CS 382E: Lab 5
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1 Objectives

- Configure QEMU
- Program translation

2 QEMU

Recall that assembly programs are closely related to the hardware platform they are executed on, so an assembly program written in the ARM instruction set cannot be executed on any other computer. To execute ARM assembly on computers without ARM processors, we can install an emulator that simulates the hardware execution of ARM machines on a different computer. This is called cross-compilation.

To install the `aarch64` cross compiler for the 64-bit ARM architecture, type the following in the VM terminal:

```
sudo apt-get install gcc-aarch64-linux-gnu
```

To install QEMU, the emulator, on your virtual machine, type the following in the terminal:

```
sudo apt-get install qemu-user
```

Note that this is an ARM not a LEG emulator and some differences exist.

The regular `gdb` we used for debugging C programs cannot be used here, because our program can only be executed in the QEMU emulator, and the architecture is different. We will have to install a `gdb` that can be used for multiple different architectures. To install multiarch-GDB type:

```
sudo apt-get install gdb-multiarch
```

3 Program Translation

See "ARM Lab Translation" slides on Canvas.

Apply the following steps

```
aarch64-linux-gnu-gcc-9 -E test.c > test.i
cat test.i
```

and **submit a screenshot showing the terminal with your username in the prompt and the print out from `cat`.**

```
aarch64-linux-gnu-gcc-9 test.c -S
cat test.s
```

and **submit a screenshot showing the terminal with your username in the prompt and the print out from `cat`.**

To assemble a program in the terminal:

```
aarch64-linux-gnu-as demo.s -o demo.o
```

Then link the object files:

```
aarch64-linux-gnu-ld demo.o
```

The output binary name by default is a.out, but can be renamed. To run it:

```
qemu-aarch64 a.out
```

Assemble and link demo.s (provided on Canvas) and **submit a screenshot showing the terminal with your username in the prompt, the above steps and the contents of the directory afterwards.** You can use `ls` to list the contents of the directory.

What to Submit

A pdf with the three screenshots specified above.