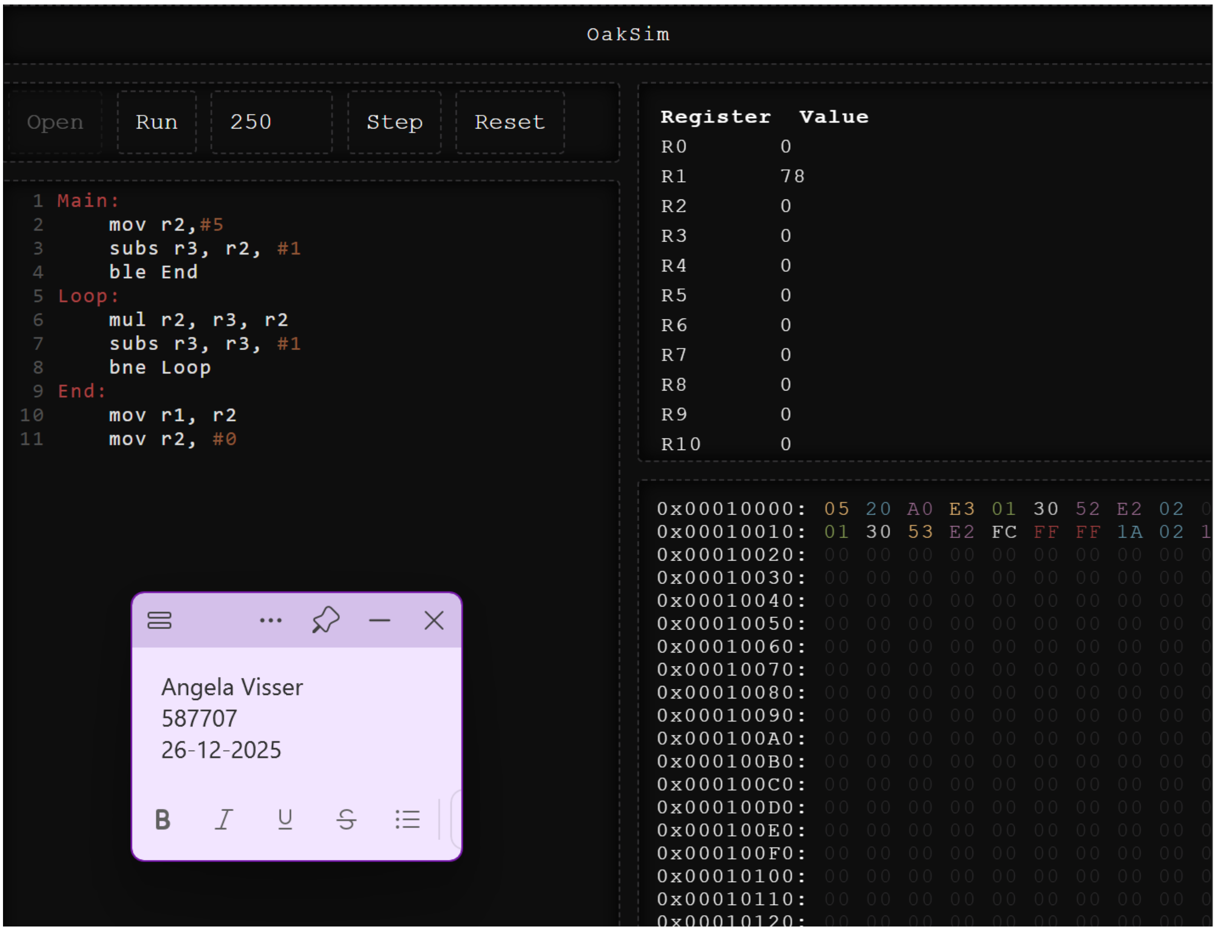
Template Week 4 – Software

Student number: 587707

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:

