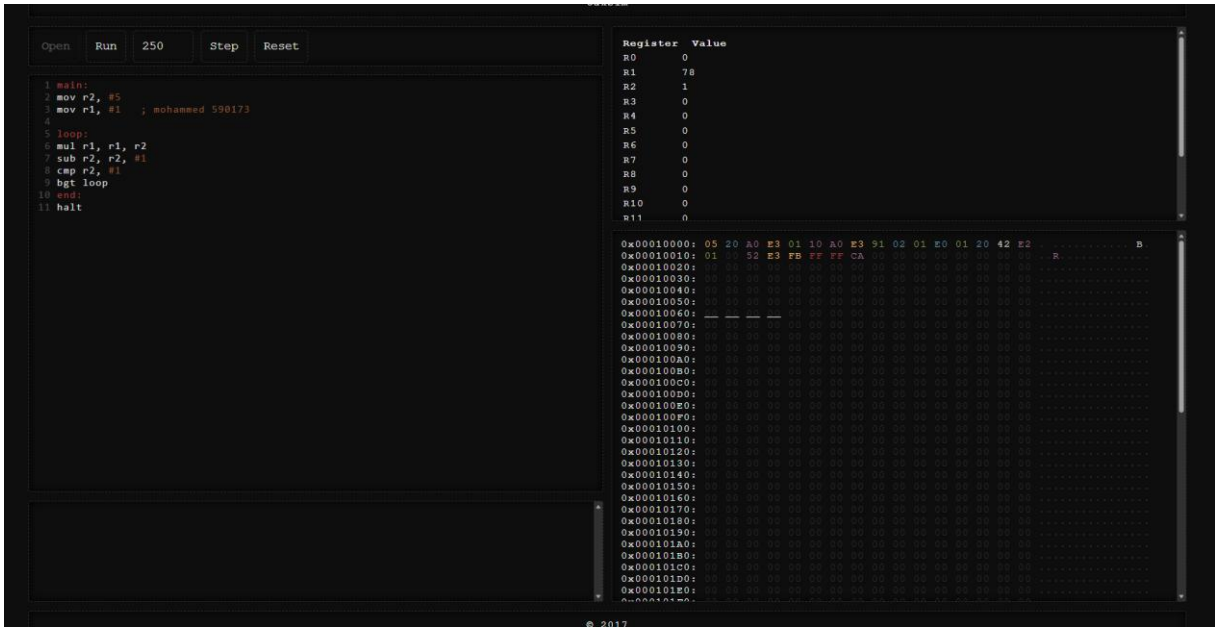
Template Week 4 – Software

Student number: 590173

Assignment 4.1: ARM assembly

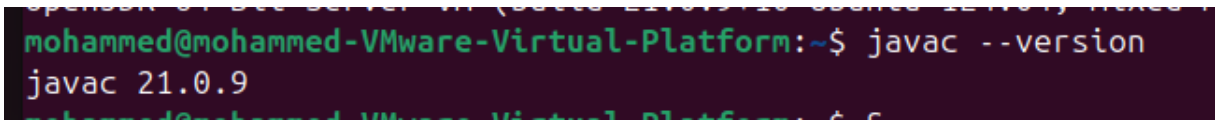
Screenshot of working assembly code of factorial calculation:



