

# 443 Database Management Systems

## Fall 2014 PL3

Your answers must be typed and submitted (on CDF) in a PDF file. Please include the names of all team members at the top of the file. Please do not repeat verbatim what is in the text or on wikipedia, rather describe the essential issues in the problems discussed. No credit will be given if there is any plagiarism in an answer.

### 1. B+tree Concurrency Control

- (a) A number of special locking protocols have been proposed for B+ trees. What problem do they address (e.g., why consider special locking protocols for B+ tree)?
- (b) Would the same problem be better or worse if the system used an optimistic concurrency control method rather than locking? Explain your answer.
- (c) Describe one B+tree locking protocol other than the one presented in the textbook.
- (d) Consider an index that is implemented with linear hashing rather than by a B+ tree. Would you need a special purpose locking protocol for this data structure? If so, outline such a locking protocol. If not, explain why not.

### 2. This question relates to the design of a transaction manager.

- (a) Specify the design (data structures and algorithms) of a 2PL lock manager with deadlock detection that implements the full S/X/IS/IX/SIX hierarchical locking protocol. Since it is extremely important to be able to set and release locks very quickly, your design should be as efficient as possible. In particular, a transaction should be able to release all of its locks with a single call to the lock manager. (Be sure to illustrate your data structure design via a small example.)
- (b) What extensions/changes would be necessary to extend this lock manager for use in a distributed DBMS?

### 3. Consider the Aries' page-oriented logging scheme for recovery where data is updated in place. In this question, you are asked to explain checkpointing and why a log, by itself, is not sufficient to make recovery work.

- (a) Briefly explain why checkpoints are needed in Aries.
- (b) Describe two possible checkpointing strategies. One should be optimized for an environment where failures are rare, and the other for an environment where failures are common. For each strategy, explain what should be logged, what should be forced to disk, and when, both during normal system operation and at checkpoint time.