Lab 1: Getting Started with RISC-V (Assembly Language) in VS Code

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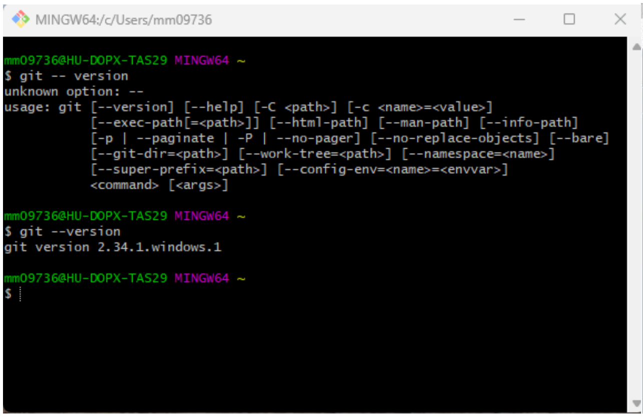
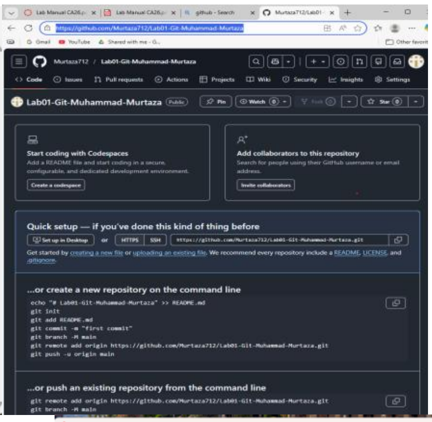
Task 1:



MINGW64:/c/Users/mm09736

```
mm09736@HU-DOPX-TAS29 MINGW64 ~
$ git -- version
unknown option: --
usage: git [--version] [--help] [-C <path>] [-c <name>=<value>]
           [--exec-path[=<path>]] [--html-path] [--man-path] [--info-path]
           [-p | --paginate | -P | --no-pager] [--no-replace-objects] [--bare]
           [--git-dir=<path>] [--work-tree=<path>] [--namespace=<name>]
           [--super-prefix=<path>] [--config-env=<name>=<envvar>]
           <command> [<args>]

mm09736@HU-DOPX-TAS29 MINGW64 ~
$ git --version
git version 2.34.1.windows.1

mm09736@HU-DOPX-TAS29 MINGW64 ~
$ |
```



https://github.com/Murtaza712/Lab01-Git-Muhammad-Murtaza

Murtaza712 / Lab01-Git-Muhammad-Murtaza

Start coding with Codespaces
Add a README file and start coding in a secure, configurable, and dedicated development environment.

Add collaborators to this repository
Search for people using their GitHub username or email address.

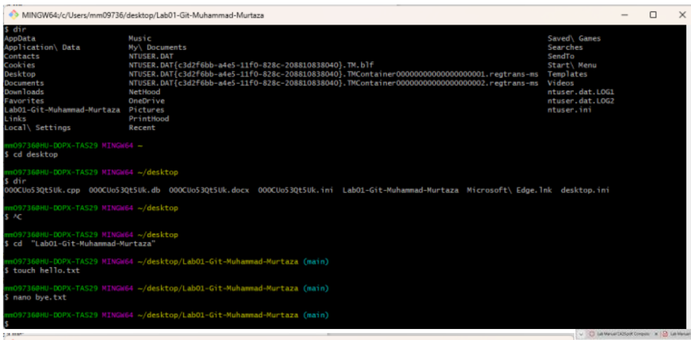
Quick setup — if you've done this kind of thing before
https://github.com/Murtaza712/Lab01-Git-Muhammad-Murtaza.git
Get started by creating a new file or uploading an existing file. We recommend every repository include a README, LICENSE, and .gitignore.

