

Advanced Embedded Software Development

Homework 1


-Ashish Tak

Problem 1

ECEE Classroom Lab Policy Agreement - Message - Mail

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ECEE Classroom Lab Policy Agreement

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ECEE Classroom Lab Policy Agreement

You will be emailed a copy of your responses. Please make sure to read and understand everything you agree to. If you violate any of the terms here, your lab access may be revoked. For any questions, email ecehelp@colorado.edu.

Your email address (asta0463@colorado.edu) was recorded when you submitted this form.

Student Commitment as a Lab User

I understand that *

☒ [X] No food or drinks are allowed in the lab at the computer stations. Water bottles may be brought in but left off of the computer stations. Food should be eaten before entering the lab.

☒ [X] I have an obligation to help keep the labs, computers, and equipment in good working condition.

☒ [X] My login and access card are for my personal use only. I will not disclose this information or give my access to another person.

☒ [X] If I bring guests into the lab I am responsible for their behavior and they must leave the lab with me.

☒ [X] I will not prop open any doors, or grant entry to any unknown person(s).

☒ [X] I will act professionally in the lab, treating my teaching assistants and fellow students with respect, and I will adhere to the University of Colorado's Honor Code and Student Code of Ethics.

Problem 6

<Bash script (sysinfo.sh) and output file(log.txt) in the git repository>

Problem 7

Executing the static library version of the application:

```
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ ./hello-arm-static
Hello from ARM
add_ints
4 + 5 = 9
multiply_ints
4 * 5 = 20
```

Executing the shared library version of the application:

```
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ LD_LIBRARY_PATH=./shared ./hello-arm-shared
Hello from ARM
add_ints
4 + 5 = 9
multiply_ints
4 * 5 = 20
```

Shared library results in a lesser size (8416 vs 11232):

```
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ ls -l hello-arm-static
-rwxr-xr-x 1 ashish ashish 11232 Jan 23 21:03 hello-arm-static
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ ls -l hello-arm-shared
-rwxr-xr-x 1 ashish ashish 8416 Jan 23 21:03 hello-arm-shared
```

Shared library usage of each executable:

```
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-static | grep "Shared library"
0x0000000000000001 (NEEDED)      Shared library: [libc.so.6]
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-shared | grep "Shared library"
0x0000000000000001 (NEEDED)      Shared library: [libtest.so]
0x0000000000000001 (NEEDED)      Shared library: [libc.so.6]
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-shared | grep "program interpreter"
[Requesting program interpreter: /lib64/ld-linux-x86-64.so.2]
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-static | grep "program interpreter"
[Requesting program interpreter: /lib64/ld-linux-x86-64.so.2]
```

Problem 8

Crosstool-NG toolchain for the Beaglebone Black

Version and configuration info:

```
ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm/crosstool-ng$ ./ct-ng arm-cortex_a8-linux-gnueabi -v
GNU Make 4.1
Built for x86_64-pc-linux-gnu
Copyright (C) 1988-2014 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
```

(Sysroot directory: ~/x-tools/arm-cortex_a8-linux-gnueabi/hf/arm-cortex_a8-linux-gnueabi/hf/sysroot)

Size of executables:

```
ashish@Merseyside:~/Documents/Homework1_build2/MELP/Chapter02/library/hello-arm$ ls -l hello-arm-shared
-rwxr-xr-x 1 ashish ashish 12228 Jan 25 10:40 hello-arm-shared
ashish@Merseyside:~/Documents/Homework1_build2/MELP/Chapter02/library/hello-arm$ ls -l hello-arm-static
-rwxr-xr-x 1 ashish ashish 14788 Jan 25 10:40 hello-arm-static
```

Shared library usage of each executable:

```
ashish@Merseyside:~/Documents/Homework1_build2/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-static | grep "Shared library"
0x00000001 (NEEDED) Shared library: [libc.so.6]
ashish@Merseyside:~/Documents/Homework1_build2/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-shared | grep "Shared library"
0x00000001 (NEEDED) Shared library: [libtest.so]
0x00000001 (NEEDED) Shared library: [libc.so.6]
ashish@Merseyside:~/Documents/Homework1_build2/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-shared | grep "program interpreter"
[Requesting program interpreter: /lib/ld-linux-armhf.so.3]
ashish@Merseyside:~/Documents/Homework1_build2/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-static | grep "program interpreter"
[Requesting program interpreter: /lib/ld-linux-armhf.so.3]
```

Crosstool-NG toolchain for QEMU emulator

Version and configuration info:

```
[165:47] / ashish@Merseyside:~/Documents/Homework1/MELP/Chapter02/library/hello-arm/crosstool-ng$ ./ct-ng arm-unknown-linux-gnueabi -v
GNU Make 4.1
Built for x86_64-pc-linux-gnu
Copyright (C) 1988-2014 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
```

Size of executables:

```
ashish@Merseyside:~/Documents/Homework1_build3/MELP/Chapter02/library/hello-arm$ ls -l hello-arm-shared
-rwxr-xr-x 1 ashish ashish 12168 Jan 26 00:26 hello-arm-shared
ashish@Merseyside:~/Documents/Homework1_build3/MELP/Chapter02/library/hello-arm$ ls -l hello-arm-static
-rwxr-xr-x 1 ashish ashish 14736 Jan 26 00:26 hello-arm-static
```

Shared library usage of each executable:

```
ashish@Merseyside:~/Documents/Homework1_build3/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-shared | grep "Shared library"
0x00000001 (NEEDED)      Shared library: [libtest.so]
0x00000001 (NEEDED)      Shared library: [libc.so.6]
ashish@Merseyside:~/Documents/Homework1_build3/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-static | grep "Shared library"
0x00000001 (NEEDED)      Shared library: [libc.so.6]
ashish@Merseyside:~/Documents/Homework1_build3/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-static | grep "program interpreter"
[Requesting program interpreter: /lib/ld-linux.so.3]
ashish@Merseyside:~/Documents/Homework1_build3/MELP/Chapter02/library/hello-arm$ readelf -a hello-arm-shared | grep "program interpreter"
[Requesting program interpreter: /lib/ld-linux.so.3]
```