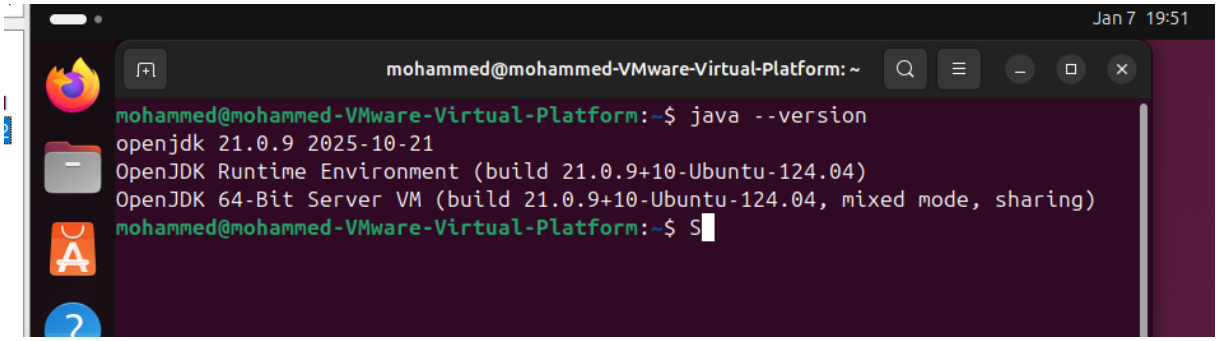
Assignment 4.2: Programming languages

Take screenshots that the following commands work:

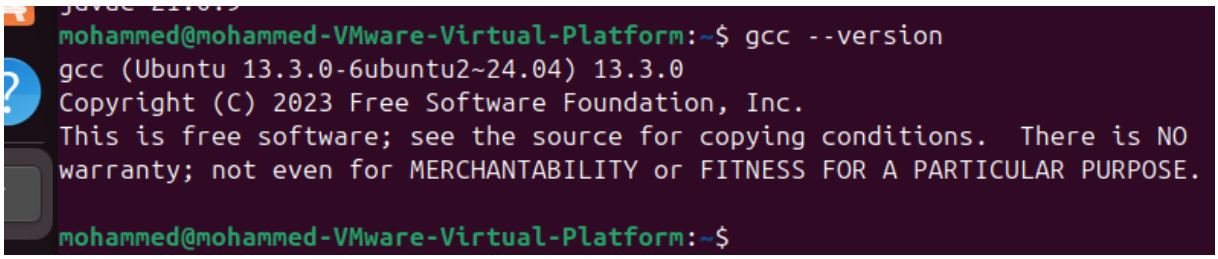
javac –version



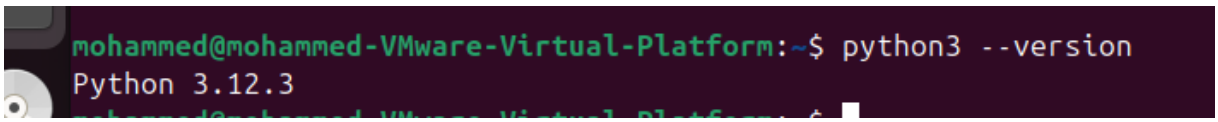
java –version



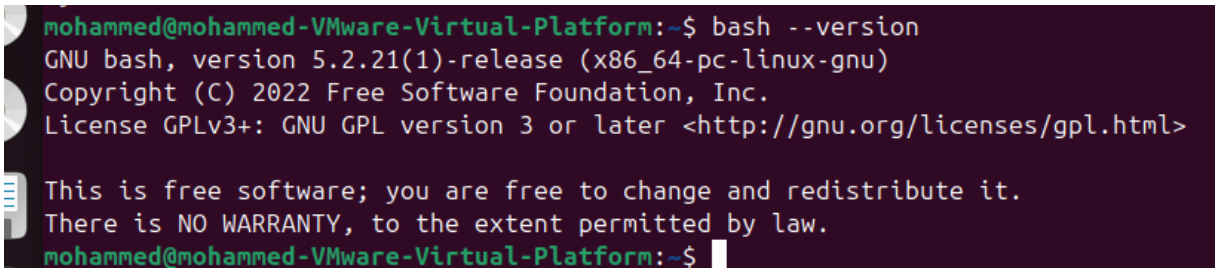
gcc –version



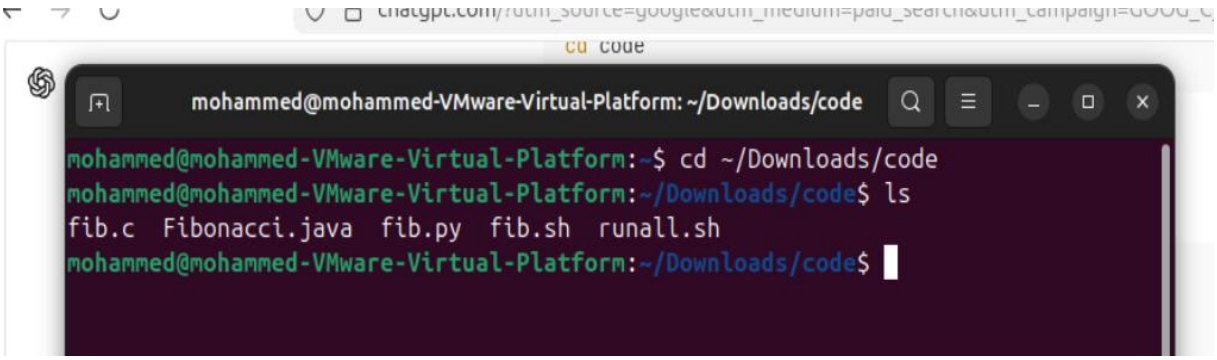
python3 –version



bash --version



Assignment 4.3: Compile



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

fib.c → YES (must be compiled)

Fibonacci.java → YES (must be compiled)

fib.py → NO

fib.sh → NO

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

fib.c C compiles directly to CPU instructions.

Which source code files are compiled to byte code?

Fibonacci.java Java compiles to .class bytecode and runs on the JVM

Which source code files are interpreted by an interpreter?

fib.py (Python interpreter)

fib.sh (Bash interpreter)

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

The C program (fib.c) will be expected to perform the calculation the fastest.

How do I run a Java program?

To run a Java program, you first need to compile it using javac, and then run the compiled program with java.

How do I run a Python program?

Python is an interpreted language, so you don't need to compile it. You just run it directly with the python3 command.

How do I run a C program?

To run a C program, you need to compile it into an executable first and then run that file.

How do I run a Bash script?

To run a Bash script, you can either make it executable and then run it, or just run it directly using bash.

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

Yes, new files will be created when you compile the programs:

For fib.c (C program):

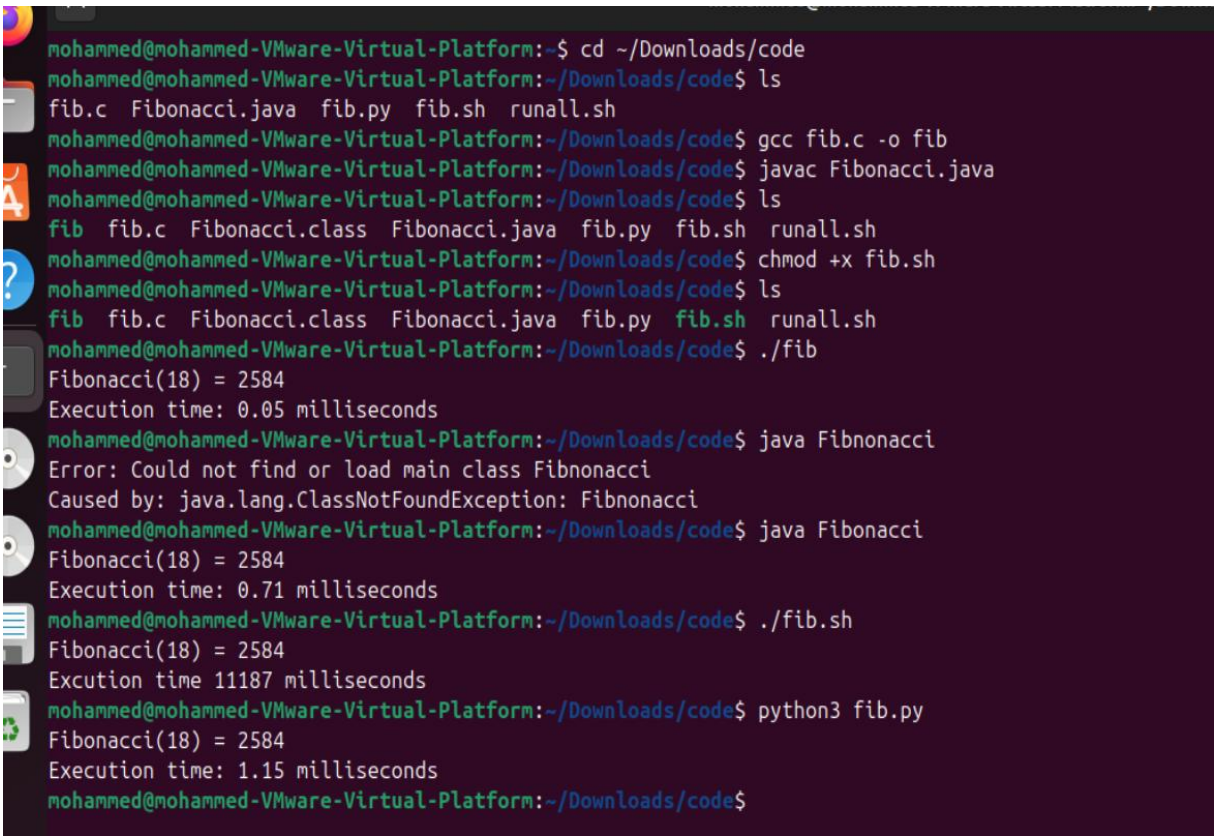
A new file called fib will be created after compiling. This is the executable file.

