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

COLÁISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

AUTUMN EXAMINATION 2004

First Year Computer Science

CS1101: Systems Organisation

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Instructions

Answer all questions.

All questions carry equal marks.
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. In the context of shell scripts, what are positional parameters?

   ii. Explain how the `expr` utility in UNIX can be used in shell scripts. Give examples of its use.

   iii. Explain how access permissions on files in UNIX can be modified.

   iv. What are the differences between a *compiler* and an *interpreter*?

   (*8 marks*)

   b) In the laboratory sessions for this course students were asked to develop simple shell scripts as exercises. Write a shell script for the Bourne Shell which fulfills the following specification.

   Name: `hide` - makes a file hidden.

   Syntax: `hide <filename>`

   Description: This is the outline for `hide`:

   - Select `sh`
   - Prefix the name of `<filename>` with a '.' so as to make in hidden – `<filename>` can be accessed as argument ($1)
   - Inform the user that file is now hidden

   (*16 marks*)

   c) 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>`

   (*8 marks*)

2. 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?

   (*8 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*:

   - 15
   - 22

   ii. Convert the 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*:

- -11
- -17

iv. Count from -3 to +3 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;

(*16 marks*)

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

(*8 marks*)

3. a) Explain any 3 of the following, making use of suitable examples:

i. 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.

ii. Describe the relationships between a *bit*, a *byte* and a *register*?

iii. Name the digital logic circuits that perform the following functions: (a) select one input from amongst a set of possibilities; and (b) compares two n-bit words for equivalence.

iv. How many Boolean functions involving 3 inputs are there? Why?

(*8 marks*)

b) Consider the following truth-table – having 3 inputs (A, B, C) and 1 output $F(A, B, C)$.

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

i. Derive Sum-of-Products expressions for each of the outputs in the truth-table;

ii. Draw a logic circuit of the Sum-of-Products expressions you have derived.

(*16 marks*)

c) Explain, with the aid of diagrams, how an S-R Latch works. Ensure that you explain both states of the latch. (*8 marks*)

4. a) Explain any 3 of the following, making use of suitable examples:

   i. 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?

   ii. How are zero, infinite and 'not-a-number' represented in the IEEE 754 Floating Point Standard?

   iii. Compare the Instruction Set Architecture Level and Microarchitecture level of a computer.

   iv. What is an *addressing mode*? Give some examples.

   (*8 marks*)

   b) i. Convert the following decimal numbers into IEEE 754 format single precision numbers. Give your answer in hexadecimal.

   - 10.25
   - -12.5

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

   - 3FC00000
   - 30000000

   (*16 marks*)

   c) Floating point numbers can be used to model the real-number system of mathematics, although there are some important differences. Explain how *zero* and *infinity* are represented. Does this scheme handle division by zero robustly i.e. does dividing by zero always result in infinity? (*8 marks*)

5. 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. (*8 marks*)

   b) What is the difference between the Instruction-Set Architecture Level and Operating System Level of a computer? What additional features does an operating system bring? (*8 marks*)

   c) In the context of the assembly process, explain the processes *linking* and *loading*. (*8 marks*)

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

   i. pseudo-instruction

   ii. macro

   iii. macro-expansion

   iv. machine code

   (*8 marks*)