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LEARNING

mips

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#mips

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About

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Chapter 1: Getting started with mips

Remarks

This section provides an overview of what mips is, and why a developer might want to use it.

It should also mention any large subjects within mips, and link out to the related topics. Since the Documentation for mips is new, you may need to create initial versions of those related topics.

Examples

Installation or Setup

Detailed instructions on getting mips set up or installed.

QtSpim for windows

1. download QtSpim from here 32.6 MB
2. install it easy installation
3. make your first assembly file (.s) or use the sample *C:\Program Files (x86)\QtSpim\helloworld.s*
4. run the program from the desktop shortcut or *C:\Program Files (x86)\QtSpim\QtSpim.exe*

there are two windows for the program the main one labeled QtSpim here you see the program you are executing (labeled text), the memory(labeled data), the values of the registers (labeled FP Regs for floating point and Int Regs for integer) and the control for the simulator

the other window labeled console is where you will see the output and enter the input of your program if there are any

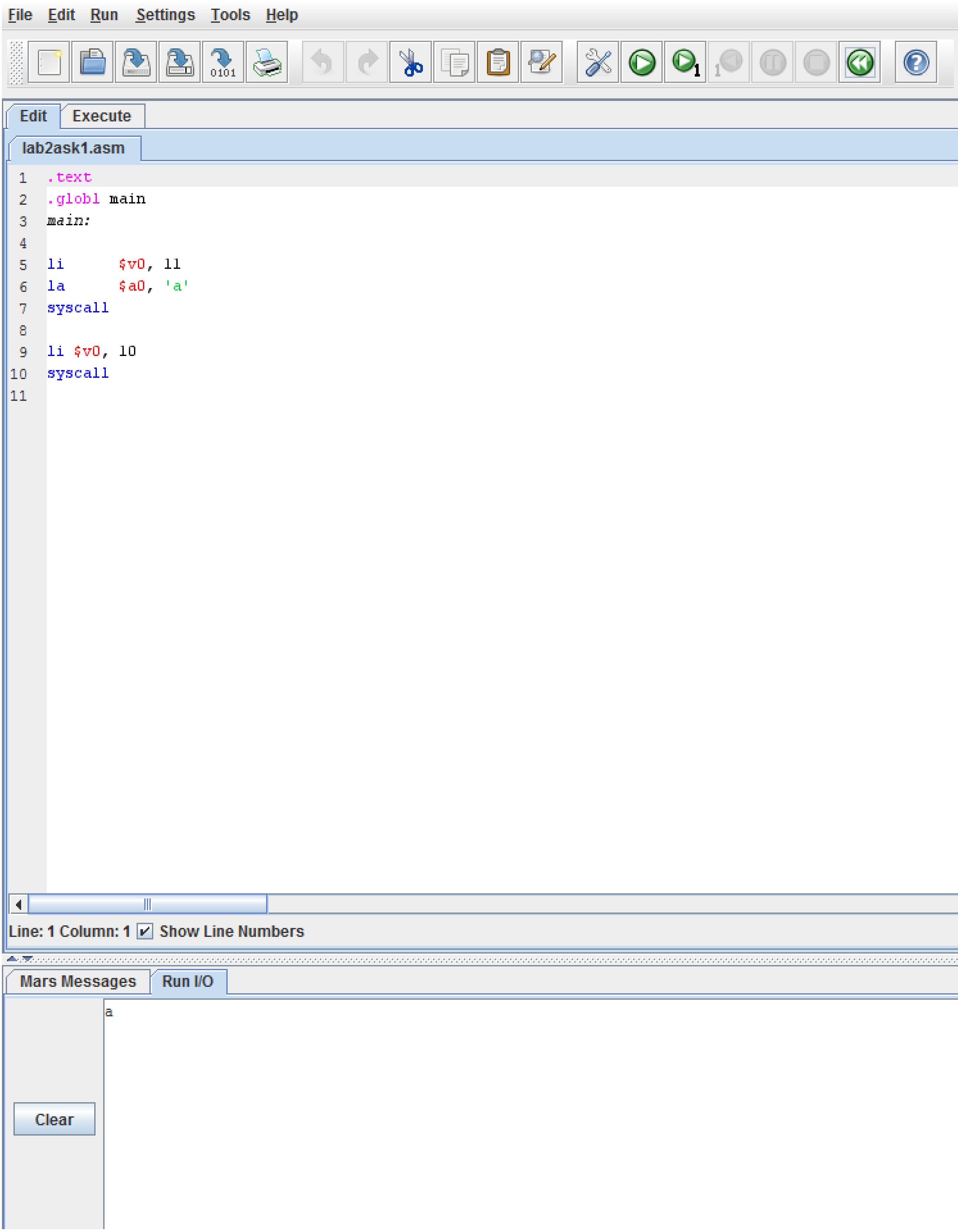
5. load the file using File -> Load File
6. you can use click run (f5) to see the end result or go step by step (p10) to see state of the register and memory while the program executing to debug

