CMPT-300 Evening: Assignment 3

October 30, 2003

1 The deadline

Due at 4:30pm, Nov.14th, Friday, 2003.

2 Where to submit

Please drop your answers into the assignment drop-in box outside the room ASB 9838. Collaborations are strictly not allowed.

3 Questions

In this assignment, you have **9** problems which count for **33** marks. You need to answer all of these questions. Please write your answers clearly.

3.1 (4 points)

Describe the purpose and basic operations of a generic paging system. Please explain why processes need their own page tables.

3.2 (4 marks)

We know that in order to keep track of free memory, the system needs storage. In the following settings, compare the two methods - bitmap and linked list - in terms of the storage needed. Suppose that in a computer system, the main memory is 128 MB. The allocation unit is n bytes. For the linked list, assume that the current memory consists of an alternating sequence of segments and holes, each 64 KB. Assume that each node in the list needs a 32-bit memory address, a 16-bit length, and a 16-bit next-node field. How many bytes of storage is required for each method? Which one is better?

3.3 (3 points)

Using the page table of Fig.4-10, page 204 in text book, calculate the physical address (in decimal form) corresponding to each of the following virtual address (in decimal form):
1) 60 2) 12300 3) 45100

3.4 (5 points)

Give the page reference string: 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. Show the number of page faults for the LRU, FIFO and Optimal page replacement algorithms. Suppose the number of page frame is 6. All frames are initially empty.

3.5 (3 points)

What is thrashing? How to detect it? Once detected, how to solve it?

3.6 (3 points)

A process has 1024 pages in its virtual address space. Suppose the system store the entire page table in main memory. The overhead required for reading a word from the page table is 500 nsec. To reduce this overhead, the system has a TLB which has 32 (page, page frame) pairs and can do look up in 100 nsec. What hit rate is needed to reduce the average overhead to 200 nsec?

3.7 (4 points)

A small computer has four page frames. At the first clock tick, the R bits are 0111 (page 0 is 0, the rest are 1). At subsequent clock ticks, the values are 1011, 1110, 1101, 0110, 1011, 1001, and 0001. If the aging algorithm is used with a 8-bit counter, give the values of the four counters after the last tick.

3.8 (4 points)

In the WSClock algorithm of Fig 4-22(b), page 226, the hand points to a page with $R = 0$. Now we have a page fault. For each of the following conditions, determine if that page will be evicted.
1)$\tau = 400, M = 1$
2)$\tau = 400, M = 0$
3)$\tau = 1000, M = 1$

4)$\tau = 1000, M = 0$

3.9 (3 points)

Is the following page replacement algorithm a stack algorithm? Please explain your answer. Assume the virtual address space has 26 pages. Each page is assigned a letter from a to z. The internal array M is maintained as follows: whenever a page fault occurs, the letter of that page is moved to the top of the array, and the remainder are sorted alphabetically.