

Massey University

ALBANY CAMPUS

EXAMINATION FOR 159.102 COMPUTER SCIENCE FUNDAMENTALS
Semester Two - 2002

Time Allowed: THREE (3) Hours

INSTRUCTIONS

Attempt **ALL FIVE (5)** questions.

This final examination contributes 70% to the final assessment.
Calculators are permitted.

Turn over to pg. 2...

1. (a) Convert the following decimal numbers to 8 bit binary using twos complement.

- (i) 100
- (ii) 42
- (iii) -2
- (iv) -127

[4 marks]

(b) Convert the following unsigned binary numbers to hexadecimal notation.

- (i) 111110101011
- (ii) 1111000000001101

[2 marks]

(c) For each of the of the following operations on 8 bit unsigned integers, state if the operation causes a carry, a borrow or neither.

- (i) 100+100
- (ii) 200+100
- (iii) 10-10
- (iv) 100-200

[4 marks]

(d) Convert the following decimal numbers to fixed point binary.

- (i) 1.5
- (ii) 28.125

[2 marks]

(e) Name and describe all the parts of a floating point number.

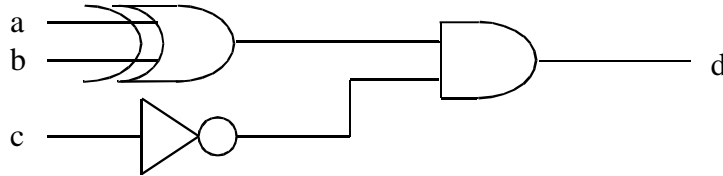
[2 marks]

Turn over to pg. 3...

2. (a) Draw the truth table and logic symbol for an Exclusive OR gate.

[2 marks]

- (b) Draw a truth table for the following logic diagram.



[2 marks]

- (c) Briefly explain the difference between sequential and combinational logic.

[3 marks]

- (d) Briefly describe the purpose of the following CPU registers

- (i) The Program Counter
- (ii) The Flags
- (iii) The Instruction Register

[3 marks]

- (e) Draw the truth table for a simple flip-flop that can remember one bit and briefly explain how it works (hint: your table should use the previous output as an input).

[4 marks]

Turn over to pg. 4...

3. (a) A list of integers is implemented using an array and the following global definitions.

```
int list[100];  
int length=0;
```

- (i) Write a C function to add an integer to the end of the list. *[3 marks]*
- (ii) Write a C function to remove all occurrences of an integer from the list. The initial ordering of numbers in the list need not be maintained. *[3 marks]*
- (b) Consider an empty stack. After the following operations, what will be on the stack.

push(10),pop(),push(20),push(30),pop(),push(40),pop(),push(50) *[2 marks]*
- (c) A queue is often used as a 'buffer' between two parts of a computer system. Briefly explain the purpose of this. *[2 marks]*
- (d) The following words are inserted in the order given into a binary tree with words nearer the start of the dictionary to the left.

tree,fish,ball,chocolate,like,umbrella
- (i) Draw the resulting tree. *[2 marks]*
- (ii) The tree is printed using inorder traversal. In what order are the words printed? *[2 marks]*

Turn over to pg. 5...

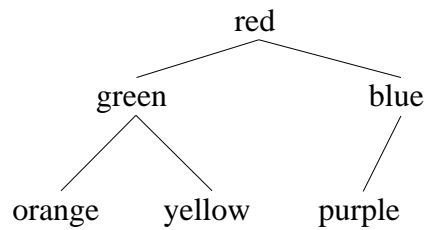
4. (a) Write a recursive function to print an unsigned integer in binary.

[4 marks]

- (b) The following is a BNF grammar that describes a tree.

```
<data> := red|orange|green|yellow|blue|purple
<tree> := (<tree>,<data>,<tree>)|
          (<data>)|(<tree>,<data>)|(<data>,<tree>)
```

- (i) Use this grammar to describe the following tree



state any assumptions you make.

[4 marks]

- (ii) Draw the tree described by the following sentence

((yellow),blue,((orange),red,(green)))

[2 marks]

- (c) Given that a bubble sort can sort 1000 items in 100 seconds, roughly how long would a quicksort take to sort the same items?

[2 marks]

- (d) What is the Church-Turing thesis?

[2 marks]

Turn over to pg. 6...

5. (a) Given the following precondition

$$\{x < 10\}$$

after the operation:

$$x = x + 2;$$

What is the postcondition?

[3 marks]

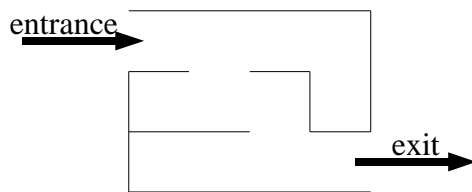
(b) Draw a diagram to show how multiprogramming may be used to run more than one program at the same time.

[3 marks]

(c) What is a filesystem?

[3 marks]

(d) Given the following maze:



(i) Draw a search tree that could be used by a program to find a path from the entrance to the exit (label any important places in the maze).

[3 marks]

(ii) Redraw the diagram from part (i) illustrating the shortest path from the entrance to the exit.

[2 marks]

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