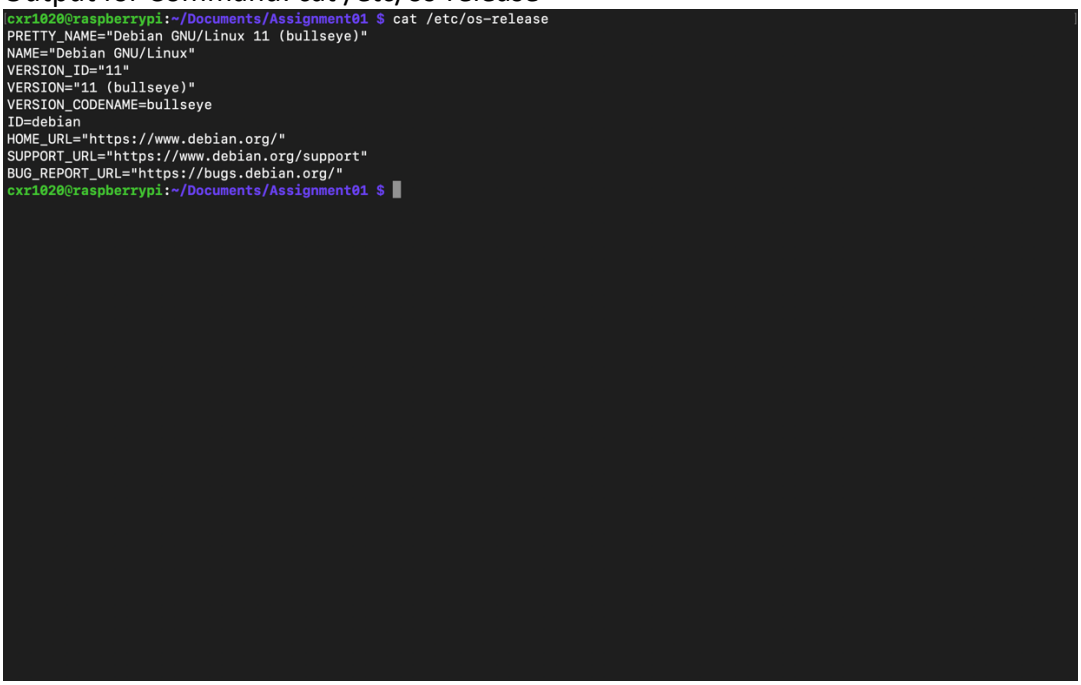
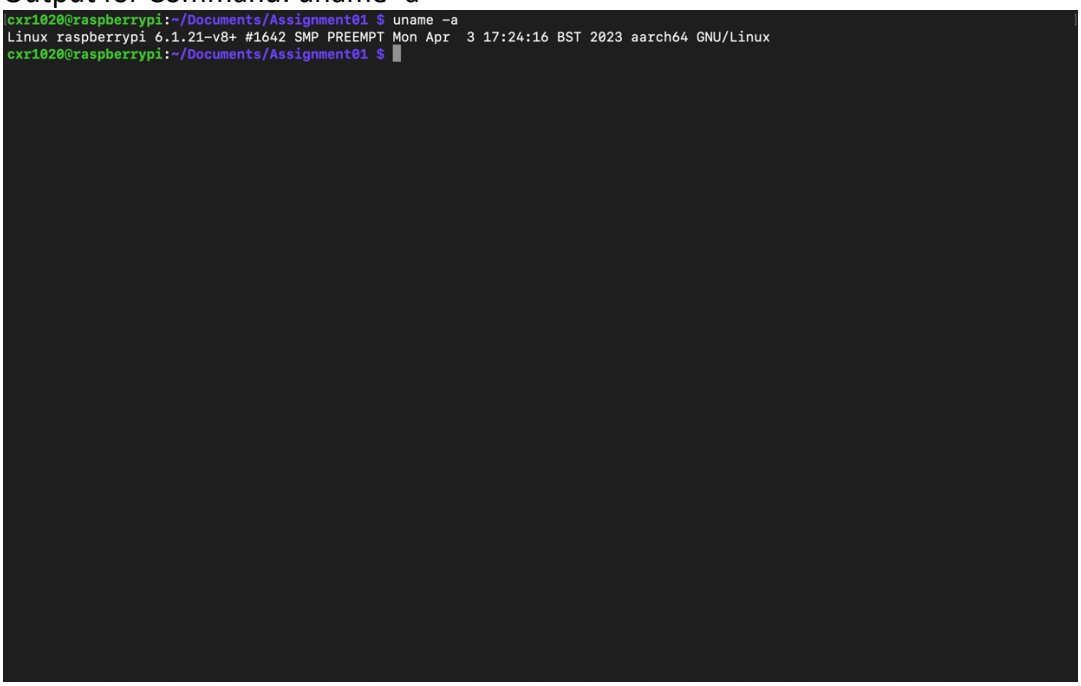
Lesson 1: Intro To Embedded Linux (Assignment 1)

