

OLLSCOIL NA hÉIREANN
THE NATIONAL UNIVERSITY OF IRELAND

NATIONAL UNIVERSITY OF IRELAND, GALWAY

SPRING EXAMINATIONS 1998/1999

Third University Examination in Information Technology

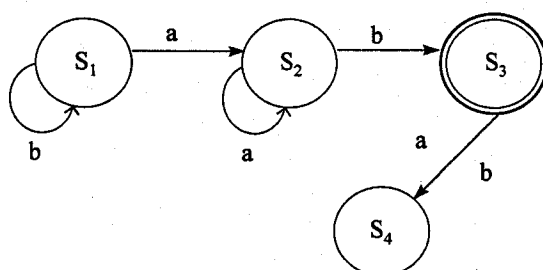
Applications Software Programming II
CT322

Prof. D. Bell
 Dr. G. Lyons
 Ms. J. Griffith

Time allowed: **Two hours**

Answer any **THREE** questions
 All questions carry equal marks

- Q. 1.** (i) Explain why a formal grammar is used in the definition of the syntax of a programming language.
- (ii) Using BNF grammar give the syntactic definition of an identifier where an identifier is defined as a sequence of letters and digits beginning with a letter. Use a parse tree to show that identifier *X77a* conforms to the definition you develop.
- (iii) Given the following automaton:



- (a) Specify and write the automaton relations in PROLOG.
- (b) Write a PROLOG program which will take a string in the form of a list as input and will output true or not true depending on whether the automaton accepts the string.

- Q. 2.** (i) Bohm and Jacobini (1966) proved that any proper program which uses *goto* statements may also be programmed using only sequences of statements with *if* and *while* statements. Take as an example a program with several loops and branches. Give one version of the program using *gotos* and a second version using only *if* and *while* constructs. Evaluate both with respect to:

- ease of reading
- understanding
- writing the program

- (ii) Discuss how control is achieved in the programming languages Scheme and PROLOG.

- (iii) Consider the following Scheme code which finds the factorial of a number:

```
(define factorial (lambda (number)
  (cond ((eq? number 0) 1)
        (#t (* number (factorial (- number 1)))))))
```

- (a) Comment on the efficiency of the code.
(b) Write a more efficient version, discussing your solution.

- Q. 3.** (i) With the aid of a diagram, briefly discuss the main stages in program translation. Comment on the translation strategies traditionally used when:

- compilation speed is most important, and
- execution speed is most important.

- (ii) Compare error recovery and error repair algorithms. Discuss how an error recovery and error repair algorithm might deal with the following C statement:

```
a = b    c + d;
```

- (iii) Discuss why garbage collection is so important in functional and logic program implementations. Outline a garbage collection algorithm for one of the language paradigms.

- Q. 4.** (i) Discuss the development of quicksort algorithm and discuss its merits over other sorting algorithms.
- (ii) Develop *any* sorting procedure in Scheme, which takes a list and a comparison predicate as arguments and returns a list sorted according to the comparison rule.
- (iii) Given two lists of elements, both monotonically non-decreasing according to some ordering predicate, develop a Scheme procedure which constructs a monotonically non-decreasing list containing all the elements of both source lists.

- Q. 5.** (i) With the aid of an example, discuss the representation of a binary tree in PROLOG.
- (ii) The predicate `member (X,L)` to test whether X is a member of a list L can be programmed as:

```
member (X, [X|L]).  
member (X, [_|L]) :-  
    member (X, L).
```

Discuss why this is an inefficient approach and develop a more efficient membership function based on a binary tree representation.

- (iii) Discuss the steps involved in inserting an item into a binary tree and develop PROLOG code for a function which inserts an item into a binary tree.