

## Lesson 8 : building MicroPython : 32 bit and 64 bit (Assignment 8)

Command - dpkg --print-foreign-architectures

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $ dpkg --print-foreign-architectures  
armhf  
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $
```

SourceCode - hello\_c

```
GNU nano 5.4                                     hello.c  
include <stdio.h>  
  
int main()  
{  
    puts("Hello World");  
    return 0;  
}
```

[ Read 7 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 ^L Go To Line M-E Redo M-C Copy

## Output – hello64

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $ dpkg --print-foreign-architectures  
armhf  
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $ mkdir Assignment08-Code  
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $ cd Assignment08-Code/  
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ nano hello.c  
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ gcc -Wall -o hello64 hello.c  
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ file hello64  
hello64: ELF 64-bit LSB pie executable, ARM aarch64, version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-aarch64.so.1,  
BuildID[sha1]=258dad24418874f66f32d2039382b3ca7b72f00, for GNU/Linux 3.7.0, not stripped  
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ █
```

## Command - sudo apt install gcc-arm-gnueabihf

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt install gcc-arm-linux-gnueabihf  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
The following packages were automatically installed and are no longer required:  
  libfuse2 raspinfo  
Use 'sudo apt autoremove' to remove them.  
The following additional packages will be installed:  
  binutils-arm-linux-gnueabihf cpp-10-arm-linux-gnueabihf cpp-arm-linux-gnueabihf gcc-10-arm-linux-gnueabihf  
  gcc-10-arm-linux-gnueabihf-base gcc-10-cross-base libasan6-armhf-cross libatomic1-armhf-cross libc6-armhf-cross  
  libc6-dev-armhf-cross libgcc-10-dev-armhf-cross libgcc-s1-armhf-cross libgomp1-armhf-cross libstdc++6-armhf-cross  
  libubsan1-armhf-cross linux-libc-dev-armhf-cross  
Suggested packages:  
  binutils-doc gcc-10-locales cpp-doc gcc-10-doc autoconf automake libtool flex bison gdb-arm-linux-gnueabihf gcc-doc  
The following NEW packages will be installed:  
  binutils-arm-linux-gnueabihf cpp-10-arm-linux-gnueabihf cpp-arm-linux-gnueabihf gcc-10-arm-linux-gnueabihf  
  gcc-10-arm-linux-gnueabihf-base gcc-10-cross-base gcc-arm-linux-gnueabihf libasan6-armhf-cross libatomic1-armhf-cross  
  libc6-armhf-cross libc6-dev-armhf-cross libgcc-10-dev-armhf-cross libgcc-s1-armhf-cross libgomp1-armhf-cross  
  libstdc++6-armhf-cross libubsan1-armhf-cross linux-libc-dev-armhf-cross  
0 upgraded, 17 newly installed, 0 to remove and 0 not upgraded.  
Need to get 102 MB of archives.  
After this operation, 441 MB of additional disk space will be used.  
Do you want to continue? [Y/n] y  
Get:1 http://deb.debian.org/debian bullseye/main arm64 binutils-arm-linux-gnueabihf arm64 2.35.2-2 [2,483 kB]  
Get:2 http://deb.debian.org/debian bullseye/main arm64 gcc-10-arm-linux-gnueabihf-base arm64 10.2.1-6cross1 [202 kB]  
Get:3 http://deb.debian.org/debian bullseye/main arm64 cpp-10-arm-linux-gnueabihf arm64 10.2.1-6cross1 [42.8 MB]  
Get:4 http://deb.debian.org/debian bullseye/main arm64 cpp-arm-linux-gnueabihf arm64 4:10.2.1-1 [16.8 kB]  
Get:5 http://deb.debian.org/debian bullseye/main arm64 gcc-10-cross-base all 10.2.1-6cross1 [197 kB]  
Get:6 http://deb.debian.org/debian bullseye/main arm64 libc6-armhf-cross all 2.31-9cross4 [1,094 kB]  
Get:7 http://deb.debian.org/debian bullseye/main arm64 libgcc-s1-armhf-cross all 10.2.1-6cross1 [36.3 kB]  
Get:8 http://deb.debian.org/debian bullseye/main arm64 libgomp1-armhf-cross all 10.2.1-6cross1 [82.6 kB]  
Get:9 http://deb.debian.org/debian bullseye/main arm64 libatomic1-armhf-cross all 10.2.1-6cross1 [6,688 B]  
Get:10 http://deb.debian.org/debian bullseye/main arm64 libasan6-armhf-cross all 10.2.1-6cross1 [2,010 kB]  
Get:11 http://deb.debian.org/debian bullseye/main arm64 libstdc++6-armhf-cross all 10.2.1-6cross1 [381 kB]  
Get:12 http://deb.debian.org/debian bullseye/main arm64 libubsan1-armhf-cross all 10.2.1-6cross1 [745 kB]  
Get:13 http://deb.debian.org/debian bullseye/main arm64 libgcc-10-dev-armhf-cross all 10.2.1-6cross1 [694 kB]  
Get:14 http://deb.debian.org/debian bullseye/main arm64 gcc-10-arm-linux-gnueabihf arm64 10.2.1-6cross1 [48.2 MB]  
Get:15 http://deb.debian.org/debian bullseye/main arm64 gcc-arm-linux-gnueabihf arm64 4:10.2.1-1 [1,468 B]
```

## Result - Cross Toolchain