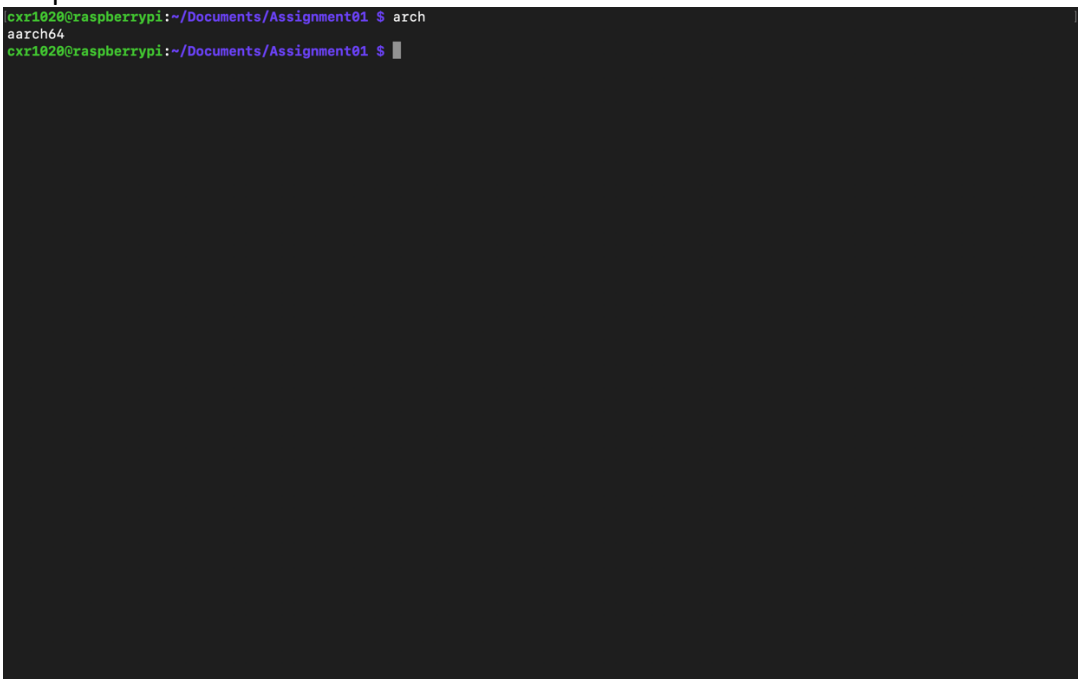
Output for Command: cat /etc/os-release



Output for Command: uname -a



Output for Command: arch



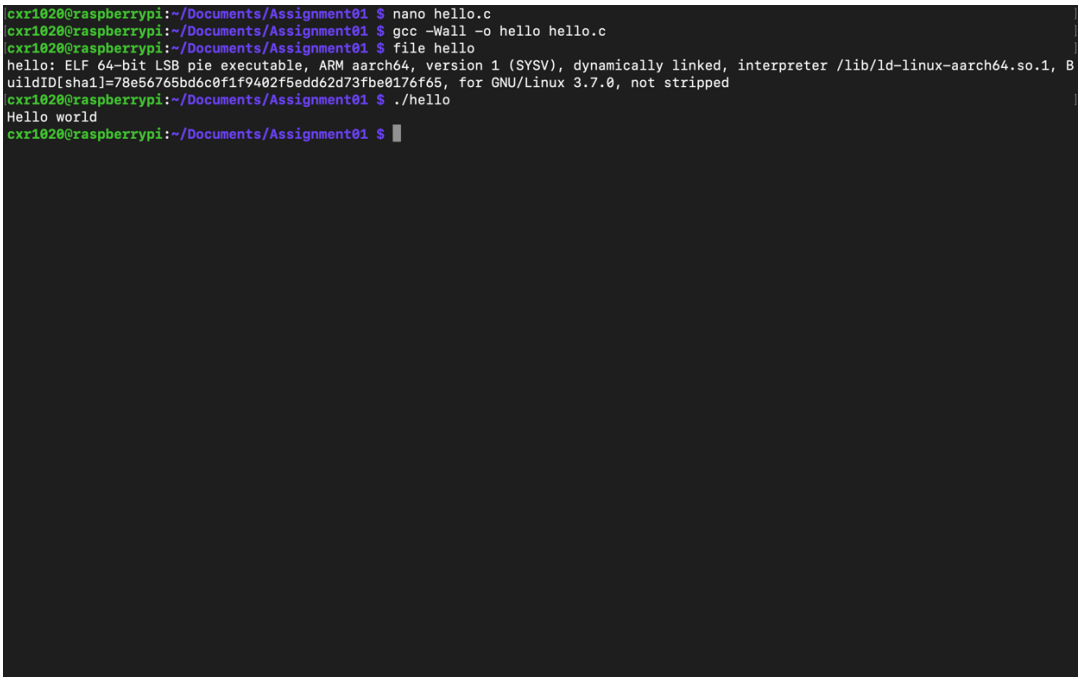
Show your hello.c source code and also the commands/output of building and running the code.

- Source Code

- Commands / Output

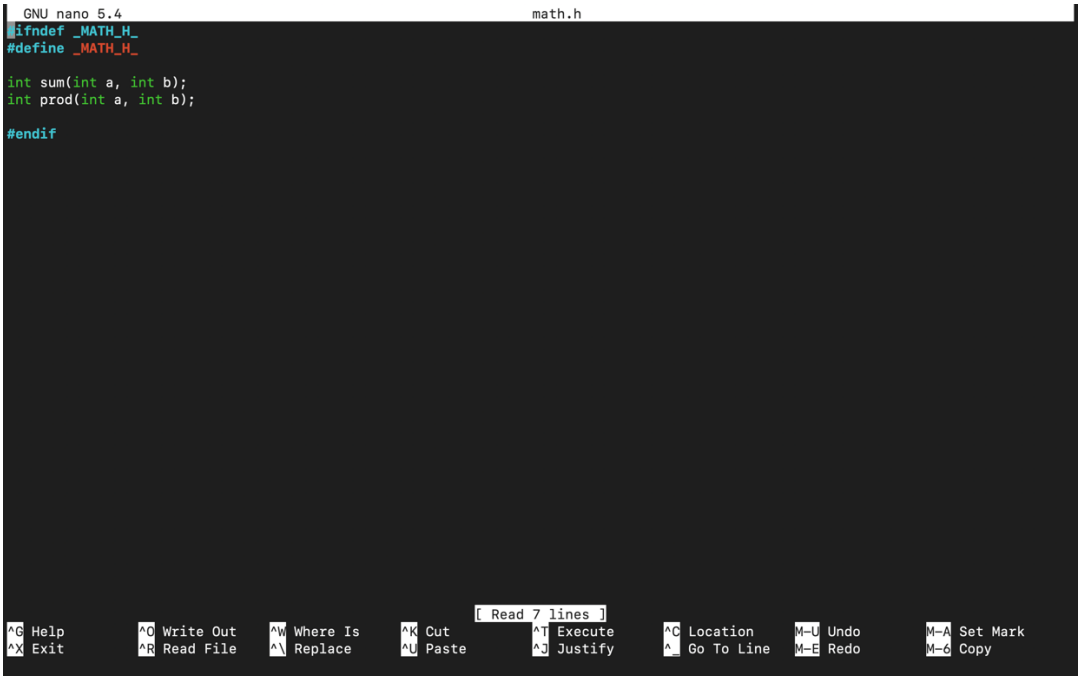
```
cxr1020@raspberrypi:~/Documents/Assignment01 $ nano hello.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o hello hello.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ file hello
hello: ELF 64-bit LSB pie executable, ARM aarch64, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-aarch64.so.1, B
uildID[sha1]=78e56765bd6c0f1f9402f5edd62d73fbe0176f65, for GNU/Linux 3.7.0, not stripped
cxr1020@raspberrypi:~/Documents/Assignment01 $
```