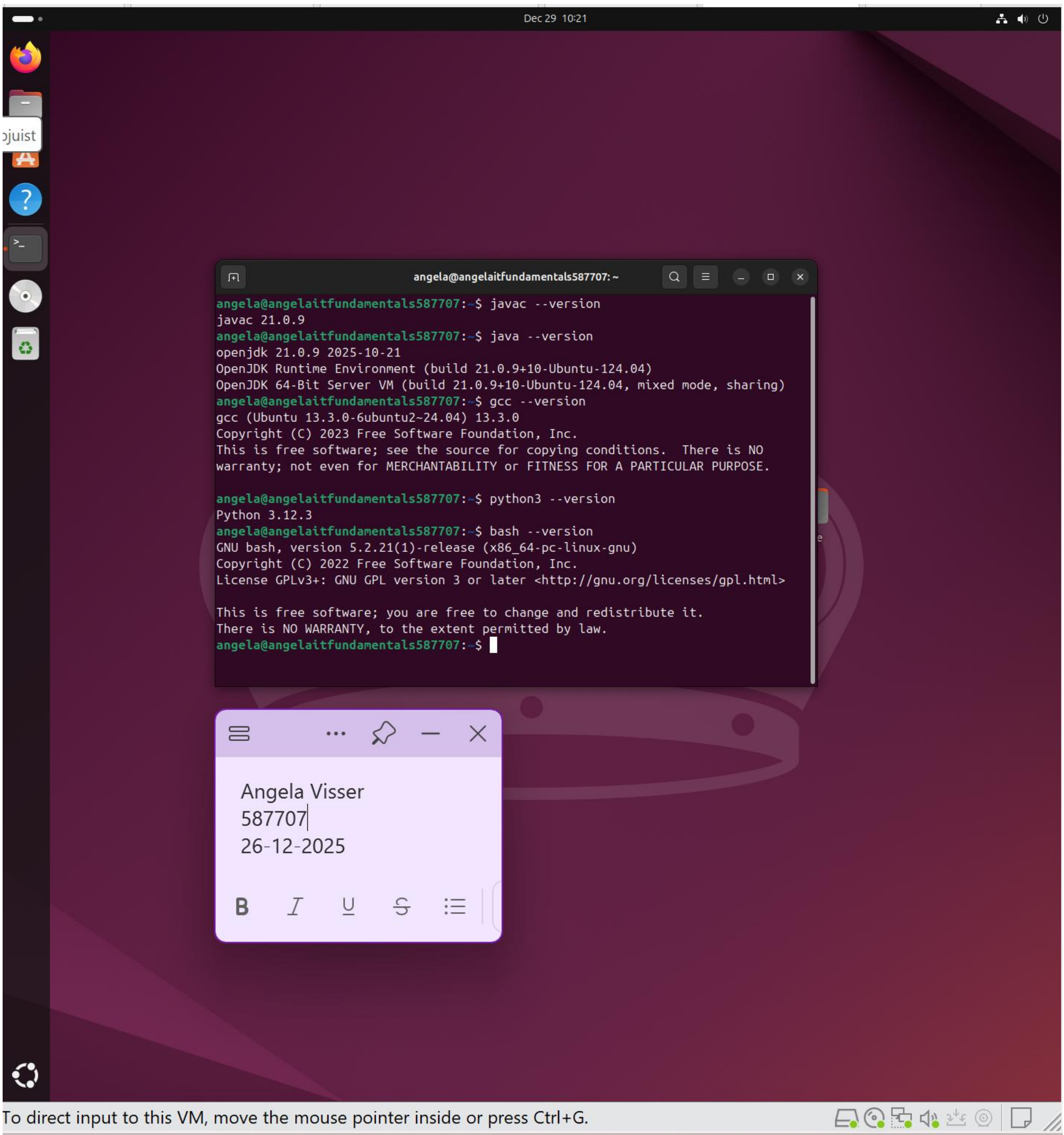
javac --version

java --version

gcc --version

python3 --version

bash --version



Assignment 4.3: Compile

O output

D disassemble

Fibonacci.java -java source code

fib.c -c source code

fib.py -python3 source code

fib.sh -bash script source code

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

Fibonacci.java en fib.c

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

Fib.c, c is a language that is compiled directly into machine code.
java is compiled into bytecode and runs on the java virtual machine.
the other two are interpreted languages.

Which source code files are compiled to byte code?

Fibonacci.Java, see explanation above.

Which source code files are interpreted by an interpreter?

Fib.py and fib.sh

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

Fib.c is expected to run the fastest. This is because c is compiled directly into machine code.

How do I run a Java program?

First, Java has to be compiled into bytecode, which then is runs within the Java virtual machine.

How do I run a Python program?

A python program is read and executed by the interpreter. And the interpreter's machine code runs on the CPU.

How do I run a C program?

Because c is a compiled language, the source code is converted into machine instructions that can be directly executed by a processor.

How do I run a Bash script?

