Aims	1. Enable students to analyze and employ appropriate distributed and parallel computing techniques to solve problems. 2. Enable students to use relevant libraries, such as OpenMP, CUDA or OpenCL to improve the performance of an application.
Learning Outcomes Assessed	1. Demonstrate appropriate programming skills with regards to parallel and distributed computing. (P4, PLO3) 2. Analyse a given scenario with parallel and distributed computing techniques. (C4, PLO2) 3. Discuss the variety of parallel and distributed computing techniques. (C2, PLO1)
Outline of Problem	For your assignment, you should critically evaluate current technologies in High Performance Computing, and then pick a problem of interest, implement distributed and parallel computing techniques to solve the problem.
Details	The Assignment consists of **TWO (2)** parts, please refer to **Project Details Part A** and **Project Details Part B.** Both parts are related. Group yourself into a team of **TWO OR THREE (2-3)** members. A list of suggested problems is as shown below. Please note that the following are the basic requirements of the assignment. **Fulfilling the requirements may lead you to an Average or Good grade.** Achieving an Excellent grade requires evident **extra efforts**, such as learning new skills, introducing new ideas, demonstrating the ability to build parallel processes, and/or producing excellent reports with working prototype. Your group is expected to produce ideas that originated from the members, but not to take the work or an idea of someone else (including the Web) and pass it off as your own. **NO GROUP IS ALLOWED** to share the same idea, i.e., each group must propose a unique title or solution.
Suggested problems	1. Simulations: e.g. Molecular Dynamics 2. Machine Learning / Data mining: Feature detection, Pattern matching, Clustering, Classification 3. Network Analysis: large-scale graph processing, e.g. using Pregel 4. Linear Algebra 5. Monte Carlo Sampling 6. Image processing algorithms, e.g Hough Transform 7. Solving massive linear equations 8. Others suggested complex processing, that potentially to generate better results using parallel processing, in terms of execution time.

Submission Deadlines	**Part A: Week 7 (Amended)** **Part B: Week 12 (Remain)** **Presentation: Starts on Week 12 Practical class** Please submit to your tutor. Late submission will be penalized.
Contribution	This assignment contributes **60%** to the **coursework** component. (The other 40% comes from the Mid-term test).
Academic Integrity and Plagiarism	There must be originality in your work, i.e. do not copy or refer to other group(s). You may only work with your team member(s) to produce the solution of this assignment. You must not share with nor refer to any part of the assignment (including the code) of anyone else except your team member(s) and your tutor. Before submitting your assignment, please make sure that you have complied with **TARUC plagiarism Policy**. Any cheating, attempt to cheat, plagiarism, collusion and any other attempts to gain an unfair advantage in assessment will cause the students concerned to be penalized. **IMPORTANT**: Students found to be dishonest are liable to disciplinary action.
Late Submission	Late submission without valid reason will NOT be tolerated. For late submission, there will be a reduction of total marks: ● Late 1 to 3 days after deadline of submission: minus 10 marks ● Late 4 to 7 days after deadline of submission: minus 20 marks ● Late more than 7 days after deadline of submission: 0 marks In certain circumstances, a student may be allowed to submit the assignment late with valid reason. S/he must contact the tutor at least one week before the assignment is due. The tutor will evaluate whether the circumstance warrants submitting the assignment late, but no guarantee that the students will not be penalized. Failing to submit the reports & code will lead to failure of the coursework.

Project Details: Part A – Proposal Writing

Introduction	1. Pick a problem of interest, i.e. a computationally expensive problem. 2. Clearly establish the problem by writing a project description 3. Write a literature report in which you isolate a class of algorithms that can be (and have been) used 4. Identify new research on them, then, pick the algorithm of choice. 5. If you are using existing codes, identify important and time-consuming functions.

What to hand in?	Students are required to submit the proposal for the selected topic.
	
	The proposal should contain the following:
	
	    • Title of the proposed project.
	    • Brief description of your proposed distributed and parallel computing techniques to solve the problem. (Problem Statement)
	    • Describes how your proposed solution works on a level that does not lose interesting details. Make some sensible breakdown into headings (Methodology).
	    • Use clear, well-written English language.
	    • Task allocations for each of the respective group members and a project plan.
	* Each student is expected to produce **individual** work regarding the specified items.
	
	Note: The proposal shall be compiled and submitted in group.

Format for Deliverable	For your report, you are required to adhere to the followings: 1. Length : **Between 5 to 10 pages** 2. Paper size : A4 3. Font : Times New Roman / Arial, 11 points 4. Cover page : Please use Appendix 1 5. Last page : Please attach Appendix 2 **Note:** Submit all your materials (final report and source code) to Google Classroom assignment submission page.

Project Details: Part B – Final Report Writing

Introduction	1. Implement the algorithm (application) on a parallel platform of interest, such as a multi-core processor (using thread / pthread), a GPU (using CUDA or OpenCL), a cluster system (using e.g. MPI, OpenMP) or a combination of all the above. 2. Run performance evaluation experiments by picking several non-trivial examples to demonstrate your software. 3. Revisit the implementation and further improve it, e.g. by replacing inefficient parallel algorithms, increasing locality, reducing communication costs, improving load balancing, avoiding conditionals, taking advantage of vectorization and ILP, etc. 4. Write a final report Note: You may use different parallel platforms for performance evaluation.
What to hand in?	Students are required to submit a final report and source code for the solution. **Project assessment:** Project assessment (demo, question and answer) will be carried out during the practical class in week 13 or 14. The final report should contain the following: ● Includes and explains the evaluation outcome in the article (Result). ● Provide reasoning for the results (Discussion) ● Use clear, well-written English language. Note: The report shall be compiled and submitted in group.
Format for Deliverable	For your report, you are required to adhere to the followings: 1. Length : **Not more than 20 pages** 2. Paper size : A4 3. Font : Times New Roman / Arial, 11 points 4. Cover page : Please use Appendix 1 5. Last page : Please attach Appendix 3 **Note:** Submit all your materials (final report and source code) to Google Classroom assignment submission page.