MIDDLE EAST TECHNICAL UNIVERSITY, NORTHERN CYPRUS CAMPUS
CNG334 Introduction to Operating Systems – Assignment 2

Date handed out: 06 May 2024, Monday 8:00 AM
Date submission due: 17 May 2024, Friday 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. **You 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 hand written solutions, unreadable report due to unclarity or English language typos will not be accepted.

4. As part of the typesetting requirement, all (state) graphs (if any 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. Your code must be well commented, if your code is unreadable, unclear you may lose marks.

6. This is an individual assignment and not to be done in a group. All the material included in this assignment could be included in future quizzes, midterms and exams.

7. Cheating will be punished according to the rules mentioned in the syllabus.

Task 1 [10 marks]

Consider a system with five processes and four different types of resources as described below:

Processes	Allocation	Maximum
A	0 0 1 2	0 0 1 2
B	1 0 0 0	1 7 5 0
C	1 3 5 4	2 3 5 6
D	0 6 3 2	0 6 5 2
E	0 0 1 4	0 6 5 6

Available: R1=1, R2=5, R3=2, R4=0

Q2: Provide a safe sequence? Please, provide your answer with detailed steps

Task 2 [20 marks]

Consider a system with four processes P1, P2, P3 and P4 there types of serially reusable resources R1, R2 and R3 with 3, 2 and 2 instances.

Process P1 holds 1 instance of R1 and requests 1 instance of R2.
Process P2 holds 2 instance of R2 and requests 1 instance each of R1 and R3. Process P3 holds 1 instance of R1 and requests 1 instance of R2.
Process P4 holds 2 instance of R3 and requests 1 instance of R1.

Q3: Draw the resource allocation graph of this system. Explain whether or not there are any processes that are deadlocked.

Task 3 [20 marks]

A system allocation has four processes and five different types of resources. The current as follows:

	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	

Q4: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 (30 Points – 10 per each):
As seen in the given **variable-partition (dynamic)** 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, and worst fit**.

Hint: partition can be further divided to accommodate more process

P3	5k	P2	15k	P1	Opr. Sys.

0
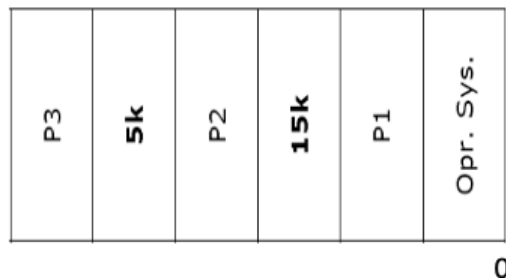
Task 5 (10 Points):
Assume that there are 3 page frames, initially empty. Consider the reference string:

2 1 4 3 1 2 4 3 2 1 for the sequence of pages accessed.

- How many page faults are generated by FIFO page replacement algorithm?
- How many page faults are generated by LRU page replacement algorithm?
- In both cases show your work in details (as showed in the classroom examples), **4 pts per each algorithm for the steps and 1 pts for the number of page faults**

Task 4 (10 pts)

Order the following page-replacement algorithms on a five-point scale from "bad" to "perfect" according to their page-fault rate. Also, identify the ones that suffer from Belady's anomaly from those that do not.

       a. LRU replacement

       b. FIFO replacement

       c. Optimal replacement

       d. Second-chance replacement

<mark>Hint: For the comparison use any of the examples provided in the course or in the assignment.</mark>

<mark>Submission requirements:</mark> a PDF file with all your solutions to the given tasks.