Assignment 6:

Memory Management

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COMP 3411 – Operating System

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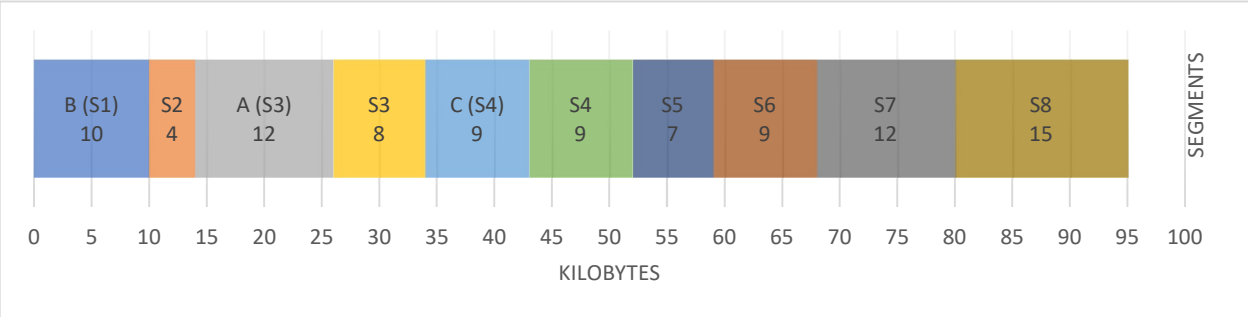
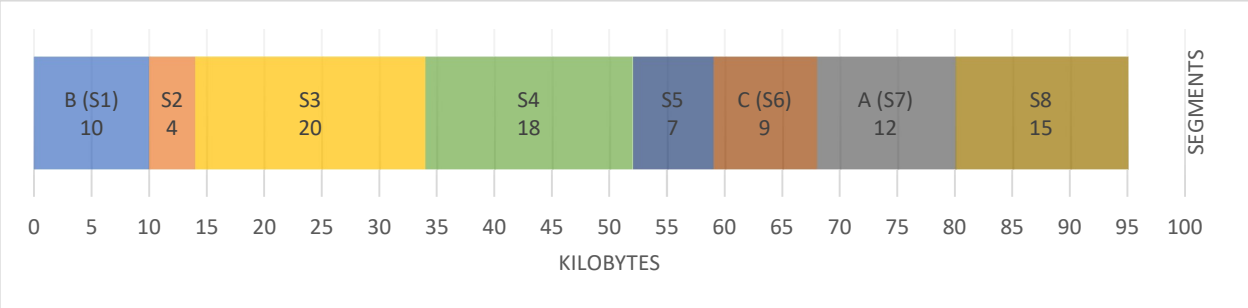
Question 1

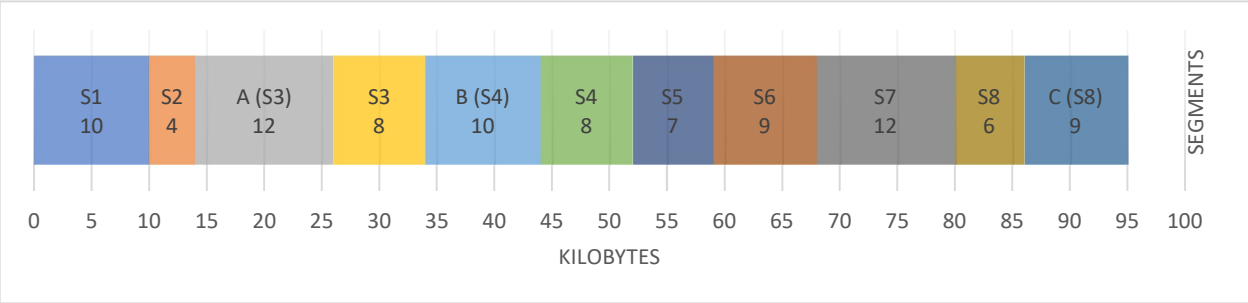
a. First fit



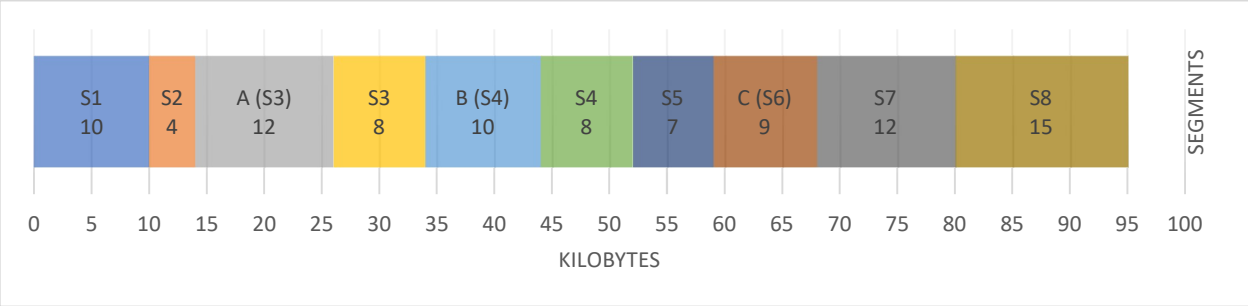
b. Best fit



c. Worst fit



d. Next fit



I would say that the Best Fit algorithm makes the best use of memory space in this case as the process A, B, and C all fit nicely into the segments 7, 1, and 6 respectively without the need of memory compact.