```
Preparing to unpack .../15-linux-libc-dev-armhf-cross_5.10.13-1cross4_all.deb ...
Unpacking linux-libc-dev-armhf-cross (5.10.13-1cross4) ...
Selecting previously unselected package libc6-dev-armhf-cross.
Preparing to unpack .../16-libc6-dev-armhf-cross_2.31-9cross4_all.deb ...
Unpacking libc6-dev-armhf-cross (2.31-9cross4) ...
Setting up libc6-armhf-cross (2.31-9cross4) ...
Setting up linux-libc-dev-armhf-cross (5.10.13-1cross4) ...
Setting up gcc-10-cross-base (10.2.1-6cross1) ...
Setting up binutils-arm-linux-gnueabihf (2.35.2-2) ...
Setting up gcc-10-arm-linux-gnueabihf-base:arm64 (10.2.1-6cross1) ...
Setting up libgomp1-armhf-cross (10.2.1-6cross1) ...
Setting up libgcc-s1-armhf-cross (10.2.1-6cross1) ...
Setting up libc6-dev-armhf-cross (2.31-9cross4) ...
Setting up libatomic1-armhf-cross (10.2.1-6cross1) ...
Setting up libstdc++-armhf-cross (10.2.1-6cross1) ...
Setting up libasan6-armhf-cross (10.2.1-6cross1) ...
Setting up cpp-10-arm-linux-gnueabihf (10.2.1-6cross1) ...
Setting up libubsan1-armhf-cross (10.2.1-6cross1) ...
Setting up libgcc-10-dev-armhf-cross (10.2.1-6cross1) ...
Setting up cpp-arm-linux-gnueabihf (4:10.2.1-1) ...
Setting up gcc-10-arm-linux-gnueabihf (10.2.1-6cross1) ...
Setting up gcc-arm-linux-gnueabihf (4:10.2.1-1) ...
Setting up man-db (2.9.4-2) ...
Processing triggers for man-db (2.9.4-2) ...
Processing triggers for libc-bin (2.31-13+rpt2+rpi1+deb11u7) ...
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ arm-linux-gnueabihf-
arm-linux-gnueabihf-addr2line      arm-linux-gnueabihf-gcc-nm          arm-linux-gnueabihf-ld.bfd
arm-linux-gnueabihf-ar            arm-linux-gnueabihf-gcc-nm-10       arm-linux-gnueabihf-ld.gold
arm-linux-gnueabihf-as            arm-linux-gnueabihf-gcc-ranlib        arm-linux-gnueabihf-lto-dump-10
arm-linux-gnueabihf-c++filt       arm-linux-gnueabihf-gcc-ranlib-10     arm-linux-gnueabihf-nm
arm-linux-gnueabihf-cpp          arm-linux-gnueabihf-gcov           arm-linux-gnueabihf-objcopy
arm-linux-gnueabihf-cpp-10         arm-linux-gnueabihf-gcov-10        arm-linux-gnueabihf-objdump
arm-linux-gnueabihf-dwp           arm-linux-gnueabihf-gcov-dump       arm-linux-gnueabihf-pkg-config
arm-linux-gnueabihf-elfedit       arm-linux-gnueabihf-gcov-dump-10     arm-linux-gnueabihf-ranlib
arm-linux-gnueabihf-gcc          arm-linux-gnueabihf-gcov-tool        arm-linux-gnueabihf-readelf
arm-linux-gnueabihf-gcc-10         arm-linux-gnueabihf-gcov-tool-10    arm-linux-gnueabihf-size
arm-linux-gnueabihf-gcc-ar         arm-linux-gnueabihf-gprof          arm-linux-gnueabihf-strings
arm-linux-gnueabihf-gcc-ar-10      arm-linux-gnueabihf-ld            arm-linux-gnueabihf-strip
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ arm-linux-gnueabihf-
```

## Output - hello32

```
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ arm-linux-gnueabihf-gcc -Wall -o hello32 h
ello.c
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ file hello32
hello32: ELF 32-bit LSB pie executable, ARM, EABI5 version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-armhf.so.3, Bu
ldID[sha1]=fc6389ca8da310bb5d0b87e5998b59894c078d9f, for GNU/Linux 3.2.0, not stripped
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ ]
```

## Result hello32 ldd (not a dynamic file)

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code$ arm-linux-gnueabihf-gcc -Wall -o hello32 hello.c
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code$ file hello32
hello32: ELF 32-bit LSB pie executable, ARM, EABI5 version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-armhf.so.3, BuildID[sha1]=fc6389ca8da310bb5d0b87e5998b59894c078d9f, for GNU/Linux 3.2.0, not stripped
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code$ ldd hello32
    not a dynamic executable
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code$ ldd hello64
    linux-vdso.so.1 (0x0000007fb1a7e000)
    libc.so.6 => /lib/aarch64-linux-gnu/libc.so.6 (0x0000007fb18b6000)
    /lib/ld-linux-aarch64.so.1 (0x0000007fb1a4e000)
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code$ ./hello64
Hello World
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code$ ./hello32
-bash: ./hello32: No such file or directory
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code$ ]
```