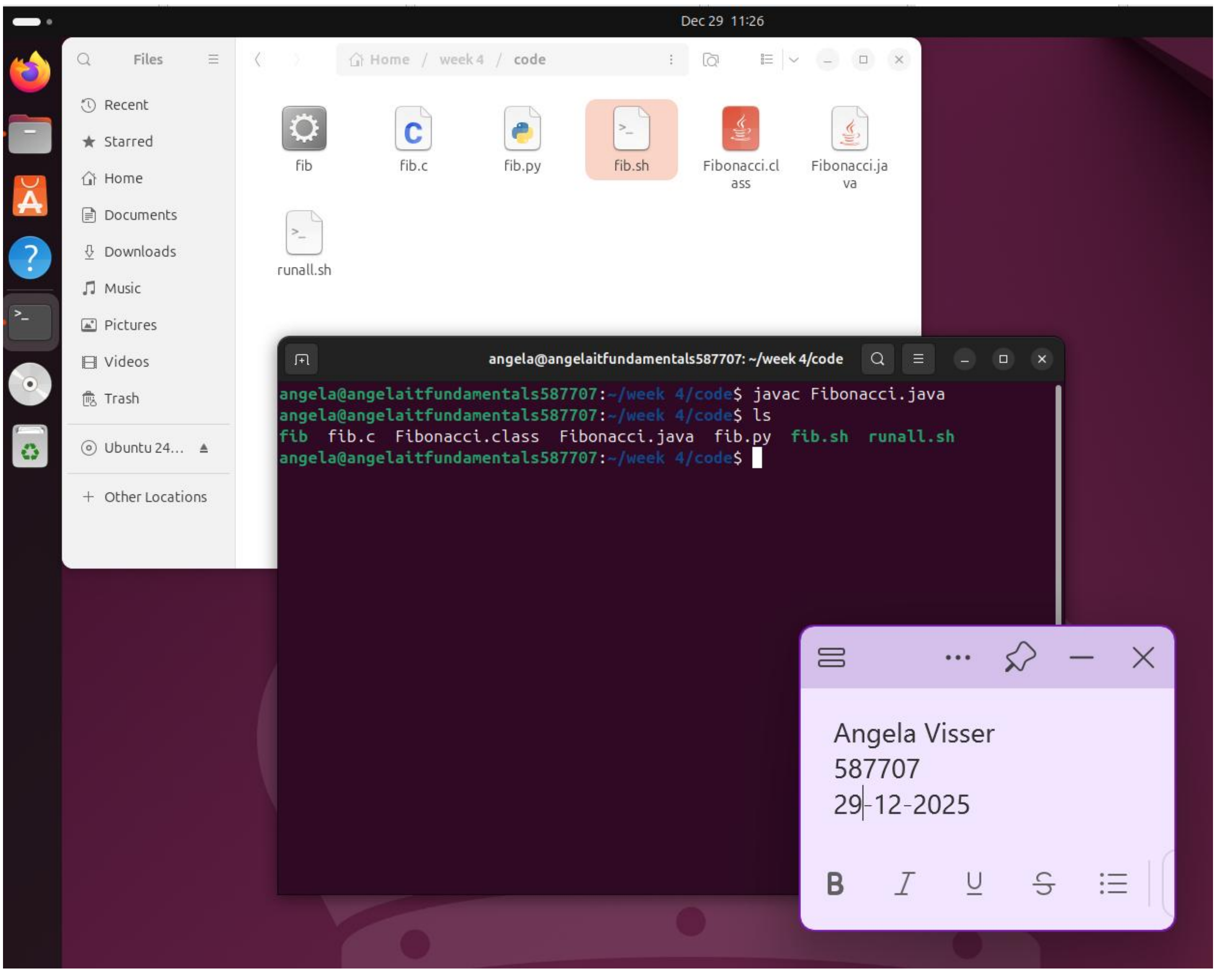
A bash script needs to be interpreted by an interpreter (Bash shell). Do note that we are trying to execute it on Ubuntu, so it needs to be made executable by changing the rights using the command: [sudo chmod a+x fib.sh].

