PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Midterm Examination: Semester 2 **Academic Year**: 2004-2005

Date: 23rd December 2004 **Time**: 9.00-12.00 (3 hours)

Subject Number: 240-631 **Room**: R300

Subject Title: Parallel and Distributed Simulation Systems

Exam Duration: 3 hours

This paper has 12 pages, 11 questions and 140 marks (50%).

Authorised Materials:

- Writing instruments (e.g. pens, pencils).
- Only a notebooks, handouts, and dictionaries are permitted.

Instructions to Students:

- Scan all the questions before answering so that you can manage your time better.
- Attempt all questions.
- Write your answers in the exam sheets.
- Use *Thai* as the main language.
- Write your name and ID on each page.
- Any unreadable parts will be considered wrong.

When drawing diagrams or coding, use good layout, and short comments; marks will not be deducted for minor syntax errors.

ทุจริตในการสอบ

โทษขั้นต่ำ ปรับตกในรายวิชานั้นและพักการเรียน 1 ภาคการศึกษา

โทษสูงสุด ให้ออก

Name_____ Code_____

Question 1 (32 marks; 45 minutes)

1.1 What are the benefits of parallel and distributed simulations? (4 marks)

1.2 Why is the term 'time' so important in a distributed simulation? Give examples of the fundamental concept about different times in a distributed simulation. (4 marks)

1.3 Analyse techniques of *Event-oriented* and *Process-oriented* simulations in comparison. (6 marks)

1.4 If simulation time = W2S(W) = T0 + S*(W-W0), where W = wallclock time, S = scale factor, W0(T0) = wallclock (simulation time at start of simulation), assuming that simulation and wallclock time use the same time units, how to make the simulation run like running a video in the following modes? (4 marks)

a) fast forward

b) slow motion

1.5 Amongst the following applications:- (4 marks)

a) war gaming simulations

b) simulation of large networks such as millions of mobile subscribers

c) simulation of digital electronics circuits

d) simulation for training air traffic controllers

e) simulation of digital electronics circuits

f) multi-user home entertainment

g) simulations of adding a new runway to Bangkok airport

1.5.1 Which are considered system analysis?

1.5.2 Which are considered virtual environments?

1.6 Explain the concept of Barrier Mechanism (4 marks)

1.7 What are the advantages and disadvantages of *publication and subscription* mechanisms in distributed environments. (4 marks)

1.7.1 advantages

1.7.2 disadvantages

Question 2 (10 marks; 15 minutes)

From the example *process-oriented* simulation of a network of airports, complete the following process by taking into account of the runway usage of the departure. Define new variables and constants if necessary.

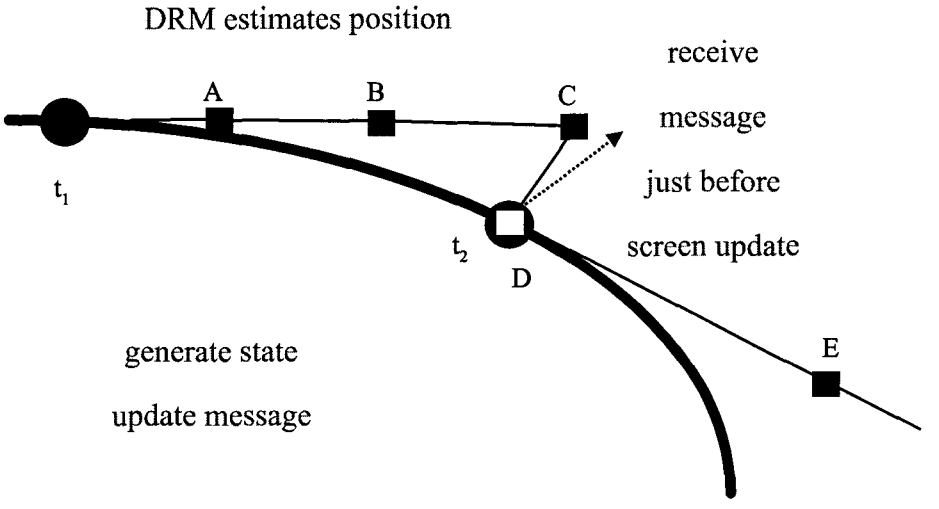
```
/* simulate aircraft arrival, circling, and landing */
Integer: InTheAir;
Integer: OnTheGround;
Boolean: RunwayFree;

InTheAir := InTheAir + 1;
WaitUntil (RunwayFree);                    /* circle */
RunwayFree := FALSE;                       /* land */
AdvanceTime(R);
RunwayFree := TRUE;

/* simulate aircraft on the ground */
InTheAir := InTheAir - 1;
OnTheGround := OnTheGround + 1;
AdvanceTime(G);
/* simulate aircraft departure TO BE ADDED*/
 OnTheGround := OnTheGround - 1;
```