...or create a new repository on the command line

```
echo "# Lab01-Git-Muhammad-Murtaza" >> README.md
git init
git add README.md
git commit -m "first commit"
git branch -M main
git remote add origin https://github.com/Murtaza712/Lab01-Git-Muhammad-Murtaza.git
git push -u origin main
```

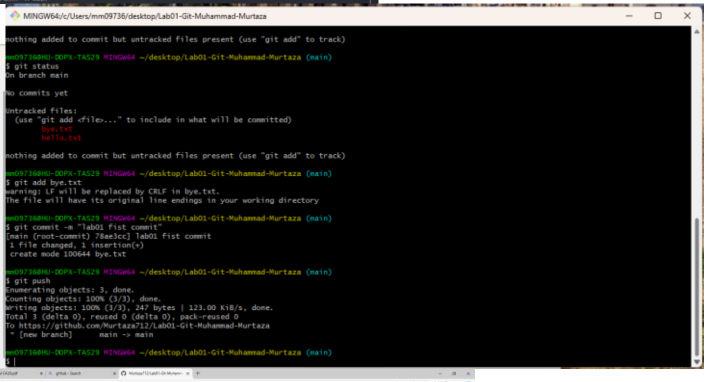
...or push an existing repository from the command line

```
git remote add origin https://github.com/Murtaza712/Lab01-Git-Muhammad-Murtaza.git
git branch -M main
```



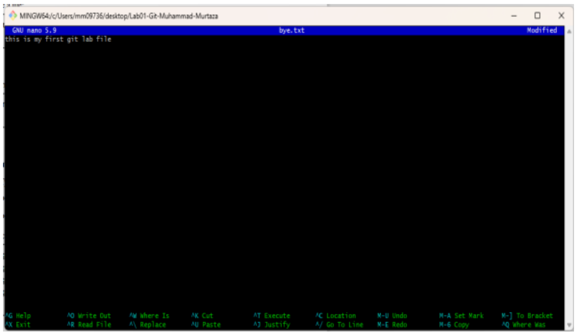
MINGW64:/c/Users/mm09736/desktop/Lab01-Git-Muhammad-Murtaza

```
$ dir
AppData                       Music                                                                                          Saved\ Games
Application\ Data             My\ Documents                                                                                  Searches
Contacts                      NTUSER.DAT                                                                                     SendTo
Cookies                       NTUSER.DAT{c3d2f6bb-a4e5-11f0-828c-208810838040}.TM.blf                                         Start\ Menu
Desktop                       NTUSER.DAT{c3d2f6bb-a4e5-11f0-828c-208810838040}.TMContainer00000000000000000001.regtrans-ms  Templates
Documents                     NTUSER.DAT{c3d2f6bb-a4e5-11f0-828c-208810838040}.TMContainer00000000000000000002.regtrans-ms  Videos
Downloads                     NetHood                                                                                        ntuser.dat.LOG1
Favorites                     OneDrive                                                                                       ntuser.dat.LOG2
Lab01-Git-Muhammad-Murtaza    Pictures                                                                                       ntuser.ini
Links                         PrintHood
Local\ Settings               Recent

mm09736@HU-DOPX-TAS29 MINGW64 ~
$ cd desktop

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop
$ dir
000CUo53Qt5Uk.cpp  000CUo53Qt5Uk.db  000CUo53Qt5Uk.docx  000CUo53Qt5Uk.ini  Lab01-Git-Muhammad-Murtaza  Microsoft\ Edge.lnk  desktop.ini

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop
$ ^C

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop
$ cd  "Lab01-Git-Muhammad-Murtaza"

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$ touch hello.txt

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$ nano bye.txt

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$
```



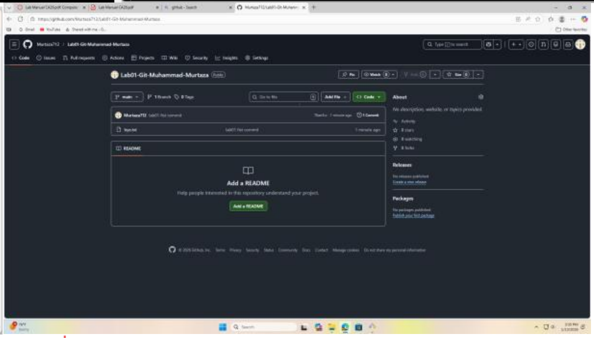
MINGW64:/c/Users/mm09736/desktop/Lab01-Git-Muhammad-Murtaza

