The University of Melbourne

Department: **Computing and Information Systems**

Subject Number: **COMP90020**

Subject Title: **Distributed Algorithms**

Reading Time: **15 minutes**

Writing Time: **3 hours**

This paper has 3 pages

Marking Scheme:

The total number of points for this exam is 60. Partial credit is available for incomplete answers or answers with minor errors.

Authorised Materials:

No materials are authorised.

Instructions to Invigilators:

…

Instructions to Students:

…

Paper to be held by the Baillieu Library: No.

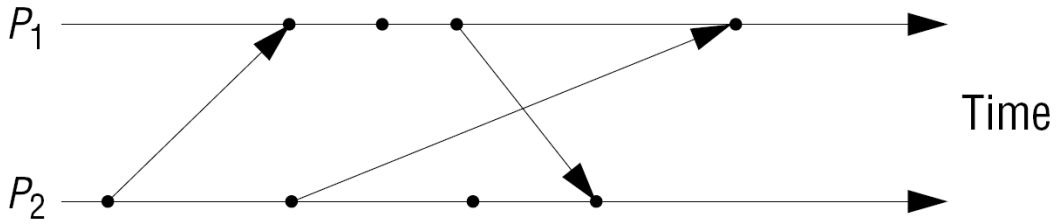
WRITE DOWN YOUR STUDENT ID HERE

Question #1:

Using Cristian's method for synchronizing clocks where we use a time server, we record the round-trip time and the timestamp returned by the server as 4 sec and 9:55:28, respectively. What time should we set the local clock to? What is the accuracy of this setting? What is the accuracy of the setting if we know for a fact that minimum round trip time is 1 sec. Show your calculations and notation clearly.

Question #2:

The figure below shows some events and messages happening for two processes on different machines. Draw the lattice of consistent global states mapping to the events and messages given by this figure. The initial state is (0,0).



Question #3:

What are the advantages and disadvantages of the ring-based mutual exclusion algorithm that we saw in class? Briefly explain.

Question #4:

In the following reliable multicast algorithm that we saw in class, explain briefly what would happen if we were to have 'R-deliver m' before the 'if (q ≠ p) then…' statement.

```
On initialization
   Received := {};

For process p to R-multicast message m to group g
   B-multicast(g, m);          // p ∈ g is included as a destination

On B-deliver(m) at process q with g = group(m)
   if ( m ∉ Received )
   then
            Received := Received ∪ {m};
            if ( q ≠ p ) then B-multicast(g, m); end if
            R-deliver m;
   end if
```

Question #5:

Explain, briefly, what happens if two processes simultaneously start elections using the ring-based election algorithm that we saw in class. Is this a problem for the algorithm?

Question #6:

How can we reach consensus from interactive consistency? Explain your answer.

Question #7:

Given transactions

```
T: y = read(k);      x = read(i);   write(j, 50);
U: write(i, 40);     write(j, 60);
```

Show an interleaved execution of these transactions such that when we use strict two-phase locking, they work in a serially equivalent manner and successfully commit.

Question #8:

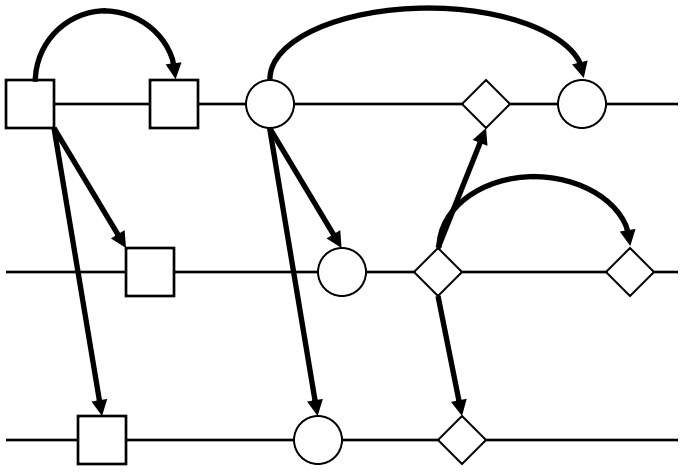
What is the two-phase commit protocol, where it is used? Briefly describe.

Question #9:

How can "phantom" deadlocks occur if transactions use two-phase locks? Explain your answer.

Question #10:

The figure below shows some multicast messages happening for three processes on different machines. Is the ordering of these multicast messages CO, FIFO and/or TO? Explain your answer.



End of Examination