MARS MIPS Simulator

MARS MIPS simulator is an assembly language editor, assembler, simulator & debugger for the MIPS processor, developed by Pete Sanderson and Kenneth Vollmar at Missouri State University (src).

You get the MARS for free here. As for installing the 4.5 version, you might need the suitable Java SDK for your system from here

Before assembling, the environment of this simulator can be simplisticly split to three segments: the *editor* at the upper left where all of the code is being written, the compiler/output right beneath the editor and the *list of registers* that represent the "CPU" for our program.

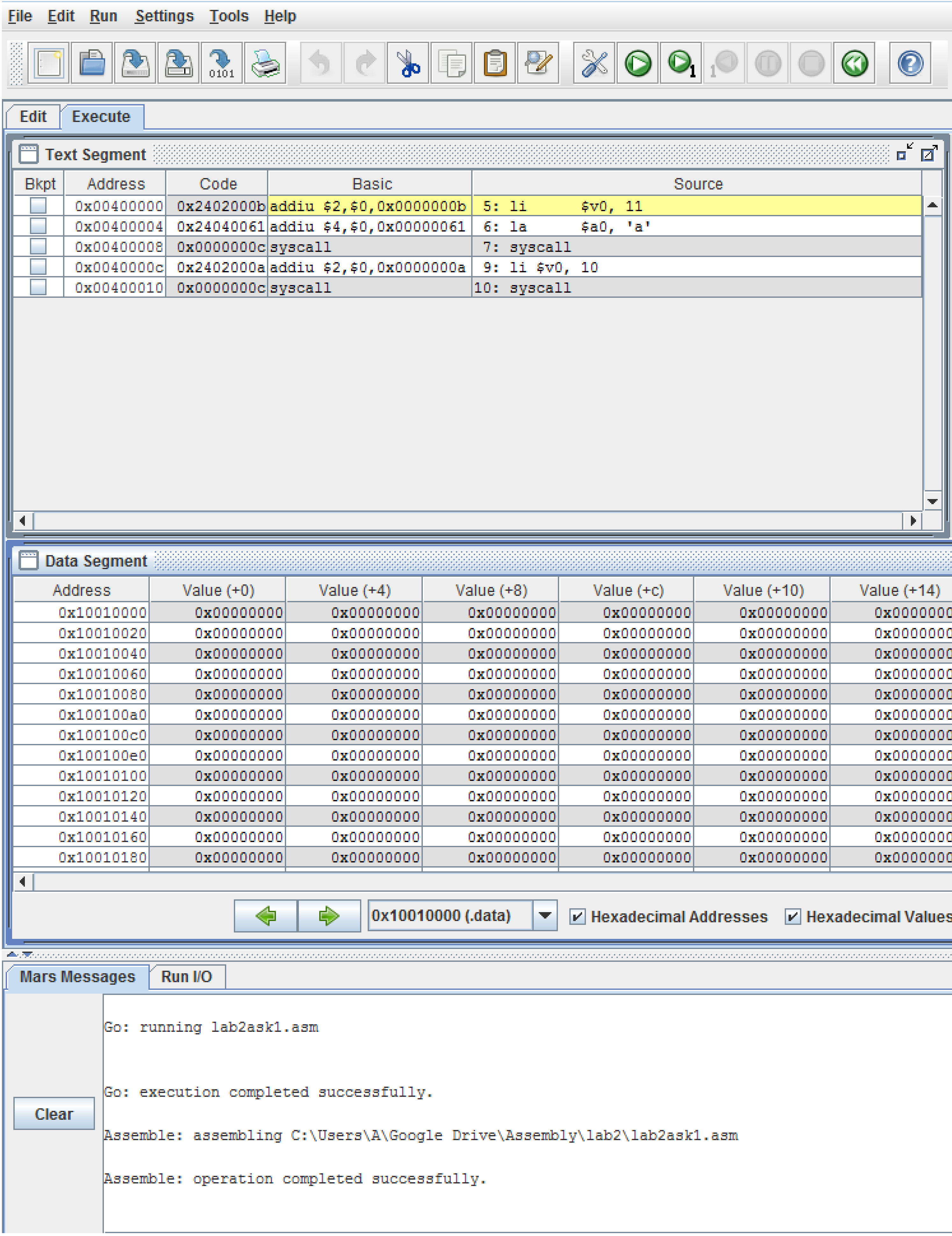


After assembling (by simply pressing F3) the environment changes, with two new segments getting the position of the editor: the *text segment* where