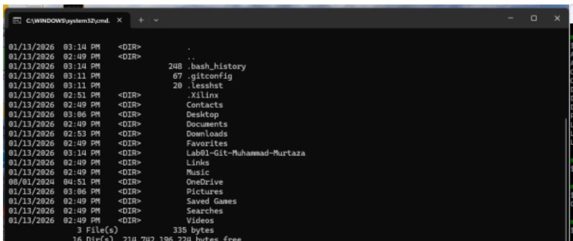
```
nothing added to commit but untracked files present (use "git add" to track)

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$ git status
On branch main

No commits yet

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        bye.txt
        hello.txt

nothing added to commit but untracked files present (use "git add" to track)

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$ git add bye.txt
warning: LF will be replaced by CRLF in bye.txt.
The file will have its original line endings in your working directory

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$ git commit -m "lab01 fist commit"
[main (root-commit) 78ae3cc] lab01 fist commit
 1 file changed, 1 insertion(+)
 create mode 100644 bye.txt

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$ git push
Enumerating objects: 3, done.
Counting objects: 100% (3/3), done.
Writing objects: 100% (3/3), 247 bytes | 123.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To https://github.com/Murtaza712/Lab01-Git-Muhammad-Murtaza
 * [new branch]      main -> main

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop/Lab01-Git-Muhammad-Murtaza (main)
$ |
```



MINGW64:/c/Users/mm09736/desktop/Lab01-Git-Muhammad-Murtaza

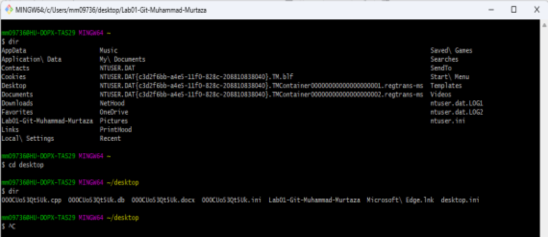
```
  GNU nano 5.9                          bye.txt                          Modified
this is my first git lab file



^G Help      ^O Write Out  ^W Where Is   ^K Cut       ^T Execute   ^C Location   M-U Undo   M-A Set Mark   M-] To Bracket
^X Exit      ^R Read File  ^\ Replace    ^U Paste     ^J Justify   ^/ Go To Line M-E Redo   M-6 Copy       ^Q Where Was
```





C:\WINDOWS\system32\cmd.