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

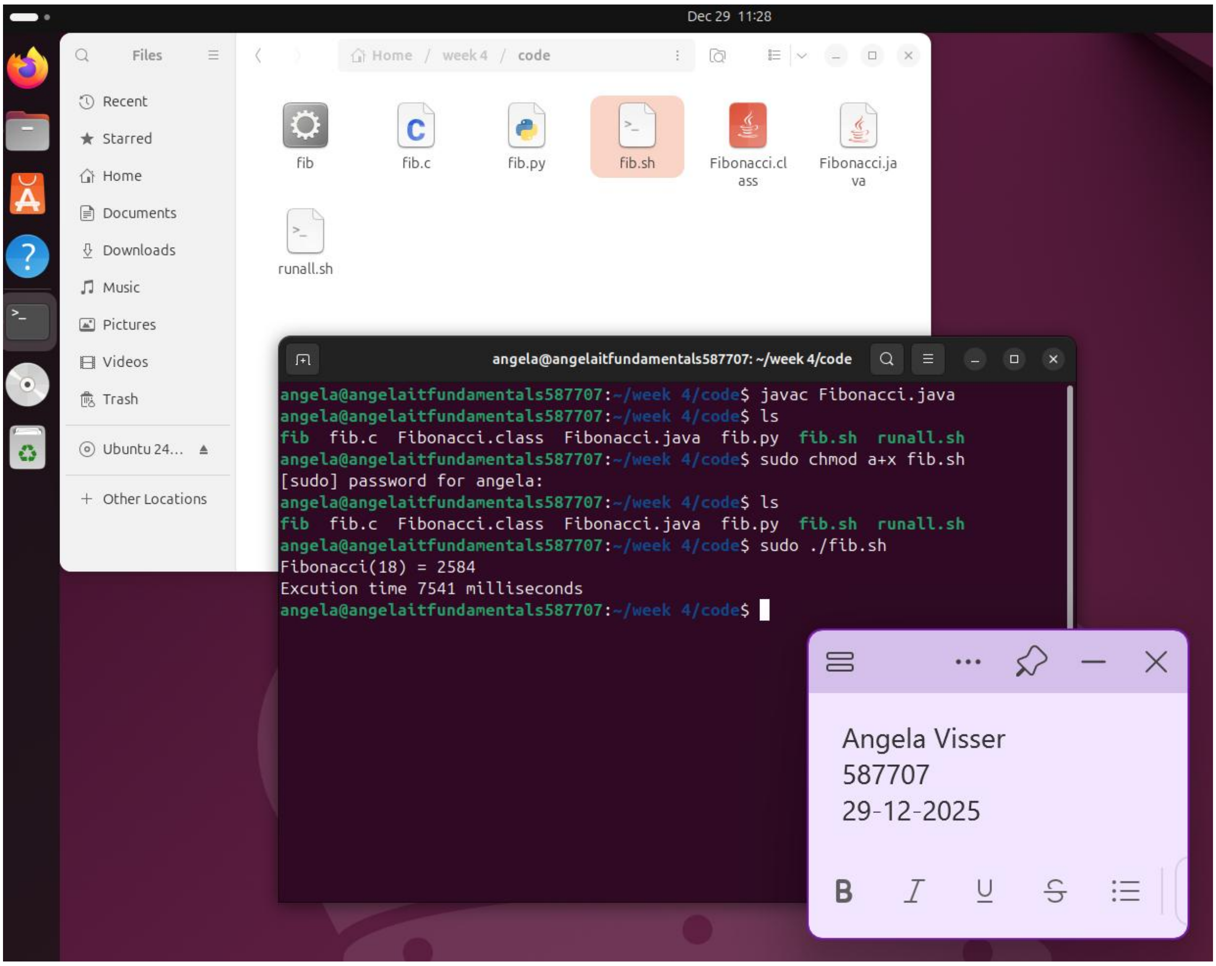
The compiled languages will add a file after compilation. The interpreted languages will not.
Fibonacci.java → Fibonacci.class
fib.c → fib.

