Week 4 – Software

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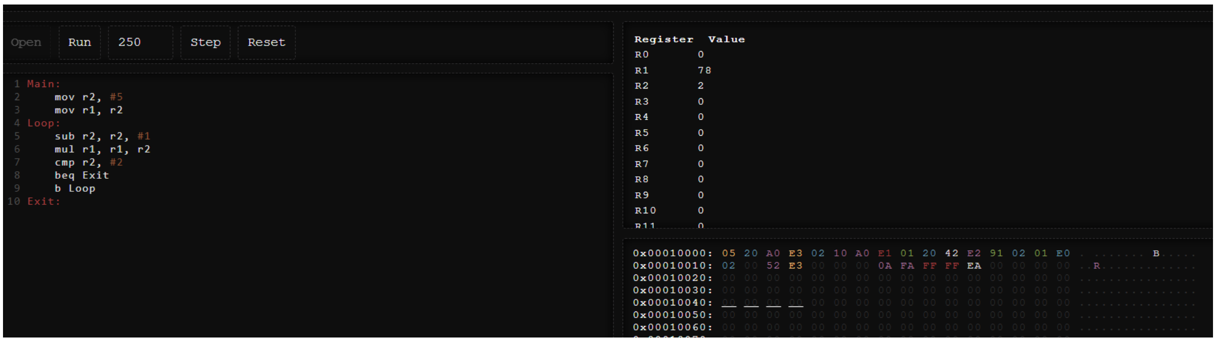
Assignment 4.1: ARM assembly

Screenshot of working assembly code of factorial calculation:



Assignment 4.2: Programming languages

Take screenshots that the following commands work:

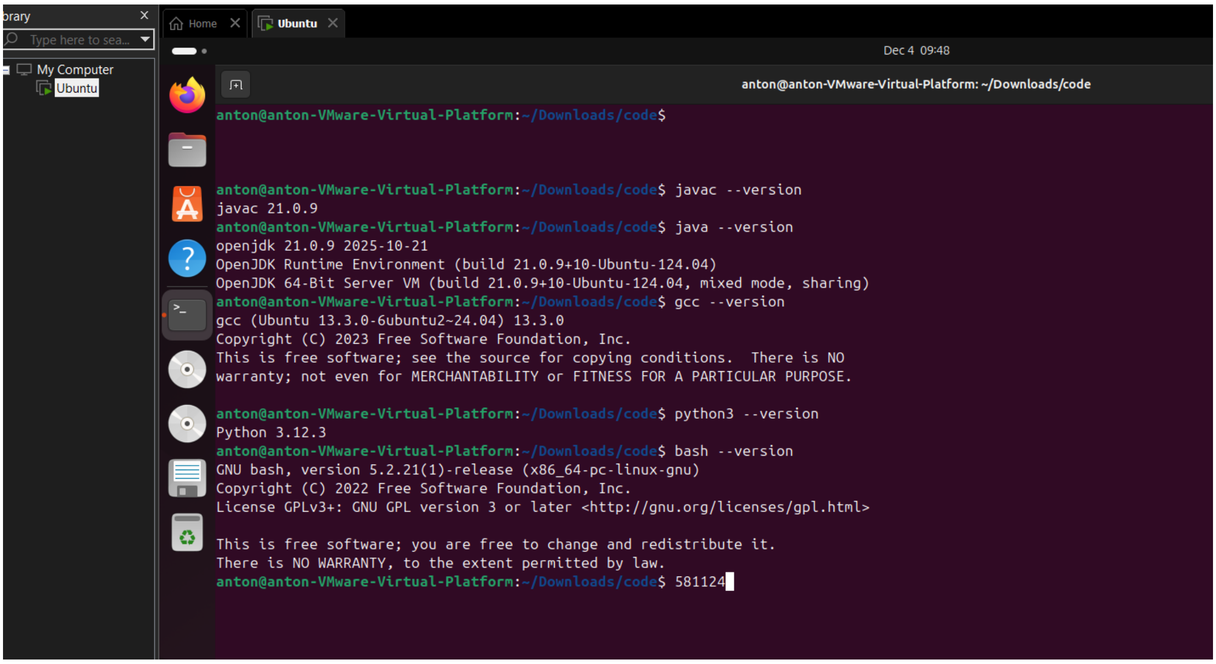
javac --version

java --version

gcc --version

python3 --version

bash --version



Assignment 4.3: Compile

Which of the above files need to be compiled before you can run them?