## Command - readelf -a hello64 (& hello32 to compare)

<pre>cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code\$ readelf -a hello32 ELF Header:   Magic: 7f 45 4c 46 01 01 01 00 00 00 00 00 00 00 00 00   Class: ELF32   Data: 2's complement, little endian   Version: 1 (current)   OS/ABI: UNIX - System V   ABI Version: 0   Type: DYN (Shared object file)   Machine: ARM   Version: 0x1   Entry point address: 0x3fd   Start of program headers: 52 (bytes into file)   Start of section headers: 7104 (bytes into file)   Flags: 0x5000400, Version5 EABI, hard-float ABI   Size of this header: 52 (bytes)   Size of program headers: 32 (bytes)   Number of program headers: 9   Size of section headers: 40 (bytes)   Number of section headers: 29   Section header string table index: 28    Section Headers:   [Nr] Name           Type     Addr     Off      Size   ES Flg Lk Inf Al   00          .interp PROGBITS 00000154 000154 000019 00 A  0   1   00          .note.gnu.bu[...] NOTE   00000170 000170 000024 00 A  0   4   00          .note.ABI-tag NOTE   00000194 000194 000020 00 A  0   4   04          .gnu.hash GNU_HASH 000001b4 0001b4 000018 04 A  5   0   4</pre>	<pre>cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code\$ readelf -a hello64 ELF Header:   Magic: 7f 45 4c 46 02 01 01 00 00 00 00 00 00 00 00 00   Class: ELF64   Data: 2's complement, little endian   Version: 1 (current)   OS/ABI: UNIX - System V   ABI Version: 0   Type: DYN (Shared object file)   Machine: AArch64   Version: 0x1   Entry point address: 0x660   Start of program headers: 64 (bytes into file)   Start of section headers: 7504 (bytes into file)   Flags: 0x0   Size of this header: 64 (bytes)   Size of program headers: 56 (bytes)   Number of program headers: 9   Size of section headers: 64 (bytes)   Number of section headers: 29   Section header string table index: 28    Section Headers:   [Nr] Name           Type     Address      Offs      Size      EntSize   Flags  Link  Info  Ali   00          .interp PROGBITS 0000000000000000 0000000000000000 0000000000000000 0000000000000000 0000   00          .note.gnu.bu[...] NOTE   0000000000000000 0000000000000000 0000000000000000 0000000000000000 0000   00          .note.ABI-tag NOTE   0000000000000001b 0000000000000000 A       0       0   01          .note.gnu.bu[...] NOTE   00000000000000254 0000000000000000 0000000000000000 0000000000000000 0000</pre>
---	---

Command - apt-file /lib/ld-linux-armhf.so.3

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ apt-file /lib/ld-linux-armhf.so.3
-bash: apt-file: command not found
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt update
Hit:1 http://security.debian.org/debian-security bullseye-security InRelease
Hit:2 http://deb.debian.org/debian bullseye InRelease
Hit:3 http://deb.debian.org/debian bullseye-updates InRelease
Hit:4 http://archive.raspberrypi.org/debian bullseye InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
All packages are up to date.
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt install apt-file
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfuse2 raspinfo
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  libapt-pkg-perl libexporter-tiny-perl liblist-moreutils-perl liblist-moreutils-xs-perl libregexp-assemble-perl
The following NEW packages will be installed:
  apt-file libapt-pkg-perl libexporter-tiny-perl liblist-moreutils-perl liblist-moreutils-xs-perl libregexp-assemble-perl
0 upgraded, 6 newly installed, 0 to remove and 0 not upgraded.
Need to get 315 kB of archives.
After this operation, 889 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://deb.debian.org/debian bullseye/main arm64 libapt-pkg-perl arm64 0.1.39 [69.4 kB]
Get:2 http://deb.debian.org/debian bullseye/main arm64 libexporter-tiny-perl all 1.002002-1 [37.8 kB]
Get:3 http://deb.debian.org/debian bullseye/main arm64 liblist-moreutils-xs-perl arm64 0.430-2 [36.8 kB]
Get:4 http://deb.debian.org/debian bullseye/main arm64 liblist-moreutils-perl all 0.430-2 [46.9 kB]
Get:5 http://deb.debian.org/debian bullseye/main arm64 libregexp-assemble-perl all 0.36-1.1 [85.5 kB]
Get:6 http://deb.debian.org/debian bullseye/main arm64 apt-file all 3.2.2 [38.5 kB]
Fetched 315 kB in 0s (799 kB/s)
Selecting previously unselected package libapt-pkg-perl.
(Reading database ... 113188 files and directories currently installed.)
Preparing to unpack .../0-libapt-pkg-perl_0.1.39_arm64.deb ...
Unpacking libapt-pkg-perl (0.1.39) ...
Selecting previously unselected package libexporter-tiny-perl.
```

Command - sudo apt-file update (this will update cache to search /lib/ld-linux-armhf.so.3)(cache is a map of file names to the packages)

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt-file update
Hit:1 http://deb.debian.org/debian bullseye InRelease
Hit:2 http://deb.debian.org/debian bullseye-updates InRelease
Hit:3 http://security.debian.org/debian-security bullseye-security InRelease
Hit:4 http://archive.raspberrypi.org/debian bullseye InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
All packages are up to date.
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ █
```

