

Massey University

ALBANY CAMPUS

EXAMINATION FOR 159.102 COMPUTER SCIENCE FUNDAMENTALS
Semester Two - 2000

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...

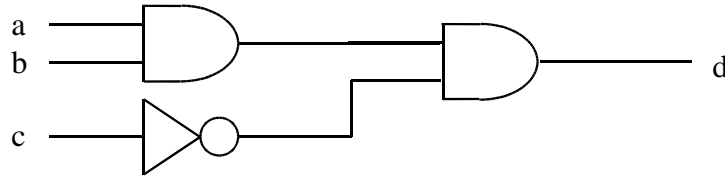
1. (a) Convert the following unsigned binary numbers to decimal numbers.
- (i) 11111110
 - (ii) 01110111
- [2 marks]*
- (b) Convert the following signed 8 bit twos complement binary numbers to decimal numbers.
- (i) 11111110
 - (ii) 01110111
- [2 marks]*
- (c) Convert the following unsigned hexadecimal numbers to decimal numbers.
- (i) fab
 - (ii) f00d
- [2 marks]*
- (d) Briefly explain the difference between a carry and an overflow.
- [2 marks]*
- (e) Convert the following decimal numbers to binary.
- (i) 4.25
 - (ii) 17.75
- [2 marks]*
- (f) What is the range of signed numbers that can be stored in 8-bits when using twos complement.
- [2 marks]*
- (g) Explain the purpose of the exponent in a floating point number.
- [2 marks]*

Turn over to pg. 3...

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

[2 marks]

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



[2 marks]

- (c) Briefly explain the function of the following CPU components:

- (i) ALU
- (ii) Program Counter
- (iii) Data Bus

[6 marks]

- (d) Given the following machine instruction:

```
ADD A,[500] // Add content of address 500 to Accumulator
```

Briefly explain the fetch/execute cycle using this instruction as an example.

[4 marks]

Turn over to pg. 4...

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

```
int stack[100];  
int tos=0;
```

- (i) Write a C function to implement the PUSH operation. Remember to check for stack overflow. *[3 marks]*
- (ii) Write a C function to implement the POP operation. Remember to check for an empty stack. *[3 marks]*
- (b) A Telephone Directory contains 100000 entries in alphabetic order.
- (i) On average, how many entries would you expect to have to examine when using binary search to find a person's phone number? *[2 marks]*
- (ii) On average, how many entries would you expect to have to examine when trying find out who has a particular phone number? *[2 marks]*
- (c) The following numbers are inserted into an ordered tree with smaller numbers to the left.
- 7365,765,9267,63,736,5563
- (i) Draw the resulting tree. *[2 marks]*
- (ii) The tree is printed using preorder traversal (print root then traverse left then traverse right). In what order are the numbers printed? *[2 marks]*

Turn over to pg. 5...

4. (a) Using a simple example, describe the quicksort algorithm.

[4 marks]

(b) The following is a BNF grammar that describes an unsigned integer.

```
<digit> := 0|1|2|3|4|5|6|7|8|9  
<unsigned integer> := <digit>|<digit><unsigned integer>
```

(i) Give a BNF grammar for a signed integer.

[2 marks]

(ii) Give a BNF grammar for a decimal number such as:

-273.735

[2 marks]

(c) Write a recursive function called "product" to find the product of the digits in an unsigned integer.

e.g. `product(4231)=4*2*3*1=24`

Hint: make sure `prod(0)` gives the correct answer.

[4 marks]

(d) What is the complexity (in big O notation) of your function for part c?
Assume n is the number of digits in the integer.

[2 marks]

Turn over to pg. 6...

5. Briefly define the following terms:

- (i) Turing Machine
- (ii) Postcondition
- (iii) Local Area Network
- (iv) Object Oriented Paradigm
- (v) Turing Test
- (vi) Data Structures
- (vii) Pipelining

[14 marks]

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