-Fibonacci.java and fib.c must be compiled

Which source code files are compiled into machine code and then directly executable by a processor?

- fib.c

Which source code files are compiled to byte code?

-Fibonacci.java is compiled into a Fibonacci.class file

Which source code files are interpreted by an interpreter?

-fib.py

These source code files will perform the same calculation after compilation/interpretation. Which one is expected to do the calculation the fastest?

-The fib.c, because it runs as machine code.

How do I run a Java program?

- Use this commands in bash:

1.javac Fibonacci.java

2.java Fibonacci

How do I run a Python program?

- Type in a bash: python3 fib.py

How do I run a C program?

- 1)gcc fib.c -o fib

2)./fib

How do I run a Bash script?

- ./fib.sh

If I compile the above source code, will a new file be created? If so, which file?

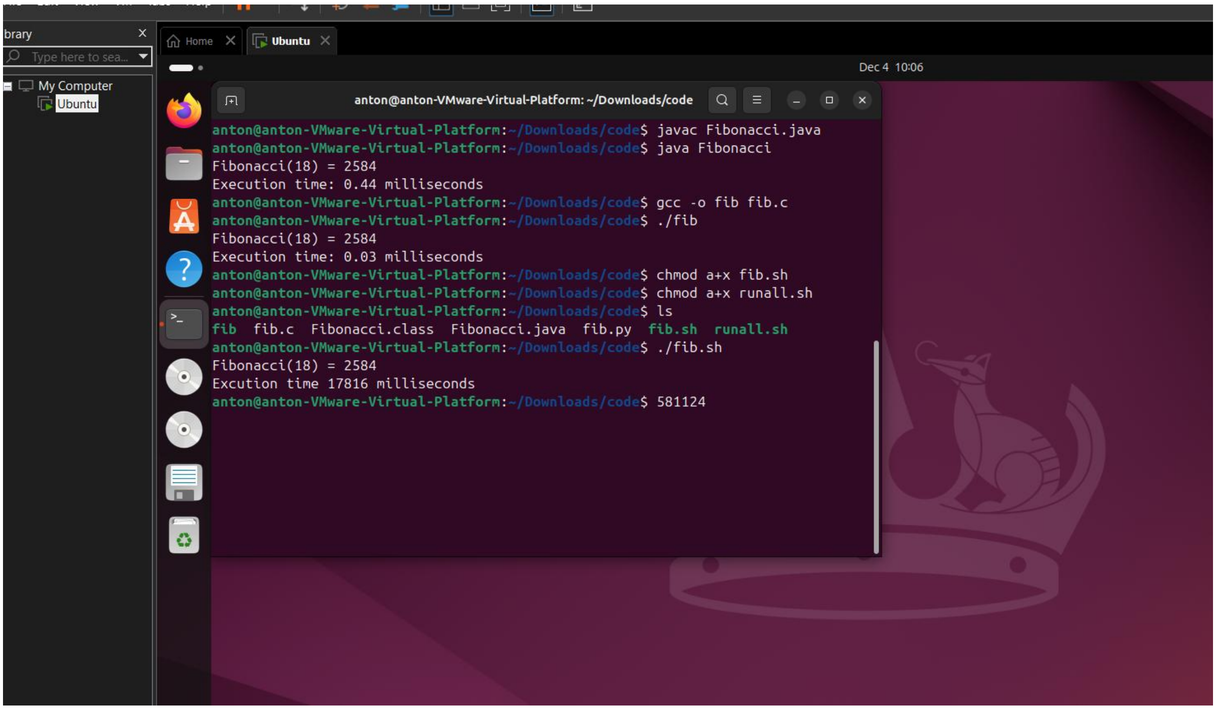
- Java will produce Fibonacci.class after compiling