For Fibonacci.java (Java program):

A new file called Fibonacci.class will be created after compiling. This is the bytecode file.

Take relevant screenshots of the following commands:

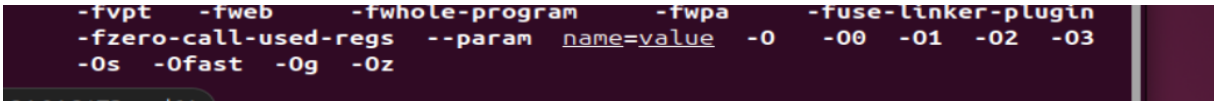
- Compile the source files where necessary
- Make them executable
- Run them
- Which (compiled) source code file performs the calculation the fastest?



Assignment 4.4: Optimize

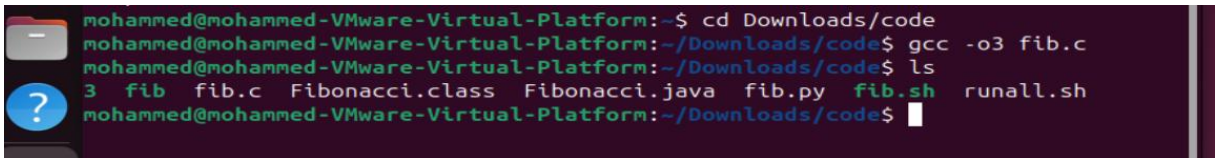
Take relevant screenshots of the following commands:

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.

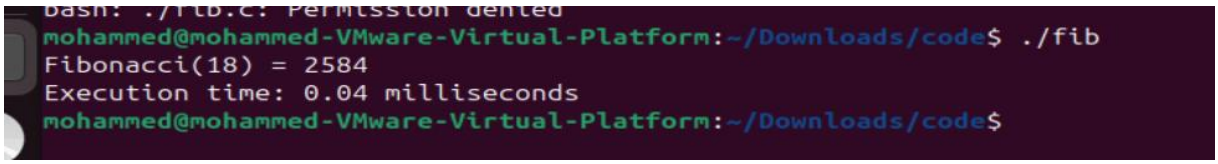


in the world of gcc, the higher the number, the harder the compiler works to make your code fast. While -o2 is good, -o3 turns on even more "speed tricks" to ensure your C program is the fastest in the race.

