PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Department of Computer Engineering

**Final Examination**: Semester 1 **Academic Year**: 2005-2006

**Date**: Wednesday, 5th October, 2005 **Time**: 13:30 – 16:30 (**3 hours**)

**Subject Number**: 240-304 **Room**: R200

**Subject Title**: Mathematics for Computer Engineering

**Lecturer**: Aj. Andrew Davison

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**Exam Duration**: 3 hours

**This paper has 4 pages.**

**Authorized Materials**:

- Writing instruments (e.g. pens, pencils).
- Books (e.g. dictionaries) and calculators are **not** permitted.

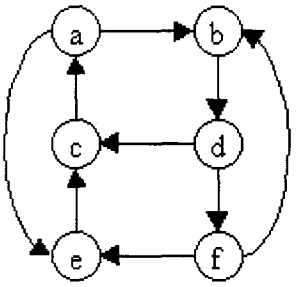
**Instructions to Students:**

- *Answer questions in English.* Perfect English is **not** required.
- Attempt all questions.
- Write your answers in an answer book.
- Start your answer to each question on a new page
- Clearly number your answers.
- Any unreadable parts will be considered wrong.
- When writing programs, use good layout, and short comments; marks will not be deducted for minor syntax errors.
- The marks for each part of a question are given in brackets (...).

## Question 1

(25 marks; 25 minutes)

For the following graph:




a) Draw an adjacency list for the graph. (5)

b) Draw an adjacency matrix for the graph. (5)

c) Give the C (or C++) data types for the adjacency list **and** the adjacency matrix. (10)

d) If the adjacency matrix is called A, what does an entry in row i and column j mean in $A^3$ ? (5)

## Question 2

(25 marks; 25 minutes)

The table below shows the network links between the computers in the "Hundred Acre Wood" LAN, together with average times in milliseconds to send a message from the machine in the first column to the machine in the second column. For example, the first row says that it takes 10 ms to send a message from "pooh" to "kanga".

| From Machine | To Machine | Message Time |
|---|---|---|
| pooh | kanga | 10 |
| pooh | tigger | 8 |
| kanga | owl | 12 |
| kanga | piglet | 5 |
| kanga | roo | 3 |
| tigger | piglet | 4 |
| tigger | roo | 6 |
| piglet | hefalump | 17 |
| owl | hefalump | 8 |

a) Draw a directed graph representing the table. The nodes must be the machines, and the arcs are the message communication links from one machine to another. Label each arc with its message sending time. (10)

b) Use Dijkstra's shortest path algorithm on the graph from part (a). Use "pooh" as the start node. Find the shortest time to send a message from "pooh" to "hefalump". **Show all your working;** do not only write down the time. (15)

## Question 3

(30 marks; 30 minutes)

Explain in words the following concepts:

a) game tree; (5)

b) evaluation function; (5)

c) the minimax algorithm; (10)

d) alpha-beta pruning. (10)

Each idea should be illustrated with a **brief** example game, such as tic-tac-toe, or another simple game that you know.

## Question 4

(40 marks; 40 minutes)

Consider the regular expression:

( a b c* ) | ( a b d*)

a) Draw an automaton with ε-transitions for the regular expression. (20)

b) Draw an equivalent automaton to the one in part (a) *without* using ε-transitions. Explain in words the technique you used to simplify the automaton. (10)

c) Is the automaton of part (b) deterministic? (5)
Explain your answer in words; do not just write "yes" or "no".

d) If the automaton of part (b) is not deterministic, draw an equivalent automaton which is deterministic. (5)

## Question 5

(45 marks; 45 minutes)

You have a robot that can move forwards and backwards, and turn left and right. You task is to write a grammar and parser for its 'task' language.

A task consists of one or more commands. Each command is separated by a space. A command can be either 'f', 'b', 'l', or 'r'. ('f' and 'b' for moving forwards and backwards, 'l' and 'r' for turning left and right).

For example, the task "f l b r" makes the robot move forwards, turn left, move backwards, and finally turn to the right.

a) Write a grammar for the task language. (5)

b) Draw a parse tree for the task "f l b r". (5)

c) Translate the grammar into syntax graphs. Show all your working. (10)

d) Translate the syntax graphs into a parser. The parser should print "yes" if the input task string matches the grammar; "no" otherwise. The parser should **not** build a parse tree. (20)

e) What type of grammar is the task grammar of part (a)? Explain your answer in words. (5)

## Question 6 (15 marks; 15 minutes)

Use *deduction* to show that the following hypotheses prove the conclusion:

Hypotheses: $a \rightarrow (b + c)$ $a \rightarrow (b + \text{not } c)$

Conclusion: $a \rightarrow b$

Explain each line of the proof using comments.

*--- End of Examination ---*