Question 3 (10 marks; 15 minutes)

About *dead reckoning*, show how to solve the following potential problems by modifying the following picture and giving some explanation:



3.1 Discontinuity may occur when position update arrives; may produce "jumps" in display (5 marks)

3.2 Message latency (5 marks)

Question 4 (10 marks; 15 minutes)

Suppose that A, B and C are logical processes (LPs) that connect to each other as below.

Qa is a message queue received from logical process A.

Qb is a message queue received from logical process B.

Qc is a message queue received from logical process C.

At LP A, Qb has two messages with time stamp 5 and 7.

At LP B, Qc has two messages with time stamp 6 and 8.

At LP C, Qa has one message with time stamp 9.

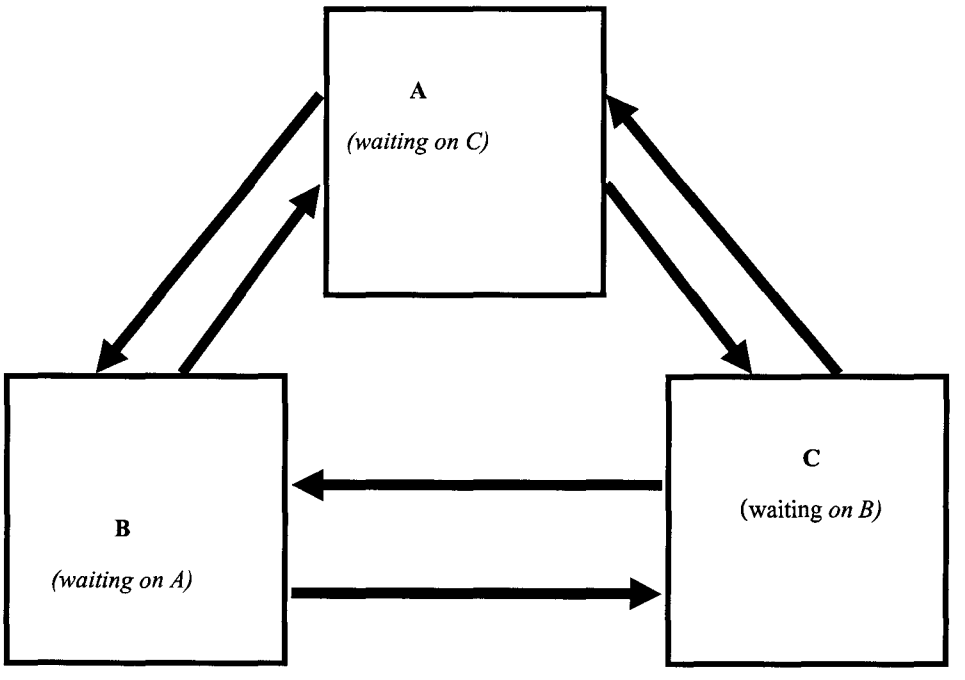
LP A is waiting on LP C (Qc has no messages)

LP B is waiting on LP A (Qa has no messages)

LP C is waiting on LP B (Qb has no messages)

Assume that each logical process sends a null message to the correspondent logical process every simulation loop, If the *lookahead* for all processes is 2 and the current simulation time at all processes is 2,

4.1 Calculate the number of null messages needed in order to avoid *deadlock*. Start from LP A sending a null message to LP B. (5 marks)



Number of null messages required _____

4.2 After using null messages which events are **safe** to process? Explain why?

(5 marks)

Question 5

(10 marks; 15 minutes)

According to *Diffusing computation* for deadlock detection by Dijkstra and Scholten, draw diagrams show how a deadlock can be detected if the total number of logical processes is 4.

Question 6 (10 marks; 10 minutes)

In a simulation system, the current simulation time is 3. Show how to change the *lookahead* by drawing graphs.

