

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

AUTUMN EXAMINATION 2005

CS1101: Systems Organisation

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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:
 - i. Why is it that computers are not built so that all instructions can be implemented in hardware? How are computers normally structured?
 - ii. Given a negative binary number in *two's complement*, how can its decimal equivalent be computed?
 - iii. Explain some of the limitations of fixed length integers. Give some examples of numbers that cannot be represented in 4-bit binary.
 - iv. Explain how one could convert a decimal number into a number in base k . Also, show how one could convert a number in base k to decimal. Use an example in each case. (10 marks)
 - b) Answer all of the following:
 - i. Convert the following numbers to binary using both the *successive halving method* and the *powers of two method*:
 - 19
 - 11
 - ii. Convert both of the above numbers into octal and hexadecimal.
 - iii. Convert the following numbers into 8-bit *signed-magnitude*, *one's complement*, *two's complement* and *excess notation*:
 - -19
 - -11
 - iv. Count from -3 to +3, in steps of 1, in each of the following:
 - A. 3-bit signed magnitude;
 - B. 3-bit one's complement;
 - C. 3-bit two's complement;
 - D. 3-bit excess notation;
- (20 marks)
- c) Explain how overflow can occur in one's complement and in two's complement. How can it be detected? (10 marks)
2. a) Explain any 3 of the following, making use of suitable examples:
 - i. Explain, with the aid of diagrams, how an S-R Latch works. Ensure that you explain both states of the latch.
 - ii. Give the symbol and truth table for the following digital logic gates: AND, OR, NOT, XOR, NAND, NOR. Where appropriate assume that gates have at most two inputs.
 - iii. Name the digital logic circuits that perform the following functions: (a) select one input from amongst a set of possibilities; (b) selects one output from amongst a set of possibilities and (c) compares two n -bit words for equivalence.
 - iv. How many Boolean functions involving 2 inputs are there? Why? (10 marks)
 - b) Consider the following truth-table – having 3 inputs (A, B, C) and 1 output $F(A, B, C)$.

A	B	C	F(A,B,C)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

- i. Derive a Sum-of-Products expression for the output in the truth-table; (10 marks)
 - ii. Draw a logic circuit of the Sum-of-Products expression you have derived. (10 marks)
 - c) De Morgan's Law states that $\overline{A.B} = \overline{A} + \overline{B}$ and $\overline{A + B} = \overline{A}.\overline{B}$. These are the AND form and OR form, respectively. Draw a circuit diagram for each of these forms of De Morgan's Law. (10 marks)
3. a) Explain any 3 of the following, making use of suitable examples:
- i. The UltraSparc is often described as having a *load-and-store* architecture. What does this mean?
 - ii. How are zero, infinite and 'not-a-number' represented in the IEEE 754 Floating Point Standard?
 - iii. At the Instruction Set Architecture Level, what are the differences between a procedure and a coroutine?
 - iv. Why are floating point numbers in a computer represented using the IEEE 754 standard? Why is it not desirable to use a fixed number of bits to directly encode a floating point number? (10 marks)
- b) i. Convert the following decimal numbers into IEEE 754 format single precision numbers. Give your answer in hexadecimal.
- 10.5
 - -2.125
- (10 marks)
- ii. Convert the following IEEE 754 format single precision numbers into decimal.
- 40200000
 - BFC00000
- (10 marks)
- c) Floating point numbers can be used to model the real-number system of mathematics, although there are some important differences. Explain why floating point numbers do not form a continuum, i.e. explain why some real numbers cannot be represented. (10 marks)
4. a) Explain what is meant by the term *virtual memory*. Discuss how it could be implemented. A diagram should be used to illustrate your explanation. (10 marks)
- b) Explain 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; mydocuments and myemails are directories;
- i. `mkdir ../mydocuments <return>`
 - ii. `cd ../mydocuments <return>`
 - iii. `cp file1 ../myemails/file2 <return>`
 - iv. `mv file1 ~ <return>`
 - v. `chmod go-rwx 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
 - iii. macro-expansion
 - iv. machine code
- (10 marks)