FIT3143 Assignment 2

Marks:	This assignment is worth 100 marks and 25% of all marks for the unit.
Due Date:	**Week 11**, **Mon 08/Oct/2018, 2PM**.
Submission:	(i) The assignment submission must be made through Moodle for this unit **by the due date**. (ii) The submission of this assignment must be in the form of a single zip archive comprising a single PDF or a MS-Word file, for the report, and full source code.
Extensions:	*No extensions will be given.*
Lateness:	Late penalty of 5% per day after the due date, including the weekends.
Authorship:	This assignment is an individual assignment and the final submission must be identifiably your own work. Breaches of this requirement will result in an assignment not being accepted for assessment and may result in disciplinary action.
Cover Sheet:	A completed individual assignment covered sheet must be added to the submission.
Word Limit:	1000+500 = 1500 words

General instructions

- All MPI programs must compile with Open MPI using the GNU C compiler (gcc).
- Programs using more than one file for compilation and execution must include a Makefile.

Part A – Event detection in a fully distributed wireless sensor network - WSN (90 marks)

WSN Description: The wireless sensor network comprises **20 nodes** and a **base station**. These nodes are arranged in a **4 x 5** (rectangular-shaped) grid.

Distance between the adjacent nodes is kept as such that these nodes can wirelessly communicate. The adjacent nodes can exchange data through *unicast* and *broadcast* modes of communications.

Communication between non-adjacent nodes is not possible.

Every node in the WSN can however independently exchange data with the base-station (e.g. through a satellite link). Base-station for this WSN is an additional computer node that is entrusted with the task of gathering data from all the 20 nodes in the WSN.

Event Detection Criterion: In order for an event to be recorded by the WSN, at least ***three*** adjacent nodes, to a reference node, must simultaneously report their activations to the base-station (explanatory figure in the end). The base station then collects all the event reports and writes these to its log file.

Assignment Project: Develop a MPI code that simulates the operation of this WSN including the base station in an efficient manner. The criterion for measuring efficiency in this exercise is in finding the communication scheme that minimises the messages to the base-station whilst satisfying the WSN's event detection criterion (stated above).

Hints:

1. Assume that a set of MPI tasks (processes) represents the WSN and each MPI task can represent a WSN node.

2. In order to simulate random occurrences of events within the WSN, each WSN node may be provisioned with an independent random number generator with the condition that at least **three** adjacent nodes must produce the same random number, at the sampling time, to constitute an event.

3. Write the key performance metrics e.g. the simulation time, number of events detected, number of messages/event with senders' adjacency information/addresses, total number of messages (for this simulation), to an output file. Doing so may assist in proving the correctness and efficiency of your implementation.

Programming Task: Write, and demonstrate in the lab, a MPI program that effectively addresses all the points in the problem statement. Assume that a set of MPI processes represents the WSN and each MPI process represents a WSN node.

Write-up Task (Up to 1000 words): (1) Describe the MPI program structure with the aid of program flow-chart/s. (2) Explain the inter-process communication scheme for the MPI program.

Part A Marking Guide		Marks
Demonstrate the following in Week 11 and 12 Lab sessions		
1.	The program (1) compile without any warning(s), (2) accurately implement the WSN rules, (3) correctly computes and displays the results, (4) is efficient e.g. requires fewer than ***four*** message per event being reported to the base-station.	10+10+10+10= 40 marks
2.	Program coding is well structured, commented, and easy to understand.	5+5=10
Include the following in your Moodle submission, Monday, Week 11		
3	The written report fully describes, a) The program structure b) Inter-process communication scheme of the MPI program c) Source code files, from the lab demo, with complete instructions on how to compile and run, preferably with a Make file.	15+15+10=40
Total Marks for Part A		90 marks

Part B Content-addressable search engine (10 marks)

Problem Statement: Searching for images and other multi-media on the Internet require a distributed associative memory scheme. Hierarchical Graph Neuron is a fast distributed associative memory technique that is well suited for distributed systems. Details of the Hierarchical Graph Neuron Technique can be obtained by legally downloading the following paper from Monash Library's website:

Title: A Hierarchical Graph Neuron Scheme for Real-Time Pattern Recognition

This paper appears in: Neural Networks, IEEE Transactions on
Issue Date : Feb. 2008, **Volume :** 19 , Issue:2 , **On page(s):** 212 - 229

Persistent Link for Downloading the Paper PDF:
http://ieeexplore.ieee.org.ezproxy.lib.monash.edu.au/servlet/opac?punumber=72

ISSN : 1045-9227, **INSPEC Accession Number:** 9794258
Digital Object Identifier : 10.1109/TNN.2007.905857 , **Date of Current Version :** 07 February 2008

Write-up Task (Up to 500 words): Recommend a suitable parallel processing architecture that will best suit the HGN associative memory technique and then state at least 5 reasons in support of your recommendation.

Part B Marking Guide
Include the following in your Moodle submission, Monday, Week 11
The write-up for this part is to be included within the overall report file as a separate section. The section may include diagrams/flowchart to strengthen the explanation (2 x 5 = 10 marks).

Additional Notes:

1. Each student will be allocated **5 minutes** for the demonstration (Part A).
2. You may bring your own portable computer(s) for the demonstration.
3. Write-ups for Part A and Part B constitute the Moodle submission file (a single PDF or MS-Word document comprising Part A and B).

An explanatory note on the adjacent nodes:

The nodes being a single hop away from one another meet the adjacency requirement. Figure below illustrates a couple of cases for selecting adjacent nodes. The nodes pointed to by the green arrows provide the minimum number of adjacent nodes to count towards an event.

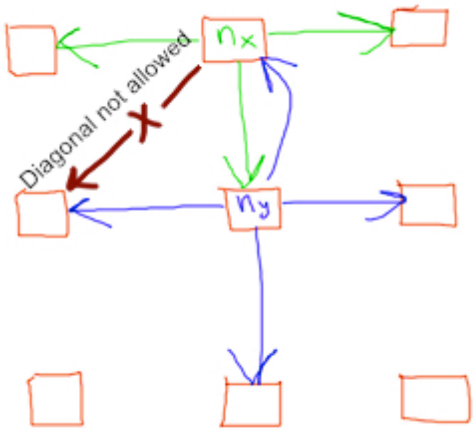

Figure: In this partial view of the WSN, valid adjacent nodes, to node n_x and node n_y, are indicated by the green and blue arrows respectively.

Additional explanatory notes

At any given time, we would like to have several nodes to agree on an event's value (sensor reading) in order to reduce the probability of spurious readings being recorded as event/s by the WSN.

We would normally use the Euclidean distance measure for selecting the adjacent nodes. For simplicity you may assume a unit distance between the adjacent nodes.