Take relevant screenshots of the following commands:

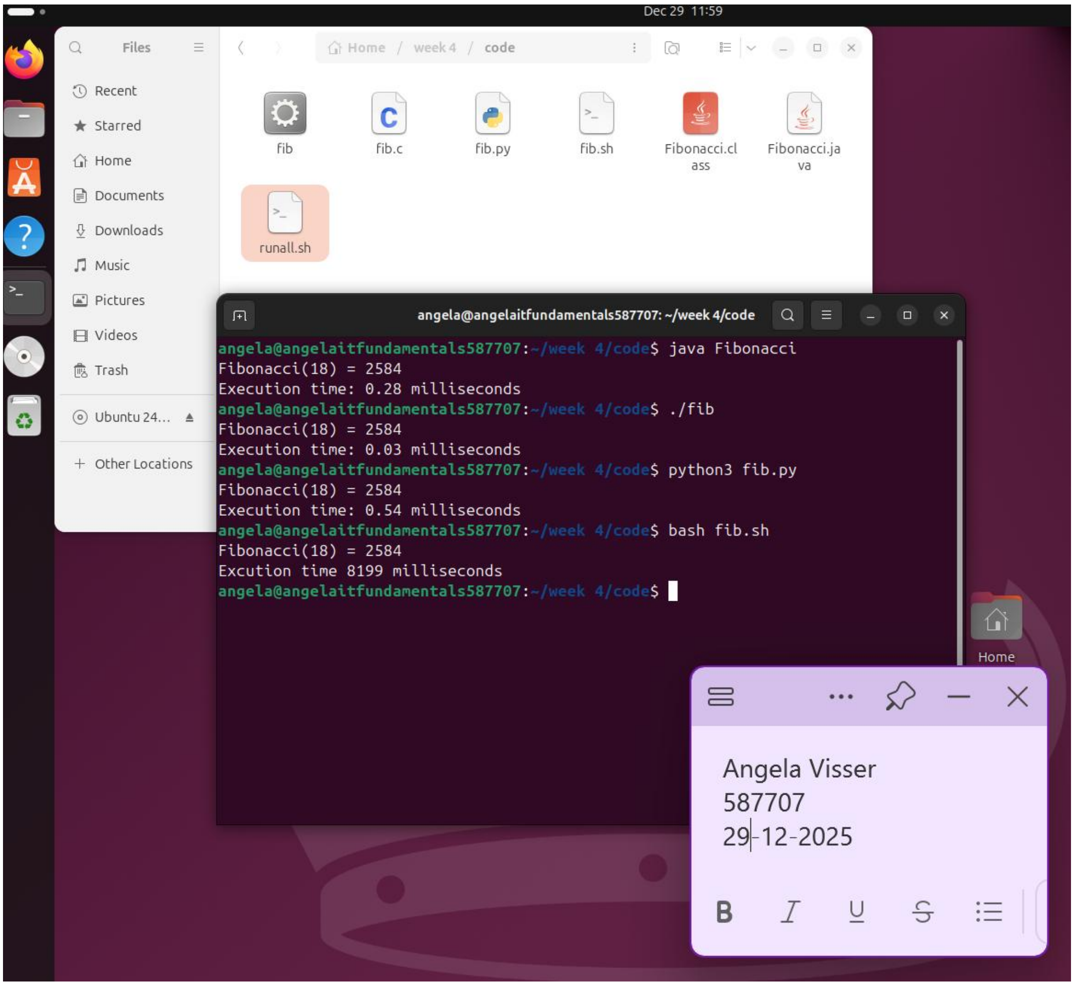
- Compile the source files where necessary



- Make them executable


Dec 29 11:28
Files
Recent
Starred
Home
Documents
Downloads
Music
Pictures
Videos
Trash
Ubuntu 24...
Other Locations
Home / week 4 / code
fib
fib.c
fib.py
fib.sh
Fibonacci.class
Fibonacci.java
runall.sh
angela@angelaitfundamentals587707: ~/week 4/code
angela@angelaitfundamentals587707:~/week 4/code$ javac Fibonacci.java
angela@angelaitfundamentals587707:~/week 4/code$ ls
fib fib.c Fibonacci.class Fibonacci.java fib.py fib.sh runall.sh
angela@angelaitfundamentals587707:~/week 4/code$ sudo chmod a+x fib.sh
[sudo] password for angela:
angela@angelaitfundamentals587707:~/week 4/code$ ls
fib fib.c Fibonacci.class Fibonacci.java fib.py fib.sh runall.sh
angela@angelaitfundamentals587707:~/week 4/code$ sudo ./fib.sh
Fibonacci(18) = 2584
Excution time 7541 milliseconds
angela@angelaitfundamentals587707:~/week 4/code$
Angela Visser
587707
29-12-2025

