

CS 480 Distributed Systems Sample Exam 1

February 7, 2018

Name:

There are 100 points in five question. You must show your work for full credit. Guessing or simply “knowing” the answer will only be worth partial credit. You may not be able to show all your work on the actual exam so write your name and student number on each sheet you turn in. You are allowed **one** sheet of notes (front and back). You do not need to turn in your notes sheet.

1. Define the following terms (5 points each):

a) Distributed System.

Answer: A set of processes or threads, typically running on multiple physical or virtual machines. The system is designed to solve a problem, or problems.

b) Safety Property.

Answer: Any property that insures “bad things never happen.”

c) Liveness Property.

Answer: Any property that insures “good things eventually happen.”

d) Atomic Statement or Action

Answer: A statement or action that cannot be split into multiple statements and cannot be interrupted while it is active.

e) Critical Section

Answer: The section of a program where interference from another process could alter the results or an action by this process could modify the actions of another process.

f) Guard

Answer: A logical expression that controls whether or not a statement is available for the scheduler to initiate.

g) Clock drift (ρ)

Answer: Any two or more clocks may be set to the same time (synchronized), but do to slight variations in how the clocks measure time, they will begin to drift apart and have different times. This is clock drift.

h) FIFO

Answer: First In, First Out or a queue.

2. Given the following statement

1. **do** $x = 0 \rightarrow x := x + 1$
 2. \square $x = 3 \rightarrow x := 0$
 3. \square $0 \leq x \leq 5 \rightarrow x := x + 1$
 4. \square $x > 5 \rightarrow x := -1$
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a) (10 points) Is this loop guaranteed to end if the scheduler is unfair? Explain.

Answer: No, because an unfair scheduler could always choose statement 2 every time $x = 3$ and loop forever with $x = 0, 1, 2, 3, 0, 1, 2, 3, 0 \dots$

b) (10 points) Is this loop guaranteed to end if the scheduler is fair? Explain.

Answer: Yes because the guard for 3 is always open if the program is looping as above; therefore, statement 3 is guaranteed to be chosen eventually. At that point the program would eventually continue on to statement 4. The next time through the loop all the guards are closed (false).

c) (10 points) Is this loop guaranteed to end if the scheduler is completely fair? Explain.

Answer: Yes for the same reasons as for 2b.

3. (10 points) Give an explanation as to how $a \prec b$ could be possible. (There are multiple correct answers)

Answer:

- a) The events could occur on the same process such that b has a larger local time stamp than a .
- b) One process could have sent a message at local time a which was received by a different process at local time b .
- c) The relationship $(a \prec c) \wedge (c \prec b)$ could exist in which case $a \prec b$.

4. (10 points) What is meant if a is concurrent with b ?

Answer: It is not possible to construct a causal relationship between events a and b .

5. (10 points) Why do we need to construct models for distributed systems?

Answer: Typically the detailed operations of a distributed system are too complex to handle easily, so we construct a strong model to describe the actions of the system. As we gain more understanding of the system, the model can be *weakened* to more accurately reflect the true operations of the system.