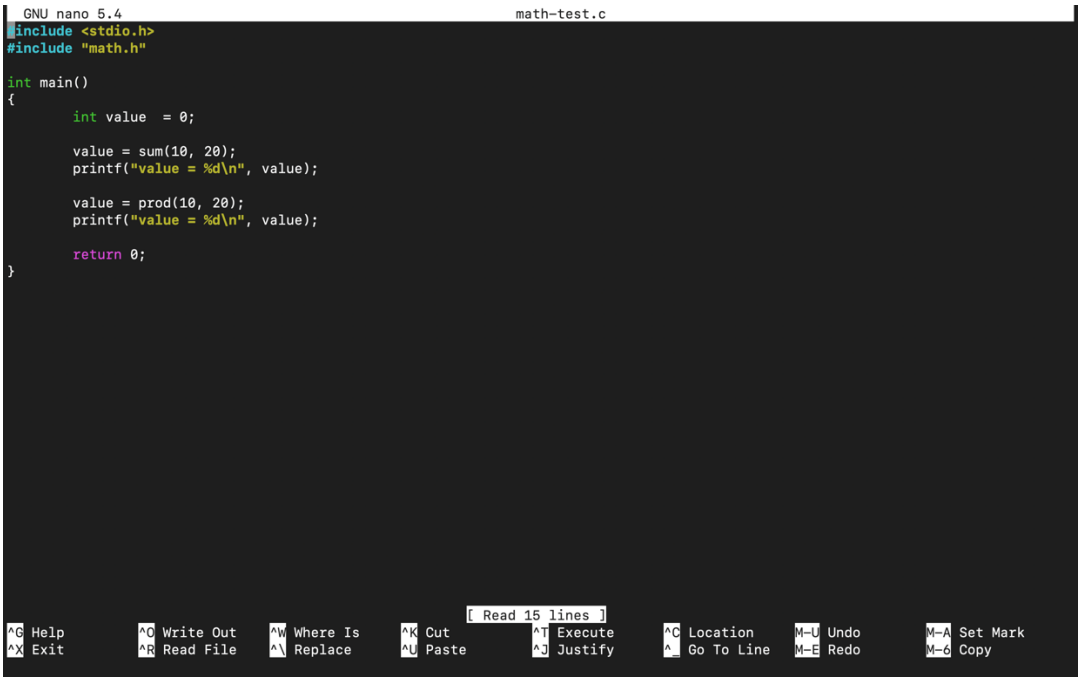
```
cxr1020@raspberrypi:~/Documents/Assignment01 $ nano hello.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o hello hello.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ file hello
hello: ELF 64-bit LSB pie executable, ARM aarch64, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-aarch64.so.1, B
uildID[sha1]=78e56765bd6c0f1f9402f5edd62d73fbe0176f65, for GNU/Linux 3.7.0, not stripped
cxr1020@raspberrypi:~/Documents/Assignment01 $ ./hello
Hello world
cxr1020@raspberrypi:~/Documents/Assignment01 $ ldd hello
        linux-vdso.so.1 (0x0000007f83590000)
        libc.so.6 => /lib/aarch64-linux-gnu/libc.so.6 (0x0000007f833c8000)
        /lib/ld-linux-aarch64.so.1 (0x0000007f83560000)
cxr1020@raspberrypi:~/Documents/Assignment01 $
```