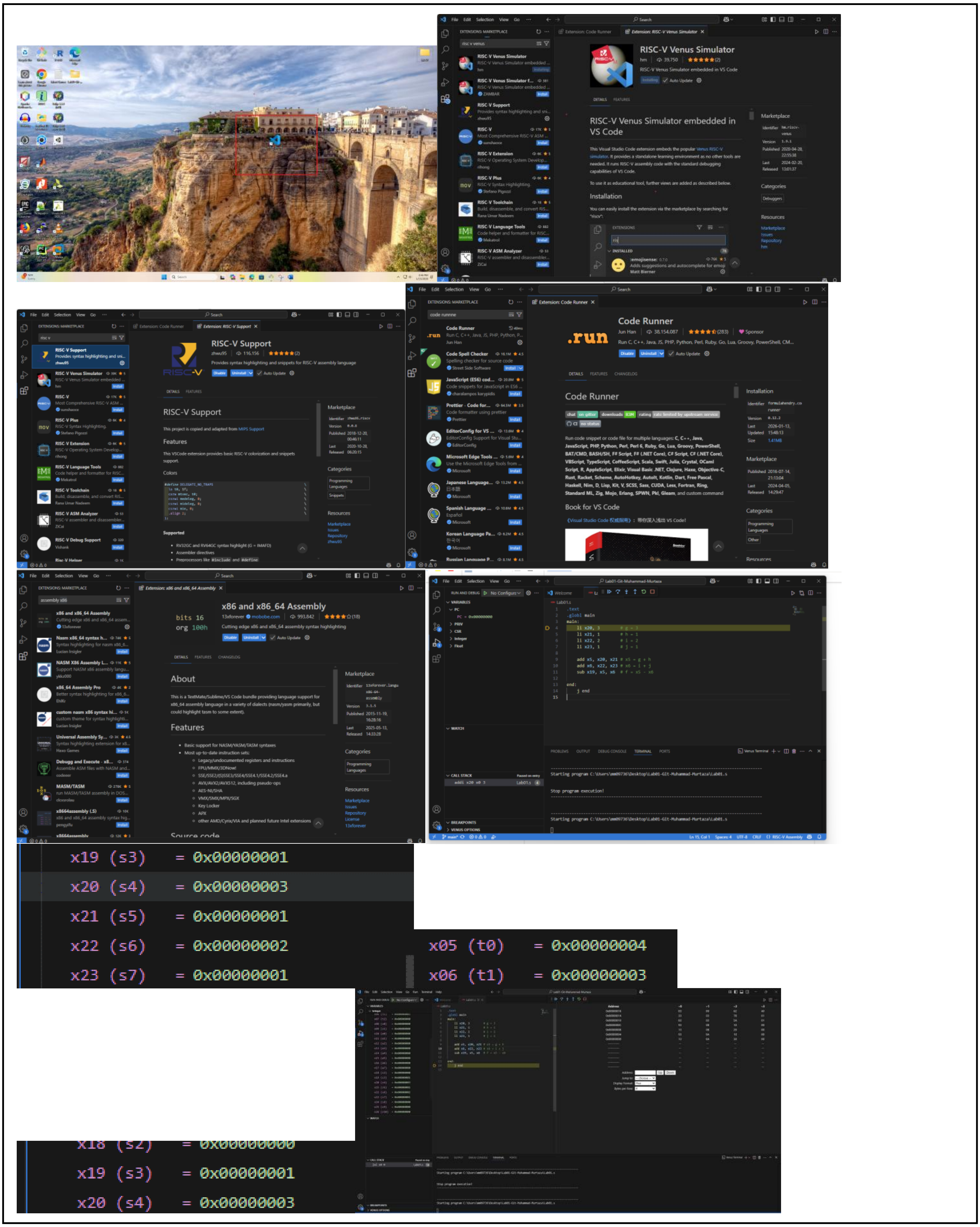
```
01/13/2026  03:14 PM    <DIR>          .
01/13/2026  02:49 PM    <DIR>          ..
01/13/2026  03:14 PM               248 .bash_history
01/13/2026  03:11 PM                67 .gitconfig
01/13/2026  03:11 PM                20 .lesshst
01/13/2026  02:51 PM    <DIR>          .Xilinx
01/13/2026  02:49 PM    <DIR>          Contacts
01/13/2026  03:06 PM    <DIR>          Desktop
01/13/2026  02:49 PM    <DIR>          Documents
01/13/2026  02:53 PM    <DIR>          Downloads
01/13/2026  02:49 PM    <DIR>          Favorites
01/13/2026  03:14 PM    <DIR>          Lab01-Git-Muhammad-Murtaza
01/13/2026  02:49 PM    <DIR>          Links
01/13/2026  02:49 PM    <DIR>          Music
08/01/2024  04:51 PM    <DIR>          OneDrive
01/13/2026  03:06 PM    <DIR>          Pictures
01/13/2026  02:49 PM    <DIR>          Saved Games
01/13/2026  02:49 PM    <DIR>          Searches
01/13/2026  02:49 PM    <DIR>          Videos
               3 File(s)            335 bytes
              16 Dir(s)  214,702,196,224 bytes free
```



