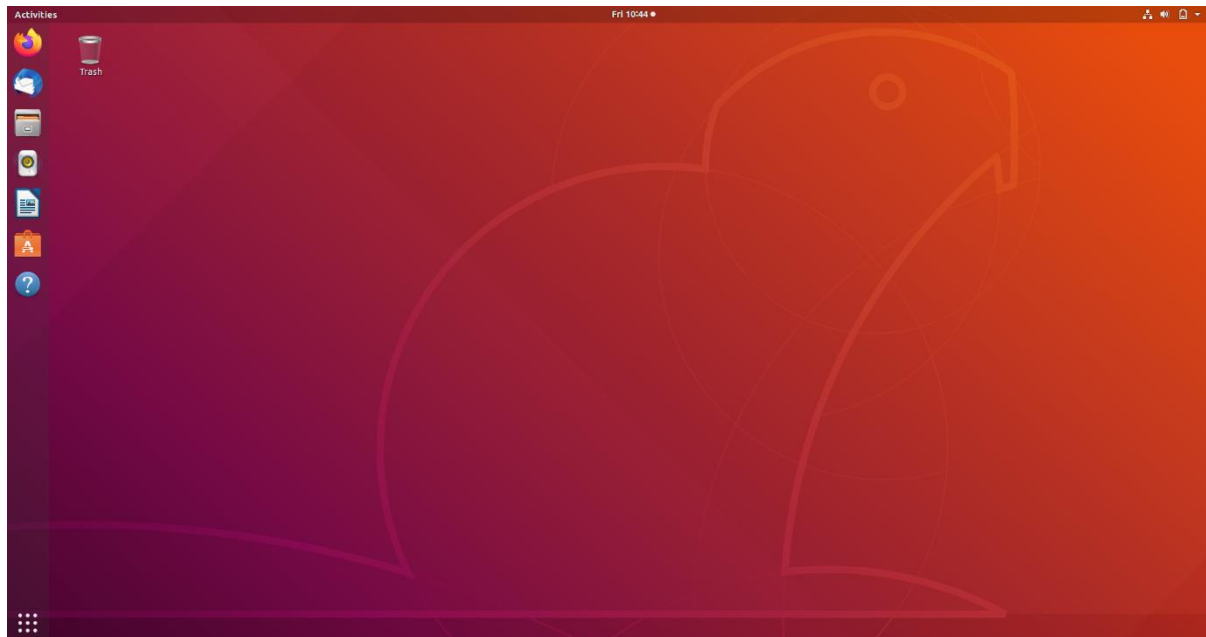
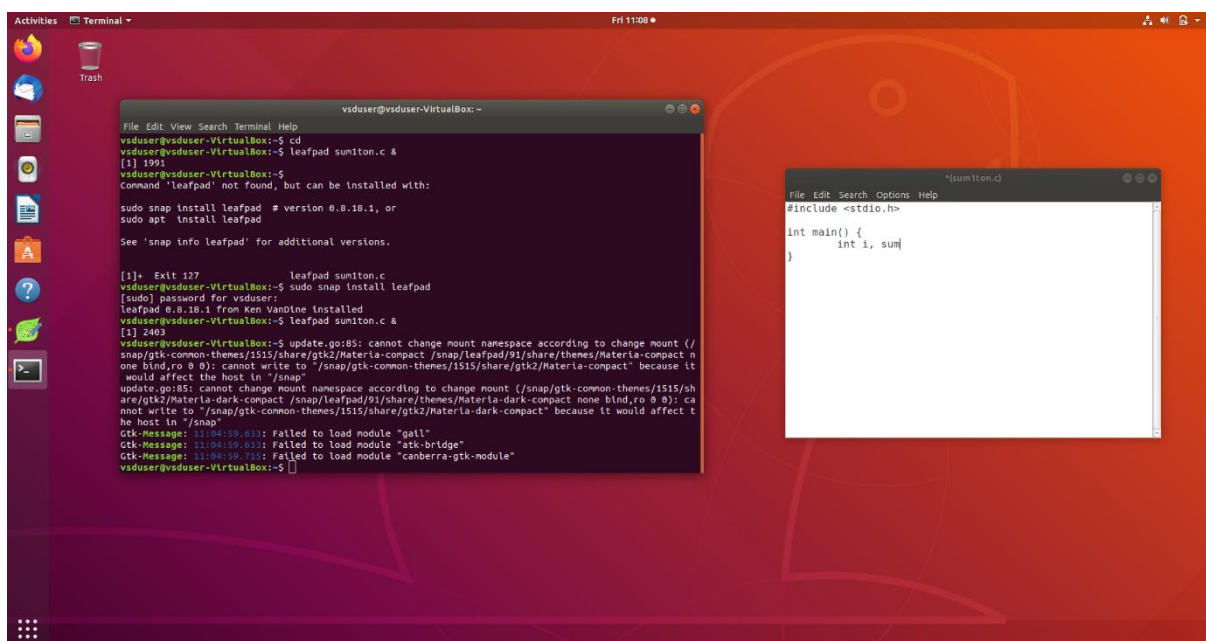


