## CS2100 (AY2018/9 Semester 2)

# /15

Assignment #1

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# Tutorial Grp: 20

You are to do this assignment **on your own**. (Students found copying will be penalised.) Please fill in your **name** and **tutorial group number** in the boxes above, and your answers in the space indicated below. You are not required to show workings.

Please submit this assignment by **15 February 2019, Friday, 23:59** to the submission File on LumiNUS according to your tutorial group**.** Please submit either a .docx or .pdf file. **Late submission and email submission will not be accepted**.

1. Although C language does not have the **NOR** operator, it can be emulated as follows:

int NOR**(**int x**,** int y**)** **{**

**return** **!(**x **||** y**);**

**}**

Consider the truth tables of **NOR**, **AND**, and **OR** below (from Lecture #7, Slide 35):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **X** | **Y** | **X NOR Y** | **X AND Y** | **X OR Y** |
| 0 | 0 | **1** | **0** | **0** |
| 0 | 1 | **0** | **0** | **1** |
| 1 | 0 | **0** | **0** | **1** |
| 1 | 1 | **0** | **1** | **1** |

Suppose the **NOR** operator has been implemented as a **NOR** function. We can then create **NOT**, **OR** and **AND** using solely the **NOR** function without using the operators corresponding to each of those (i.e. for logical operation, **!** for **NOT**, **|** for **OR**, and **&** for **AND**).

Fill in the code below (the code for NOT has been filled in to provide an example). Note that you can only use the **NOR** function above as well as any constants. You are not to use any other functions or operators. Assume the parameters x and y take in values 0 or 1 only.

int NOT**(**int x**)** **{**

**return** NOR**(**x**,** 0**);** **//** alternatively: **return** NOR**(**x**,** x**);**

**}**

int AND**(**int x**,** int y**)** **{**

**return** NOR(NOR(x, 0), NOR(y, 0))**;** [1 Mark]

**}**

int OR**(**int x**,** int y**)** **{**

**return** NOR(NOR(x, y), 0)**;** [1 Mark]

**}**

1. How do you represent **-2100** in the IEEE 754 single-precision floating-point representation? Write your answer in the *hexadecimal* form.

***Answer:*** 0xC5034000 [3 Marks]

1. Certain numbers cannot be represented in *decimal* number system unless we use repeating decimal. For instance, the number in *decimal* will be . Using the repeating decimal representation, we can then write it as since the 3s are repeating.

Similarly, you have numbers in *binary* number system that cannot be represented unless repeating decimal is used. For instance, the number in *binary* will be . In repeating decimal, it will be because 0011s are repeating.

1. What is in *binary*? Write your answer using repeating decimal.

***Answer:*** [1 Mark])

1. What is in *decimal*? Note that only 1001s are repeating.  
   **Hint:** *Perform expansion up to some number and approximate.*

***Answer:*** (0.3)10 [2 Marks]

For Questions 4-6, refer to the MIPS code below. The code reads an integer array ***A*** and modifies the array. Consider the variable to register mapping that maps variable ***A*** to register **$s0**. Assume that the array is initialized with **int A[] = { 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 };** at the start.

**addi** *$t0*, $s0, **0**

**addi** *$t1*, $s0, **40**

**Top:** **lw** *$t2*, **0**($t0)

**lw** *$t3*, **0**($t1)

**sw** $t2, **0**($t1)

**sw** $t3, **0**($t0)

**addi** *$t0*, $t0,  **4**

**addi** *$t1*, $t1, **-4**

**beq** $t0, $t1, **Bot**

**j Top**

**Bot:**

1. Assume that the array starts at address **0x2100AB10**.
2. How many elements of array ***A*** are NOT loaded to either **$t2** or **$t3**?

***Answer:*** 1 [1 Mark]

1. What are the final values in array ***A*** after the program finished execution?

***Answer:*** { 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0 } [1 Mark]

1. Assume that the first instruction **addi** *$t0*, $s0, **0** is at address **0x00000070**.
2. What is the *hexadecimal* representation of the **beq** $t0, $t1, **Bot** instruction?

***Answer:*** 0x11090001 [2 Marks]

1. What is the immediate value, in *decimal*, in the **j Top** instruction?

***Answer:*** 30 [2 Marks]

1. How many **addi** instructions are performed during the execution of the program?

***Answer:*** 12 [1 Mark]