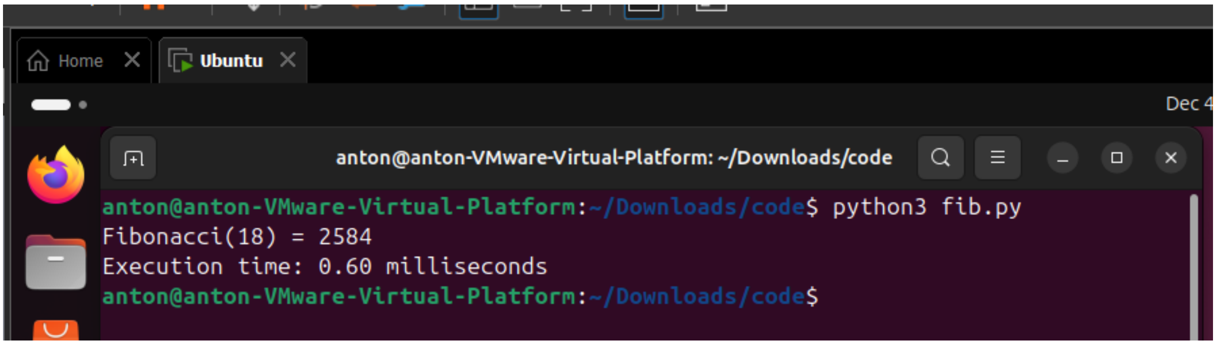
- C will create executable fib or a.out

Take relevant screenshots of the following commands:

- Compile the source files where necessary
- Make them executable
- Run them

- Which (compiled) source code file performs the calculation the fastest – C program shows the fastest performance





Assignment 4.4: Optimize

Take relevant screenshots of the following commands:

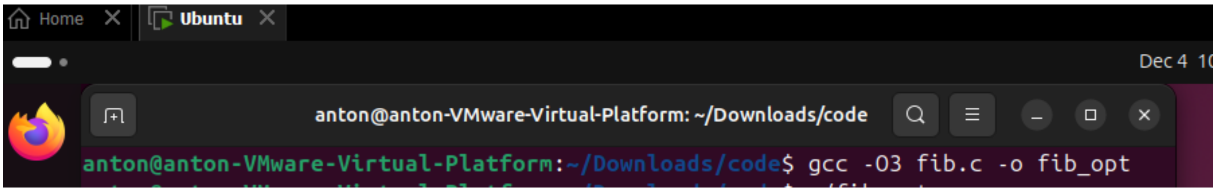
a) Figure out which parameters you need to pass to **the gcc** compiler so that the compiler performs a number of optimizations that will ensure that the compiled source code will run faster. **Tip!** The parameters are usually a letter followed by a number. Also read **page 191** of your book, but find a better optimization in the man pages. Please note that Linux is case sensitive.

```
anton@anton-VMware-Virtual-Platform:~$ gcc --help=optimizers
The following options control optimizations:
  -O<number>                  Set optimization level to <number>.
  -Ofast                      Optimize for speed disregarding exact standards
                              compliance.
```