### Command - sudo apt-file search /lib/ld-linux-armhf.so.3

```
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt-file update
Hit:1 http://deb.debian.org/debian bullseye InRelease
Hit:2 http://deb.debian.org/debian bullseye-updates InRelease
Hit:3 http://security.debian.org/debian-security bullseye-security InRelease
Hit:4 http://archive.raspberrypi.org/debian bullseye InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
All packages are up to date.
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt-file search /lib/ld-linux-armhf.so.3
libc6-armhf-cross: /usr/arm-linux-gnueabihf/lib/ld-linux-armhf.so.3
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $
```

### Command - sudo apt install libc6:armhf

```
All packages are up to date.
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt-file search /lib/ld-linux-armhf.so.3
libc6-armhf-cross: /usr/arm-linux-gnueabihf/lib/ld-linux-armhf.so.3
cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ sudo apt-get install libc6:armhf
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfuse2 raspinfo
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  gcc-10-base:armhf krb5-locales libcom-err2:armhf libcrypt1:armhf libgcc-s1:armhf libgssapi-krb5-2:armhf libidn2-0:armhf
  libk5crypto3:armhf libkeyutils1:armhf libkrb5-3:armhf libkrb5support0:armhf libnsl2:armhf libnss-nis:armhf
  libnss-nisplus:armhf libssl1.1:armhf libtirpc3:armhf libunistring2:armhf
Suggested packages:
  glibc-doc:armhf locales:armhf krb5-doc:armhf krb5-user:armhf
The following NEW packages will be installed:
  gcc-10-base:armhf krb5-locales libc6:armhf libcom-err2:armhf libcrypt1:armhf libgcc-s1:armhf libgssapi-krb5-2:armhf
  libidn2-0:armhf libk5crypto3:armhf libkeyutils1:armhf libkrb5-3:armhf libkrb5support0:armhf libnsl2:armhf libnss-nis:armhf
0 upgraded, 18 newly installed, 0 to remove and 0 not upgraded.
Need to get 5,354 kB of archives.
After this operation, 17.1 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://deb.debian.org/debian bullseye/main armhf gcc-10-base armhf 10.2.1-6 [201 kB]
Get:2 http://deb.debian.org/debian bullseye/main arm64 krb5-locales all 1.18.3-6+deb11u4 [95.7 kB]
Get:3 http://deb.debian.org/debian bullseye/main armhf libgcc-s1 armhf 10.2.1-6 [36.2 kB]
Get:4 http://deb.debian.org/debian bullseye/main armhf libcrypt1 armhf 1:4.4.18-4 [95.6 kB]
Get:5 http://deb.debian.org/debian bullseye/main armhf libcom-err2 armhf 1.46.2-2 [73.4 kB]
Get:6 http://deb.debian.org/debian bullseye/main armhf libkrb5support0 armhf 1.18.3-6+deb11u4 [62.7 kB]
Get:7 http://deb.debian.org/debian bullseye/main armhf libk5crypto3 armhf 1.18.3-6+deb11u4 [111 kB]
Get:8 http://deb.debian.org/debian bullseye/main armhf libkeyutils1 armhf 1.6.1-2 [14.4 kB]
Get:9 http://deb.debian.org/debian bullseye/main armhf libkrb5-3 armhf 1.18.3-6+deb11u4 [319 kB]
Get:10 http://deb.debian.org/debian bullseye/main armhf libgssapi-krb5-2 armhf 1.18.3-6+deb11u4 [143 kB]
Get:11 http://deb.debian.org/debian bullseye/main armhf libunistring2 armhf 0.9.10-4 [374 kB]
Get:12 http://deb.debian.org/debian bullseye/main armhf libidn2-0 armhf 2.3.0-5 [83.4 kB]
Get:13 http://deb.debian.org/debian bullseye/main armhf libtirpc3 armhf 1.3.1-1+deb11u1 [72.5 kB]
```

## Output - hello 32 (working)

```
Unpacking libunistring2:armhf (0.9.10-4) ...
Selecting previously unselected package libidn2-0:armhf.
Preparing to unpack .../13-libidn2-0_2.3.0-5_armhf.deb ...
Unpacking libidn2-0:armhf (2.3.0-5) ...
Selecting previously unselected package libtirpc3:armhf.
Preparing to unpack .../14-libtirpc3_1.3.1-1+deb11u1_armhf.deb ...
Unpacking libtirpc3:armhf (1.3.1-1+deb11u1) ...
Selecting previously unselected package libnsl2:armhf.
Preparing to unpack .../15-libnsl2_1.3.0-2_armhf.deb ...
Unpacking libnsl2:armhf (1.3.0-2) ...
Selecting previously unselected package libnss-nis:armhf.
Preparing to unpack .../16-libnss-nis_3.1-4_armhf.deb ...
Unpacking libnss-nis:armhf (3.1-4) ...
Selecting previously unselected package libnss-nisplus:armhf.
Preparing to unpack .../17-libnss-nisplus_1.3-4_armhf.deb ...
Unpacking libnss-nisplus:armhf (1.3-4) ...
Setting up krb5-locales (1.18.3-6+deb11u4) ...
Setting up gcc-10-base:armhf (10.2.1-6) ...
Setting up libcrypt1:armhf (1:4.4.18-4) ...
Setting up libgcc-s1:armhf (10.2.1-6) ...
Setting up libc6:armhf (2.31-13+rpt2+rpi1+deb11u7) ...
Setting up libkeyutils1:armhf (1.6.1-2) ...
Setting up libssl1.1:armhf (1.1.1w-0+deb11u1+rpt1) ...
Setting up libunistring2:armhf (0.9.10-4) ...
Setting up libidn2-0:armhf (2.3.0-5) ...
Setting up libcom-err2:armhf (1.46.2-2) ...
Setting up libkrb5support0:armhf (1.18.3-6+deb11u4) ...
Setting up libk5crypto3:armhf (1.18.3-6+deb11u4) ...
Setting up libkrb5-3:armhf (1.18.3-6+deb11u4) ...
Setting up libgssapi-krb5-2:armhf (1.18.3-6+deb11u4) ...
Setting up libtirpc3:armhf (1.3.1-1+deb11u1) ...
Setting up libnsl2:armhf (1.3.0-2) ...
Setting up libnss-nisplus:armhf (1.3-4) ...
Setting up libnss-nis:armhf (3.1-4) ...
Processing triggers for libc-bin (2.31-13+rpt2+rpi1+deb11u7) ...
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ ./hello32
Hello World
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ ]
```

