CSE 112: | IIIT-Delhi, Winter 2023

Computer Organization

Quiz I

Sujay Deb
Tammam Tillo

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Guidelines

If you found any ambiguity in any of the questions or there appears to be a lack of information, then write an assumption on the answer sheet to explain your side interpretation of the problem and solve accordingly.

Problem I: Signed Unsigned Representation **(5 Points)**

Consider the following operation to be performed: Operand1 = $(-255)_{10}$, Operand2 = $(- 250)_{10}$.

(a) Write the 1's complement representation of both the operands in 12 bits.

(b) State the rule for getting 2's complement representation from 1's complement representation.

(c) Use this rule to get 2's complement representation of the mentioned numbers.

i) Using 12 bits ii) using 9 bits

(d) Perform the addition operation in 2's complement form itself. Show your computation.

i) Using 9 bits ii) Using 12 bits

(e) Report the minimum bits required to represent the above computed output correctly in 2's complement notation.

Problem II: Opcode Assignment and Instruction encoding **(10 Points)**

Imagine a virtual ISA having instruction size of 32-bits, having 32 registers. Suppose the ISA supports an address space of **1MegaBytes** with Byte addressable memory. The number of **unique** Instructions/Operations supported by the processor is 32.

Syntax for Memory type instruction : <Opcode> <Filler Bits> <Register address> <Memory address>
Syntax for Register type instruction : <Opcode> <Filler Bits> <Destination Register Address> <Source Register Address>

a) Assign opcodes to the below-listed Operations/Instructions in Binary/Hex format.
b) Form a complete Binary/Hex instruction code using these opcodes.

Instruction (mnemonic)	Operation	Opcode (Hex)	Instruction Code (Hex)
Mov A,B	Move/Copy the contents of Register B into A(B = A).		
Add C,D	Add registers C and D and store the result in register C(C = C + D).		
LDR A, Address	Load register A with the data stored at the given address(mentioned below).		
STR B, Address	Store the content of register B at the specified address(mentioned below).		

Address = $(0x00\_0000\_1000)_{16}$ + $(last\_three\_digit\_of\_your\_roll\_number * 4)_{10}$.
e.g Roll_Number = abcd2468; Address = $(468 * 4)_{10}$ + $(0x00\_0000\_1000)_{16}$.

***Note*:** Students can opt to answer the question in Binary representation also.

Problem III: Assembly Programming **(5 Points)**

a) Write an assembly program to swap two numbers that are stored at two different memory locations. Instructions that are available to the programmer.

Instruction (mnemonic)	Operation
Mov A,B	Move/Copy the contents of Register B into A (A = B).
Add C,D	Add registers C and D and store the result in register C (C = C + D).
LDR A, Address	Load register A with the data stored at the given address.
STR B, Address	Store the content of register B at the specified address.

Note: Students can choose any memory locations where the variables are stored.

Problem IV: Radix Conversion and Binary Algebra **(5 Points)**

a) $(101010 . 0110)_2 = (\ )_{10}$
b) $(Last\_three\_digit\_of\_your\_roll\_number)_{10} = (\ )_8$.
c) $(123.3)_{10} \cong (\ )_2$.
d) Determine x if $(10400)_x = (725)_{10}$.
e) Multiply the following numbers after converting them into binary. And, represent the result in binary.
$(24)_{10} * (20)_{10}$