- Run them



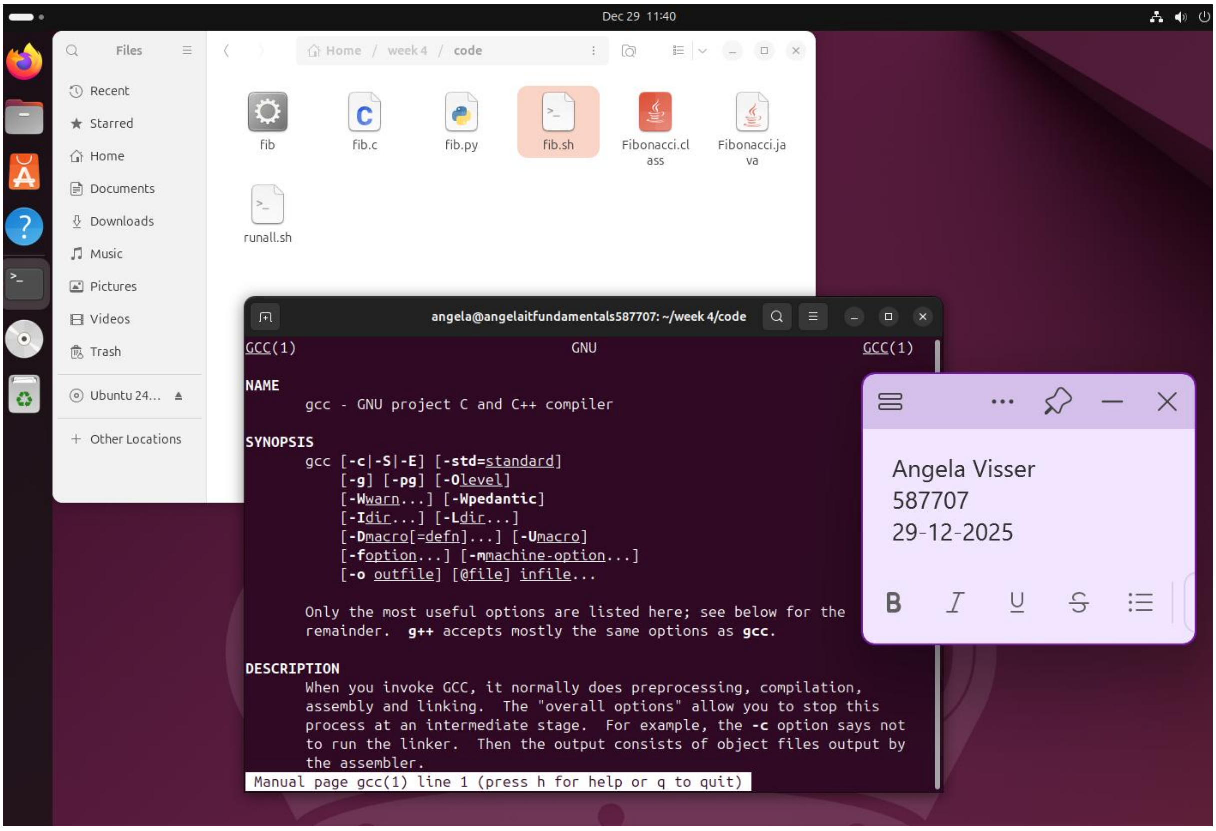
- Which (compiled) source code file performs the calculation the fastest?

The c source code performs the fastest.