## Command - git clone --depth=1 <https://github.com/micropython/micropython>

```
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux/Assignment08-Code $ cd ..
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo/CSR-EmbeddedLinux $ cd ..
[cxr1020@raspberrypi:~/Documents/EmbeddedLinuxRepo $ cd ..
[cxr1020@raspberrypi:~/Documents $ mkdir MicroPythonRepo
[cxr1020@raspberrypi:~/Documents $ cd MicroPythonRepo/
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo $ git clone --depth=1 https://github.com/micropython/micropython
Cloning into 'micropython'...
remote: Enumerating objects: 5570, done.
remote: Counting objects: 100% (5570/5570), done.
remote: Compressing objects: 100% (4531/4531), done.
remote: Total 5570 (delta 1334), reused 3049 (delta 716), pack-reused 0
Receiving objects: 100% (5570/5570), 7.98 MiB | 3.81 MiB/s, done.
Resolving deltas: 100% (1334/1334), done.
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo $ cd micropython/
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython $ ls
ACKNOWLEDGEMENTS CODEOFCONDUCT.md docs examples lib logo ports pyproject.toml shared tools
CODECONVENTIONS.md CONTRIBUTING.md drivers extmod LICENSE mpy-cross py README.md tests
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython $ ]
```

## Command - make submodules (for ports/unix)

```
$ make
External dependencies
-----
The core MicroPython VM and runtime has no external dependencies, but a given
port might depend on third-party drivers or vendor HALs. This repository
includes [several submodules](lib/) linking to these external dependencies.
Before compiling a given port, use

$ cd ports/name
$ make submodules

to ensure that all required submodules are initialised.
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython $ cd ports/
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports $ cd unix/
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ make submodules
Use make V=1 or set BUILD_VERBOSE in your environment to increase build verbosity.
Package libffi was not found in the pkg-config search path.
Perhaps you should add the directory containing `libffi.pc'
to the PKG_CONFIG_PATH environment variable
No package 'libffi' found
Package libffi was not found in the pkg-config search path.
Perhaps you should add the directory containing `libffi.pc'
to the PKG_CONFIG_PATH environment variable
No package 'libffi' found
Updating submodules: lib/mbedtls lib/berkeley-db-1.xx lib/micropython-lib
Submodule 'lib/berkeley-db-1.xx' (https://github.com/pfalcon/berkeley-db-1.xx) registered for path '....lib/berkeley-db-1.xx'
Submodule 'lib/mbedtls' (https://github.com/ARMmbed/mbedtls.git) registered for path '....lib/mbedtls'
Submodule 'lib/micropython-lib' (https://github.com/micropython/micropython-lib.git) registered for path '....lib/micropython-lib'
Cloning into '/home/cxr1020/Documents/MicroPythonRepo/micropython/lib/berkeley-db-1.xx'...
Cloning into '/home/cxr1020/Documents/MicroPythonRepo/micropython/lib/mbedtls'...
Cloning into '/home/cxr1020/Documents/MicroPythonRepo/micropython/lib/micropython-lib'...
Submodule path '....lib/berkeley-db-1.xx': checked out '35aec4418ad78628a3b935885dd189d41ce779b'
Submodule path '....lib/mbedtls': checked out '981743de6fcdb672e482b6fd724d31d0a0d2476'
Submodule path '....lib/micropython-lib': checked out 'e025c843b60e93689f0f991d753010bb5bd6a722'
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ ]
```

## Command - sudo apt install libffi-dev

```
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ apt-cache search libffi
libffindex0 - library for simple index/database for huge amounts of small files
libffindex0-dev - library for simple index/database for huge amounts of small files (development)
libffi-jni - Java Foreign Function Interface
libffi-dev - Foreign Function Interface library (development files)
libffi7 - Foreign Function Interface library runtime
libffi-checklib-perl - module to check availability of a library for FFI
libffi-platypus-perl - module to create Perl bindings to non-Perl libraries with FFI
[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ apt show libffi-dev
Package: libffi-dev
Version: 3.3-6
Priority: optional
Section: libdevel
Source: libffi
Maintainer: Debian GCC Maintainers <debian-gcc@lists.debian.org>
Installed-Size: 276 kB
Depends: libffi7 (= 3.3-6)
Conflicts: libffi4-dev
Homepage: https://sourceware.org/libffi/
Tag: devel::library, role::devel-lib
Download-Size: 53.2 kB
APT-Sources: http://deb.debian.org/debian bullseye/main arm64 Packages
Description: Foreign Function Interface library (development files)
This package contains the headers and static library files necessary for
building programs which use libffi.

.
A foreign function interface is the popular name for the interface that
allows code written in one language to call code written in another
language.

[cxr1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ sudo apt install libffi-dev
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfuse2 raspinfo
Use 'sudo apt autoremove' to remove them.
```