i) each line of assembly code gets cleared of "pseudoinstructions" (we'll talk about those in a sec) at the "basic" column and

ii) the machine code for each instruction at the "code" column,

and the *data segment* where we can have a look at a representation of the memory of a processor with little-endian order.


File Edit Run Settings Tools Help
Edit Execute
Text Segment
Bkpt Address Code Basic Source
0x00400000 0x2402000b addiu $2,$0,0x0000000b 5: li $v0, 11
0x00400004 0x24040061 addiu $4,$0,0x00000061 6: la $a0, 'a'
0x00400008 0x0000000c syscall 7: syscall
0x0040000c 0x2402000a addiu $2,$0,0x0000000a 9: li $v0, 10
0x00400010 0x0000000c syscall 10: syscall
Data Segment
Address Value (+0) Value (+4) Value (+8) Value (+c) Value (+10) Value (+14)
0x10010000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010020 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010040 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010060 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010080 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x100100a0 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x100100c0 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x100100e0 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
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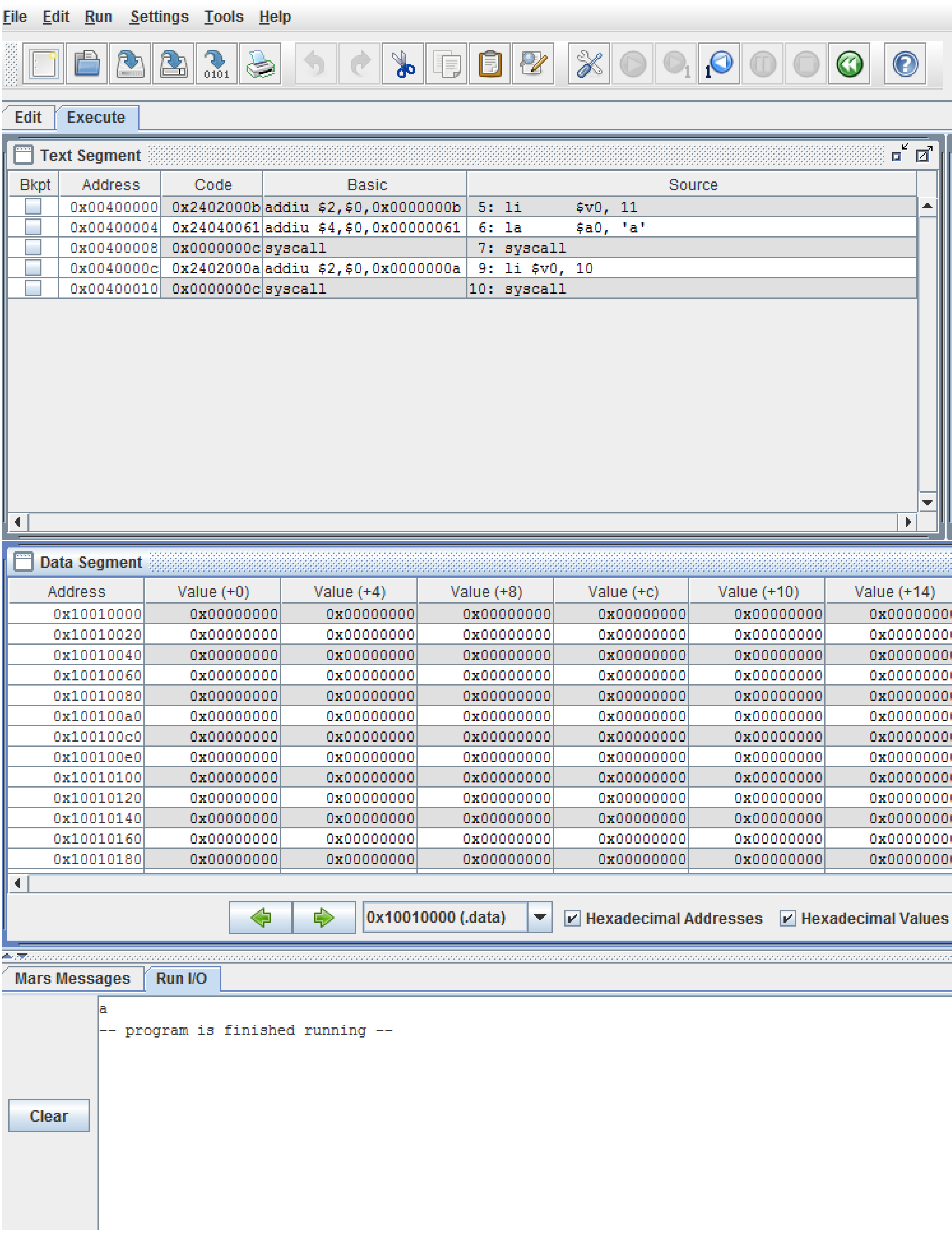
0x10010140 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010160 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010180 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010000 (.data)
Hexadecimal Addresses
Hexadecimal Values
Mars Messages Run I/O
Clear
Go: running lab2ask1.asm
Go: execution completed successfully.
Assemble: assembling C:\Users\A\Google Drive\Assembly\lab2\lab2ask1.asm
Assemble: operation completed successfully.

