**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 × (200 nanoseconds) + 0.25 × (400 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**