MINGW64:/c/Users/mm09736/desktop/Lab01-Git-Muhammad-Murtaza

```
mm09736@HU-DOPX-TAS29 MINGW64 ~
$ dir
AppData                       Music                                                                                          Saved\ Games
Application\ Data             My\ Documents                                                                                  Searches
Contacts                      NTUSER.DAT                                                                                     SendTo
Cookies                       NTUSER.DAT{c3d2f6bb-a4e5-11f0-828c-208810838040}.TM.blf                                         Start\ Menu
Desktop                       NTUSER.DAT{c3d2f6bb-a4e5-11f0-828c-208810838040}.TMContainer00000000000000000001.regtrans-ms  Templates
Documents                     NTUSER.DAT{c3d2f6bb-a4e5-11f0-828c-208810838040}.TMContainer00000000000000000002.regtrans-ms  Videos
Downloads                     NetHood                                                                                        ntuser.dat.LOG1
Favorites                     OneDrive                                                                                       ntuser.dat.LOG2
Lab01-Git-Muhammad-Murtaza    Pictures                                                                                       ntuser.ini
Links                         PrintHood
Local\ Settings               Recent

mm09736@HU-DOPX-TAS29 MINGW64 ~
$ cd desktop

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop
$ dir
000CUo53Qt5Uk.cpp  000CUo53Qt5Uk.db  000CUo53Qt5Uk.docx  000CUo53Qt5Uk.ini  Lab01-Git-Muhammad-Murtaza  Microsoft\ Edge.lnk  desktop.ini

mm09736@HU-DOPX-TAS29 MINGW64 ~/desktop
$ ^C
```

Task 02: Setting Up VS Code (RISC-V Simulation Environment)



```
.text
.globl main
main:
    li x20, 3        # g = 3
    li x21, 1        # h = 1
    li x22, 2        # i = 2
    li x23, 1        # j = 1

    add x5, x20, x21 # x5 = g + h
    add x6, x22, x23 # x6 = i + j
    sub x19, x5, x6  # f = x5 - x6

end:
    j end
```

```
Starting program C:\Users\mm09736\Desktop\Lab01-Git-Muhammad-Murtaza\Lab01.s

Stop program execution!

Starting program C:\Users\mm09736\Desktop\Lab01-Git-Muhammad-Murtaza\Lab01.s
```

```
x19 (s3)   = 0x00000001
x20 (s4)   = 0x00000003
x21 (s5)   = 0x00000001
x22 (s6)   = 0x00000002
x23 (s7)   = 0x00000001
```

```
x05 (t0)   = 0x00000004
x06 (t1)   = 0x00000003
```

```
x18 (s2)   = 0x00000000
x19 (s3)   = 0x00000001
x20 (s4)   = 0x00000003
```