Writing a C code to count the sum of numbers from 1 to n and running this program using RISC-V simulator

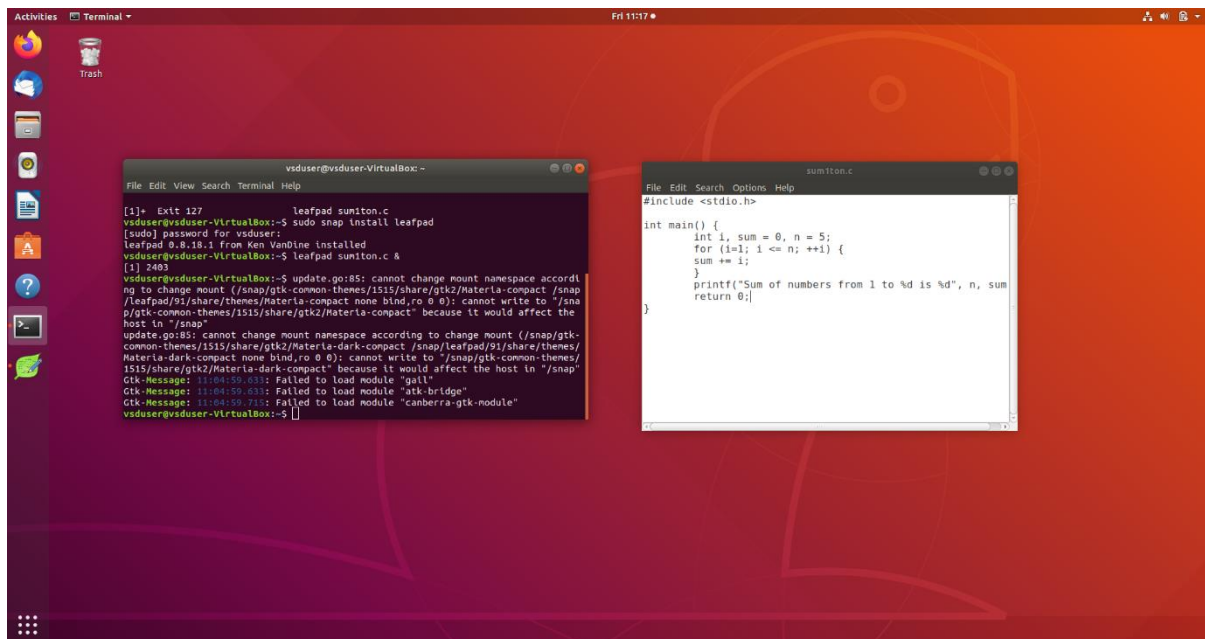
Writing a C code to count sum of numbers from 1 to n



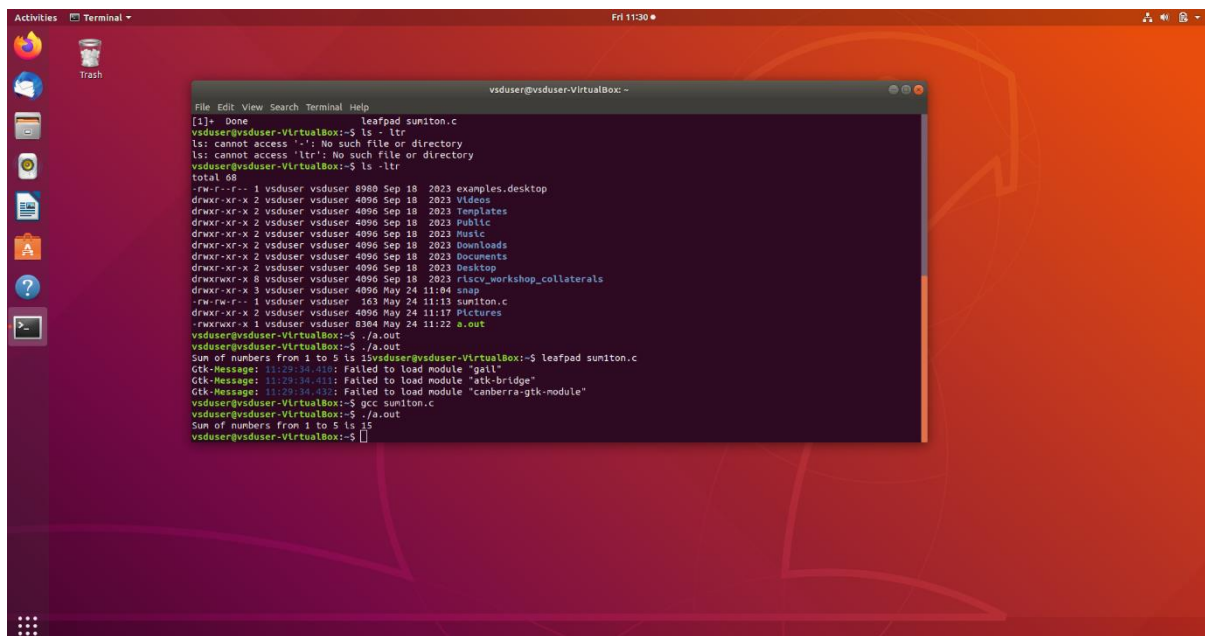
1. First I opened terminal and wrote code to make and open a new C file in leafpad as shown below:



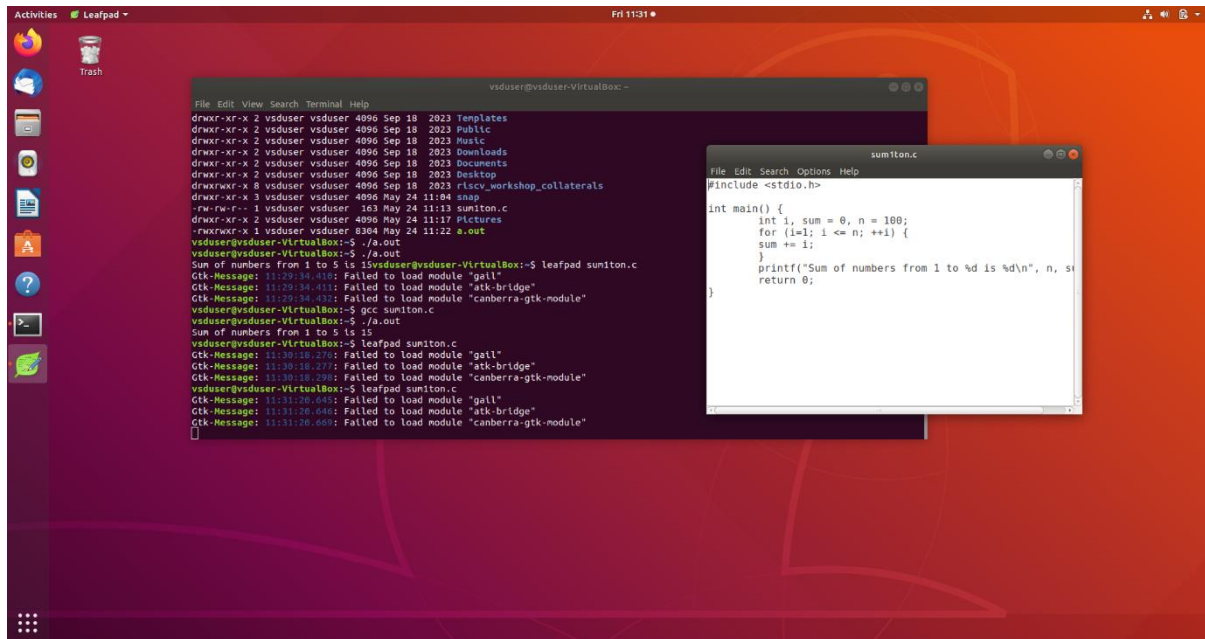
2. Then I wrote my code in leafpad as shown below:



3. And then compiled and run in terminal itself to check, and got the desired output.



4. Tried for different value of n and got the results, like n=100.

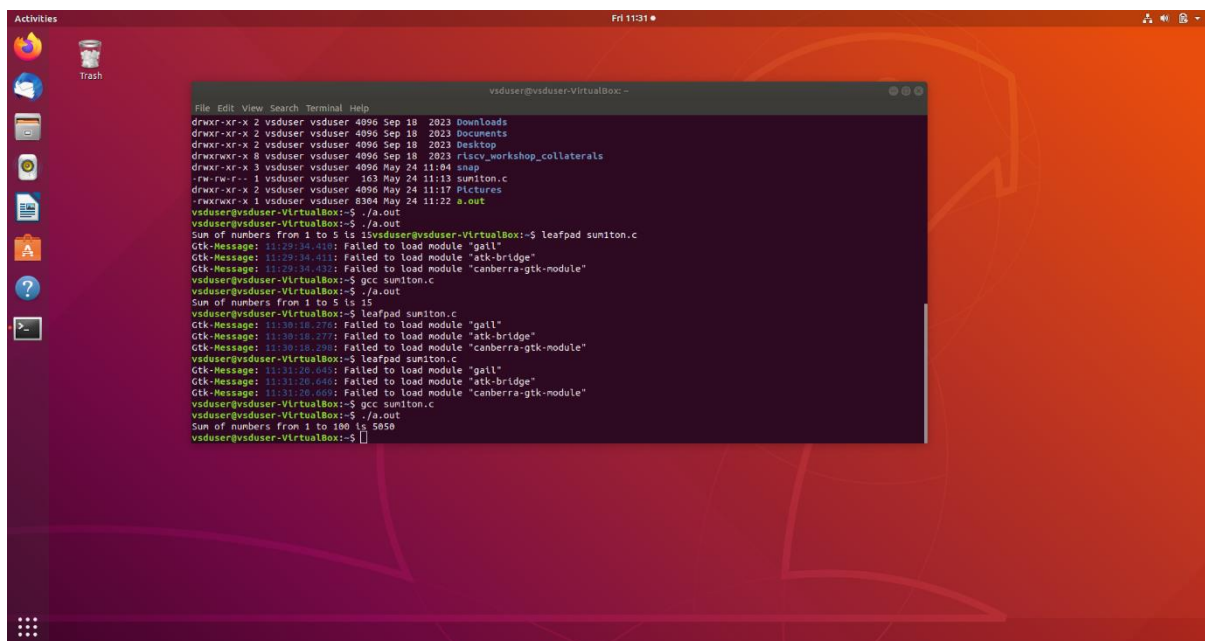


The screenshot shows a Linux desktop environment with a terminal window and a code editor window. The terminal window displays the output of a program that calculates the sum of numbers from 1 to 5. The code editor window shows the source code of the program, which is a C program that calculates the sum of numbers from 1 to n.

```
File Edit View Search Terminal Help
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Templates
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Public
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Music
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Downloads
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Documents
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Desktop
drwxrwxr-x 8 vdsuser vdsuser 4096 Sep 18 2023 riscv_workshop_collaterals
drwxr-xr-x 3 vdsuser vdsuser 4096 May 24 11:04 snap
-rw-rw-r-- 1 vdsuser vdsuser 163 May 24 11:13 suniton.c
drwxr-xr-x 2 vdsuser vdsuser 4096 May 24 11:17 Pictures
-rwxrwxr-x 1 vdsuser vdsuser 8364 May 24 11:22 a.out
vdsuser@vdsuser-VirtualBox:~$ ./a.out
Sum of numbers from 1 to 5 is 15
vdsuser@vdsuser-VirtualBox:~$ leafpad suniton.c
Gtk-Message: 11:29:34.410: Failed to load module "gall"
Gtk-Message: 11:29:34.411: Failed to load module "atk-bridge"
Gtk-Message: 11:29:34.431: Failed to load module "canberra-gtk-module"
vdsuser@vdsuser-VirtualBox:~$ gcc suniton.c
vdsuser@vdsuser-VirtualBox:~$ ./a.out
Sum of numbers from 1 to 5 is 15
vdsuser@vdsuser-VirtualBox:~$ leafpad suniton.c
Gtk-Message: 11:30:18.276: Failed to load module "gall"
Gtk-Message: 11:30:18.277: Failed to load module "atk-bridge"
Gtk-Message: 11:30:18.290: Failed to load module "canberra-gtk-module"
vdsuser@vdsuser-VirtualBox:~$ leafpad suniton.c
Gtk-Message: 11:31:20.645: Failed to load module "gall"
Gtk-Message: 11:31:20.646: Failed to load module "atk-bridge"
Gtk-Message: 11:31:20.660: Failed to load module "canberra-gtk-module"
```

```
File Edit Search Options Help
#include <stdio.h>

int main() {
    int i, sum = 0, n = 100;
    for (i=1; i <= n; ++i) {
        sum += i;
    }
    printf("Sum of numbers from 1 to %d is %d\n", n, sum);
    return 0;
}
```



