

Name: _____

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Read each question over carefully several times. Answer all questions in the space provided. The exam is two hours long. Total score = 100.

(1). Please define the following terminologies (15pts):

- 3 a. Multi-Level Cell (of Flash Memory)

One cell can store multiple bits of information.

- 3 b. Conflict Serializability

The order of conflicting operations is as the same as that of a serial schedule.

- 3 c. ACID

Atomicity, Consistency, Isolation, durability

- 3 d. Absolute/External Consistency

Data reflect the changings of the external environment

- 3 e. Basic Aborting Protocol (BAP)

It is PCP + aborting to an abortable low-priority transaction that blocks a high-priority transaction because of ceiling blocking.

(2) Please answer the following questions in disk scheduling. You might provide explanation to receive any credits. (8pts)

(a) Please explain how C-SCAN improves SCAN. (4pts)

(b) Why EDF does not perform well in disk scheduling? (4pts)

Ans: (a) ^{4->}It provides a more uniform waiting time. (b) ^{4->}It does not consider the seek time, that is huge, compared to the transfer time.

(3) For “a software automation strategy,” there are three strategies: (1) Decomposition by Critical Timing Constraints, (2) Decomposition by Centralizing Concurrency Control, (3) Decomposition by Distributed Concurrency Control. Please answer the following three questions: (17pts).

(a) Please explain what “Decomposition by Distributed Concurrency Control” is. How to determine the period of each node? (9pts)

(b) For “Decomposition by Centralizing Concurrency Control,” how to handle each asynchronous timing constraint? Because of the eliminating of substantial redundant computations, efficiency is improved. Why maintainability seems being more difficult? (8pts)

Ans: (a)^{3->} Partition the required computation into as many processes as possible so as to maximize the parallelism! In general, ^{6->} if a node is involved in the computation required by one or more periodic timing constraints, the process assigned to the node has a period equal to GCD of periods of relevant timing constraint! (b) ^{4->} Each asynchronous timing constraint is assigned a sporadic process which contains appropriate function calls. ^{4->} Sometime we need to add some control logic to implement internal scheduling decisions.

(4) Consider different strategies/algorithms for sporadic process scheduling: Background, Interrupt, Polling Server, Sporadic Server, Deferrable Server, Total Bandwidth Server, and Constant Utilization Server. Please answer the following questions: (25pts)

(a) In terms of fairness, please compare Total Bandwidth Server and Constant Utilization Server and provide the explanation to your answer. (5pts)

(b) Consider the impacts of the “servers” on the lower priority period tasks, please list the favor order for Background, Interrupt, Sporadic Server, Deferrable Server, Total Bandwidth Server. (12pts)

(c) Please give me two major differences in comparing Polling Server and Constant Utilization Server. (8pts)

Ans: (a)^{2->} Total Bandwidth Server is worse than CUS because it tends to use the background time such that ^{3->} it might create some starvation time for some time period (as shown in the (0, t, 2t) example). (b) ³Background > ³Sporadic Server > Deferrable Server > ³Total Bandwidth Server > ³Interrupt (c) ⁴Polling Server is a periodic process (CUS is not), and ⁴CUS has better total CPU utilization under EDF.

(5) Why flash-memory storage devices need to map a logical block address to a physical block address on its flash memory, such as those by the NFTL and BL policies (Hint: flash-memory characteristics)? Why we need wear leveling for flash-memory storage devices (Hint: flash-memory characteristics)? (8pts)

Ans: (a) ^{4->}It is because of the write once property. (b) ^{4->}It is because of the maximum number of allowable erases per block.

(6) What are the advantages of main-memory databases, compared to disk-based databases? Please give me two advantages. Please also give me one disadvantage. (12pts)

Ans: (a) ^{4->}better performance because of short access time. ^{4->}It has reduced unpredictability of response time. (b) ^{4->}It is more vulnerable to system failures

(7) Please answer the following questions for real-time concurrency control. You must have explanation to receive any credits. (15pts)

(a) When there are lots of access/lock conflict, shall we choose lock-based concurrency control or optimistic concurrency control? Why? (5pts)

(b) Under Read/Write Priority Ceiling Protocol (RWPCP), when a transaction read-lock a data object O_i , how do you set the Read/Write Priority Ceiling of O_i ? (5pts)

(c) Under Two-Version Read/Write Priority Ceiling Protocol (2VPCP), when a transaction write-lock a data object O_i , how do you set the Read/Write Priority Ceiling of O_i ? (5pts)

Ans: (a) ^{2->}We should choose lock-based concurrency control because ^{3->}optimistic concurrency control will have lots of aborts. (b) ^{5->}The Read/Write Priority Ceiling of O_i is set as the highest priority of the transactions that might write-lock O_i . (c) ^{5->}The Read/Write Priority Ceiling of O_i is set as the highest priority of the transactions that might write-lock O_i .