

Shubhan Singh

SE-Comps B/Batch C

2022300118

OS Experiment 2: Implementing static and dynamic linking

(All source code files are submitted on moodle)

Aim: Write a program for creating a static/dynamic link library for complex number operations and then test this library through linuxld linker.

Part 1:

LAB:

Files used:

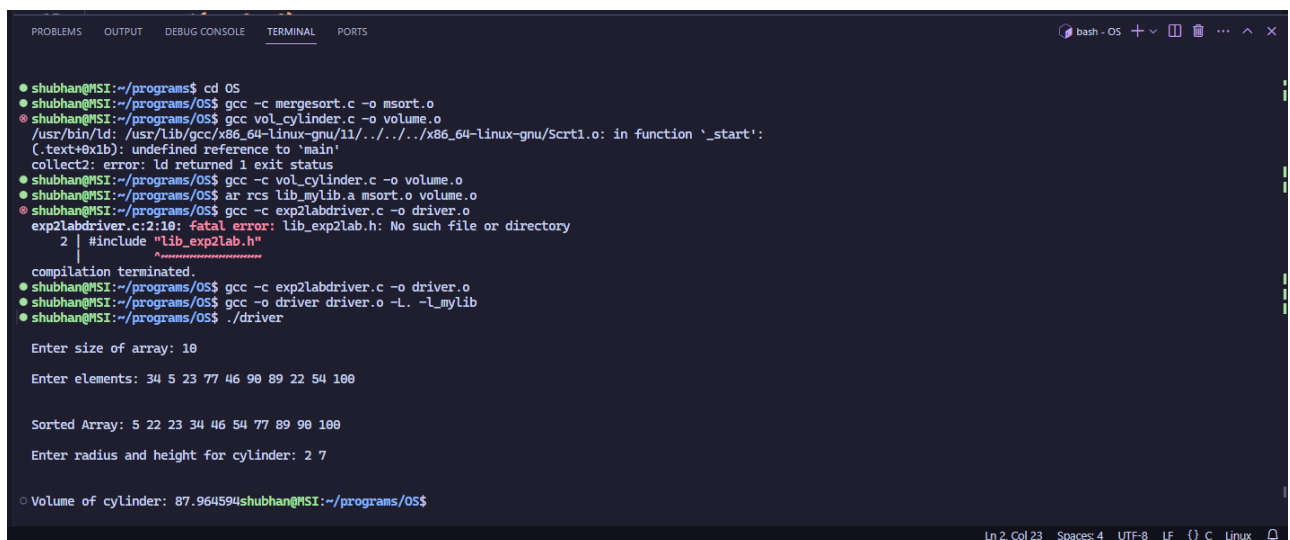
mergesort.c

vol_cylinder.c

lib_mylib.h

exp2labdriver.c

Running static linking:



```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● shubhan@MSI:~/programs$ cd OS
● shubhan@MSI:~/programs/OS$ gcc -c mergesort.c -o msort.o
● shubhan@MSI:~/programs/OS$ gcc vol_cylinder.c -o volume.o
● shubhan@MSI:~/programs/OS$ gcc -c exp2labdriver.c -o driver.o
exp2labdriver.c:2:10: fatal error: lib_exp2lab.h: No such file or directory
  2 | #include "lib_exp2lab.h"
    |          ^
compilation terminated.
● shubhan@MSI:~/programs/OS$ gcc -c exp2labdriver.c -o driver.o
● shubhan@MSI:~/programs/OS$ gcc -o driver driver.o -l. -l_mylib
● shubhan@MSI:~/programs/OS$ ./driver

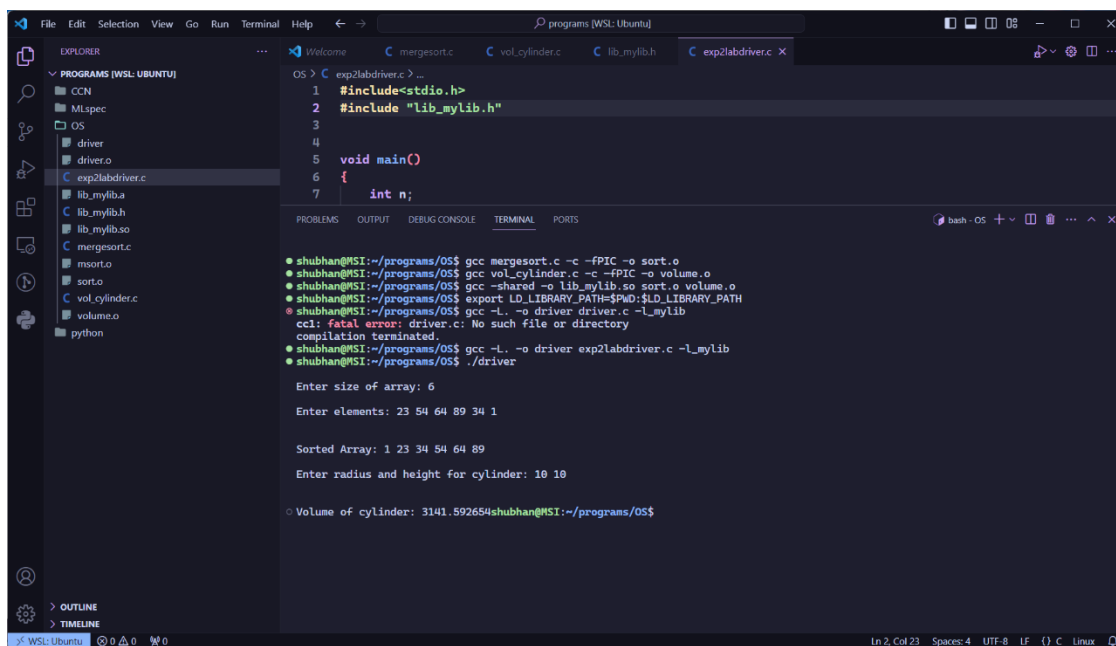
Enter size of array: 10
Enter elements: 34 5 23 77 46 98 89 22 54 100

Sorted Array: 5 22 23 34 46 54 77 89 98 100

Enter radius and height for cylinder: 2 7

○ Volume of cylinder: 87.964594shubhan@MSI:~/programs/OS$
