

CSE 140 Lab/HW#1 – Due: see below

MIPS assembly (100pts)

Since computer hardware can only communicate in 0's and 1's, our programs written in MIPS must be translated into machine code containing only 0's and 1's so that they can be executed. In this lab, we will review the conversions between MIPS and machine code.

We will use MARS (our beloved MIPS simulator!) throughout this assignment. Feel free to read the attached documents ([MARS Tutorial.pdf](#), [MARS features.pdf](#)) if you have not used MARS before or forgot about how to use it.

If you did not learn MIPS when you learned assembly language, please feel free to group with other students who have learned MIPS. You will pick it up easily with their help.

(Exercise) MIPS ↔ Machine Code

Work with your lab mate (a group can have up to 2 students) for the following tasks:

1. **Record the name(s) of your partner(s).**
2. Download “[MIPS Reference Data_full.pdf](#)” from CatCourse. We will need to refer to this sheet in order to complete all the exercises in this lab.
3. Load [fibonacci.s](#) in MARS and study the code.
4. After assembling the program, study the Text Segment window and see how your source code is translated into True Assembly Language (Basic) as well as machine code (Code).
5. In true assembly language, every single instruction can be translated into a machine instruction. **How many bits does a machine instruction contain?**
6. To utilize the limited number of bits efficiently, all machine instructions are categorized into different types (or formats). **How many types are there? What are they? Give 2 operations for each type as examples.**
7. Now, locate the instruction in **line #15 of fibonacci.s**. Let's translate this instruction into machine code.
 - a. **What instruction type is this? How many fields does this type of instruction have? What are the names of these fields?**
 - b. Refer to the MIPS sheet, **what is the value of the opcode of this instruction in Hex? What register is rs? What is the value of this register in Hex? What register is rt? What is the value of this register in Hex? What immediate value is in Hex?**
 - c. **Construct the machine code of line #15 using the values obtained from part b. Write your answer in both binary and Hex formats.** You can verify your answer with the Code column in Text Segment window.

8. Now, let's convert a machine code to a MIPS instruction by clicking Assemble menu. Locate address **0x0040004C** from the Text Segment window.
- What is the machine code at this address in Hex? Convert this code into binary.**
 - From the binary version of this machine code, **What is the instruction type? How can you tell? How many fields are there in this instruction type? What are the names of these fields?**
 - According to the binary machine code, **what is the value of each field in Hex?**
 - Refer to the MIPS sheet, **what operation is this instruction? How can you tell? What is the mapping of the registers being used in this instruction?**
 - What is the final MIPS instruction? Is it the same as the Source column in the Text Segment window?**

(Assignment) Individual Work

In the exercise, we identified types of instructions, fields of the instruction type, and the values of the fields. With the identified information, we converted the given machine code to a corresponding instruction.

We will do the same for the instructions located in the following addresses of [simple_loop.s](#) file.

For each instruction, find the instruction type, field names of the instruction type, the values of each field, and finally what instruction it is.

0x00400000

0x0040002c

0x00400030

0x00400048

Verify your answers with the Text Segment window.

Submission

- Your answers for the bold typed questions in the exercise and the assignment in a pdf or an MS Word document.
- Deadline: **Before the next lab time** (If this lab is assigned at the 7:30 AM session on 2/1, the deadline is 7:29 AM on 2/8)