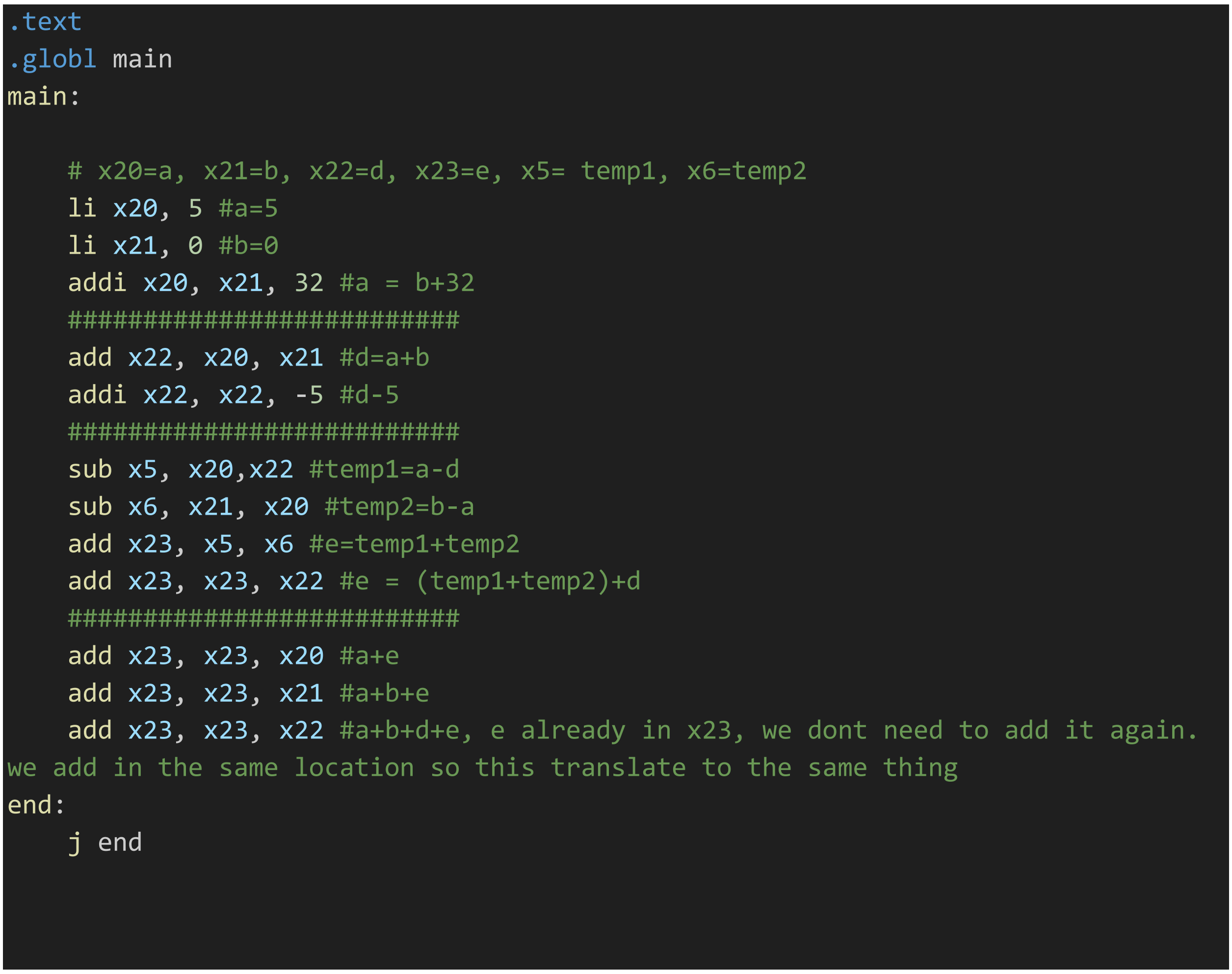
Figure 1.4: RISC-V Memory

Task 3

Convert the following statement to RISC V. You can use the same registers as given in

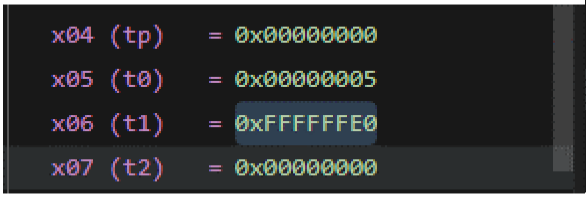
```
int a = 5;
int b = 0 + 0;
a = b + 32;
int d = (a + b) - 5;
int e = (((a - d) + (b - a)) + d);
e = a + b + d + e;
```

Code

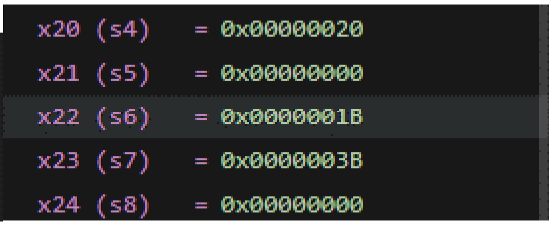


```
.text
.globl main
main:

    # x20=a, x21=b, x22=d, x23=e, x5= temp1, x6=temp2
    li x20, 5 #a=5
    li x21, 0 #b=0
    addi x20, x21, 32 #a = b+32
    ##########################
    add x22, x20, x21 #d=a+b
    addi x22, x22, -5 #d-5
    ##########################
    sub x5, x20,x22 #temp1=a-d
    sub x6, x21, x20 #temp2=b-a
    add x23, x5, x6 #e=temp1+temp2
    add x23, x23, x22 #e = (temp1+temp2)+d
    ##########################
    add x23, x23, x20 #a+e
    add x23, x23, x21 #a+b+e
    add x23, x23, x22 #a+b+d+e, e already in x23, we dont need to add it again.
we add in the same location so this translate to the same thing
end:
    j end
```