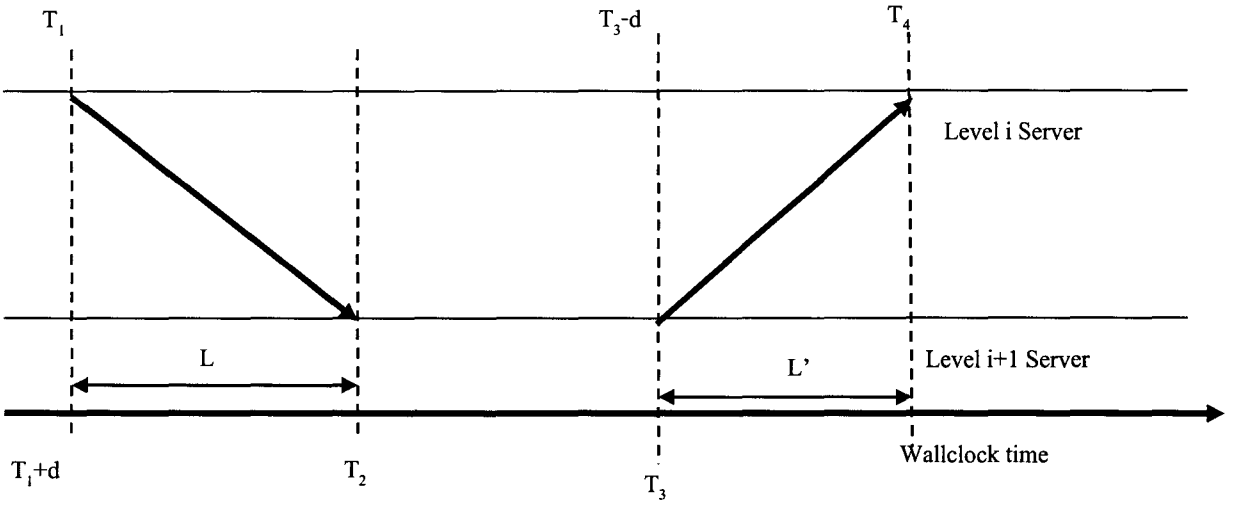
6.1 From 3 to 5 (5 marks)

6.2 From 3 to 1 . (5 marks)

Question 7 (10 marks; 10 minutes)

From the given data, estimate the NTP latency and offset.

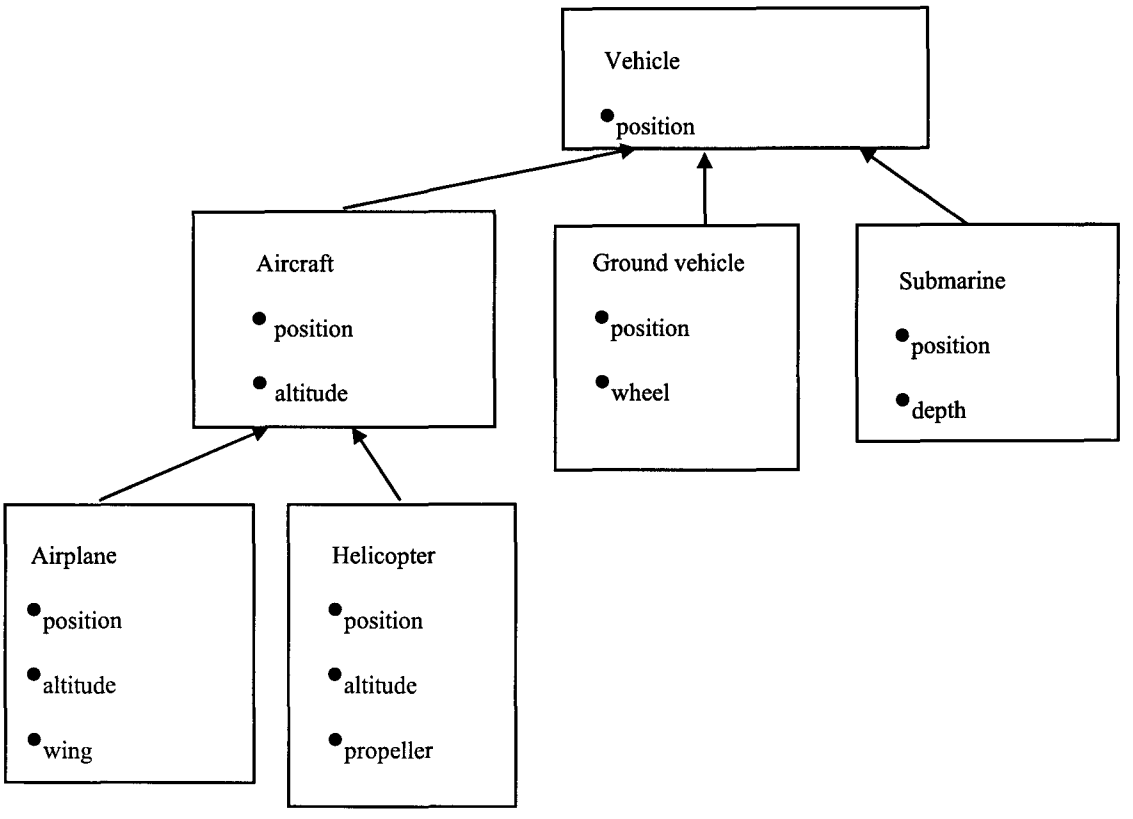
T1 = 10.0, T2 = 11.2, T3 = 13.5, T4 = 16.7



