

A27228

No calculator permitted in this examination

UNIVERSITY OF BIRMINGHAM

School of Computer Science

Degree of MSc

Computer Science

06 21933

Fundamentals: Introduction to Computer Science

Summer Examinations 2010

Time Allowed: 1 ½ hours

[Answer THREE out of Four Questions]

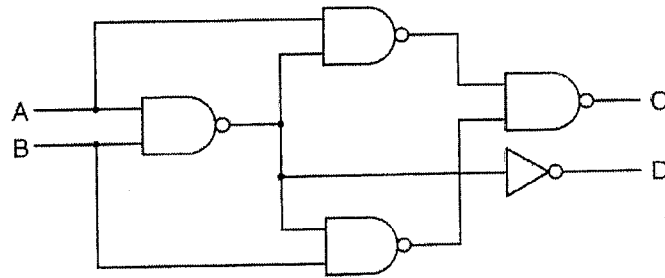
**[Marks indicated on this paper add up to 102%
The final mark will be capped at 100%]**

[Answer any THREE out of Four Questions]

1. (a) Suppose that $prime(n)$ is a module which is used to test whether a positive integer n is a prime number or not. If n is a prime number, $prime(n)$ returns 1. Otherwise, it returns 0. Given the module $prime(n)$, write an algorithm to output the first n prime numbers, in increasing order, where n is the input for this algorithm. [14%]
- (b) List all control mechanisms (or control structures) used in your algorithm. [8%]
- (c) Explain why your algorithm will terminate. [6%]
- (d) Give two examples to show how a syntactic error and a logical error could occur in your algorithm. [6%]
2. (a) Discuss the difference between the time complexity of an algorithm for solving a problem and the time complexity of a problem. [10%]
- (b) What is the Church-Turing thesis? [6%]
- (c) Explain whether it is true to say that all problems in NP cannot be solved by polynomial algorithms. [6%]
- (d) Suppose that the recurrence relation of a given algorithm is $T(n) = 3T(n/2) + cn$, where $T(n)$ denotes the time taken by the algorithm to process input data with size n , and c is a constant. Prove by induction that the solution for this recurrence relation (i.e. the time complexity of the given algorithm) is

$$T(n) = (2c + k)n^{\log_2 3} - 2cn,$$
 where $k=T(1)$ denotes another constant. [12%]

3. (a) Briefly describe the three main parts of a CPU and their functions. [9%]
 (b) What is a bus in a computer and what does it do? [5%]
 (c) Give the truth table for the following circuit and explain what it does. [12%]



- (d) The following figure shows the contents of main memory and index register of a computer. If the same machine code instruction LOAD 323 is executed with respect to direct addressing, immediate addressing, indirect addressing, and indexed addressing, which value will be loaded into the accumulator for each addressing mode. [8%]

Memory Addresses	Main Memory
...	...
322	325
323	324
324	322
325	323
...	...

Index Register

2

4. (a) What are the three major aspects of memory management? [6%]
- (b) What is the paging technique? [9%]
- (c) Modern computers usually consist of two or more levels. Give three reasons to show why there is a fundamental break between operation system level and assembly language level. [9%]
- (d) Suppose that the following productions written in BNF (Backus-Naur Form) are used to define the syntax of a language:

expression \rightarrow *term operator term*
term \rightarrow *number* | *name*
number \rightarrow *digit* {*digit*}
digit \rightarrow 0 | 1 | ... | 9
name \rightarrow *letter* {*letter*}
letter \rightarrow a | b | ... | z | A | B | ... | Z
operator \rightarrow + | - | • | /

Which of the examples given below are syntactically correct expressions?

z-Xg
X.(Y-Z)
2010-4a
cE/000
a+b•c

[10%]