

ECE 428 / CS 425

Spring 2016

Distributed Systems

Homework 6

Due: March 15, 2016 by 5:00 p.m.

Total points: ~~30~~ 40

Each question is worth 10 points.

Question 1

2

Consider the Bakery algorithm modified to delete 3 lines, as shown on the next slide. In the modified algorithm, variable *Choosing* is not used at all.

Present a scenario for $n = 2$ or 3 in which the algorithm may violate the mutual exclusion property.

Bakery Algorithm

3

Code for entry section:

```
Choosing[i] := true
Number[i] := max{Number[0], ...,
                 Number[n-1]} + 1
Choosing[i] := false
for j := 0 to n-1 (except i) do
    wait until Choosing[j] = false
    wait until Number[j] = 0 or
               (Number[j], j) > (Number[i], i)
endfor
```

Code for exit section:

```
Number[i] := 0
```

Question 2

4

Consider the 2-processor algorithm modified to delete 1 line in the code for processor p_1 , as shown on the next slides.

Present a scenario in which the algorithm either violates the mutual exclusion property, or results in a deadlock.

2-Processor Algorithm for p_0

5

Code for p_0 's entry section:

```
1  .  
2  .  
3  W[0] := 1  
4  .  
5  .  
6  wait until W[1] = 0
```

Code for p_0 's exit section:

```
7  .  
8  W[0] := 0
```

2-Processor Algorithm for p_1

6

Code for p_1 's entry section:

```
1  W[1] := 0
2  wait until W[0] = 0
3  W[1] := 1
4  .
5      if (W[0] = 1) then goto Line 1
6  .
```

Code for p_1 's exit section:

```
7  .
8  W[1] := 0
```

3. Eventual Consistency: This question is based on the paper by Doug Terry

7

Suppose that process P1 performs the following write operations in the specified order:

$x := 1$

$y := 2$

$z := 3$

Assume that, initially, all variables have value 0.

Suppose that the above operations have been completed (i.e., P1 has received acknowledgements that these operations are completed).

At a later time, process P1 performs the following operation:

$a := x + y + z$

Assume that no other operations performed. **Under each of the consistency models below**, what are the different values possible for variable a , after the above update of variable a has been completed?

(a) Eventual consistency (i.e., without read-my-write guarantee) (b) Read-my-write

4. Failure Detector

- Consider an asynchronous system. Suppose that process p sends a message to process q every 100 ms, and expects a reply from process q at least once every second. When no reply is received within 1 second interval, p assumes that q has crashed.
- (a) Is it possible that process q crashes, but process p never concludes that q has crashed?
- (b) Is it possible that process q is operating correctly, but process p concludes that q has crashed?