After assembling, we can execute our code either all at once (F5) or step by step (F7), as well as rewinding the execution several steps backwards to the back (F8).


File Edit Run Settings Tools Help
0101
Edit
Execute
Text Segment
Bkpt Address Code Basic Source
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0x00400008 0x0000000c syscall 7: syscall
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0x00400010 0x0000000c syscall 10: syscall
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Address Value (+0) Value (+4) Value (+8) Value (+c) Value (+10) Value (+14)
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0x10010060 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
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0x100100c0 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x100100e0 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010100 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010120 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010140 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010160 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010180 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000
0x10010000 (.data)
Hexadecimal Addresses
Hexadecimal Values
Mars Messages
Run I/O
a
-- program is finished running --
Clear

Now, let's see the example code from above and explain each line:

```
.text
.globl main
main:            #main function

li    $v0, 11    #11=system code for printing a character, $v0=register that gets the system
code for printing as value
la    $a0, 'a'   #'a'=our example character, $a0=register that accepts the character for
printing
syscall          #Call to the System to execute our instructions and print the character at
the a0 register

li $v0, 10       #11=system code for terminating, $v0=register that gets the system code for
terminating (optional, but desirable)
syscall          #Call to the System to terminate the execution
```

MARS accepts and exports files with the .asm filetype

But the code above prints just a character, what about the good ol' "Hello World"? What about, dunno, adding a number or something? Well, we can change what we had a bit for just that:

```
.data               #data section
str: .asciiz "Hello world\n"
number: .word 256

.text                 #code section
.globl main
main:
li       $v0, 4                #system call for printing strings
la       $a0, str              #loading our string from data section to the $a0 register
syscall

la       $t0, number         #loading our number from data section to the $t0 register
lw       $s1, 0($t0)         #loading our number as a word to another register, $s1

addi     $t2, $s1, 8          #adding our number ($s1) with 8 and leaving the sum to register
$t2

sw       $t2, 0($t0)         #storing the sum of register $t2 as a word at the first place of
$t0

li       $v0, 10               # system call for terminating the execution
syscall
```