### Command - sudo apt install libffi-dev:armhf

```
|cxd1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ sudo apt install libffi-dev:armhf
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfuse2 raspinfo
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  libffi7:armhf
The following NEW packages will be installed:
  libffi-dev:armhf libffi7:armhf
0 upgraded, 2 newly installed, 0 to remove and 0 not upgraded.
Need to get 72.7 kB of archives.
After this operation, 293 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://deb.debian.org/debian bullseye/main armhf libffi7 armhf 3.3-6 [19.9 kB]
Get:2 http://deb.debian.org/debian bullseye/main armhf libffi-dev armhf 3.3-6 [52.8 kB]
Fetched 72.7 kB in 0s (388 kB/s)
Selecting previously unselected package libffi7:armhf.
(Reading database ... 113698 files and directories currently installed.)
Preparing to unpack .../libffi7_3.3-6_armhf.deb ...
Unpacking libffi7:armhf (3.3-6) ...
Selecting previously unselected package libffi-dev:armhf.
Preparing to unpack .../libffi-dev_3.3-6_armhf.deb ...
Unpacking libffi-dev:armhf (3.3-6) ...
Setting up libffi7:armhf (3.3-6) ...
Setting up libffi-dev:armhf (3.3-6) ...
Processing triggers for libc-bin (2.31-13+rpi2+rpi1+deb11u7) ...
Processing triggers for man-db (2.9.4-2) ...
|cxd1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ dpkg -L libffi:armhf
dpkg-query: package 'libffi:armhf' is not installed
Use dpkg --contents (= dpkg-deb --contents) to list archive files contents.
|cxd1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ dpkg -L libffi-dev:armhf
/.
/usr
/usr/include
/usr/include/arm-linux-gnueabihf
/usr/include/arm-linux-gnueabihf/ffi.h
```

### Output - running 64-bit micro python

```
CC ../../lib/berkeley-db-1.xx/btree/bt_open.c
CC ../../lib/berkeley-db-1.xx/btree/bt_overflow.c
CC ../../lib/berkeley-db-1.xx/btree/bt_page.c
CC ../../lib/berkeley-db-1.xx/btree/bt_put.c
CC ../../lib/berkeley-db-1.xx/btree/bt_search.c
CC ../../lib/berkeley-db-1.xx/btree/bt_seq.c
CC ../../lib/berkeley-db-1.xx/btree/bt_split.c
CC ../../lib/berkeley-db-1.xx/btree/bt_utils.c
CC ../../lib/berkeley-db-1.xx/mpool/mpool.c
CC main.c
CC gccollect.c
CC unix_mpHal.c
CC mpthreadport.c
CC input.c
CC modmachine.c
CC alloc.c
CC fatfs_port.c
CC mpbtchipport.c
CC mpbtstackport_common.c
CC mpbtstackport_h4.c
CC mpbtstackport_usb.c
CC mpnimbleport.c
CC modtermios.c
CC modsocket.c
CC modffic.c
CC modjnic.c
CC ../../shared/runtime/gchelper_generic.c
CC ../../shared/timeutils/timeutils.c
CC ../../shared/readline/readline.c
LINK build-standard/micropython
    text      data      bss      dec      hex filename
 686665  59256   6976  752897  b7d01 build-standard/micropython
|cxd1020@raspberrypi:~/Documents/MicroPythonRepo/micropython/ports/unix $ ./build-standard/micropython
MicroPython 094b52b on 2023-11-25; linux [GCC 10.2.1] version
Use Ctrl-D to exit, Ctrl-E for paste mode
>>> print("Hello micropython")
Hello micropython
>>> 
```

### Command - make CROSS\_COMPILE=arm-linux-gnueabihf-

```
|cxi1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ make CROSS_COMPILE=arm-linux-gnueabihf-
Use make V=1 or set BUILD_VERBOSE in your environment to increase build verbosity.
GEN build-standard/genhdr/qstr.i.last
GEN build-standard/genhdr/qstr.split
GEN build-standard/genhdr/qstrdefs.collected.h
QSTR updated
GEN build-standard/genhdr/qstrdefs.generated.h
GEN build-standard/genhdr/moduledefs.split
GEN build-standard/genhdr/moduledefs.collected
Module registrations updated
GEN build-standard/genhdr/moduledefs.h
GEN build-standard/genhdr/root_pointers.split
GEN build-standard/genhdr/root_pointers.collected
Root pointer registrations updated
GEN build-standard/genhdr/root_pointers.h
GEN build-standard/genhdr/compressed.split
GEN build-standard/genhdr/compressed.collected
Compressed data updated
GEN build-standard/genhdr/compressed.data.h
mkdir -p build-standard/build-standard/
mkdir -p build-standard/extmod/
mkdir -p build-standard/lib/berkeley-db-1.xx/btree/
mkdir -p build-standard/lib/berkeley-db-1.xx/mpool/
mkdir -p build-standard/lib/littlefs/
mkdir -p build-standard/lib/mbedtls/library/
mkdir -p build-standard/lib/mbedtls_errors/
mkdir -p build-standard/lib/oofatfs/
mkdir -p build-standard/py/
mkdir -p build-standard/shared/libc/
mkdir -p build-standard/shared/readline/
mkdir -p build-standard/shared/runtime/
mkdir -p build-standard/shared/timeutils/
CC ../../py/mpstate.c
CC ../../py/nlr.c
CC ../../py/nlrx86.c
CC ../../py/nlrx64.c
CC ../../py/nlrthumb.c
CC ../../py/nlaarch64.c
```

