Birla Institute of Technology & Science – Pilani

Hyderabad Campus

1st Semester 2016-2017

Computer Architecture (CS F342) – Test I (Regular)

Date: 13.09.2016 Weightage: 20% Duration: 1 hr. Type: Closed Book

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Instructions:

1. Answer all questions. All parts of a question ***should*** be answered consecutively.

3. No of pages in the question paper: **2**

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1. Answer the following questions.

(a) Convert the MIPS 32 instruction to machine language: ***srl $s1, $t2, 3*** srl is R-type, opCode is 0 and function is 2 $s1 = 17 is rd; $t2 = 10 is rt; rs unused	(b) Translate the following machine code to MIPS: **1010 11/10 000/0 1011 /0000 0000 0000 0100** Hint: Opcode is for store.

(c) Suppose that you have already written a MIPS function with the following signature:

int sum(int A[], int first, int last).

This function calculates the sum of the elements of A starting with element first and ending with element last. Complete the following code fragment of MIPS assembly language, which calls this function and uses it to calculate the average of all values in A. You may assume that the size of the array A is N, the base address of A in $a0.

```
Average:
        add $a1, $zero, $zero # ----------------------
        addi $a2, $zero, -----------------
        addi $a2, --------------, ----------------- # index of last element is N-1
        jal --------------------
        add $t0, ----------------, $v0 # Save the return value in $t0
        addi -----------------, -------------------, N # ---------------------------
        div $t2, $t0, ---------------------- # This form of div is provided as a pseudoinstruction.
```

(2.5 + 2.5 + 5 = 10 marks)

2. Consider the following hypothetical scenario of representing floating point numbers. Assume a hypothetical 9-bit word, where the first bit is used for the sign of the number, second bit for the sign of the exponent, next four bits for the mantissa and next three for the exponent.

(a) Given the number $(54.75)_{10}$, represent it in floating point binary format. Show all the steps clearly.
(b) What number does the floating point format given below represent in base-10 format? Show all the steps clearly.

0	1	1	0	1	1	1	1	0

(5 + 5 = 10 marks)

PTO

3. (a) This problem pertains to applying Booth's algorithm to find the product of two numbers where the multiplier is a negative number. Find the product of 2_{10} and -3_{10}. Answer the problem as per the following table. The multiplicand and multiplier are 4 bit registers and the product register is of 8 bits. Also, apply the right technique to verify whether your answer is correct.

Iteration	Step	Multiplicand	Product
0	Initial values		
1			
2			
3			
4			

(b) This problem pertains to binary division. Apply the division algorithm to divide $(0000\ 0111)_{two}$ by $(0010)_{two}$. Answer the problem as per the following table.

Iter	Step	Quot	Divisor	Remainder
0	Initial values			
1				
2				
3				
4				
5				

(5 + 5 =10 marks)

4. For the purpose of solving a given application problem, you benchmark a program on two computer systems. On system A, the object code executed 80 million Arithmetic Logic Unit operations (ALU ops), 40 million load instructions, and 25 million branch instructions. On system B, the object code executed 50 million ALU ops, 50 million loads, and 40 million branch instructions. In both the systems, each ALU op takes 1 clock cycle, each load takes 3 clock cycles, and each branch takes 5 clock cycles.

(a) Compute the relative frequency of occurrence of each type of instruction executed in both systems.
(b) Find the CPI for each system.
(c) Assuming that the clock on system B is 10% faster than the clock on system A, which system is faster for the given application problem and by how much percent?

(3 + 3 + 4 =10 marks)