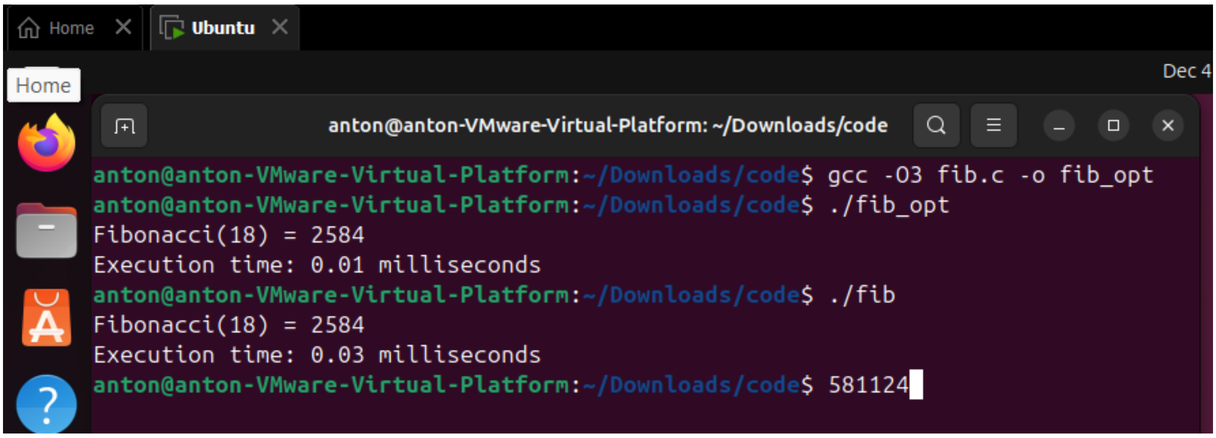
-O1 – basic optimization

-O2 – good optimization
-O3 – fastest general optimization
-Ofast – very aggresive optimization

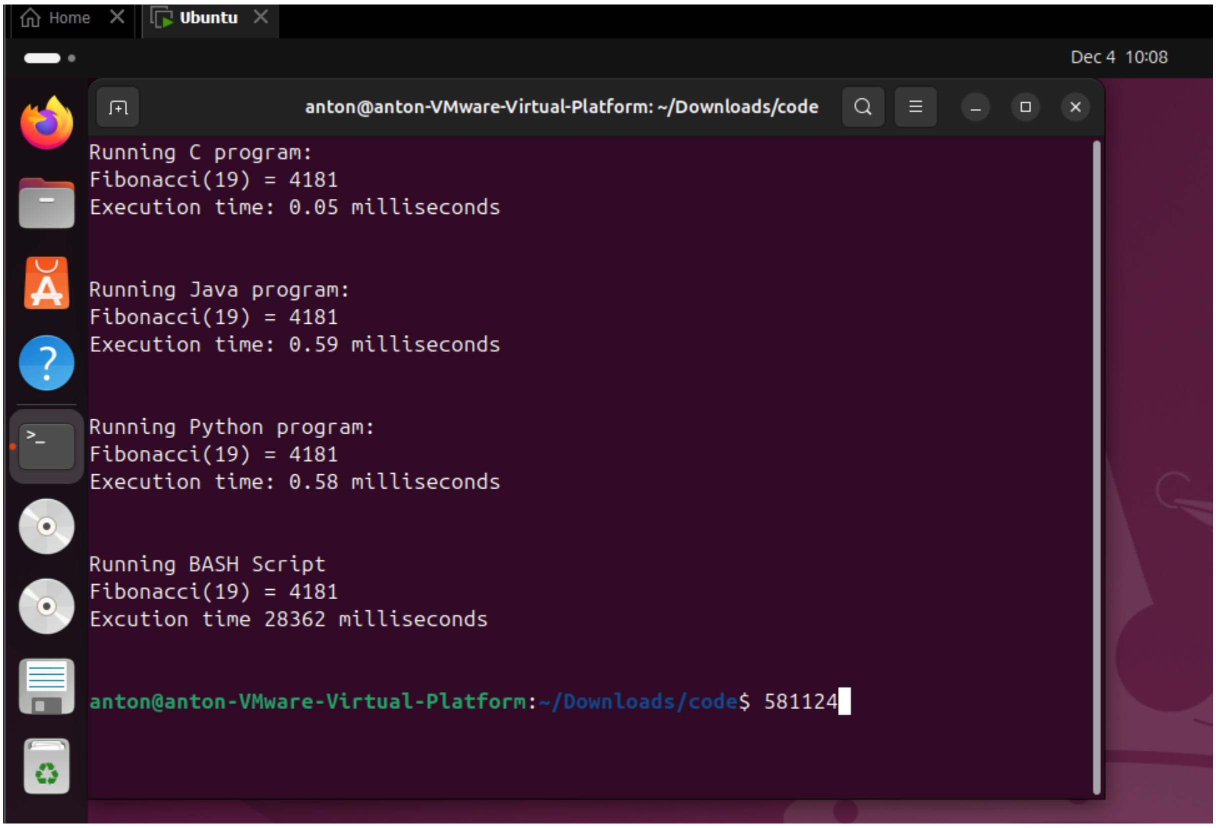
b) Compile **fib.c** again with the optimization parameters



