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THE UNIVERSITY
of LIVERPOOL

MAY 2003 EXAMINATIONS

Bachelor of Science : Year 2
Bachelor of Science : Year 3

COMPUTER SYSTEMS

TIME ALLOWED : Two hours

INSTRUCTIONS TO CANDIDATES

Answer ALL questions in section A and answer THREE questions from section B

If you attempt to answer more questions than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).

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Section A

Answer **ALL** questions in this section

A.1 Outline the principal steps carried out by the computer processor in the execution of a single typical machine-code instruction. Explain the role of the program counter and other processor registers in this cycle.

(7 marks)

A.2 Explain the term **elementary logic gate.** Draw logic gates and truth tables for the logic functions **OR**, **AND** and **NOT**.

(6 marks)

A.3 Describe briefly how positive and negative integers are represented in **two's complement** binary notation. Illustrate your answer by showing the representation of the numbers +6 and -6 as 8-bit signed binary numbers.

(8 marks)

A.4 Write a sequence of instuctions in the 68000 assembly language which will perform the equivalent of the Java conditional statement:

```
if (p < 0)
    neg = neg + p;
else
    pos = pos + p;
```

(7 marks)

A.5 What is the function of the **status register** in the 68000 processor? Explain how it is used in the construction of conditional sequences of instructions.

(7 marks)

A.6 Explain what is meant by an **interrupt**, an **interrupt handler** and an **interrupt vector**.

(7 marks)

A.7 For each of the following 68000 assembly language instructions, identify and explain the addressing modes being used:

```
 i)   move #5,d1
ii)   move d0,dest
iii)  move d0,(a2)
```

(8 marks)

A.8 Describe briefly the difference between **preemptive** and **non-preemptive** operating systems.

(5 marks)

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Section B

Answer **THREE** questions from this section.

B.1 The piece of program below, in 68000 assembly language, is written with the address of each instruction shown as a decimal number in the left-hand column.

Draw up an execution history of the program, tabulating changes in the values of the PC and the other registers used throughout an execution of the program.

(15 marks)

```
2000                move #3,d0
2004                lea array,a0
2008                move #0,d2
2012                move #0,d3
2016  loop:         move (a0)+,d1
2018                bgt positive
2022                add d1,d3
2024                jmp endloop
2028  positive:     add d1,d2
2030  endloop:      sub #1,d0
2034                bne loop

3000 array:         dc.w 7,-8,5
```

B.2 **(a)** Write a 68000 assembly language subroutine called **min** which takes as parameters two integers in the d0 and d1 registers, and returns the minimum of the two integer values in the d2 register. Use the d3 register for any calculations within the subroutine.

(8 marks)

(b) The subroutine in (a) is to be used in a 68000 assembly language program to evaluate the minimum of two integer variables **numa** and **numb**. The minimum value is to be placed in an integer variable **minno.**

Give the instructions required to accomplish this, including the reservation of the memory locations for the variables **numa**,**numb** and **minno.**

(7 marks)

B.3 **(a)** Write the logic expression equivalent to the following circuit.

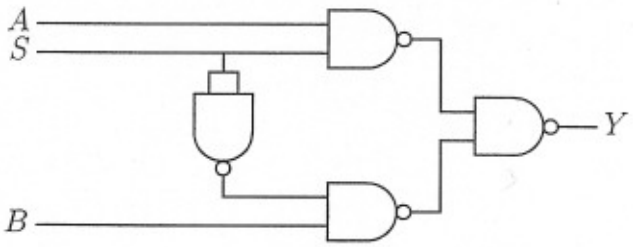

Figure 1:

Using the expression compute the output this circuit produces for the input **A = 0, B = 0, S = 1.**

(8 marks)

(b) Draw a logic diagram to represent the logic expression
f(A,B) = **not**(A **or** B) **or** (A **and** B)

(7 marks)

B.4 Describe the main steps carried out by a typical High-Level Language compiler.

(15 marks)