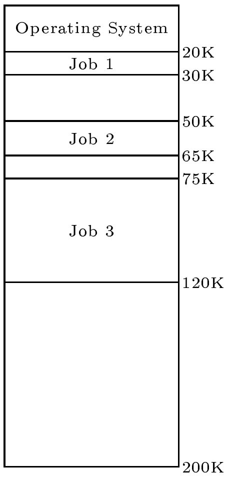
CS 376	**Operating Systems**	Test 3
Name:		Maximum Points: 66

Important: This is an open book test. You can use any books, notes, or paper. *Do not log into the computer during the test.* Any calculations and rough work can be done on the back side of the test pages.

1. [16 pt] Given the following memory configuration



At this point, Job 4 arrives requesting a block of 100K. Answer the following:

(a) Can Job 4 be accommodated? Why or why not?

(b) If relocation is used, what are the contents of the relocation registers for Job 1, Job 2, and Job 3 after recompaction?

(c) What are the contents of the relocation register for Job 4 after it has been loaded into memory?

(d) The instruction `ADDI 4,10` is part of Job 1 and was originally loaded into memory location 22K. What is its new location after compaction?

(e) The instruction `MUL 4,NUMBER` is part of Job 2 and was originally loaded into memory location 55K. What is its new location after compaction?

(f) The instruction `MOVE 3,SUM` is part of Job 3 and was originally loaded into memory location 80K. What is its new location after compaction?

(g) If `SUM` was originally located into memory location 110K, what is its new location after compaction?

(h) If the instruction `MOVE 3,SUM` is stored as follows (this is in octal instead of binary for compactness):

```
200    03 00    334000
```

where the rightmost value indicates the memory location where `SUM` is stored, what would that value be after compaction?

2. [5 pt] Explain the difference between a page and a segment.

3. [5 pt] What is the purpose of a reference bit in the demand paging system?

4. [15 pt] Consider the following page reference string:

$$4, 3, 2, 1, 4, 3, 5, 4, 3, 2, 1, 5, 1, 2, 1, 3, 1, 2, 4, 2, 1, 3, 4$$

How many page faults would occur in a pure demand paging environment for each of the following replacement algorithms, assuming three frames?

(a) FIFO replacement

(b) Optimal replacement

(c) LRU replacement

(d) LFU replacement

(e) Second chance algorithm

5. [8 pt] Given that main memory is composed of four page frames for public use, use the following table to answer all parts of this problem:

Page frame	Time loaded	Time last referenced	Reference bit	Dirty bit
0	126	279	0	0
1	230	280	1	0
2	120	282	1	1
3	160	290	1	1

(a) The contents of which page will be swapped out by FIFO?

(b) The contents of which page will be swapped out by LRU?

(c) The contents of which page will be swapped out by MRU?

(d) The contents of which page will be swapped out by LFU?

6. [5 pt] A `Unix` file system uses 1024-byte blocks and 16-bit disk addresses. The i-node holds 8 disk addresses for data blocks, one single-indirect block address, and one double-indirect block address. What is the maximum file size?

7. [12 pt] Given that it takes 1 ms to travel from one track to the next, and that the arm is positioned at track 15 moving toward the low-numbered tracks, compute how long it will take to satisfy the following requests:

$$4, 45, 40, 132, 11, 20, 35, 23, 7, 198, 14, 170, 180, 78, 73, 150$$

What is the total number of head movements needed to satisfy these requests for the following disk-scheduling algorithms? The disk contains 200 tracks, numbered starting with 0.

(a) FCFS scheduling

(b) SSTF scheduling

(c) SCAN scheduling

(d) LOOK scheduling

(e) C-SCAN scheduling

(f) C-LOOK scheduling