

OLLSCOIL NA hÉIREANN, CORCAIGH
THE NATIONAL UNIVERSITY OF IRELAND, CORK
COLÁISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

SUMMER EXAMINATION 2006

CS1101: Systems Organisation

Professor Susan Crow
Professor Gregory M. Provan
Dr. Barry O'Sullivan

Instructions

Answer all questions.

All questions carry equal marks (i.e. 40 per question).

This examination is worth 160 marks.

Coursework submitted during term is worth 40 marks.

Calculators may be used.

Please indicate the make and model of your calculator at the start of your exam script.

Duration

3 Hours

1. a) Explain any 3 of the following, making use of suitable examples:
- Explain briefly how dot-matrix, inkjet and laser printers work.
 - Explain two approaches to instruction-level parallelism in CPU design.
 - Explain how one could convert a decimal number into a number in base 9. Also, show how one could convert a number in base 9 to decimal. Use an example in each case.
 - What is the difference between a signed and an unsigned binary number? For 8-bit binary, what is the maximum number representable as a signed and as an unsigned number? (10 marks)
- b) Answer all of the following:
- Convert the following numbers to binary using both the *successive halving method* and the *powers of two method*:
 - 17
 - 25
 - Convert both of the above numbers into octal and hexadecimal.
 - Convert the following numbers into 8-bit *signed-magnitude*, *one's complement*, *two's complement* and *excess notation*:
 - -17
 - -25
 - Show how the following calculations are performed in both 8-bit ones-complement and twos-complement, showing that your answer has the correct decimal value in each case: $25 - 17$, $-25 - 17$. (20 marks)
- c) In decimal, $25+17 = 42$ and $25-17 = 8$. Show that by performing the corresponding calculations in both octal and hexadecimal that you arrive at the same answers. Specifically, perform the above calculations on the octal and hexadecimal representations of these numbers, showing the details of the calculation, and showing that converting the result into decimal gives the answer one expects. (10 marks)

2. a) Explain any 3 of the following, making use of suitable examples:
- Explain, with the aid of diagrams, how an S-R Latch works. Discuss both consistent states.
 - Show how De Morgan's Laws can be used to give a NAND gate-based implementation of an OR Gate and a NOR Gate-based implementation of an AND Gate. De Morgan's Law states that $\overline{A \cdot B} = \overline{A} + \overline{B}$ and $\overline{A + B} = \overline{A} \cdot \overline{B}$.
 - What does equivalence of two logic circuits mean? Give an example.
 - How many Boolean functions involving n inputs are there? Why? (10 marks)
- b) The 1-bit Full Adder circuit has three inputs and two outputs. Its truth-table is presented below.

A	B	Carry in	Carry-Out	Sum
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

- i. Derive a Sum-of-Products expression for each output in the truth-table; (10 marks)
 - ii. Draw a logic circuit of the Sum-of-Products expression you have derived. You do not need to simplify your circuit in any way. (10 marks)
- c) A simple multiplexer circuit is shown in Figure 1. Explain how it works.

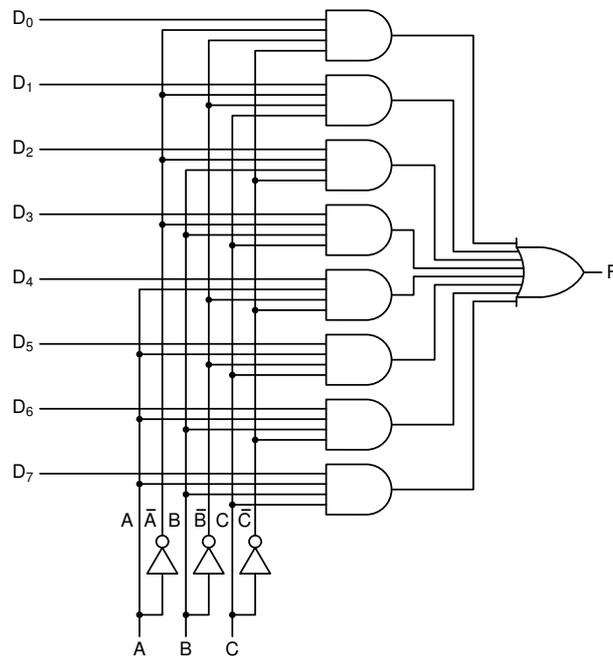


Figure 1: A multiplexer circuit.

(10 marks)

3. a) Explain any 3 of the following, making use of suitable examples:
 - i. What is the primary function performed by the micro-architecture of a computer? Relate the micro-architecture to the digital logic level.
 - ii. Explain how, in the IEEE 754 Floating Point standard, denormalised numbers can be used to present very small positive and negative numbers.
 - iii. Explain why the IEEE 754 Floating Point standard only gives us an approximation of the real number line. How do relative versus absolute errors change over the range of expressible numbers?
 - iv. What is an *addressing mode*? Give some examples. (10 marks)
- b) i. Convert the following decimal numbers into IEEE 754 format single precision numbers. Give your answer in hexadecimal.
 - 7.5
 - -10.125

(10 marks)
- ii. Convert the following IEEE 754 format single precision numbers into decimal.
 - 40C00000
 - 40080000

(10 marks)

- c) Explain how the IEEE 754 Floating Point standard represents infinity, denormalised numbers, zero and not-a-number.

(10 marks)

4. a) Explain what is meant by the term *paging*. Discuss how it could be implemented. A diagram should be used to illustrate your explanation. (10 marks)

- b) Explain *precisely* the effects of the following UNIX commands. Note that <return> means pressing the Return or Enter key on the keyboard; file1 and file2 are files; www and var are directories;

- i. mkdir ./www <return>
- ii. cd ../../.. <return>
- iii. cp ~/john/file1 ./file2<return>
- iv. chmod ugo=r file1 <return>
- v. chmod go-wx file1 <return>

(10 marks)

- c) In the context of the assembly process, explain the processes *linking* and *loading*. (10 marks)

- d) In the context of assembly languages, briefly explain the following terms:

- i. pseudo-instruction;
- ii. macro and macro-expansion;
- iii. two pass assembly process;
- iv. machine code.

(10 marks)