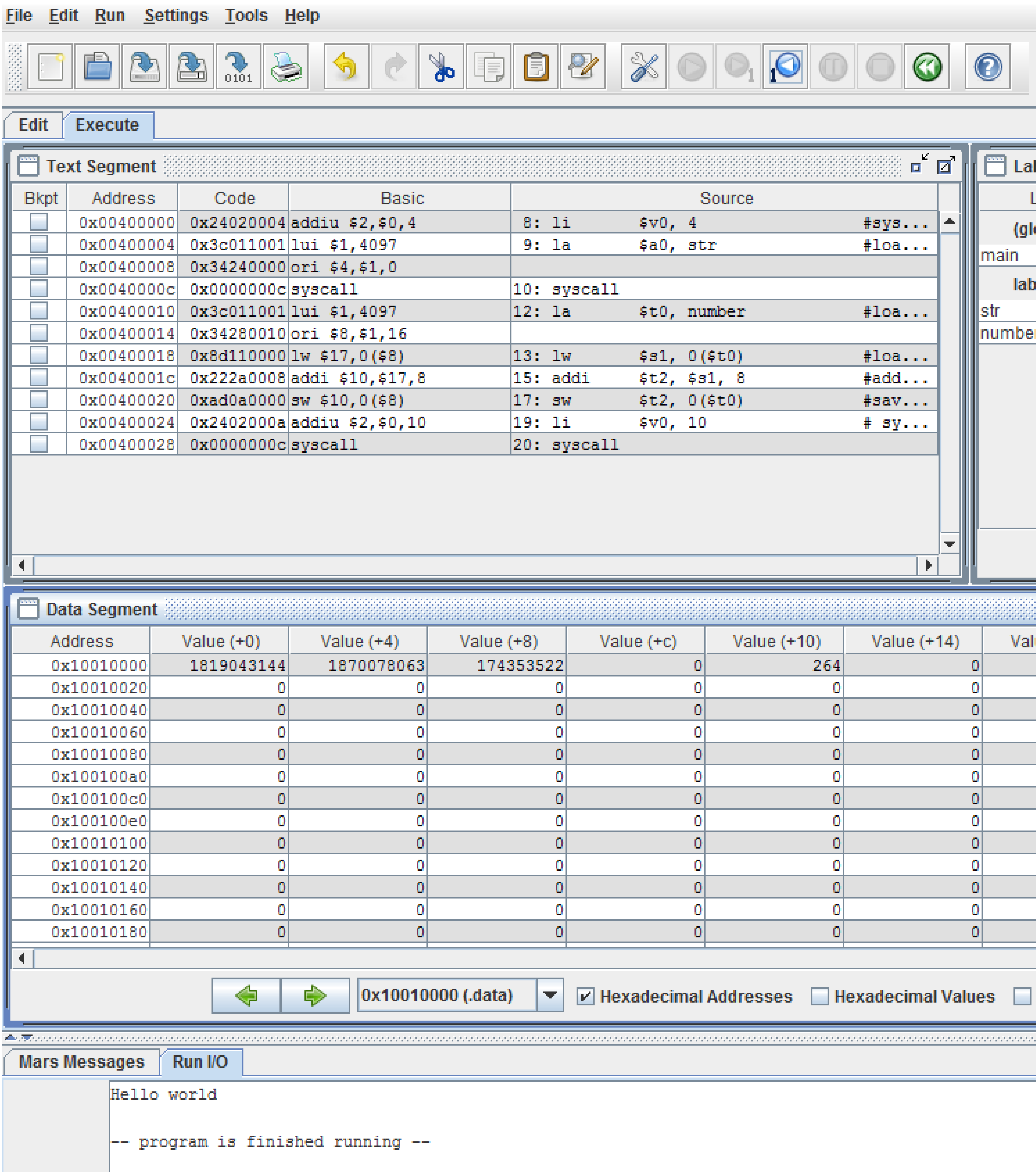
Before illustrating the results through MARS, a little more explanation about these commands is needed:

- ***System calls*** are a set of services provided from the operating system. To use a system call, a *call code* is needed to be put to $v0 register for the needed operation. If a system call has arguments, those are put at the $a0-$a2 registers. Here are all the system calls.
- `li` (load immediate) is a pseudo-instruction (we'll talk about that later) that instantly loads a register with a value. `la` (load address) is also a pseudo-instruction that loads an address to a register. With `li $v0, 4` the $v0 register has now `4` as value, while `la $a0, str` loads the

