OLLSCOIL NA hÉIREANN
THE NATIONAL UNIVERSITY OF IRELAND

COLÁISTE NA hOLLSCOILE, CORCAIGH
UNIVERSITY COLLEGE, CORK

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Semester 2 – Summer 2017

CS2507

Computer Architecture

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1.5 Hours

Answer All Questions

Paper Total: 80 Marks

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PLEASE ENSURE THAT YOU HAVE THE CORRECT EXAM PAPER

1. **Architectural & Performance Issues**

   (a)   Describe the steps that transform a program written in a high-level language such as C into a representation that is directly executed by a computer processor.   *[4 Marks]*

   (b)   What is CPU execution time? Express the formula of CPU execution time for a program. *[4 Marks]*

   (c)   One of the "great ideas" in computer architecture is Performance via Pipelining. Briefly explain this concept with a real-world analogy or example.   *[8 Marks]*

2. **Number Representation & Processing**

   (a)   Convert $5ED4_{16}$ into a binary number. What makes base 16 (hexadecimal) an attractive numbering system for representing values in computers?   *[4 Marks]*

   (b)   Write down the binary representation of the decimal number 63.25 assuming the IEEE 754 single precision format.   *[8 Marks]*

   (c)   Outline the steps which must be undertaken in multiplying two floating point numbers?   *[4 Marks]*

3. **Instruction Set Architecture (ISA) & Assembly Language Programming**

   (a)   Describe the I-format MIPS register and give an example of instruction it supports.

   [4 Marks]

   (b)   For the following C instructions, write corresponding MIPS assembly language fragments (stating any assumptions you make regarding memory/register allocation):

   i.   f = g + (h − 5);   *[4 Marks]*
   ii.   B[8] = A[i-j];   *[4 Marks]*

   (c)   Translate the following loop into C. Assume that the C-level integer i is held in register $t1, $s2 holds the C-level integer called result, and $s0 holds the base address of the integer MemArray.

   addi $t1, $0, $0

   LOOP: lw $s1, 0($s0)

   add $s2, $s2, $s1

   addi $s0, $s0, 4

   addi $t1, $t1, 1

   slti $t2, $t1, 100

   bne $t2, $s0, LOOP   *[8 Marks]*

   ↖ meant to be $0?

4. **The Processor**

   (a) What is the primary solution to data hazard? How does it work?   *[4 Marks]*

   (b) With a graphical sketch explain the hardware implementation of MIPS R-Format instruction.

                   [8 Marks]

5. **Memory Hierarchy**

   (a) Explain in few sentences the principle of locality. What is spatial locality?   *[4 Marks]*

   (b) Describe DRAM Technology. How is data value maintained?   *[4 Marks]*

   (c) With a graphical sketch, describe direct-mapped cache.   *[8 Marks]*