

THE UNIVERSITY OF BIRMINGHAM

Answers to Sample Exam Questions

**06 06995**

Fundamentals of Computer Science Part i2

3 hours

[Answer ALL Questions]

## Part i2

1. Name the main components of the von Neumann computer design and briefly explain their function.

[3%]

Memory (stores program coded as bit sequences and data), Arithmetic Logic Unit with Accumulator (for arithmetic operations), Control Unit (to execute the program).

2. Describe how each of the following is represented in computer memory: [4%]

- (a) an integer number, e.g. 10 and -3;

Positive integers are represented in binary format, e.g. 10 will be represented on 8 bits as 00001010.

Negative integers are represented in two's complement, with the most significant bit representing the sign (1 if negative). The number -2 will be represented on 8 bits by 11111110 =  $1 \times (-128) + 1 \times 64 + 1 \times 32 + 1 \times 16 + 1 \times 8 + 1 \times 4 + 1 \times 2 + 0 \times 1$ .

- (b) a real number, e.g. 1.05.

In floating-point representation with mantissa (e.g. 105 in binary) and exponent (here -2) understood as  $105 \times 10^{-2}$ .

3. What is the function of a **NAND** gate?

[2%]

NAND (not and) inputs two binary signals, A and B, and yields 0 if and only if both A and B are 1; otherwise it yields 1.

4. Translate the pseudocode instruction:

$$X = (Y+10)*2$$

into machine code, assuming the first instruction is placed at address 100 and integer variables X and Y are placed at address 200 and 201 respectively. [4%]

```
100:  LOAD 201
101:  ADD 202
102:  MULT 203
103:  STORE 200
...
200:  (X)
201:  (Y)
202:  10
203:  2
```

5. Describe the main phases of a compiler. [2%]

Lexical analysis (breaks text into tokens);  
Syntax analysis (checks the grammatical structure and builds a parse tree of the program if syntactically correct; a further simplification to abstract syntax is also made);  
Code generation (traversal of the abstract syntax tree, allocating addresses for variables, space for constants and registers);  
Optimisation (improvements to code, removal of redundant or unnecessary instructions).