PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING
Department of Computer Engineering

Final Examination: Semester 1

Date: Wednesday 30th September, 2009

Subject Number: 241-437

Subject Title: Compiler Structures

Lecturer: Aj. Andrew Davison

Academic Year: 2009-2010

Time: 9:00 – 12:00 (3 hours)

Room: A400

Exam Duration: 3 hours

This paper has 3 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   (80 minutes; 80 marks)

a) Use shift-reduce parsing to evaluate the string "(y-y-x)" against the grammar:

S → '(' A ')'
A → y '-' A | x

S and A are non-terminals, and '(', ')', '-', y, and x are terminals. S is the starting
non-terminal. (10)

b) **Briefly** explain the following LR table generation techniques:

- LR(0) items (5)

- the closure() function (5)

- the goto() function (5)

c) Produce a LR parse table for the grammar in part (a) using the techniques of part
(b). Show **all** your working. (40)

d) Evaluate the string "(y-y-x)" using your LR parse table from part (c). (15)

Question 2   (55 minutes; 55 marks)

a) Explain yacc by specifying the main sections of a typical yacc program. (10)

b) What is an attribute grammar? (10)

c) Define an attribute grammar for the context free grammar given below:

Pos → Path
Path → Path Move | ε
Move → left | right | fwd | back | up | down

Pos, Path, and Move are non-terminals, while left, right, fwd, back, up, and down
are terminals. Pos is the starting non-terminal.

A Pos sentence specifies how an object is moved from its starting position at the
coordinates (0,0,0) to a new position in (x,y,z) space. (15)

d) Write a yacc grammar which implements your attribute grammar of part (c).
Explain in words what data types you have defined.
Note: do **not** write a lex grammar. (20)

Question 3 on Next Page.

Question 3   (45 minutes; 45 marks)

a) What is intermediate code? Give some **brief** examples of the different kinds. (15)

b) Describe the stack-based intermediate code used by the expressions language. Do **not** include any parser code, but include diagrams where possible. (10)

c) Translate the expressions program:

> let x = 2
> let y = 3 + x

into intermediate code. Explain the translation in words. Do **not** include any parser code, but include diagrams where possible. (10)

d) Evaluate the intermediate code of part (c). Show all your working. Do **not** include any parser code, but include diagrams where possible. (10)

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