

4. Lab exercises

Exercise 1

Load the program *Sum.s* in the *MARS* simulator and compile. Try to find an answer to the following questions. Yes, you can!

1. The first instruction (labeled `main`), in which memory position can it be found?

| | |
|------|------------|
| main | 0x10010000 |
|------|------------|

2. What is the memory position of the following variables?

| | |
|-------|------------|
| data1 | 0x10010000 |
| data2 | 0x10010004 |
| sum | 0x10010008 |

3. What would be the reason the instruction `lw $9, data2($0)` has been decomposed into three instructions? Because it can't do the three instructions in the same, so it decomposes into three that does:
-1st: It moves the direction of memory without shifting to the upper side of the register.
-2nd: It adds without sign the \$1 and the \$0 to clean the register.
-3rd: It loads the number from the memory to the register.
4. Sometimes the code uses a `lui` instruction. For the instruction you observe in the code, give the exact relation between the immediate argument of `lui` you see and the value that is loaded in the register. It does instruction number one: it moves the direction of memory without shifting to the upper side of the register.
5. Studying the instruction formats at the end of this paper, construct the binary code of instruction `add $10, $8, $9` and translate to hexadecimal.

| Binary OPCODE \$8 \$9 \$10 Function | Hexadecimal |
|--|-------------|
| 0000 0001 0000 1001 0101 0000 0010 0000 | 01095020 |

Compare your code with the one provided by the simulator.

Run the complete program and check the value of variable `sum`.

The help part of the program explains all instructions and pseudo-instructions. Read the part with respect to the command `syscall`.

6. What is the meaning of the value 10 in register \$2 before running `syscall`? Exit (terminate execution)

The fact that a program returns the right result does not prove the correctness of it. A good habit is to at least try several values for the input data and to check whether the outcome is the expected one. For instance, what happens with negative values? Please, try several instances (a difficult word for a set of input values of the program) and check the result.