Output



```
x04 (tp)    = 0x00000000
x05 (t0)    = 0x00000005
x06 (t1)    = 0xFFFFFFE0
x07 (t2)    = 0x00000000
```



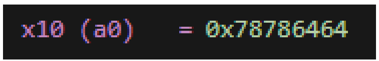
```
x20 (s4)    = 0x00000020
x21 (s5)    = 0x00000000
x22 (s6)    = 0x0000001B
x23 (s7)    = 0x0000003B
x24 (s8)    = 0x00000000
```

Task 4a

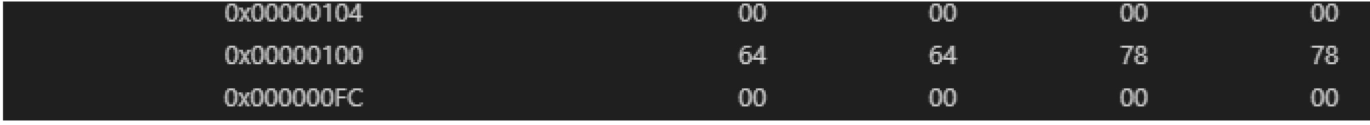
Initialize the register x10 and x11 with values 0x78786464, 0xA8A81919, respectively manually. Write the RISC-V assembly code for each item below. Try guessing the result in each destination before executing the instruction and corroborate it after execution:

Store x10 as unsigned integer at address 0x100.

```
    li x10 0x78786464
    sw x10, 0x100(x0)
```



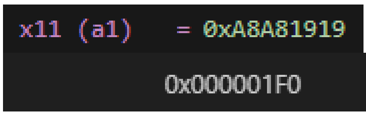
```
x10 (a0)    = 0x78786464
```



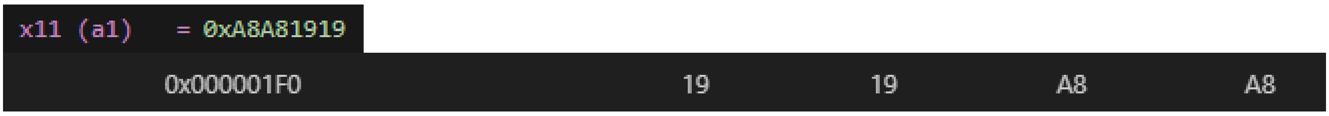
```
0x00000104    00    00    00    00
0x00000100    64    64    78    78
0x000000FC    00    00    00    00
```

Store x11 as unsigned integer at address 0x1F0.

```
    li x11 0xA8A81919
    sw x11, 0x1F0(x0)
```



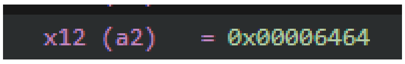
```
x11 (a1)    = 0xA8A81919
```



```
0x000001F0    19    19    A8    A8
```

Load an unsigned short integer (two bytes) from address 0x100 in x12.

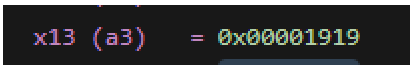
```
  lhu x12, 0x100(x0)
```



```
x12 (a2)    = 0x00006464
```

Load a short integer from address 0x1F0 in register x13.