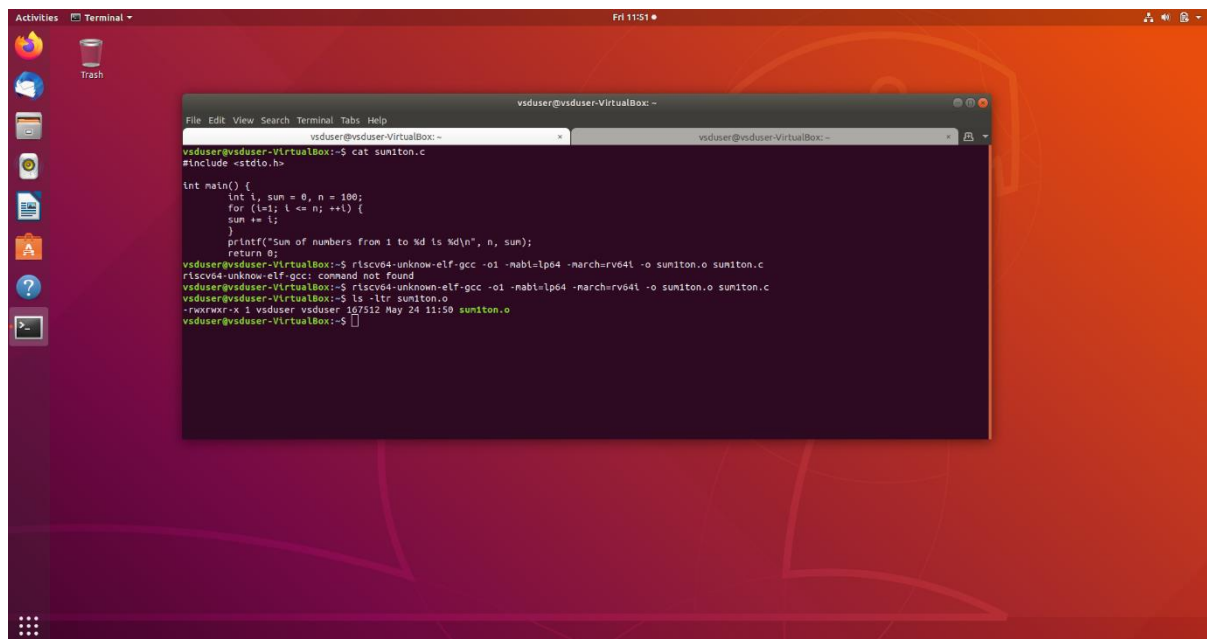
The screenshot shows a Linux desktop environment with a terminal window. The terminal window displays the output of a program that calculates the sum of numbers from 1 to 100. The program is the same as the one in the previous screenshot, but with n=100.

```
File Edit View Search Terminal Help
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Downloads
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Documents
drwxr-xr-x 2 vdsuser vdsuser 4096 Sep 18 2023 Desktop
drwxrwxr-x 8 vdsuser vdsuser 4096 Sep 18 2023 riscv_workshop_collaterals
drwxr-xr-x 3 vdsuser vdsuser 4096 May 24 11:04 snap
-rw-rw-r-- 1 vdsuser vdsuser 163 May 24 11:13 suniton.c
drwxr-xr-x 2 vdsuser vdsuser 4096 May 24 11:17 Pictures
-rwxrwxr-x 1 vdsuser vdsuser 8364 May 24 11:22 a.out
vdsuser@vdsuser-VirtualBox:~$ ./a.out
Sum of numbers from 1 to 5 is 15
vdsuser@vdsuser-VirtualBox:~$ leafpad suniton.c
Gtk-Message: 11:29:34.410: Failed to load module "gall"
Gtk-Message: 11:29:34.411: Failed to load module "atk-bridge"
Gtk-Message: 11:29:34.431: Failed to load module "canberra-gtk-module"
vdsuser@vdsuser-VirtualBox:~$ gcc suniton.c
vdsuser@vdsuser-VirtualBox:~$ ./a.out
Sum of numbers from 1 to 5 is 15
vdsuser@vdsuser-VirtualBox:~$ leafpad suniton.c
Gtk-Message: 11:30:18.276: Failed to load module "gall"
Gtk-Message: 11:30:18.277: Failed to load module "atk-bridge"
Gtk-Message: 11:30:18.290: Failed to load module "canberra-gtk-module"
vdsuser@vdsuser-VirtualBox:~$ leafpad suniton.c
Gtk-Message: 11:31:20.645: Failed to load module "gall"
Gtk-Message: 11:31:20.646: Failed to load module "atk-bridge"
Gtk-Message: 11:31:20.660: Failed to load module "canberra-gtk-module"
vdsuser@vdsuser-VirtualBox:~$ gcc suniton.c
vdsuser@vdsuser-VirtualBox:~$ ./a.out
Sum of numbers from 1 to 100 is 5050
vdsuser@vdsuser-VirtualBox:~$
```

