving (300 KB, 242 KB, 350 KB, 200 KB, 135 KB, 125 KB)

q. 200 KB is put in 350 KB partition, leaving (300 KB, 242 KB, 150 KB, 200 KB, 135 KB, 125 KB)

r. 375 KB must wait

Worst fit does not allow a request to be satisfied. Best-fit is most efficient as it leaves the largest holes after allocation. However, best-fit runs at time $O(n)$ and first-fit runs in constant time $O(1)$.

2. (Exercise 8.20) Assuming a 1-KB page size, what are the page numbers and offsets for the following... (5pts)

a. 3085 - page = 3; offset = 13

b. 42095 - page = 41; offset = 111

c. 215201 - page = 210; offset = 161

d. 650000 - page = 634; offset = 784

e. 2000001 - page = 1953; offset = 129

3. (Exercise 8.25) Consider a paging system with the page table stored in memory..(5pts)

a. 400 nanoseconds: 200 nanoseconds to access the page table and 200 nanoseconds to access the word in memory.

b. Effective access time = $0.75 \times (200 \text{ nanoseconds}) + 0.25 \times (400 \text{ nanoseconds}) = 250$ nanoseconds.

Virtual Memory (15 pts)

1. (Exercise 9.21) Consider the following page reference string...(5pts)

LRU replacement – 18

FIFO replacement – 17

Optimal replacement – 13

2. (Exercise 9.26) The VAX/VMS system uses a FIFO replacement algorithm...(5pts)

a. When a page fault occurs and if the page does not exist in the free-frame pool, then one of the pages in the free-frame pool is evicted to disk, creating space for one of the resident pages to be moved to the free-frame pool. The accessed page is then moved to the resident set.

b. When a page fault occurs and if the page exists in the free-frame pool, then it is moved into the set of resident pages, while one of the resident pages is moved to the free-frame pool.

c. When the number of resident pages is set to one, then the system degenerates into the page replacement algorithm used in the free-frame pool, which is typically managed in a LRU fashion.

d. When the number of pages in the free-frame pool is zero, then the system degenerates into a FIFO page-replacement algorithm.

3. (Exercise 9.30) A page replacement algorithm should minimize... (5pts)

a. Define a page-replacement algorithm addressing the problems of:

i. Initial value of the counters—0.

ii. Counters are increased—whenever a new page is associated with that frame.

iii. Counters are decreased—whenever one of the pages associated with that frame is no longer required.

iv. How the page to be replaced is selected—find a frame with the smallest counter. Use FIFO for breaking ties.

b. 14 page faults

c. 11 page faults