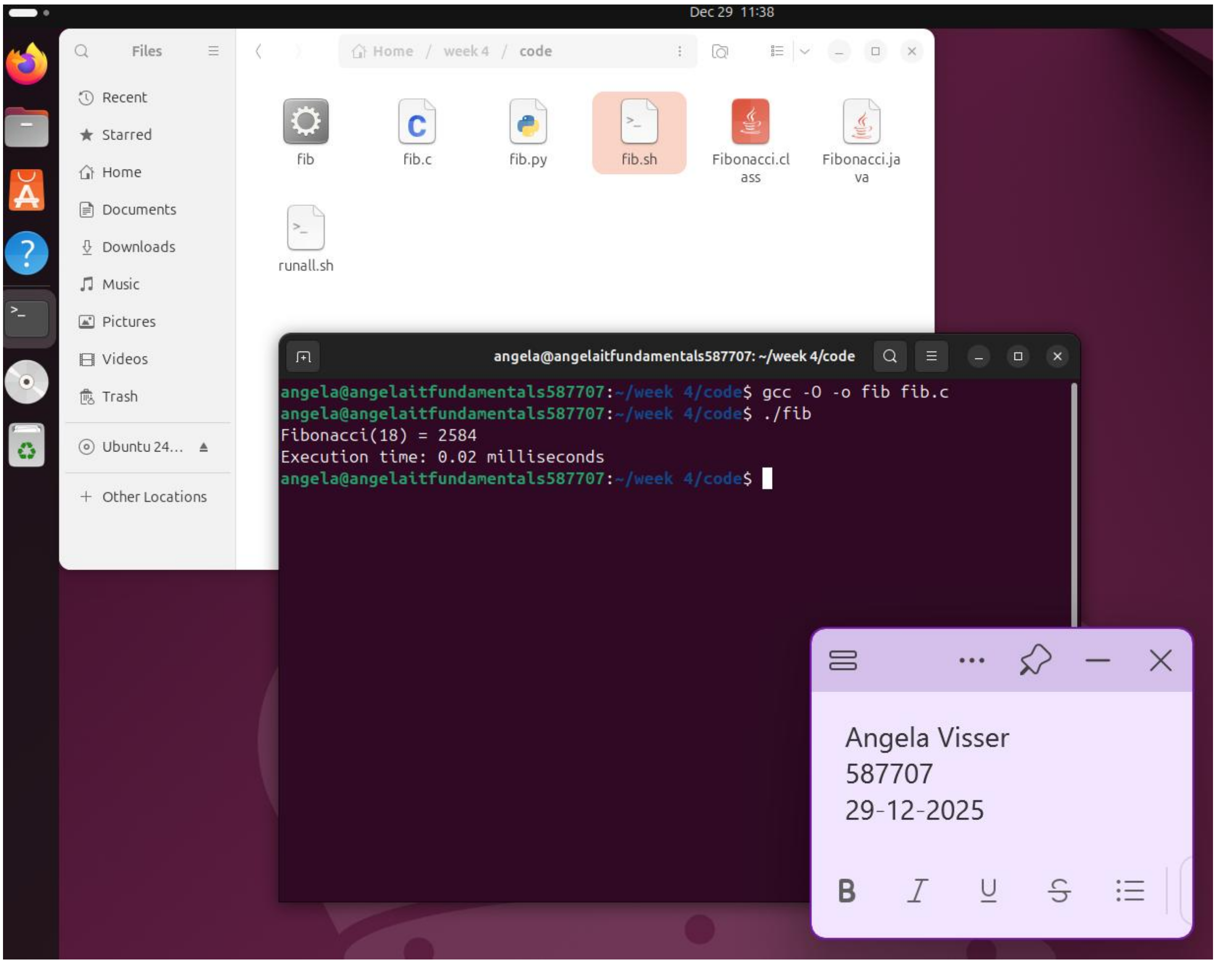
Assignment 4.4: Optimize

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.