### Output - Running micropython (32 bit)

```
CC ../../lib/berkeley-db-1.xx/btree/bt_open.c
CC ../../lib/berkeley-db-1.xx/btree/bt_overflow.c
CC ../../lib/berkeley-db-1.xx/btree/bt_page.c
CC ../../lib/berkeley-db-1.xx/btree/bt_put.c
CC ../../lib/berkeley-db-1.xx/btree/bt_search.c
CC ../../lib/berkeley-db-1.xx/btree/bt_seq.c
CC ../../lib/berkeley-db-1.xx/btree/bt_split.c
CC ../../lib/berkeley-db-1.xx/btree/bt_utils.c
CC ../../lib/berkeley-db-1.xx/mpool/mpool.c
CC main.c
CC gccollect.c
CC unix_mphal.c
CC mpthreadport.c
CC input.c
CC modmachine.c
CC alloc.c
CC fatfs_port.c
CC mpbtchipart.c
CC mpbtstackport_common.c
CC mpbtstackport_h4.c
CC mpbtstackport_usb.c
CC mpnimbleport.c
CC modtermios.c
CC modsocket.c
CC modffic.c
CC modjnic
CC ../../shared/runtime/gchelper_generic.c
CC ../../shared/timeutils/timeutils.c
CC ../../shared/readline/readline.c
LINK build-standard/micropython
    text      data      bss      dec      hex filename
 382170   32428   6116  420714  66b6a build-standard/micropython
|cxi1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ filr build-standard/micropython
-bash: filr: command not found
|cxi1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ file build-standard/micropython
build-standard/micropython: ELF 32-bit LSB pie executable, ARM, EABI5 version 1 (SYSV), dynamically linked, interpreter /lib/ld-linux-armhf.so.3, BuildID[sha1]=ce2561c9cc950b201d97e59aa62fb3c365a6e3ffd, for GNU/Linux 3.2.0, stripped
|cxi1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $
```

Command - scp ./build-standard/micropython pi@192.168.1.189:/Downloads

```
|cxd1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ scp ./build-standard/micropython pi@192.168.1.189:./Downloads/  
pi@192.168.1.189's password:  
micropython  
cxd1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ █
```

100% 407KB 778.2KB/s 00:00

Output - ldd micropython (issue)

```
|pi@raspberrypi:~/Downloads $ arch  
armv7l  
|pi@raspberrypi:~/Downloads $ ls  
micropython  
|pi@raspberrypi:~/Downloads $ ldd micropython  
. /lib/arm-linux-gnueabihf/libm.so.6: version `GLIBC_2.29' not found (required by ./micropython)  
    linux-vdso.so.1 (0x7effee000)  
    /usr/lib/arm-linux-gnueabihf/libarmmem-${PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmem-v7l.so (0x76eee000)  
libm.so.6 => /lib/arm-linux-gnueabihf/libm.so.6 (0x76e44000)  
libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76e1a000)  
libffi.so.7 => not found  
libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76e07000)  
libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76cba000)  
/lib/ld-linux-armhf.so.3 (0x76f7a000)  
pi@raspberrypi:~/Downloads $ █
```

### Command - scp correct libffi shared object

```
cxr1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ scp ./build-standard/micropython pi@192.168.1.189:./Downloads/
pi@192.168.1.189's password:
micropython
100% 407KB 778.2KB/s 00:00
cxr1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ find /usr/lib | grep libffi
/usr/lib/arm-linux-gnueabihf/libffi.so
/usr/lib/arm-linux-gnueabihf/libffi.a
/usr/lib/arm-linux-gnueabihf/libffi.so.7
/usr/lib/arm-linux-gnueabihf/libffi.so.7.1.0
/usr/lib/arm-linux-gnueabihf/pkgconfig/libffi.pc
/usr/lib/arm-linux-gnueabihf/libffi_pic.a
/usr/lib/aarch64-linux-gnu/libffi.so
/usr/lib/aarch64-linux-gnu/libffi.a
/usr/lib/aarch64-linux-gnu/libffi.so.7
/usr/lib/aarch64-linux-gnu/libffi.so.7.1.0
/usr/lib/aarch64-linux-gnu/pkgconfig/libffi.pc
/usr/lib/aarch64-linux-gnu/libffi.a
cxr1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $ scp /usr/lib/arm-linux-gnueabihf/libffi.so.7 pi@192.168.1.189:./Downloads
pi@192.168.1.189's password:
libffi.so.7
100% 22KB 1.2MB/s 00:00
cxr1020@raspberrypi:~/Documents/MicroPythonRepo-32/micropython/ports/unix $
```