NTP latency = _____

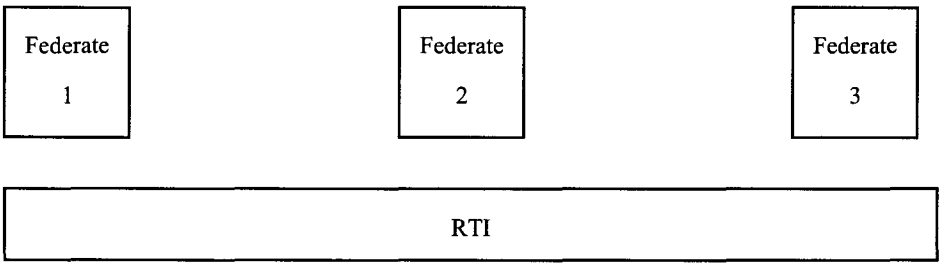
offset = _____

Question 8 (14 marks; 15 minutes)



Class hierarchy diagram

8.1 Edit the above *class hierarchy diagram* to show that adding a new sub class (i.e. boat, pick-up, truck) can be done at a federate without class modification at the other federates. (7 marks)

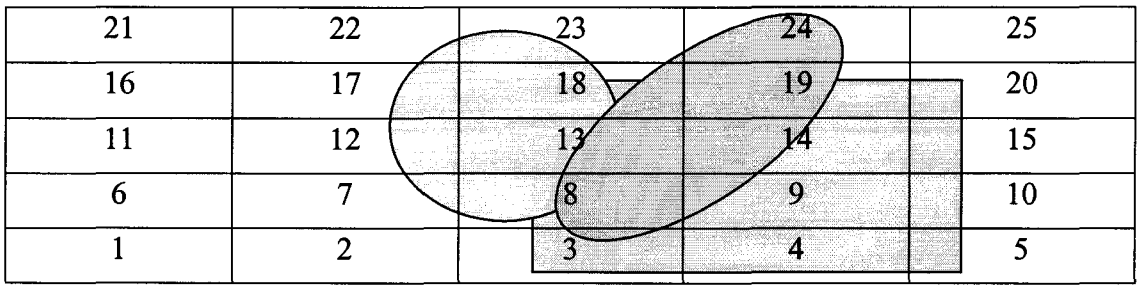


Federation diagram

8.2 Edit the above *federation diagram* to give examples of using *interest expressions* and *description expressions* from the modified class hierarchy diagram in 8.1 to support the idea of adding a new sub class without class modification at other federates (7 marks)

Question 9 (10 marks; 10 minutes)

From the *Grid-based* implementation in *Data Distribution*, find out *unwanted* and *duplicate* messages and their receivers and explain why they are unwanted and duplicated.



Update region Subscriber 1 Subscriber 2

Unwanted messages _____ (2 marks)