Running above program in RISC-V Simulator

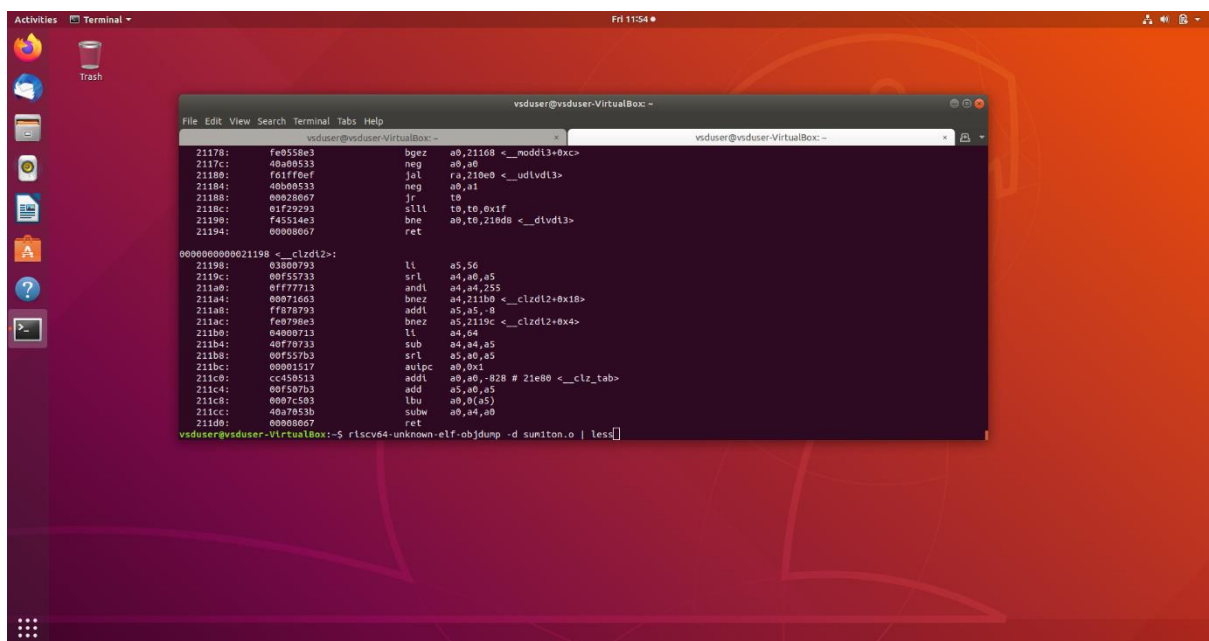
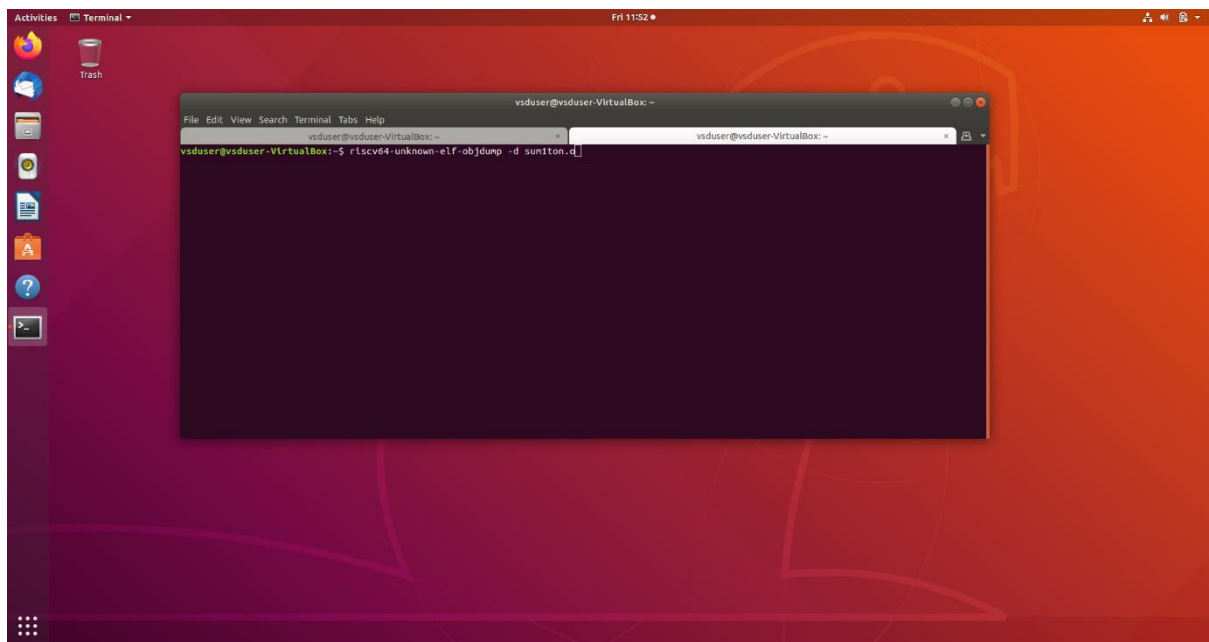
Once I have ran the code in terminal, I need to run in RISC-V simulator so for that there is special set of code needed which I have done in following steps:

1. First I wrote a code to compile it with RISC-V gcc compiler with option 1 so it will generate a file with .o extension.



```
vsduser@vsduser-VirtualBox: ~  
File Edit View Search Terminal Tabs Help  
vsduser@vsduser-VirtualBox:~  
vsduser@vsduser-VirtualBox:~$ cat sum1ton.c  
#include <stdio.h>  
  
int main() {  
    int i, sum = 0, n = 100;  
    for (i=1; i <= n; ++i) {  
        sum += i;  
    }  
    printf("Sum of numbers from 1 to %d is %d\n", n, sum);  
    return 0;  
}  
vsduser@vsduser-VirtualBox:~$ riscv64-unknown-elf-gcc -O1 -mabi=lp64 -march=rv64i -o sum1ton.o sum1ton.c  
riscv64-unknown-elf-gcc: command not found  
vsduser@vsduser-VirtualBox:~$ riscv64-unknown-elf-gcc -O1 -mabi=lp64 -march=rv64i -o sum1ton.o sum1ton.c  
vsduser@vsduser-VirtualBox:~$ ls -ltr sum1ton.o  
-rwxrwxr-x 1 vsduser vsduser 167512 May 24 11:50 sum1ton.o  
vsduser@vsduser-VirtualBox:~$
```

2. Next I wrote a code `riscv-unknown-elf-objdump -d sum1ton.o` for getting the assembly code for the above c program, and got many assembly codes. Reduced the number of assembly codes just by writing `| less` after the command. We wanted main section so I searched for the main. The byte address for main was found to be 10184 and got 15 instructions when using option 1. It is observed that the address of each consecutive instructions get incremented by 4.



```

10178: 00000317      aulpc  t1,0x0
1017c: 00000067      jr     zero # 0 <register_fint-0x100b0>
10180: 00000067      ret

0000000000010184 <exit>:
10184: fe011113      addi   sp,sp,-32
10188: 00113c23      sd     ra,24(sp)
1018c: 00813823      sd     s0,10(sp)
10190: 02010415      addi   s0,s0,32
10194: fe042423      sw     zero, 24(s0)
10198: 00400793      li     a5,100
1019c: fef42223      sw     a5,-28(s0)
10200: 00500793      li     a5,1
10184: fef42023      sw     a5,-20(s0)
101a8: 0200006f      j      101c8 <_exit+0x44>
101ac: fe042783      lw     a4,-24(s0)
101b0: fec42783      lw     a5,-20(s0)
101b4: 00f707bb      addw   a5,a4,a5
101b8: fecf4243      sw     a5,-24(s0)
101bc: fec42783      lw     a5,-20(s0)
101c0: 0017879b      addiw  a5,a5,1
101c4: fecf4263      sw     a5,-20(s0)
101c8: fec42783      lw     a4,-20(s0)
101cc: fec42783      lw     a5,-28(s0)
101d0: 0007071b      sext.w a4,a4
101d4: 0007879b      sext.w a5,a5
101d8: fec740e3      bge    a5,a4,101ac <_exit+0x28>
101dc: fe042783      lw     a4,-24(s0)
101e0: fec42783      lw     a5,-28(s0)
101e4: 00070613      mv     a2,a4
101e8: 00078593      mv     a1,a5
101ec: 000217b7      lui    a5,0x21
101f0: 1e078513      addi   a0,a5,408 # 211e0 <__clzdl2+0x48>
101f4: 274000ef      jal    ra,10460 <printf>
101f8: 00000793      li     a5,0
101fc: 00078513      mv     a0,a5
10200: 01013003      ld     ra,24(sp)
10204: 01013403      ld     s0,10(sp)
10208: 02010113      addi   sp,sp,32
1020c: 00000067      ret

0000000000010210 <atexit>:
10210: 00050593      mv     a1,a0
10214: 00000093      li     a3,0
10218: 00000613      li     a2,0
1021c: 00000513      li     a0,0
10220: 4390206f      j      12e58 <__register_exitproc>

0000000000010224 <exit>:

```

- Next I run the same commands but with different option, instead of O1, I used Ofast. This time I got less number of instructions i.e. 12. This shows that the instructions in assembly codes of the file changes for different options of compilation.

```

vdsuser@vdsuser-VirtualBox: ~
File Edit View Search Terminal Tabs Help

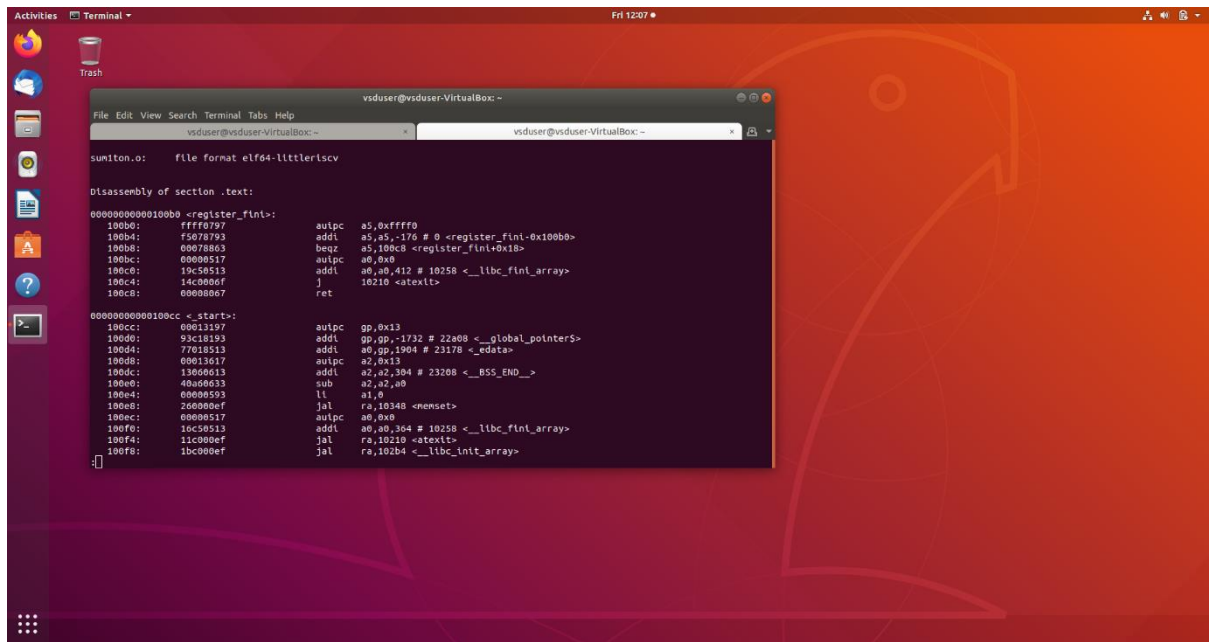
vdsuser@vdsuser-VirtualBox: ~
vdsuser@vdsuser-VirtualBox: ~

vdsuser@vdsuser-VirtualBox:~$ cat sumiton.c
#include <stdio.h>

int main() {
    int i, sum = 0, n = 100;
    for (i=1; i <= n; ++i) {
        sum += i;
    }
    printf("Sum of numbers from 1 to %d is %d\n", n, sum);
    return 0;
}

vdsuser@vdsuser-VirtualBox:~$ riscv64-unknown-elf-gcc -o1 -mabi=lp64 -march=rv64l -o sumiton.o sumiton.c
riscv64-unknown-elf-gcc: command not found
vdsuser@vdsuser-VirtualBox:~$ riscv64-unknown-elf-gcc -o1 -mabi=lp64 -march=rv64l -o sumiton.o sumiton.c
vdsuser@vdsuser-VirtualBox:~$ ls -ltr sumiton.o
vdsuser@vdsuser-VirtualBox:~$ riscv64-unknown-elf-gcc -ofast -mabi=lp64 -march=rv64l -o sumiton.o sumiton.c

```



```
sumiton.o: file format elf64-littleriscv

Disassembly of section .text:

0000000000100b0: <register_fini>:
100b0: fffff797          auipc a5,0xfffff0
100b4: 75b78793          addi a5,a5,-176 # 0 <register_fini-0x100b0>
100b8: 00078063          beqz a5,100c0 <register_fini+0x18>
100bc: 00000517          auipc a0,0x0
100c0: 19c50513          addi a0,a0,412 # 10258 <__libc_fini_array>
100c4: 14c0000f          j 10210 <atexit>
100c8: 00000067          ret

0000000000100cc: <start>:
100cc: 00e13197          auipc gp,0x13
100d0: 93c18193          addi gp,gp,-1732 # 22a08 <__global_pointer$>
100d4: 77618513          addi a0,gp,1904 # 23178 <edata>
100d8: 00e13017          auipc a2,0x13
100dc: 13000013          addi a2,a2,304 # 23208 <_BSS_END__>
100e0: 40a00033          sub a2,a2,a0
100e4: 00000593          li a1,9
100e8: 200000ef          jal ra,10340 <mempset>
100ec: 00000517          auipc a0,0x0
100f0: 10c50513          addi a0,a0,304 # 10258 <__libc_fini_array>
100f4: 11c000ef          jal ra,10210 <atexit>
100f8: 1bc000ef          jal ra,102b4 <__libc_init_array>
```

That is it for Task1!