### Output - copy correct libffi

```
libm.so.6 => /lib/arm-linux-gnueabihf/libm.so.6 (0x76e44000)
libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76e1a000)
libffi.so.7 => not found
libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76e07000)
libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76cba000)
/lib/ld-linux-armhf.so.3 (0x76f7a000)
pi@raspberrypi:~/Downloads $ find /usr/lib | grep libffi
/usr/lib/arm-linux-gnueabihf/libffi.a
/usr/lib/arm-linux-gnueabihf/libffi.so.6.0.4
/usr/lib/arm-linux-gnueabihf/pkgconfig/libffi.pc
/usr/lib/arm-linux-gnueabihf/libffi_pic.a
/usr/lib/arm-linux-gnueabihf/libffi.so.6
/usr/lib/arm-linux-gnueabihf/libffi.so
pi@raspberrypi:~/Downloads $ ldd micropython
./micropython: /lib/arm-linux-gnueabihf/libm.so.6: version `GLIBC_2.29' not found (required by ./micropython)
    linux-vdso.so.1 (0x7eff3000)
    /usr/lib/arm-linux-gnueabihf/libarmmmem-{$PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmmem-v7l.so (0x76e98000)
    libm.so.6 => /lib/arm-linux-gnueabihf/libm.so.6 (0x76dee000)
    libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76dc4000)
    libffi.so.7 => not found
    libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76db1000)
    libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76c64000)
    /lib/ld-linux-armhf.so.3 (0x76f24000)
pi@raspberrypi:~/Downloads $ ls
libffi.so.7  micropython
pi@raspberrypi:~/Downloads $ sudo mv libffi.so.7 /usr/lib/arm-linux-gnueabihf/
pi@raspberrypi:~/Downloads $ ldd micropython
./micropython: /lib/arm-linux-gnueabihf/libm.so.6: version `GLIBC_2.29' not found (required by ./micropython)
    linux-vdso.so.1 (0x7efa2000)
    /usr/lib/arm-linux-gnueabihf/libarmmmem-{$PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmmem-v7l.so (0x76ea0000)
    libm.so.6 => /lib/arm-linux-gnueabihf/libm.so.6 (0x76df6000)
    libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76dcc000)
    libffi.so.7 => /usr/lib/arm-linux-gnueabihf/libffi.so.7 (0x76db6000)
    libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76da3000)
    libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76c56000)
    /lib/ld-linux-armhf.so.3 (0x76f2c000)
    libgcc_s.so.1 => /lib/arm-linux-gnueabihf/libgcc_s.so.1 (0x76c29000)
pi@raspberrypi:~/Downloads $
```

## Output – Issue 2

```
libffi.so.7 => not found
libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76e07000)
libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76cba000)
/lib/ld-linux-armhf.so.3 (0x76f7a000)
pi@raspberrypi:~/Downloads $ find /usr/lib | grep libffi
/usr/lib/arm-linux-gnueabihf/libffi.a
/usr/lib/arm-linux-gnueabihf/libffi.so.6.0.4
/usr/lib/arm-linux-gnueabihf/pkgconfig/libffi.pc
/usr/lib/arm-linux-gnueabihf/libffi_pic.a
/usr/lib/arm-linux-gnueabihf/libffi.so.6
/usr/lib/arm-linux-gnueabihf/libffi.so
pi@raspberrypi:~/Downloads $ ldd micropython
./micropython: /lib/arm-linux-gnueabihf/libm.so.6: version `GLIBC_2.29' not found (required by ./micropython)
    linux-vdso.so.1 (0x7eff3000)
    /usr/lib/arm-linux-gnueabihf/libarmmem-${PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmem-v7l.so (0x76e98000)
    libm.so.6 => /lib/arm-linux-gnueabihf/libm.so.6 (0x76dee000)
    libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76dc4000)
    libffi.so.7 => not found
    libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76db1000)
    libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76c64000)
    /lib/ld-linux-armhf.so.3 (0x76f24000)
pi@raspberrypi:~/Downloads $ ls
libffi.so.7 micropython
pi@raspberrypi:~/Downloads $ sudo mv libffi.so.7 /usr/lib/arm-linux-gnueabihf/
pi@raspberrypi:~/Downloads $ ldd micropython
./micropython: /lib/arm-linux-gnueabihf/libm.so.6: version `GLIBC_2.29' not found (required by ./micropython)
    linux-vdso.so.1 (0x7efa2000)
    /usr/lib/arm-linux-gnueabihf/libarmmem-${PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmem-v7l.so (0x76ea0000)
    libm.so.6 => /lib/arm-linux-gnueabihf/libm.so.6 (0x76df6000)
    libpthread.so.0 => /lib/arm-linux-gnueabihf/libpthread.so.0 (0x76dcc000)
    libffi.so.7 => /usr/lib/arm-linux-gnueabihf/libffi.so.7 (0x76db6000)
    libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0x76da3000)
    libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0x76c56000)
    /lib/ld-linux-armhf.so.3 (0x76f2c000)
    libgcc_s.so.1 => /lib/arm-linux-gnueabihf/libgcc_s.so.1 (0x76c29000)
pi@raspberrypi:~/Downloads $ ./micropython
./micropython: /lib/arm-linux-gnueabihf/libm.so.6: version `GLIBC_2.29' not found (required by ./micropython)
pi@raspberrypi:~/Downloads $
```