```

Running dynamic linking:



The screenshot shows a Visual Studio Code editor window with the following content:

EXPLORER (WSL: UBUNTU)

- CCN
- MLSpec
- OS
 - driver
 - driver.o
 - exp2labdriver.c
 - lib_mylib.a
 - lib_mylib.h
 - lib_mylib.so
 - mergesort.c
 - msort.o
 - sort.o
 - vol_cylinder.c
 - volume.o
 - python

OS > C exp2labdriver.c

```
1 #include<stdio.h>
2 #include "lib_mylib.h"
3
4
5 void main()
6 {
7     int n;
```

TERMINAL

```
shubhan@MSI:~/programs/OS$ gcc mergesort.c -c -fPIC -o sort.o
shubhan@MSI:~/programs/OS$ gcc vol_cylinder.c -c -fPIC -o volume.o
shubhan@MSI:~/programs/OS$ gcc -shared -o lib_mylib.so sort.o volume.o
shubhan@MSI:~/programs/OS$ export LD_LIBRARY_PATH=$PWD:$LD_LIBRARY_PATH
shubhan@MSI:~/programs/OS$ gcc -L. -o driver driver.c -l_mylib
cc1: fatal error: driver.c: No such file or directory
compilation terminated.
shubhan@MSI:~/programs/OS$ gcc -L. -o driver exp2labdriver.c -l_mylib
shubhan@MSI:~/programs/OS$ ./driver

Enter size of array: 6
Enter elements: 23 54 64 89 34 1

Sorted Array: 1 23 34 54 64 89
Enter radius and height for cylinder: 10 10

Volume of cylinder: 3141.592654shubhan@MSI:~/programs/OS$
```

Part 2:

Aim: Write a program for creating a static/dynamic link library for complex number arithmetic.

Files used:

add_sub.c

mult_div.c

lib_mylib3.c

exp2lab2driver.c

Running static linking:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● shubhan@MSI:~/programs/OS$ gcc -c add_sub.c -o a.o
● shubhan@MSI:~/programs/OS$ gcc -c mult_div.c -o m.o
● shubhan@MSI:~/programs/OS$ ar rcs lib_mylib3.a a.o m.o
● shubhan@MSI:~/programs/OS$ gcc -c exp2lab2driver.c -o driver3.o
● shubhan@MSI:~/programs/OS$ gcc -o driver3 driver3.o -L. -l_mylib3
● shubhan@MSI:~/programs/OS$ ./driver3
Enter real and imaginary component of first complex number:
2 4
Enter real and imaginary component of second complex number:
6 7
(2 + 4i) + (6 + 7i) = (8) + (11)i
(2 + 4i) - (6 + 7i) = (-4) + (-3)i
(2 + 4i) * (6 + 7i) = (-16) + (38)i
(2 + 4i) / (6 + 7i) = (0.47) + (0.12)i
○ shubhan@MSI:~/programs/OS$
```

Running dynamic linking:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
● shubhan@MSI:~/programs/OS$ gcc add_sub.c -c -fPIC -o a.o
● shubhan@MSI:~/programs/OS$ gcc mult_div.c -c -fPIC -o m.o
● shubhan@MSI:~/programs/OS$ gcc -shared -o lib_mylib3.so a.o m.o
● shubhan@MSI:~/programs/OS$ export LD_LIBRARY_PATH=$PATH:$LD_LIBRARY_PATH
● shubhan@MSI:~/programs/OS$ gcc -L. -o driver3 exp2lab2driver.c -l_mylib3
● shubhan@MSI:~/programs/OS$ ./driver
bash: ./driver: No such file or directory
● shubhan@MSI:~/programs/OS$ ./driver3
Enter real and imaginary component of first complex number:
2 4
Enter real and imaginary component of second complex number:
6 7
(2 + 4i) + (6 + 7i) = (8) + (11)i
(2 + 4i) - (6 + 7i) = (-4) + (-3)i
(2 + 4i) * (6 + 7i) = (-16) + (38)i
(2 + 4i) / (6 + 7i) = (0.47) + (0.12)i
○ shubhan@MSI:~/programs/OS$
```

Part 3:

Post lab question: Create a scientific calculator program in C using static and dynamic linking. Create a separate file for each operation:

1. Basic arithmetic operations (addition, subtraction, multiplication, and division)
2. Trigonometric operations (sine, cosine, and tangent)
3. Logarithmic operations (natural logarithm and log base 10)
4. Exponential operations (e^x and x^y)

5. Factorial operation (n!)

Source Code:

arithmetic.c

logarithmic.c

exponential.c

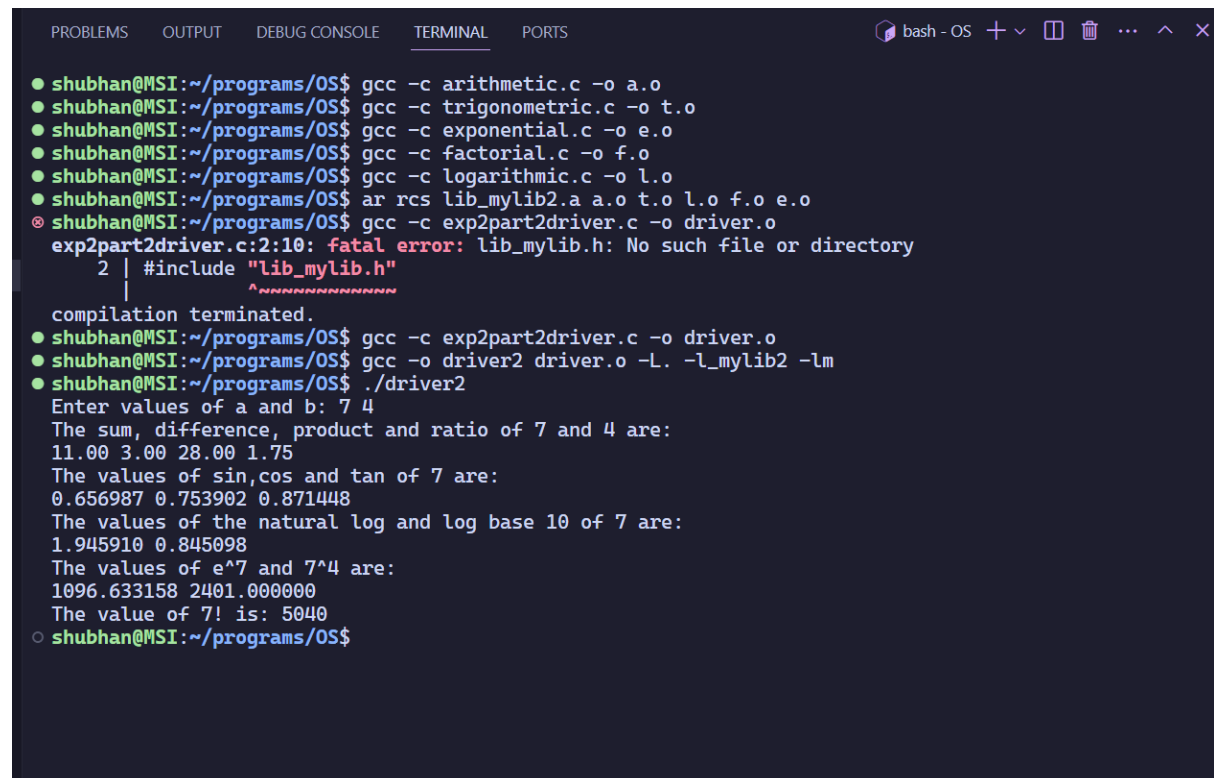
trigonometric.c

factorial.c

lib_mylib2.h

exp2part2driver.c

Running static linking:



```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS bash - OS + v [ ] [ ] ... ^ x

● shubhan@MSI:~/programs/OS$ gcc -c arithmetic.c -o a.o
● shubhan@MSI:~/programs/OS$ gcc -c trigonometric.c -o t.o
● shubhan@MSI:~/programs/OS$ gcc -c exponential.c -o e.o
● shubhan@MSI:~/programs/OS$ gcc -c factorial.c -o f.o
● shubhan@MSI:~/programs/OS$ gcc -c logarithmic.c -o l.o
● shubhan@MSI:~/programs/OS$ ar rcs lib_mylib2.a a.o t.o l.o f.o e.o
⊗ shubhan@MSI:~/programs/OS$ gcc -c exp2part2driver.c -o driver.o
exp2part2driver.c:2:10: fatal error: lib_mylib.h: No such file or directory
  2 | #include "lib_mylib.h"
    | ^~~~~~
compilation terminated.
● shubhan@MSI:~/programs/OS$ gcc -c exp2part2driver.c -o driver.o
● shubhan@MSI:~/programs/OS$ gcc -o driver2 driver.o -L. -l_mylib2 -lm
● shubhan@MSI:~/programs/OS$ ./driver2
Enter values of a and b: 7 4
The sum, difference, product and ratio of 7 and 4 are:
11.00 3.00 28.00 1.75
The values of sin,cos and tan of 7 are:
0.656987 0.753902 0.871448
The values of the natural log and log base 10 of 7 are:
1.945910 0.845098
The values of e^7 and 7^4 are:
1096.633158 2401.000000
The value of 7! is: 5040
○ shubhan@MSI:~/programs/OS$
```

Running dynamic linking:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS bash - OS + - [ ] [ ] ... ^ x

● shubhan@MSI:~/programs/OS$ gcc arithmetic.c -c -fPIC -o a.o -lm
● shubhan@MSI:~/programs/OS$ gcc logarithmic.c -c -fPIC -o l.o -lm
● shubhan@MSI:~/programs/OS$ gcc exponential.c -c -fPIC -o e.o -lm
● shubhan@MSI:~/programs/OS$ gcc trigonometric.c -c -fPIC -o t.o -lm
● shubhan@MSI:~/programs/OS$ gcc factorial.c -c -fPIC -o f.o -lm
● shubhan@MSI:~/programs/OS$ gcc -shared -o lib_mylib2.so a.o l.o e.o t.o f.o
⊗ shubhan@MSI:~/programs/OS$ export LD_LIBRARY_PATH:$PWD:$LD_LIBRARY_PATH
bash: export: `LD_LIBRARY_PATH:/home/shubhan/programs/OS:`: not a valid identifier
● shubhan@MSI:~/programs/OS$ export LD_LIBRARY_PATH=$PWD:$LD_LIBRARY_PATH
● shubhan@MSI:~/programs/OS$ gcc -L. -o driver2 exp2part2driver.c -l_mylib2 -lm
● shubhan@MSI:~/programs/OS$ ./driver2
Enter values of a and b: 7 4
The sum, difference, product and ratio of 7 and 4 are:
11.00 3.00 28.00 1.75
The values of sin,cos and tan of 7 are:
0.656987 0.753902 0.871448
The values of the natural log and log base 10 of 7 are:
1.945910 0.845098
The values of e^7 and 7^4 are:
1096.633158 2401.000000
The value of 7! is: 5040
○ shubhan@MSI:~/programs/OS$
```

Ln 1, Col 19 Spaces: 4 UTF-8 LF {} C Linux