MONASH University

Lecture Revision

OBJECTIVES

- Revise the materials and deepen the understanding of Week 10 to 12 lectures.

MARKS

- The applied session is worthed 4 of the unit final mark.

INSTRUCTIONS

1. **Preparation is required for this Applied session.** Please do NOT plan to complete the Applied preparation during the Applied class. **Late penalty** (5% per day) will apply if you submit late!
2. The purpose of these **flipped Applieds** is for students to get an opportunity to test their understanding of lecture/pre-reading material with a low cost in lost marks if they have not understood the material, rather than not understanding the material.
3. Students should produce **written answers** to the Applied questions prior to starting the Applied.
4. Students must submit their answers via Moodle in **PDF format** before their allocated class.
5. Students' answers will be reviewed in a question and answer format during the Applied. Each student will explain their answer.
6. For many of the questions, marks will be allocated for **both the correctness of the written answer and the correctness & clarity of the verbal answer.** Therefore, plan also for a brief 60 seconds summary explanation of each question. Try to focus on the most important and critical idea in the answer. Marks will be awarded on the student's ability to explain their submitted answers in the PDF: concise, focused and accurate answers will earn full marks, answers with errors and lengthy explanations will lose marks. Read the marking rubric for detailed instructions.
7. All questions are based on lecture/pre-reading slides, and lecture/pre-reading slides are in effect the answer sheets for these Applieds.
8. Worked answers will not be posted after Applieds as most of the answers are already in the lecture/pre-reading slides and discussed in the class.
9. Marks will not be awarded if you skip the class, or do not make any submissions, or make an empty submission to Moodle (unless a special consideration extension has been approved).
10. You are allowed to use AI tools to search for information and resources during pre-class preparation. **You must declare in your report!** AI tools are not allowed during the interview.

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11. Certain tasks may be selected to be interviewed as a group during the in-class presentation/interview session. However, all the tasks are still individually assessed based on your Moodle submission and your own oral interview performance.

Questions

Answer all the following questions.

Question 1 [Concurrency Control] (30%):

A) For lock based concurrency control, explain why parallel & distributed algorithms can be improved in performance by distinguishing read locks from write locks. Draw diagram(s) [similar to Lecture Week 10, page 18] with at least two transactions to demonstrate and explain your answers.

B) For lock based concurrency control, explain how lock granularity would affect the parallel performance of a parallel / distributed algorithm. Use a diagram / pseudo code to explain your answers.

C) For timestamp based concurrency control, explain why clock synchronization algorithms are needed. Explain what would happen if clocks are not synchronized in a cluster of distributed machines.

Question 2 [Matrix Operations & Partitioning] (40%):

A) Compare row-wise block striped decomposition and tile segmentation-based partitioning scheme in terms of communication efficiency. Use a matrix multiplication example to showcase how they differ.

B) Given the following pseudo-code (in C style) on three integer variables x, y, and z:

```
y = y + z + 1; // Instruction 1
x = z; // Instruction 2
```

Based on the theory of Bernstein's conditions, write down the reading (input) set and writing (output) set for both instructions 1 and 2. Show in detail whether the two instructions 1 and 2 satisfies Bernstein's conditions.

C) Explain how matrix data is communicated for Cannon Algorithm. For simplicity, we are allowed to use the simplified algorithm (in https://en.wikipedia.org/wiki/Cannon%27s_algorithm) for square matrices to demonstrate your concepts.

Question 3 [Exponential Growth] (30%):

A) Research on "Dennard scaling", and explain why the power density stays constant when transistors get smaller is important for exponential growth in computational performance.

B) Moore's law says that the number of transistors doubles approximately every two years. With higher number of cores and increasing core frequency in the future, give two reasons why sometimes algorithms/tasks would not have significant improvements in performance. Explain your answers with Amdahl's Law.

C) Explain how Keck's Bandwidth Law would affect the performance of a distributed application in the future.