OLLSCOIL NA hÉIREANN, CORCAIGH
THE NATIONAL UNIVERSITY OF IRELAND, CORK

COLÁISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

SUMMER 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. Explain the differences between a CD, a CD-R and a CD-RW.

   ii. Explain what is meant by a *pipeline* in CPU design. What is its effect?

   iii. Explain how one could convert a decimal number into a number in base 7. Also, show how one could convert a number in base 7 to decimal. Use an example in each case.

   iv. What is the difference between a signed 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:

   i. Convert the following numbers to binary using both the *successive halving method* and the *powers of two method*:

   - 21
   - 12

   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*:

   - -21
   - -12

   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) Show, using both 8-bit one's complement and 8-bit two's complement that $10 - 7 = 3$ and that $8 - 12 = -4$. (*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 4 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	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

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. Explain, with the aid of diagrams, how De Morgan's Law give us alternative ways of implementing AND, OR, NAND, NOR. (*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. 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.

- 10.25
- -12.5

(*10 marks*)

ii. Convert the following IEEE 754 format single precision numbers into decimal.

- 3FC00000
- 3F000000

(*10 marks*)

c) Floating point numbers can be used to model the real-number system of mathematics, although there are some important differences. What are these differences? How does the IEEE 754 standard represent very small numbers? (*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 *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 file1 ~john/file2 <return>`

iv. `mv file1 ~/john <return>`

v. `chmod ugo=r 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*)