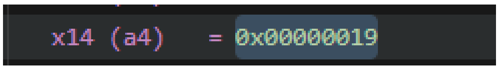
```
    lh x13, 0x1F0(x0)
```



```
x13 (a3)    = 0x00001919
```

Load a singed character from address 0x1F0 in register x14.

```
    lb x14, 0x1F0(x0)
```



x14 (a4) = 0x00000019

*

Task 4b – - Loop unrolling

```

Assume there are three character arrays a, b, and c located at addresses 0
    x100, 0x200, 0x300 respectively.

for (int i=0 ; i<4; i++ )
c [ i ]=a [ i ]+b [ i ] ; # c [ 0 ]=a [ 0 ]+b [0 ] ;

Write equivalent RISC−V code for the piece of code given. You have not
    studied loops yet, but the above code is manageable without loop
    instructions. Also assume that A is a character array, B is a short array
    , and C is an unsigned integer array.
```

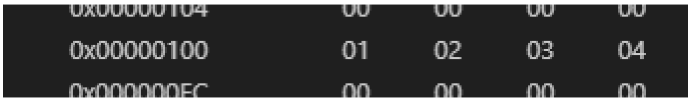
Code

```
# initializing array a at 0x100
li x5, 1
li x1, 0
sb x5, 0x100(x1)
###########################
li x5 2
li x1 1
sb x5, 0x100(x1)
###########################
li x5 3
li x1 2
sb x5, 0x100(x1)
###########################
li x5 4
li x1 3
sb x5, 0x100(x1)
###########################


# initializing array b at 0x200
li x5, 1
li x1, 0
sh x5, 0x200(x1)
###########################
li x5 2
li x1 1
```

```
sh x5, 0x200(x1)
###########################
li x5 3
li x1 2
sh x5, 0x200(x1)
###########################
li x5 4
li x1 3
sh x5, 0x200(x1)
###########################


#c[0]=a[0]+b[0]
li x1, 0
lb x2, 0x100(x1) #load array vals
lh x3, 0x200(x1)
add x4, x3, x2
sw x4, 0x300(x1)
#c[1]=a[1]+b[1]
li x1, 1
lb x2, 0x100(x1) #load array vals
lh x3, 0x200(x1)
add x4, x3, x2
sw x4, 0x300(x1)
#c[2]=a[2]+b[2]
li x1, 2
lb x2, 0x100(x1) #load array vals
lh x3, 0x200(x1)
add x4, x3, x2
sw x4, 0x300(x1)
#c[3]=a[3]+b[3]
li x1, 3
lb x2, 0x100(x1) #load array vals
lh x3, 0x200(x1)
add x4, x3, x2
sw x4, 0x300(x1)
```

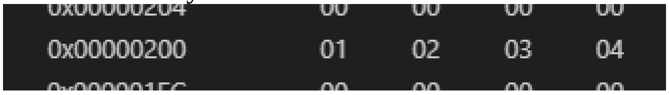
Output

Memory location 0x100:



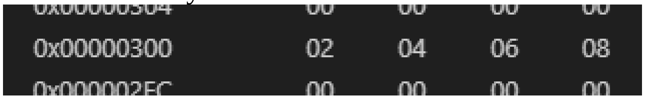
```
0x00000104     00    00    00    00
0x00000100     01    02    03    04
0x000000FC     00    00    00    00
```

Memory location 0x200:



```
0x00000204     00    00    00    00
0x00000200     01    02    03    04
0x000001FC     00    00    00    00
```

Memory location 0x300:



```
0x00000304     00    00    00    00
0x00000300     02    04    06    08
0x000002FC     00    00    00    00
```

We used the same registers for multiple operations therefore there values kept changing. The output is as expected therefore we are not adding screenshots for the register values.

Assessment Rubric

Lab 1: Getting Started with RISC-V (Assembly Language) in VS Code

Name:	**Student ID:**	**section*:**

Points Distribution

	Task No.	LR 2 Code	LR 5 Results
In - Lab	**Task 1**	/0	/15
	Task 2	/0	/15
	Task 3	/10	/5
	Task 4a	/10	/5
	Task 4b	/10	/10
Total Points: 100		**/30**	**/50**
CLO Mapped		CLO 2	

Affective Domain Rubric		Points	CLO Mapped
AR7	**Report Submission & Git Upload**	/10 & /10	CLO 2

CLO	Total Points	Points Obtained
2	100	
Total	**100**	

For description of different levels of the mapped rubrics, please refer to the Lab Evaluation Assessment Rubrics and Affective Domain Assessment Rubrics provided here.