

Embedded linux

Task_1

Static Linking :

```
tarek@tarek-VirtualBox: ~/iti/Bishoy/library/staticLib_lab/lib
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -c sub.c -o sub.o
/usr/bin/ld: /usr/lib/gcc/x86_64-linux-gnu/11/../../../../x86_64-linux-gnu/Scrt1.o: in function `_start':
(.text+0x1b): undefined reference to `main'
collect2: error: ld returned 1 exit status
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -c sub.c -o sub.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -c div.c -o div.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -c mult.c -o mult.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -c modl.c -o modl.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ls
add.c add.o div.c div.o main.c modl.c modl.o mult.c mult.o sub.c sub.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -c main.c -o main.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ls
add.c add.o div.c div.o main.c main.o modl.c modl.o mult.c mult.o sub.c sub.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ar -rcs libCalculator.a add.o sub.o mult.o div.o modl.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ls
add.c add.o div.c div.o libCalculator.a main.c main.o modl.c modl.o mult.c mult.o sub.c sub.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ cat libCalculator.a
!
/
r~
addsubmultdivmodladd.o/
ELF>
GCC: (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0GNUzRx
```

```
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -o main.exe main.o -L. libCalculator.a
/usr/bin/ld: cannot find libCalculator.a: No such file or directory
collect2: error: ld returned 1 exit status
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -o main.exe main.o -L. libCalculator.a
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ls
add.c add.o div.c div.o libCalculator.a main.c main.exe main.o modl.c modl.o mult.c mult.o sub.c sub.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ./main.exe
subtraction = 5
addition = 15
multiplication = 50
division = 2
modulus = 0
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$
```

Ldd !!

& file

```
tarek@tarek-VirtualBox: ~/iti/Bishoy/library/staticLib_lab/lib
modulus = 0
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ldd main.exe
linux-vdso.so.1 (0x00007ffe1c0de000)
libc.so.6 => /lib/x86_64-linux-gnu/libc.so.6 (0x00007f0f36c00000)
/lib64/ld-linux-x86-64.so.2 (0x00007f0f36cf0000)
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ file main.exe
main.exe: ELF 64-bit LSB pie executable, x86-64, version 1 (SYSV), dynamically linked, interpreter /lib64/ld-linux-x86-64.so.2, BuildID[sha1]=2eab355d7ced0796de310170e219844b2583793d, for GNU/Linux 3.2.0, not stripped
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ objdump main.exe
Usage: objdump <option(s)> <file(s)>
Display information from object <file(s)>.
At least one of the following switches must be given:
-a, --archive-headers    Display archive header information
-f, --file-headers       Display the contents of the overall file header
-p, --private-headers    Display object format specific file header contents
-P, --private=OPT,OPT... Display object format specific contents
-h, --[section-]headers   Display the contents of the section headers
-x, --all-headers         Display the contents of all headers
-d, --disassemble         Display assembler contents of executable sections
-D, --disassemble-all    Display assembler contents of all sections
--disassemble=<sym>      Display assembler contents from <sym>
-S, --source              Intermix source code with disassembly
--source-comment[=<txt>] Prefix lines of source code with <txt>
-s, --full-contents       Display the full contents of all sections requested
-g, --debugging            Display debug information in object file
-e, --debugging-tags       Display debug information using CTAGS style
-G, --stabs                Display (in raw form) any STABS info in the file
-W, --dwarf[a/=abbrev, A/=addr, r/=ranges, c/=cu_index, l/=decodedline,
f/=frames, F/=frames-interp, g/=gdb_index, i/=info, o/=loc,
m/=macro, p/=pubnames, t/=pubtypes, R/=Ranges, l/=rawline,
s/=str, O/=str-offsets, u/=trace_abbrev, T/=trace_ranges,
U/=trace_info]            Display the contents of DWARF debug sections
```

Objdump:

```
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ objdump -T main_StaticLink.exe

main_StaticLink.exe:      file format elf64-x86-64

DYNAMIC SYMBOL TABLE:
0000000000000000      DF *UND* 0000000000000000 (GLIBC_2.34) __libc_start_main
0000000000000000      D  *UND* 0000000000000000 Base      _ITM_deregisterTMCloneTable
0000000000000000      DF *UND* 0000000000000000 (GLIBC_2.2.5) printf
0000000000000000      D  *UND* 0000000000000000 Base      _gmon_start__
0000000000000000      w  D  *UND* 0000000000000000 Base      _ITM_registerTMCloneTable
0000000000000000      w  D  *UND* 0000000000000000 Base      div
00000000000001268  g  DF .text 0000000000000017 Base      div
0000000000000000      w  DF *UND* 0000000000000000 (GLIBC_2.2.5) __cxa_finalize

tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ objdump -D main_StaticLink.exe
```