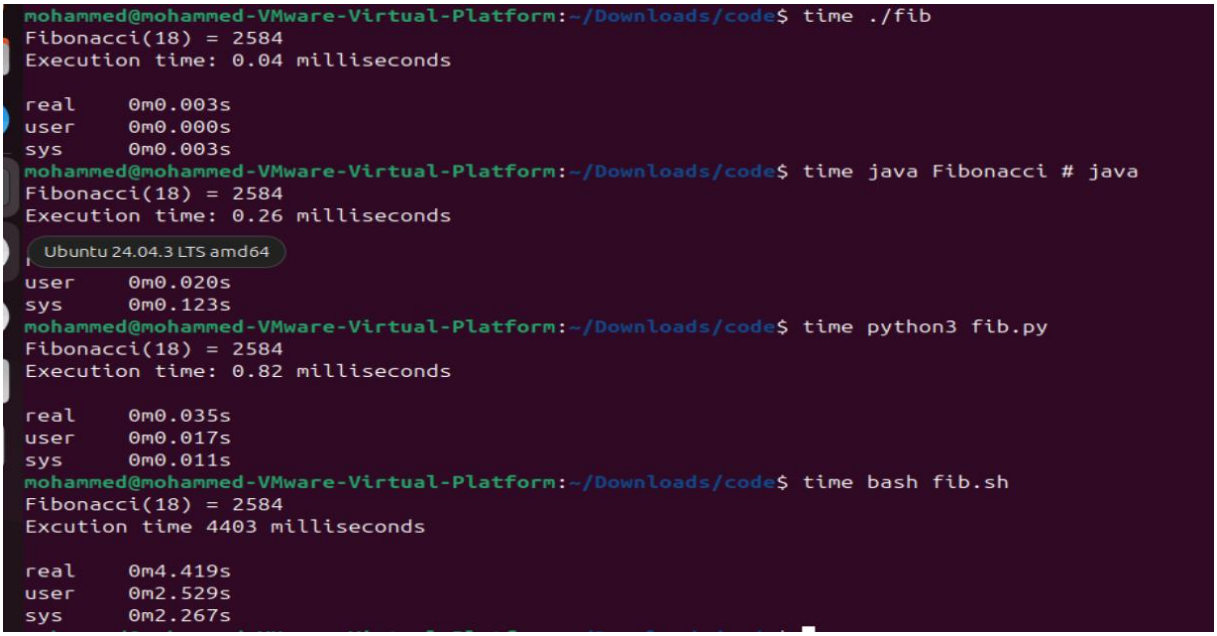
b) Compile **fib.c** again with the optimization parameters



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.

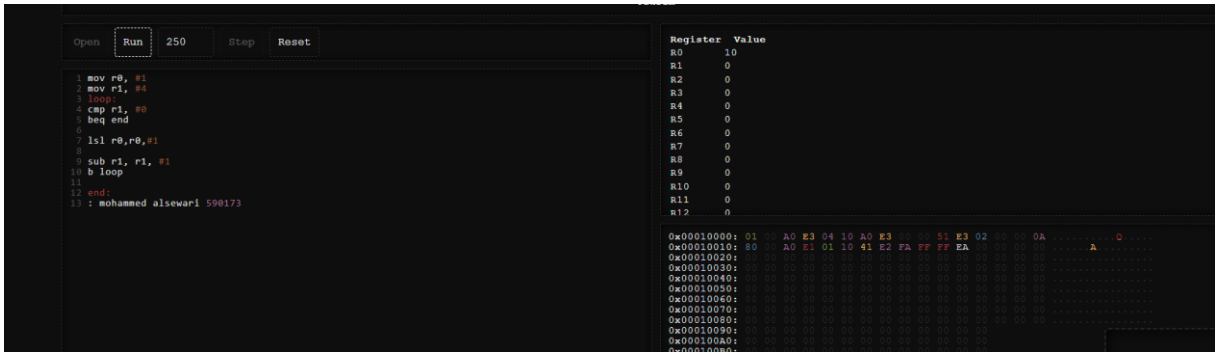
```
Main:
mov r1, #2
mov r2, #4

Loop:

End:
```

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

Screenshot of the completed code here.



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