



Date handed out: 25 May 2023 at 2:00 PM

Date submission due: 9 June 2023 at 11:00 PM

Important: Read all the instructions below carefully before you start working on the assignment, and before you make a submission.

1. In the report to be submitted: please include your name and student IDs on the first page.
2. Your code files, MUST include name and student IDs.
3. We recommend typesetting your submission in Word or any similar tool as you must submit the PDF version of it. Images of handwritten solutions unreadable reports due to the lack of clarity, or English language typos will not be accepted.
4. As part of the typesetting requirement, all (state) graphs (if any are needed) must be computer-generated (no hand-drawn or stylus-drawn graphs will be accepted). We recommend using Powerpoint/Google Slides or any other tool you prefer to draw any graphs.
5. Cheating will be punished according to the rules mentioned in the syllabus

Task 1 [20 Marks, 5 Points per each, 10 for second chance]

1,2,3,1,2,2,2,3,3,4,4,4,4,2,1,3,5,6,7,8,7,6,6,5,8,1,1,1,2,2

Compute the number of page faults resulting from the stated reference string with 4 frames for:

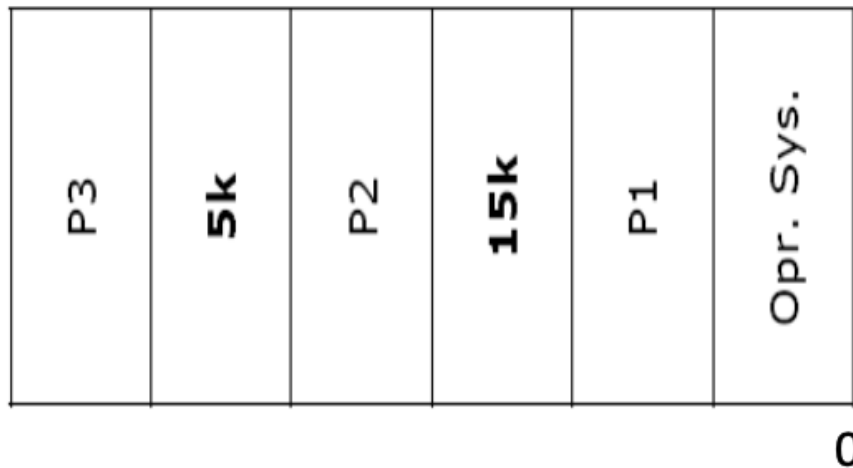
- Second Chance Algorithm (check Naresh book for hints)
- LRU
- Optimal Algorithm

Task 2 [15 Marks, 5 Points per each]

As seen in the given **variable-partition based memory layout**, the processes P1, P2 and P3 are currently in memory. If the processes P4=5k, P5=8k and P6=5k arrive in this sequence, plot the memory layouts for:

- Best-fit
- First-fit
- Worst fit.

(be careful from which side your start applying your algorithm.)



Task 3 [20 Marks]

A system allocation has four processes and five different types of resources. The current and maximum needs are;

	Allocated	Maximum	Available
Process A	1 0 2 1 1	1 1 2 1 3	0 0 2 1 1
Process B	2 0 1 1 1	2 2 X 1 1	
Process C	1 1 0 1 0	2 1 3 1 0	
Process D	1 1 1 1 0	1 1 2 2 1	

What is the **largest possible value of X** so that DCBA is a safe sequence? In order to get credits, *you should show your work clearly!*

Task 4 [15 Marks, 7.5 for each]

1. A process of size 300 MB needs to be swapped-in from the hard disk. But there is no space in the memory. After observing the memory, it was found that two processes of size 150 MB and 200 MB are lying idle, and therefore, can be swapped out. How much swap-time is required for swap- in and swap-out of the processes, if the following is given: Average latency time of the hard disk = 10 ms, Transfer rate of the hard disk = 60 MB/s, **Show clearly your steps.**
2. A process has relocatable code of size 700 K. The relocation register is loaded with 30010 K and the limit register contains the address 31000 K. If the processor generates logical addresses, 990 and 1020, where will they be located in the physical memory? **Show all the steps of your work, and clearly explain your answer if needed.**

Task 5 [30 Marks]

The Problem of Producer- Consumer problem with bounded buffer was explained in the class. In addition, you were able to work on different exercises to create threads, processes...etc. In this task you are request to you all the knowledge you gain to:

1. **Write a C program that simulates this problem [20 Marks].**
 2. In similar way to the book **Sketch** a solution to Sleeping barber problem which is as follow:
The Sleeping-Barber Problem. A barbershop consists of a waiting room with n chairs and a barber room with one barber chair. If there are no customers to be served, the barber goes to sleep. If a customer enters the barbershop and all chairs are occupied, then the customer leaves the shop. If the barber is busy but chairs are available, then the customer sits in one of the free chairs. If the barber is asleep, the customer wakes up the barber **[10 Marks]**.
- To get hints on how to solve this question, please refer to: **Abraham Silberschatz, Greg Gagne, Peter B. Galvin - Operating System Concepts-Wiley (2011), Chapter Process synchronization, pages 274 – 280**
 - **Please note, you must obey exactly the skeletons and the steps shown in the book. Other solutions will not be accepted.**

To SUBMIT:

1) PDF file that includes:

- **Answers** for task 1, 2, 3, 4
- **Sketch** of your solution to Sleeping barber problem, task 5

2) The Code for task 5, question 1.