Dynamic Linking:

```
tarek@tarek-VirtualBox: ~/iti/Bishoy/library/staticLib_lab/lib
collect2: error: ld returned 1 exit status
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ gcc -o main_DynamicLink.exe main.o -L. -lCalculator
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ls
add.c  div.c  libCalculator.a  main.c          main.o          modl.c  mult.c  sub.c
add.o  div.o  libCalculator.so  main_DynamicLink.exe  main_StaticLink.exe  modl.o  mult.o  sub.o
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ./main_DynamicLink.exe
./main_DynamicLink.exe: error while loading shared libraries: libCalculator.so: cannot open shared object file: No such file or directory
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ldd main_DynamicLink.exe
        linux-vdso.so.1 (0x00007ffc2a4ac000)
        libCalculator.so => not found
        libc.so.6 => /lib/x86_64-linux-gnu/libc.so.6 (0x00007f87e9c00000)
        /lib64/ld-linux-x86-64.so.2 (0x00007f87e9f73000)
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ sudo cp libCalculator.so /usr/lib
[sudo] password for tarek:
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ./main_DynamicLink.exe
subtraction = 5
addition = 15
multiplication = 50
division = 2
```

Ldd & file commands

```
tarek@tarek-VirtualBox: ~/iti/Bishoy/library/staticLib_lab/lib
subtraction = 2
modulus = 0
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ sudo rm /usr/lib/libCalculator.so
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ./main_DynamicLink.exe
./main_DynamicLink.exe: error while loading shared libraries: libCalculator.so: cannot open shared object file: No such file or directory
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ pwd
/home/tarek/iti/Bishoy/library/staticLib_lab/lib
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ export LD_LIBRARY_PATH=./home/tarek/iti/Bishoy/library/staticLib_lab/lib
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ./main_DynamicLink.exe
subtraction = 5
addition = 15
multiplication = 50
division = 2
modulus = 0
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ ldd main_DynamicLink.exe
        linux-vdso.so.1 (0x00007fff386a9000)
        libCalculator.so (0x00007f66edf97000)
        libc.so.6 => /lib/x86_64-linux-gnu/libc.so.6 (0x00007f66edc00000)
        /lib64/ld-linux-x86-64.so.2 (0x00007f66edfa3000)
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ file main_DynamicLink.exe
main_DynamicLink.exe: ELF 64-bit LSB pie executable, x86-64, version 1 (SYSV), dynamically linked, interpreter /lib64/ld-linux-x86-64.so.2, BuildID[sha1]: bdc374047060e7e33476f501edfa42447e3f
```

```
tarek@tarek-VirtualBox: ~/iti/Bishoy/library/staticLib_lab/lib$ file main_DynamicLink.exe
main_DynamicLink.exe: ELF 64-bit LSB pie executable, x86-64, version 1 (SYSV), dynamically link
ed, interpreter /lib64/ld-linux-x86-64.so.2, BuildID[sha1]=bdc271017069c7a22176f501cdfc43147e2f
2380, for GNU/Linux 3.2.0, not stripped
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ objdump main_DynamicLink.exe
Usage: objdump <option(s)> <file(s)>
Display information from object <file(s)>.
At least one of the following switches must be given:
-a, --archive-headers    Display archive header information
-f, --file-headers       Display the contents of the overall file header
-p, --private-headers    Display object format specific file header contents
-P, --private=OPT,OPT... Display object format specific contents
-h, --[section-]headers  Display the contents of the section headers
-x, --all-headers         Display the contents of all headers
-d, --disassemble        Display assembler contents of executable sections
-D, --disassemble-all   Display assembler contents of all sections
    --disassemble=<sym>  Display assembler contents from <sym>
-S, --source             Intermix source code with disassembly
    --source-comment[=<txt>] Prefix lines of source code with <txt>
-s, --full-contents       Display the full contents of all sections requested
-g, --debugging           Display debug information in object file
-e, --debugging-tags      Display debug information using ctags style
-G, --stabs               Display (in raw form) any STABS info in the file
```

Objdump command with -T option:

```
tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$ objdump -T main_DynamicLink.exe

main_DynamicLink.exe:      file format elf64-x86-64

DYNAMIC SYMBOL TABLE:
0000000000000000      DF *UND* 0000000000000000 (GLIBC_2.34) __libc_start_main
0000000000000000      w D  *UND* 0000000000000000 Base      _ITM_deregisterTMCloneTable
0000000000000000      DF *UND* 0000000000000000 Base      add
0000000000000000      DF *UND* 0000000000000000 Base      modl
0000000000000000      DF *UND* 0000000000000000 Base      div
0000000000000000      DF *UND* 0000000000000000 (GLIBC_2.2.5) printf
0000000000000000      w D  *UND* 0000000000000000 Base      __gmon_start__
0000000000000000      DF *UND* 0000000000000000 Base      mult
0000000000000000      w D  *UND* 0000000000000000 Base      _ITM_registerTMCloneTable
0000000000000000      DF *UND* 0000000000000000 Base      sub
0000000000000000      w DF *UND* 0000000000000000 (GLIBC_2.2.5) __cxa_finalize

tarek@tarek-VirtualBox:~/iti/Bishoy/library/staticLib_lab/lib$
```