cxr1020@raspberrypi:~/Documents/Assignment01 $ nano hello.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o hello hello.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ file hello
hello: ELF 64-bit LSB pie executable, ARM aarch64, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-aarch64.so.1, B
uildID[sha1]=78e56765bd6c0f1f9402f5edd62d73fbe0176f65, for GNU/Linux 3.7.0, not stripped
cxr1020@raspberrypi:~/Documents/Assignment01 $ ./hello
Hello world
cxr1020@raspberrypi:~/Documents/Assignment01 $

Show your math.h, math.c, and math-test.c source code and also the commands/output of building and running of the code

- Source Codes




GNU nano 5.4
math-test.c
#include <stdio.h>
#include "math.h"
int main()
{
int value = 0;
value = sum(10, 20);
printf("value = %d\n", value);
value = prod(10, 20);
printf("value = %d\n", value);
return 0;
}
[Read 15 lines]
^G Help
^O Write Out
^W Where Is
^K Cut
^T Execute
^C Location
M-U Undo
M-A Set Mark
^X Exit
^R Read File
^\ Replace
^U Paste
^J Justify
^_ Go To Line
M-E Redo
M-6 Copy

- Commands/Outputs

```
cxr1020@raspberrypi:~/Documents/Assignment01 $ nano math-test.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o math-test math-test.c
/usr/bin/ld: /tmp/cc3hjAEv.o: in function `main':
math-test.c:(.text+0x14): undefined reference to `sum'
/usr/bin/ld: math-test.c:(.text+0x34): undefined reference to `prod'
collect2: error: ld returned 1 exit status
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o math-test math.o math-test.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ ./math-test
value = 30
value = 200
cxr1020@raspberrypi:~/Documents/Assignment01 $ ldd math-test
        linux-vdso.so.1 (0x0000007fbb025000)
        libc.so.6 => /lib/aarch64-linux-gnu/libc.so.6 (0x0000007fbae5d000)
        /lib/ld-linux-aarch64.so.1 (0x0000007fbaff5000)
cxr1020@raspberrypi:~/Documents/Assignment01 $
```

Show your commands for creating libmath.so

```
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -shared -o libmath.so math.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ ls
hello  hello.c  libmath.so  math.c  math.h  math.o  math-test  math-test.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ file libmath.so
libmath.so: ELF 64-bit LSB shared object, ARM aarch64, version 1 (SYSV), dynamically linked, BuildID[sha1]=430827f665f5135dc598821
a00d14024947013d5, not stripped
cxr1020@raspberrypi:~/Documents/Assignment01 $
```

```
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o math-test math-test.c -lmath -L.
cxr1020@raspberrypi:~/Documents/Assignment01 $ ldd math-test
        linux-vdso.so.1 (0x0000007f868d6000)
        libmath.so => not found
        libc.so.6 => /lib/aarch64-linux-gnu/libc.so.6 (0x0000007f8670e000)
        /lib/ld-linux-aarch64.so.1 (0x0000007f868a6000)
cxr1020@raspberrypi:~/Documents/Assignment01 $ LD_LIBRARY_PATH=.
cxr1020@raspberrypi:~/Documents/Assignment01 $ ldd math-test
        linux-vdso.so.1 (0x0000007fa794a000)
        libmath.so => not found
        libc.so.6 => /lib/aarch64-linux-gnu/libc.so.6 (0x0000007fa7782000)
        /lib/ld-linux-aarch64.so.1 (0x0000007fa791a000)
cxr1020@raspberrypi:~/Documents/Assignment01 $ LD_LIBRARY_PATH=. ldd math-test
        linux-vdso.so.1 (0x0000007f8cda5000)
        libmath.so => ./libmath.so (0x0000007f8cd51000)
        libc.so.6 => /lib/aarch64-linux-gnu/libc.so.6 (0x0000007f8cbcb000)
        /lib/ld-linux-aarch64.so.1 (0x0000007f8cd75000)
cxr1020@raspberrypi:~/Documents/Assignment01 $ ls
hello  hello.c  libmath.so  math.c  math.h  math-test  math-test.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ ./math-test
./math-test: error while loading shared libraries: libmath.so: cannot open shared object file: No such file or directory
cxr1020@raspberrypi:~/Documents/Assignment01 $ LD_LIBRARY_PATH =. ./math-test
-bash: LD_LIBRARY_PATH: command not found
cxr1020@raspberrypi:~/Documents/Assignment01 $ LD_LIBRARY_PATH=. ./math-test
value = 30
value = 200
cxr1020@raspberrypi:~/Documents/Assignment01 $
```