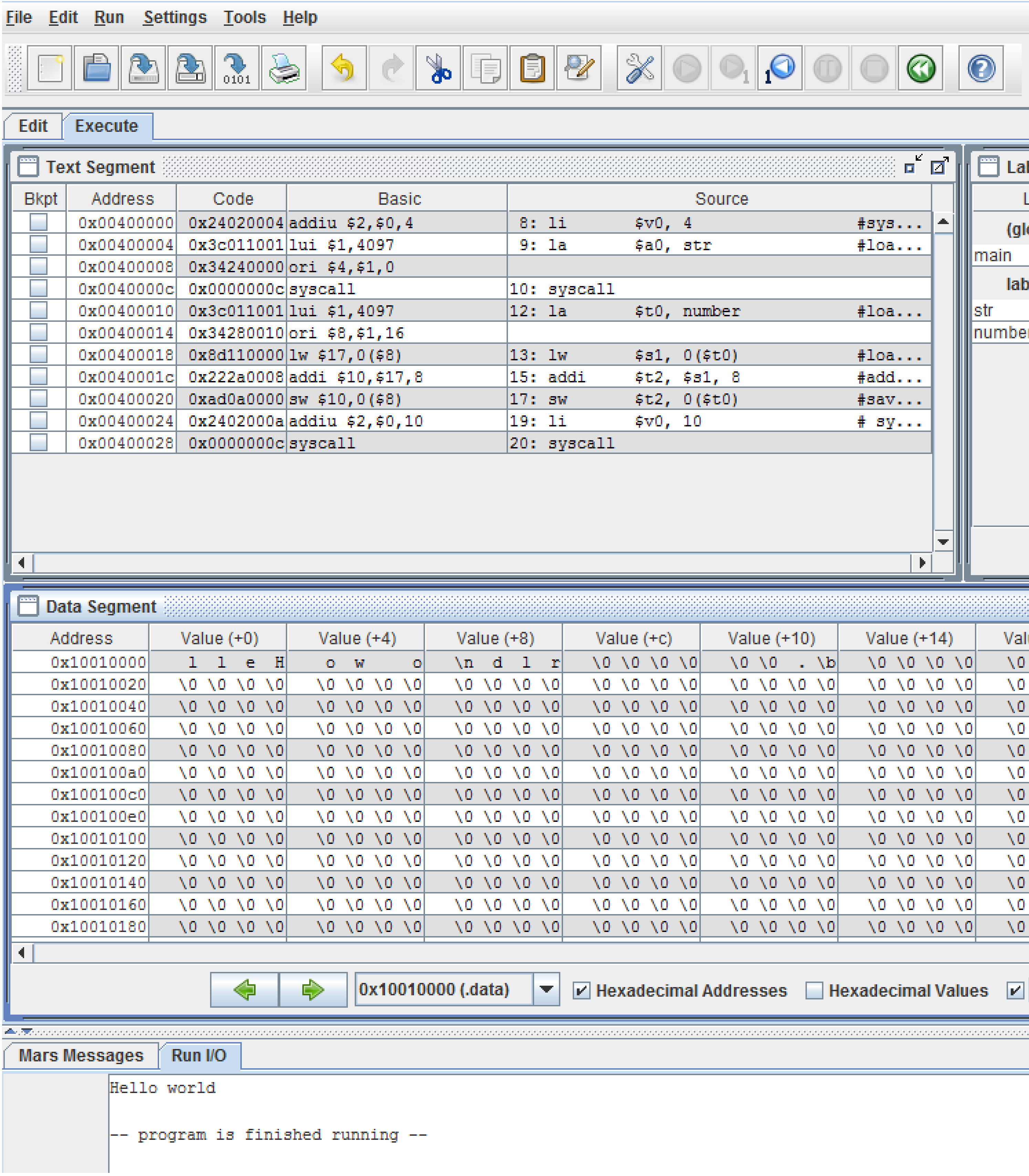
string of `str` to the `$a0` register.

- A ***word*** is (as much as we are talking about MIPS) a 32 bits sequence, with bit 31 being the Most Significant Bit and bit 0 being the Least Significant Bit.
- `lw` (load word) transfers from the memory to a register, while `sw` (store word) transfers from a register to the memory. With the `lw $s1, 0($t0)` command, we loaded to `$s1` register the value that was at the LSB of the `$t0` register (thats what the `0` symbolizes here, the offset of the word), aka `256`. `$t0` here has the address, while `$s1` has the value. `sw $t2, 0($t0)` does just the opposite job.
- MARS uses the Little Endian, meaning that the LSB of a word is stored to the smallest byte address of the memory.
- MIPS uses **byte addresses**, so an address is apart of its previous and next by 4.

By assembling the code from before, we can further understand how memory and registers exchange, disabling "Hexadecimal Values" from the Data Segment:



or enabling "ASCII" from the Data Segment:



Start it like this

```
$ java -jar Mars4_5.jar
```

Create this file and save it.

```
    .text
main:
    li    $s0,0x30
loop:
    move    $a0,$s0        # copy from s0 to a0

    li    $v0,11        # syscall with v0 = 11 will print out
    syscall            # one byte from a0 to the Run I/O window

    addi    $s0,$s0,3    # what happens if the constant is changed?

    li    $t0,0x5d
    bne    $s0,$t0,loop
    nop            # delay slot filler (just in case)

stop:    j    stop        # loop forever here
    nop            # delay slot filler (just in case)
```

Press F3 to assembly it and then press run. Now you are started compiling and executing MIPS code.

Read Getting started with mips online: https://riptutorial.com/mips/topic/7049/getting-started-with-mips

Credits

S. No	Chapters	Contributors
1	Getting started with mips	Community, Coursal, Dac Saunders, robert