Question 2

a. Each page is 4kB in size, that is 2^{12} bytes
Since the virtual address space size is 64kB, that is 2^{16} bytes. Thus, $2^{16} / 2^{12} = 2^4 = 32$ virtual pages can be generated
Since the physical address space size is 32kB, that is 2^{15} bytes. Thus, $2^{15} / 2^{12} = 2^3 = 8$ physical page frames can be generated

b. A 32-bit computer can address 2^{32} bytes
Since each page is 4kB, or 2^{12} bytes, a page table can consist of $2^{32} / 2^{12} = 2^{20}$ pages
Since each entry in a table is 4 bytes, the total size of a page table can be $2^{20} * 4 = 2^{22}$ bytes = 4 MB

Question 3

With free the segments with sizes: 6, 17, 25, 14, and 19 kB; placing a program with size 13kB in the segments using the following algorithms:

First fit: the program will be placed into the 2nd (17kB) segment leaving it with the remaining 4kB unallocated memory

Best fit: the program will be placed into the 4th (14kB) segment leaving it with the remaining 1kB unallocated memory

Worst fit: the program will be placed into the 3rd (25kB) segment leaving it with the remaining 12kB unallocated memory

Question 4

Since each page is 1024 words each, they each would require 2^{10} bits.

Since there are 8 pages in the logical address space, that is 2^3 pages. Thus, the logical address would require 10 + 3 = 13 bits

Since there are 32 frames in the physical memory space, that is 2^5 frames or pages. Thus, the physical address would require 10 + 5 = 15 bits

Question 5

Since each page is 512 bytes

i. 152 = 512 + (-360)
Thus, the virtual page number is 0, which correspond to page frame number 4, which is valid, and the offset is 360

ii. 1121 = 512 * 2 + 97
Thus, the virtual page number is 2, which correspond to page frame number 1, which is invalid, and the offset is 97

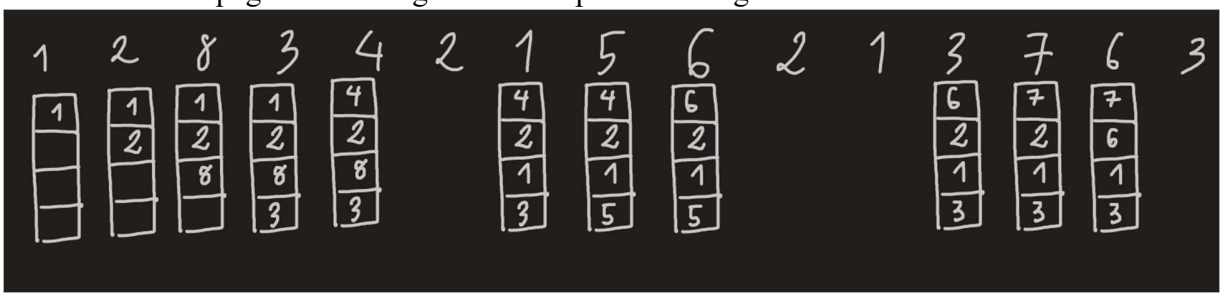
iii. 2499 = 512 * 4 + 451
Thus, the virtual page number is 4, which correspond to virtual page number 8, which is invalid, and the offset is 451

Question 6

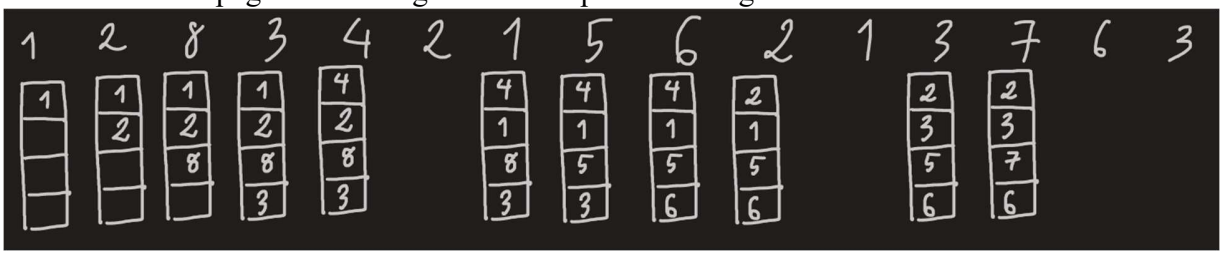
a. (0, 430). Physical address = base + offset = 219 + 430 = 649
b. (1, 10). Physical address = base + offset = 2300 + 10 = 2310
c. (2, 500). Illegal address since the offset 500 is larger than the limit = 100 of segment 2
d. (3, 400). Physical address = base + offset = 1327 + 400 = 1727
e. (4, 112). Illegal address since the offset 112 is larger than the limit = 96 of segment 4

Question 7

a. There will be 11 page faults using the LRU replacement algorithm



b. There will be 11 page faults using the FIFO replacement algorithm



c. There will be 9 page faults using the Optimal replacement algorithm