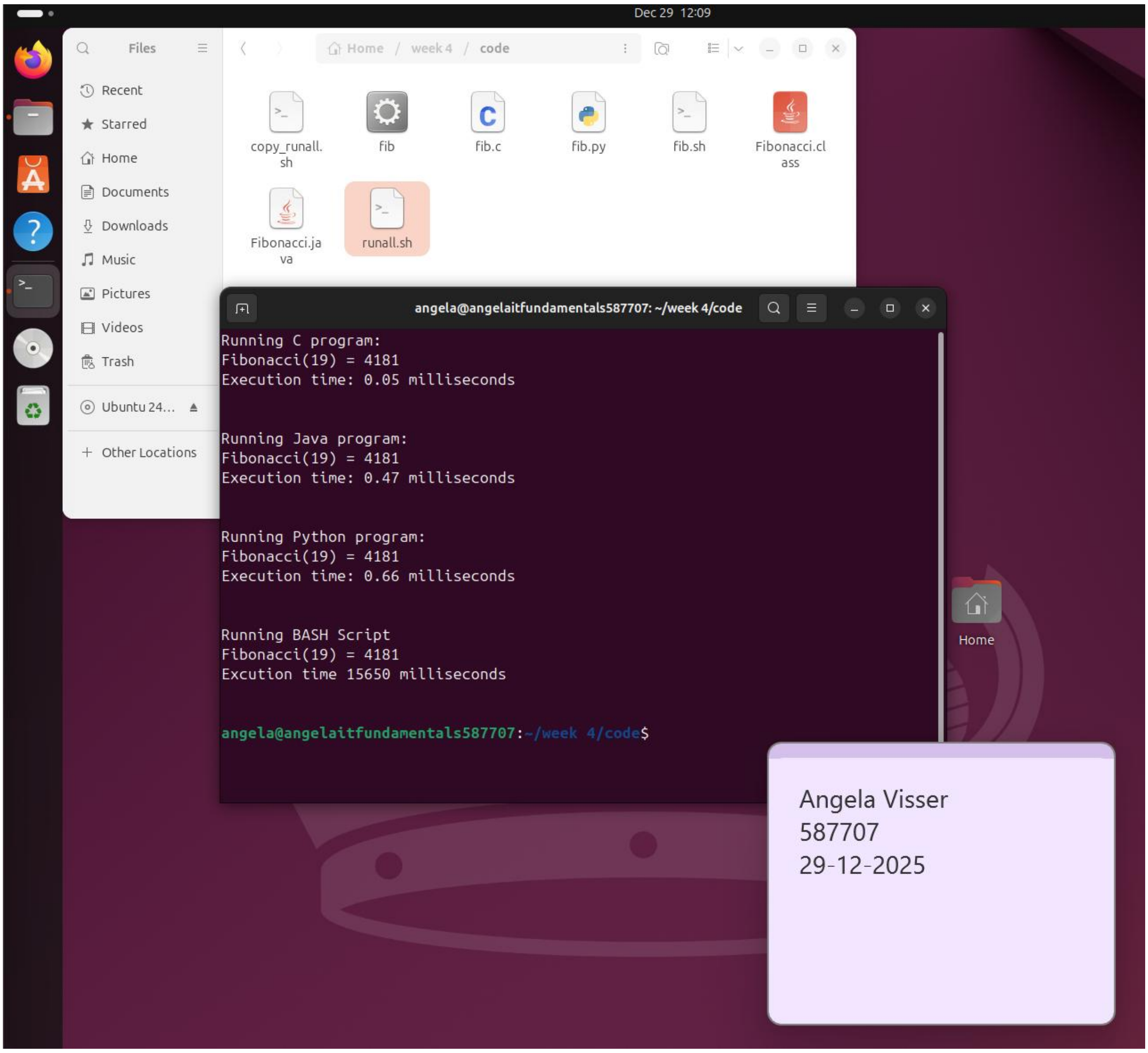
b) Compile **fib.c** again with the optimization parameters



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

Yes

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.



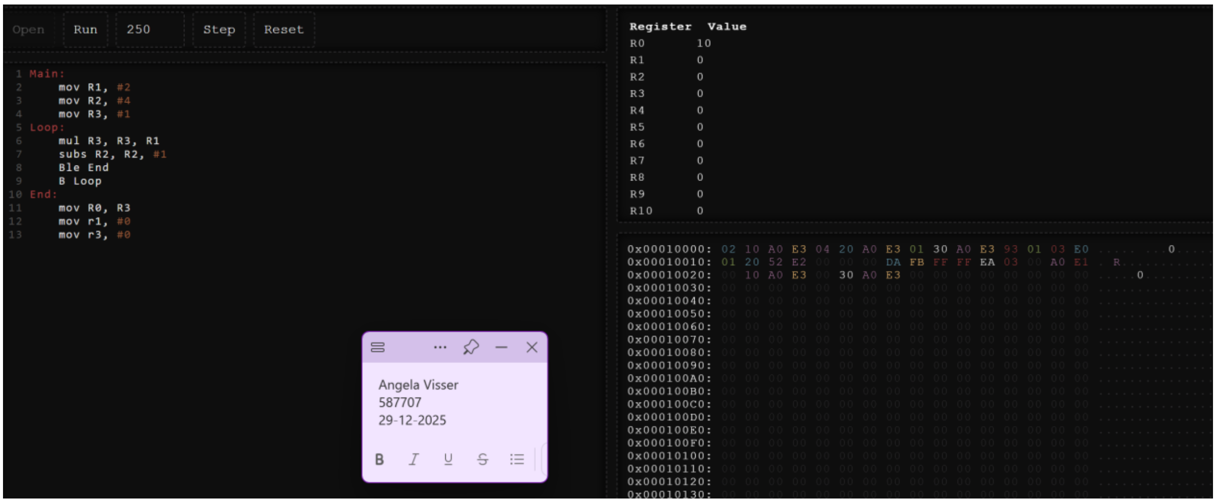
Assignment 4.5: More ARM Assembly

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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