COMP9311 24T3: Assignment 2
Deadline: 5pm Monday Week 10 (11 November)

Note: Please make sure that you always use notations consistent with lecture notes. Different notations will not be accepted.

Question 1 (12 marks)

Consider a relation R (A, B, C, D, E, G, H, I, J) and its FD set $F = \{AD \rightarrow B, BD \rightarrow G, BE \rightarrow I, AE \rightarrow DI, AI \rightarrow E, AEI \rightarrow C\}$.

Regarding the following questions, please give your **answers** and brief **justifications**.

(1) Check if $AB \rightarrow G$. (1 mark)

(2) Find all the candidate keys for R. (2 mark)

(3) Determine the highest normal form of R with respect to F. (2 marks)

(4) Find a minimal cover F_m for F. (2 marks)

(5) Regarding F, does the decomposition R1 = {ABCDJ}, R2 = {BDGI}, R3 = {BCEH} of R satisfy the lossless join property? (2 marks)

(6) Provide a step-by-step lossless decomposition of R into BCNF normal form. (3 marks)

Question 2 (8 marks)

Consider the schedule below. Here, R(*) and W(*) stand for 'Read' and 'Write', respectively. *T1, T2* and *T3* represent 3 transactions, and *t1, t2,..., t12* represents different time slots.

	t1	*t2*	*t3*	*t4*	*t5*	*t6*	*t7*	*t8*	*t9*	*t10*	*t11*	*t12*
T1	**R(x)**			**R(y)**				**W(x)**			**W(y)**	
T2			**R(y)**		**R(z)**				**W(y)**			**W(z)**
T3		**R(z)**				**R(x)**	**W(z)**			**W(x)**		

Note: Each transaction begins at the time slot of its first operation and commits right after its last operation (same time slot).

(1) Is the schedule serializable? If it is not serializable, draw a precedence graph; otherwise, provide an equivalent serial schedule. (2 marks)

(2) Use the Two-Phase Locking protocol to add appropriate locks/unlocks for each of the transactions. (3 marks)

(3) Based on the locks/unlocks you added in q(2), if the transactions attempt to follow the schedule in the table, what will happen? Please justify your answer using the method learned from the lecture. (3 marks)

Question 3 (6 marks)

Consider the following page request sequence:
P1, P2, P1, P4, P3, P7, P2, P1, P4, P5, P8, P6, P8, P2, P8.
Assume there are 3 buffers in the buffer pool.

(1) Sketch the process of how blocks are replaced in the Least Recently Used (LRU) policy, and calculate the cache hit rate. (2 marks)

(2) Sketch the process of how blocks are replaced in the Most Recently Used (MRU) policy, and calculate the cache hit rate. (2 marks)

(3) Sketch the process of how blocks are replaced in the First In First Out (FIFO) policy, and calculate the cache hit rate. (2 marks)

Assignment Submission

- You are required to submit an electronic version in **.pdf** format via **Moodle**.
- For clarity of your submission, we strongly recommend that you use a drawing program (such as draw.io) for Questions 1 and 2 and MS Word to write relational algebras for question 3.
- While we accept handwritten submissions, please ensure they are clearly written and well organized to ensure legibility. The submitted file should also be in .pdf format.

Late Submission Penalty

- 5% of the total mark (26 marks) will be deducted for each additional day.
- Submissions that are more than five days late will not be marked.

Plagiarism

The work you submit must be your own work. Submission of work partially or completely derived from any other person or jointly written with any other person is not permitted. The penalties for such an offence may include negative marks, automatic failure of the course and possibly other academic discipline.

All submissions will be checked for plagiarism. The university regards plagiarism as a form of academic misconduct and has very strict rules. Not knowing the rules will not be considered *a valid* excuse when you are caught.

- For UNSW policies, penalties, and information to help avoid plagiarism, please see: https://student.unsw.edu.au/plagiarism.
- For guidelines in the online ELISE tutorials for all new UNSW students: https://subjectguides.library.unsw.edu.au/elise/plagiarism.