MIDDLE EAST TECHNICAL UNIVERSITY, NORTHERN CYPRUS CAMPUS
CNG334 Introduction to Operating Systems – Assignment 1

Date Handed Out	**14 April at 02:00 PM**
Submission Date	**28 of April at 11: 00 PM**

Important: Read all the instructions below carefully before you startworking 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 submitthe 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 [30 marks]: Scheduling

Consider the following table that shows:

- **Process arrival**: the time the process is added to the ready queue
- **CPU burst or execution time**
- I/O blocking times: time waiting to get the I/O
- I/O Interrupt time: When the request for the I/O operation occurs

The processes will start executing, however, when an I/O interrupt occurs the process will be blockedfor a period of time defined by I/O Time Blocking.

Note: All times mentioned in the table below are in milliseconds

Process	Arrival time	Burst Time	Priority	I/O Time Blocking	I/O Interrupt time
P1	0	10	1	2	1
P2	2	7	2	3	5
P3	3	2	3	5	1
P4	13	4	4	1	2

Assume context switching requires 2 milliseconds, and is performed by special hardware. Drawthe Gantt chart, then compute the **average turnaround time**, and **average waiting time** for the followingalgorithms:

1) (5 marks) FCFS

2) (10 marks) Non-preemptive priority, where 1 is the lowest priority and 4 is the highest.
3) (10 marks) RR with a quantum of time equal to 4

4) (5 marks) SPN

Task 2 [60 Point]: Processes and Threads Creation

Write a POSIX C/C++ program that includes:

A) Processes:

1. **[5 marks]** **A** function **readSort()** that read numbers from a text file, this function should putthese numbers in a linked list and sort them from the lowest to the highest, then print the numbers sorted. **Use the selection sort algorithm.** Provide a print screen for the output
2. **[5 marks]** **Another** function **readCheck()** read numbers from the same text file, thisfunction should calculate the factorial of each number, and save it in an **array** then once it finishes, the array should be printed**.** Provide a print screen for the output

   NOTE: The previous functions should be done by one process, and the execution is done one after the other. The output screen should be added to your report.

   Example out output:

   Sorting: 1 -> 2 -> 3 ->4

   Factorial: 1, 2 , 6 ,24

3. **[20 marks]** Now, create a child process and let it execute **readSort() [15 marks]**. The parent process should wait for the child process to complete, then it should execute **readCheck() [5 marks]**. Provide a print screen for the output of the two processes. Provide a print screen for the output. **Use Wait().**

   Example out output:

   Child Process is Sorting: 1 -> 2 -> 3 ->4

   Parent Process is Calculating Factorial: 1, 2, 6 ,24

B) Threads:

4. **[20 marks]** Create two threads that execute the previous two functions. Once both threads are done executing, provide a printscreen for the output of your program.

   Example out output:

   Thread 1 is Sorting: 1 -> 2 -> 3 ->4

   Thread 2 calculating the Factorial: 1 -> 2 -> 6 ->24

5. **[10 marks] Now Prepare a new version of your code so that** the **readCheck()** thread waits 2 seconds before printing the next element, and the **readSort()**thread waits for 1 second after every print. Provide a screenshot of the output for the two threads.

Task 3 [10 Point]: Answering Questions

1. **[5 marks]** What is the difference between concurrency and parallelization, and how doesmultiprogramming increase CPU utilization?
2. **[5 marks]** Describe the differences between short-term, medium-term, and long-term scheduling.

For this assignment, you have to submit:

A) A PDF file that includes:

1. A screenshot for the outputs as requested in the questions
2. The answers for task 3

B) All the codes files for task 2, A and B.