c) Run the newly compiled program. Is it true that it now performs the calculation faster?



d) Edit the file **runall.sh**, so you can perform all four calculations in a row using this Bash script. So the (compiled/interpreted) C, Java, Python and Bash versions of Fibonacci one after the other.



Assignment 4.5: More ARM Assembly

Like the factorial example, you can also implement the calculation of a power of 2 in assembly. For example you want to calculate $2^4 = 16$. Use iteration to calculate the result. Store the result in r0.

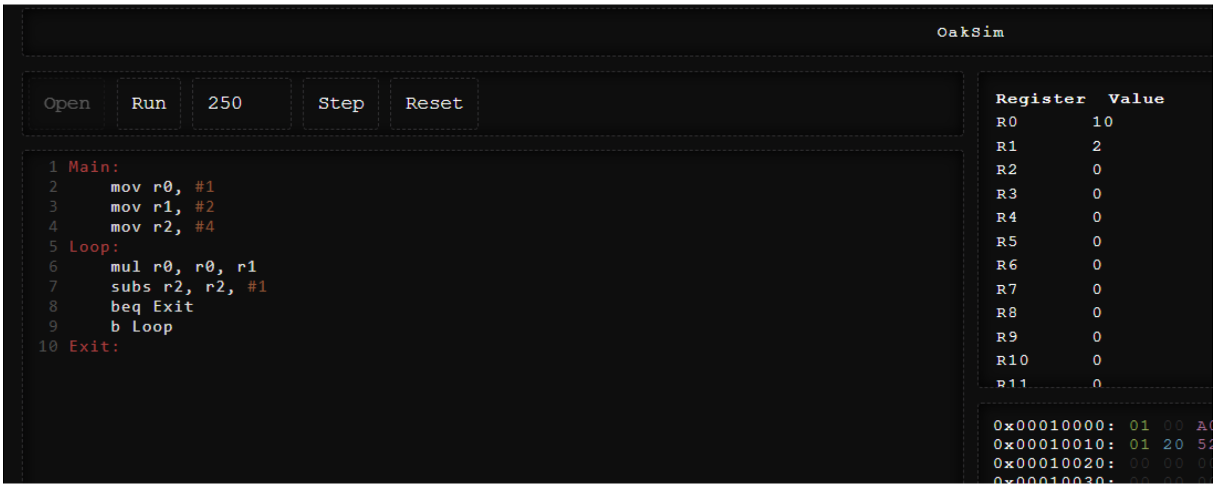
```
Main:
mov r1, #2
mov r2, #4


Loop:


End:
```

Complete the code. See the PowerPoint slides of week 4.

Screenshot of the completed code here.


OakSim
Open
Run
250
Step
Reset
Main:
mov r0, #1
mov r1, #2
mov r2, #4
Loop:
mul r0, r0, r1
subs r2, r2, #1
beq Exit
b Loop
Exit:
Register Value
R0 10
R1 2
R2 0
R3 0
R4 0
R5 0
R6 0
R7 0
R8 0
R9 0
R10 0
0x00010000: 01 00
0x00010010: 01 20
0x00010020: 00 00