Show your math-test-dynamic.c source code and also the commands/output of building and running of the code

- Source Code

```
 GNU nano 5.4                                  math-test-dynamic.c
#include <stdio.h>
#include <dlfcn.h>

#include "math.h"

int main()
{

        void* handle = dlopen("libmath.so", RTLD_LAZY);

        if(!handle)
        {
                fprintf(stderr, "%s\n", dlerror());
        }

        int (*sum)(int a, int b);
        sum = dlsym(handle, "sum");
        if(!sum)
        {
                fprintf(stderr,"%s\n",dlerror());
        }
        else
        {
                int value = sum(10,20);
                printf("value = %d\n", value);
        }

        dlclose(handle);

        return 0;

}

                              [ Read 33 lines ]
^G Help      ^O Write Out  ^W Where Is   ^K Cut        ^T Execute   ^C Location  M-U Undo     M-A Set Mark
^X Exit      ^R Read File  ^\ Replace    ^U Paste      ^J Justify   ^_ Go To Line M-E Redo     M-6 Copy
```

- Commands/Output

```
cxr1020@raspberrypi:~/Documents/Assignment01 $ nano math-test-dynamic.c
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o math-test-dynamic math-test-dynamic.c
/usr/bin/ld: /tmp/cclrWdUb.o: in function `main':
math-test-dynamic.c:(.text+0x18): undefined reference to `dlopen'
/usr/bin/ld: math-test-dynamic.c:(.text+0x38): undefined reference to `dlerror'
/usr/bin/ld: math-test-dynamic.c:(.text+0x5c): undefined reference to `dlsym'
/usr/bin/ld: math-test-dynamic.c:(.text+0x7c): undefined reference to `dlerror'
/usr/bin/ld: math-test-dynamic.c:(.text+0xc0): undefined reference to `dlclose'
collect2: error: ld returned 1 exit status
cxr1020@raspberrypi:~/Documents/Assignment01 $ gcc -Wall -o math-test-dynamic math-test-dynamic.c -ldl
cxr1020@raspberrypi:~/Documents/Assignment01 $ ldd math-test-dynamic
        linux-vdso.so.1 (0x0000007f97e6b000)
        libdl.so.2 => /lib/aarch64-linux-gnu/libdl.so.2 (0x0000007f97e03000)
        libc.so.6 => /lib/aarch64-linux-gnu/libc.so.6 (0x0000007f97c8f000)
        /lib/ld-linux-aarch64.so.1 (0x0000007f97e3b000)
cxr1020@raspberrypi:~/Documents/Assignment01 $ ./math-test-dynamic
libmath.so: cannot open shared object file: No such file or directory
./math-test-dynamic: undefined symbol: sum
Segmentation fault
cxr1020@raspberrypi:~/Documents/Assignment01 $ LD_LIBRARY_PATH=. ./math-test-dynamic
value = 30
cxr1020@raspberrypi:~/Documents/Assignment01 $
```