GRIFFITH COLLEGE DUBLIN

QUALITY AND QUALIFICATIONS IRELAND

EXAMINATION

POSTGRADUATE DIPLOMA IN SCIENCE IN COMPUTING

PARALLEL AND DISTRIBUTED PROGRAMMING
Module Code: PGDC-PDP

POSTGRADUATE DIPLOMA IN SCIENCE IN BIG DATA MANAGEMENT AND ANALYTICS

PARALLEL AND DISTRIBUTED PROGRAMMING
Module code: PGDBD-PDP

MASTER OF SCIENCE IN COMPUTING

PARALLEL AND DISTRIBUTED PROGRAMMING
Module Code: MSCC-PDP

MASTER OF SCIENCE IN BIG DATA MANAGEMENT AND ANALYTICS

PARALLEL AND DISTRIBUTED PROGRAMMING
Module code: MSCBD-PDP

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Date: 14th August 2023 **Time: 2.15-5.15**

THIS PAPER CONSISTS OF FIVE QUESTIONS
FOUR QUESTIONS TO BE ATTEMPTED
ALL QUESTIONS CARRY EQUAL MARKS

QUESTION 1

Write an C MPI program for a system that consist of is made of 3 MPI processes: MPI process 0 holds a 2D array that contains an even number of consecutive integers starting from 0. You must write a program that scatters this array, with a collective operation, such that MPI process 0 receives nothing, MPI process 1 receives all odd numbers and MPI process 2 all even ones.

Expected output

```
0   1   2
3   4   5
6   7   8
9  10  11
Received on MPI process 1:   1   3   5   7   9  11
Received on MPI process 2:   0   2   4   6   8  10
```

(a) Write the C MPI code.

(15 marks)

(b) Write a C OpenMP version of the solution.

(10 marks)

Total (25 marks)

QUESTION 2

(a) What is the purpose of the Synchronized block?

(5 marks)

(b) What is the Similarity between yield() and sleep()?

(5 marks)

(c) Can a constructor be synchronized? Explain why.

(5 marks)

(d) What happens to the object references included in the object?

(5 marks)

(e) What is the difference between starting thread with run() and start() method?

(5 marks)

Total (25 marks)

QUESTION 3

(a) How Callable Threads implemented in java?

(5 marks)

(b) What are the limitations of intrinsic lock and advantages of ReentrantLock?

(10 marks)

(c) What are the differences between CountDownLatch and Barrier? List five.

(10 marks)

Total (25 marks)

QUESTION 4 MPI

For the questions below, assume the following data for the integer a and the distributed integer array b on different processors. For the entire array b, b[i] == i. The array c is initially empty on each processor.

P0: a=0, b = [0, 1, 2, 3]
P1: a=1, b = [4, 5, 6, 7]
P2: a=2, b=[8, 9, 10, 11]
P3: a=3, b=[12, 13, 14, 15]

(a) If the command

```
MPI_Gather(b, 4, MPI_INT, c, X, MPI_INT, 3, MPI_COMM_WORLD);
```

is executed, what should the recvcnt (denoted X) above be?

(5 marks)

(b) Which process will receive the data? 0, 1, 2, 3, or all?

(5 marks)

(c) If the command

```
MPI_Reduce(b, c, 4, MPI_INT, MPI_SUM, 2, MPI_COMM_WORLD);
```

is executed, what variable receives the result of the reduction?

(5 marks)

(d) How many results will be produced?

(5 marks)

(e) Which process will receive the data? 0, 1, 2, 3, or all?

(5 marks)

Total (25 marks)

QUESTION 5

Write a Java class for an automated booking system for a theatre. The system must support multiple users that are allowed to book a single seat at a time from a list of available seats. The system must ensure that double booking is not permitted whilst allowing clients free choice of available seats. This means that a seat may appear to be free although it may be booked or in the process of being booked by another client. Implement a class that allows users to book seats whilst not permitting double booking. You should write to methods getSeats and bookSeat. Use ReentrantLock in your code.

(25 marks)