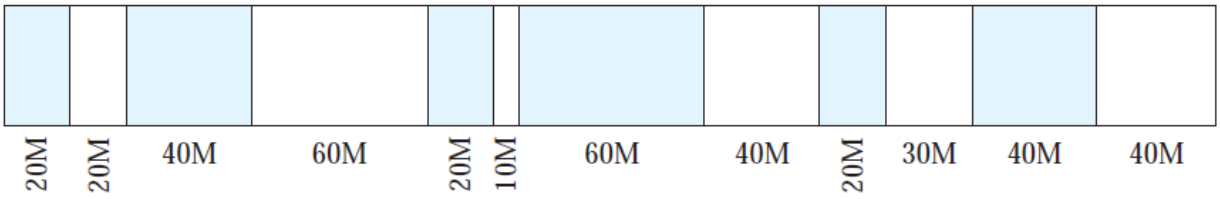
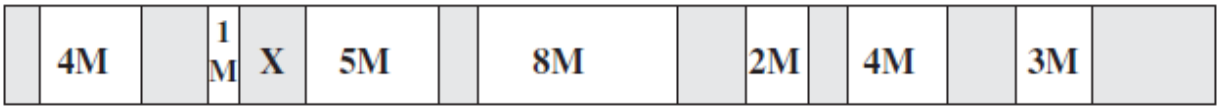
Sheet7
MEMORY MANAGEMENT

1) What requirements is memory management intended to satisfy?
2) Why is the capability to relocate processes desirable?
3) Why is it not possible to enforce memory protection at compile time?
4) What are some reasons to allow two or more processes to all have access to a particular region of memory?
5) In a fixed-partitioning scheme, what are the advantages of using unequal-size partitions?
6) What is the difference between internal and external fragmentation?
7) What are the distinctions among logical, relative, and physical addresses?
8) What is the difference between a page and a frame?
9) What is the difference between a page and a segment?
10) Consider a fixed partitioning scheme with equal-size partitions of 2^{16} bytes and a total main memory size of 2^{24} bytes. A process table is maintained that includes a pointer to a partition for each resident process. How many bits are required for the pointer?
11) Another placement algorithm for dynamic partitioning is referred to as worst-fit. In this case, the largest free block of memory is used for bringing in a process. Discuss the pros and cons of this method compared to first-, next-, and best-fit.
12) A dynamic partitioning scheme is being used, and the following is the memory configuration at a given point in time. The shaded areas are allocated blocks; the white areas are free blocks. The next three memory requests are for 40M, 20M, and 10M. Indicate the starting address for each of the three blocks using the following placement algorithms:



    a) First-fit.
    b) Best-fit.
    c) Next-fit. Assume the most recently added block is at the beginning of memory.
    d) Worst-fit.
13) This diagram shows an example of memory configuration under dynamic partitioning, after a number of placement and swapping-out operations have been carried out. Addresses go from left to right; gray areas indicate blocks occupied by processes; white areas indicate free memory blocks. The last process placed is 2-Mbyte and is marked with an X. Only one process was swapped out after that.



a) What was the maximum size of the swapped out process?
b) What was the size of the free block just before it was partitioned by X?
c) A new 3-Mbyte allocation request must be satisfied next. Indicate the intervals of memory where a partition will be created for the new process under the following four placement algorithms: best-fit, first-fit, next-fit, worst-fit. For each algorithm, draw a horizontal segment under the memory strip and label it clearly.

14) A 1-Mbyte block of memory is allocated using the buddy system.
a) Show the results of the following sequence in a figure similar to Figure 7.6 : Request 70; Request 35; Request 80; Return A; Request 60; Return B; Return D; Return C.
b) Show the binary tree representation following Return B.

15) Consider a buddy system in which a particular block under the current allocation has an address of 011011110000.
a) If the block is of size 4, what is the binary address of its buddy?
b) If the block is of size 16, what is the binary address of its buddy?

16) Consider a simple paging system with the following parameters: 2^{32} bytes of physical memory; page size of 2^{10} bytes; 2^{16} pages of logical address space.
a) How many bits are in a logical address?
b) How many bytes in a frame?
c) How many bits in the physical address specify the frame?
d) How many entries in the page table?
e) How many bits in each page table entry? Assume each page table entry contains a valid/invalid bit.

17) Write the binary translation of the logical address 0001010010111010 under the following hypothetical memory management schemes, and explain your answer:
a) A paging system with a 256-address page size, using a page table in which the frame number happens to be four times smaller than the page number
b) A segmentation system with a 1K-address maximum segment size, using a segment table in which bases happen to be regularly placed at real addresses: 22 + 4,096 * segment#

18) Consider a simple segmentation system that has the following segment table:

Starting Address	Length (bytes)
660	248
1,752	422
222	198
996	604

For each of the following logical addresses, determine the physical address or indicate if a segment fault occurs:
a) 0, 198
b) 2, 156
c) 1, 530

d) 3, 444
e) 0, 222

19) Consider a system with a 16KB memory. The sequence of processes loaded in and leaving the memory are given in the following.
P1 7K loaded
P2 4K loaded
P1 terminated and returned the memory space
P3 3K loaded
P4 6K loaded
Give the memory map showing allocated portion and free portion after the end of the sequence (if a process cannot be loaded, indicate that) for the following placement algorithms. Also, indicate the internal/external fragmentations.
a) first fit
b) best fit
c) buddy
d) simple paging (assume that each page is of size 2K)

How to submit the homework assignments?

- Solve the sheet individually without looking up the solution on the Internet. The sheet is to practice; it is a learning tool not an exam.
- Assignments are to be **handwritten**.
- Papers are to be scanned (I like camscanner app). Put all images in a pdf file (camscanner does that for you)
- Use MS Teams to submit
    - Your filename should be your user id
