

Prepare your answers to the following questions either in a plain text file or in a Microsoft Word file. Answer each question clearly and concisely, but completely, using complete sentences. Explanatory tables and/or diagrams are acceptable, but there must always be a written discussion as well.

Submit your file to the Curator system by the posted deadline for this assignment. No late submissions will be accepted.

1. [10 points] Assume that the C code shown in Figure 1 is translated to the assembly language code shown in Figure 2:

```
/* The C code */
for(i=0; i<100; i++)
    a[i] = 0;
```

Figure 1

```
; Pseudo assembly language code generated
    load    r1, =0          ; r1 is the loop counte
    store   r1, i            ; store r1 in i
    load    r2, =100        ; r2 is the loop limit
loop:  load    r1, i
    bge     r1, r2, out      ; exit loop if r1 >= r2
    load    r3, =0
    store   r3, a[r1]        ; store r3 in array cell
    incr    r1               ; increment loop counter
    store   r1, i
    br      loop             ; goto beginning of loop
out:
```

Figure 2

Assume it takes the hardware an average of 2.5 clock cycles to execute an instruction in a one-address machine language (i.e., individual machine instructions can reference at most one memory location). Estimate the number of clock cycles that would be required to execute the given code on this hardware. Do not merely state a conclusion. Explain your analysis.

2. [10 points] A memory manager for a variable-size partition strategy has the following list of free blocks:

Block start address	Block size
0x002600000	0x1200
0x003500000	0x300
0x004500000	0x800
0x007000000	0x1000
0x007050000	0x2500
0x008199999	0x1500

For each part, state which free block would be selected by the memory manager to satisfy a request of the specified size assuming the given policy is applied? Treat each request as an independent question.

- a request for 0x1603 bytes if the best-fit policy is used
- a request for 0x1603 bytes if the worst-fit policy is used
- a request for 0x500 bytes if the best-fit policy is used
- a request for 0x500 bytes if the first-fit policy is used
- a request for 0x2700 bytes if the best-fit policy is used

3. [10 points] A certain OS supports three different address spaces for each process, called SA, SB and SC. Suppose the memory manager loads the three address spaces into physical memory with the base addresses shown below.

Address space	Physical base address	Address space size
SA	0x002600000	0x800000
SB	0x003500000	0x30000
SC	0x004500000	0x10000000

In this system, processes generate relative addresses. What physical address, accessible to the process, corresponds to each of the process addresses below?

- a) 0x678 in SA
 - b) 0x4329 in SB
 - c) 0x65000 in SB
 - d) 0x5000000 in SC
 - e) 0x1000000 in SA
4. [10 points] Suppose a system has a disk with 4KB disk blocks and the average access time (time to read/write one block) is 20 milliseconds. The system uses a variable-partition memory manager, designed to swap blocked processes from physical memory to disk under certain circumstances.

A process that occupies 40KB of physical memory makes an I/O request that causes it to block. Assuming that good use could be made of its memory allocation, how long must the service time for the process's I/O request be in order to justify swapping it to disk? Justify your answer carefully.