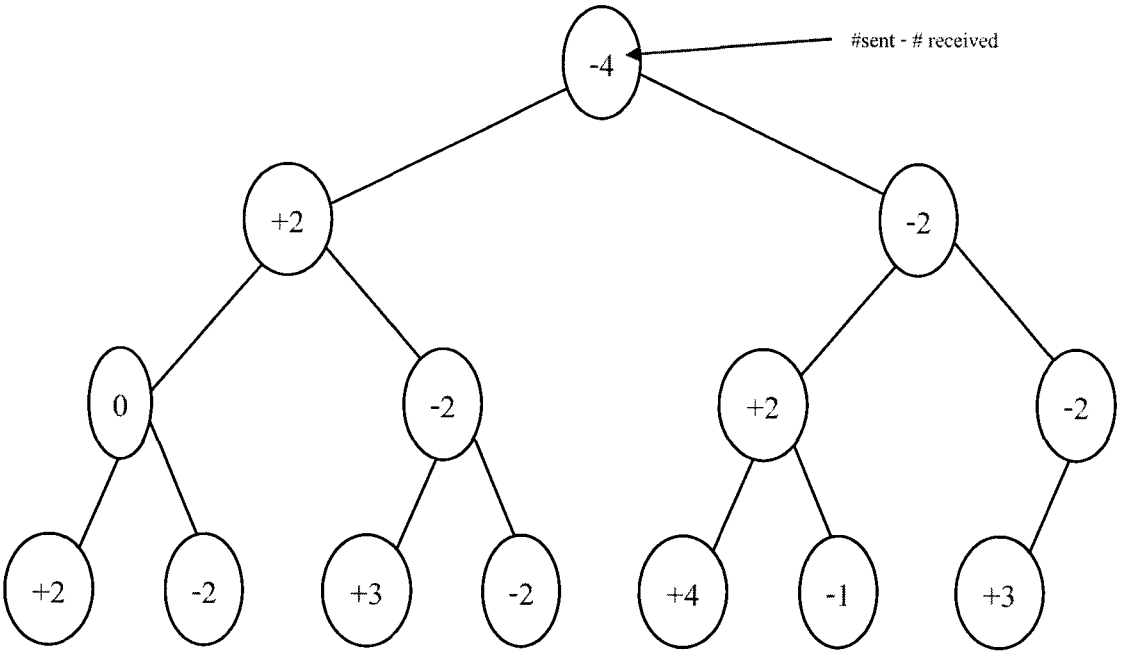
Why unwanted? _____ (2 marks)

Duplicated messages _____ (2 marks)

Why duplicated? _____ (2 marks)

Question 10 (10 marks; 10 minutes)

10.1 From the following Tree in *Flush Barrier*, check if there are still *transient messages* or not. (5 marks)



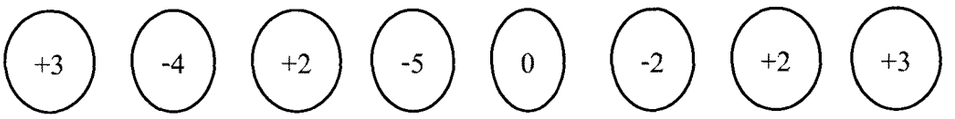
Number of transient messages _____

10.2 From the following diagram, check with *Butterfly Flush Barrier* if there are still *transient messages* or not. Also, show the computing steps. (5 marks)

Step 3

Step 2

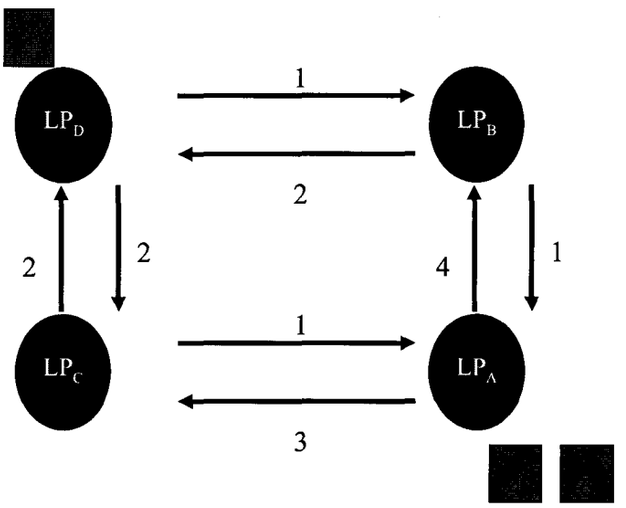
Step 1



Number of transient messages _____

Question 11 (14 marks; 20 minutes)

From the following diagram,



11.1 Calculate the distance matrix. (8 marks)

	LP A	LP B	LP C	LP D
LP A				
LP B				
LP C				
LP D				

11.2 Calculate the Lower Bound on the Time Stamp (LBST) of each logical process. (4 marks)

LBST A _____

LBST B _____

LBST C _____

LBST D _____

11.3 Is the event with the time stamp 4 safe to process? _____ (1 mark)

11.4 Is the event with the time stamp 6 safe to process? _____ (1 mark)

---End of Examination---

Merry Christmas and Happy New Year

Pichaya Tandayya

December 2004