CS703 – Advanced Operating Systems

Assignment No. 3

Instructions to Solve Assignments

The purpose of the assignments is to give you hands on practice. It is expected that students will solve the assignments themselves. Following rules will apply during the evaluation of assignment.

- Cheating from any source will result in zero marks in the assignment.
- Any student found cheating in any two of the assignments submitted will be awarded "F" grade in the course.
- No assignment after due date will be accepted.

Question No. 1 **(15 marks)**

Given memory partitions of 100KB, 500KB, 200KB, 300KB, and 600KB (in order), how would each of the first-fit, best-fit, and worst-fit algorithms place processes of 212KB, 417KB, 112KB and 426KB (in order)? Which algorithm makes the most efficient use of memory?

Question No. 2 **(10 marks)**

Why page sizes are usually powers of 2?

Question No. 3 **(5 + 5 = 10 marks)**

Consider a logical address space of 16 pages of 4096 words each, mapped onto a physical memory of 64 frames?

a. How many bits are there in the logical address?
b. How many bits are there in the physical address?

Question No. 4 **(5 + 10 = 15 marks)**

Consider a paging system with the page table stored in memory.

a. If a memory reference takes 300 nanoseconds, how long does a paged memory reference take?
b. If we add associative registers, and 85 percent of all page-table references are found in the associative registers, what is the effective memory reference time? (Assume that finding a page-table entry in the associative registers takes zero time, if the entry is there.)

Question No. 5 **(10 marks)**

Explain why it is easier to share a reentrant module using segmentation than it is to do so when pure paging is used.

Question No. 6 **(15 marks)**

Assume that we have a demand-paged memory. The page table is held in registers. It takes 10 milliseconds to service a page fault if an empty page is available or if the replaced page is not modified, and 30 milliseconds if the replaced page is modified. Memory access time is 200 nanoseconds.

Assume that the page to be replaced is modified 60 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 500 nanoseconds?

Question No. 7 **(15 marks)**

Consider the following page reference string:

1, 2, 3, 4, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6, 2, 1, 5, 6, 2.

How many page faults would occur for the following replacement algorithms, assuming one, two, three, four, five, six, or seven frames? Remember all frames are initially empty, so your first unique pages will all cost one fault each.

a. LRU replacement
b. FIFO replacement
c. Optimal replacement

Question No. 8 **(10 marks)**

Consider the two dimensional array A:

```
int A[ ] [ ] = new int [50] [50]
```

where A[0] [0] is at location 400, in a paged system with pages of size 400. A small process is in page 0 (locations 0 to 399) for manipulating the matrix; thus, every instruction fetch will be from page 0.

For three page frames, how many page faults are generated by the following array-initialization loops, using LRU replacement, and assuming page frame 1 has the process in it, and the other two are initially empty:

```
for (int j = 0; j < 100; j++)
        for (int i = 0; i < 100; i++)
                A[i][j] = 0;
```