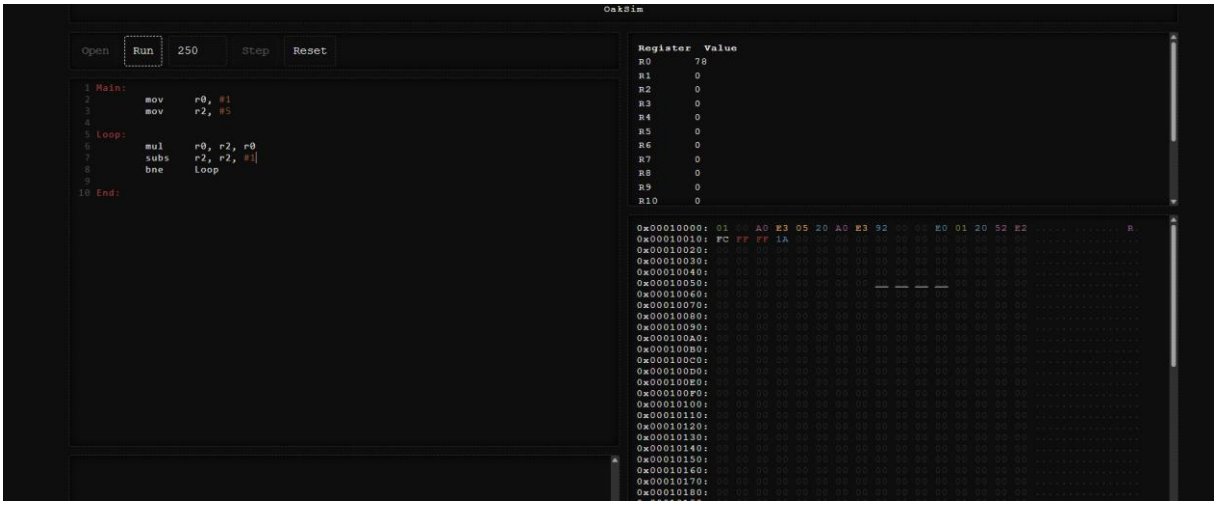
Template Week 4 – Software

Student number:

Assignment 4.1: ARM assembly

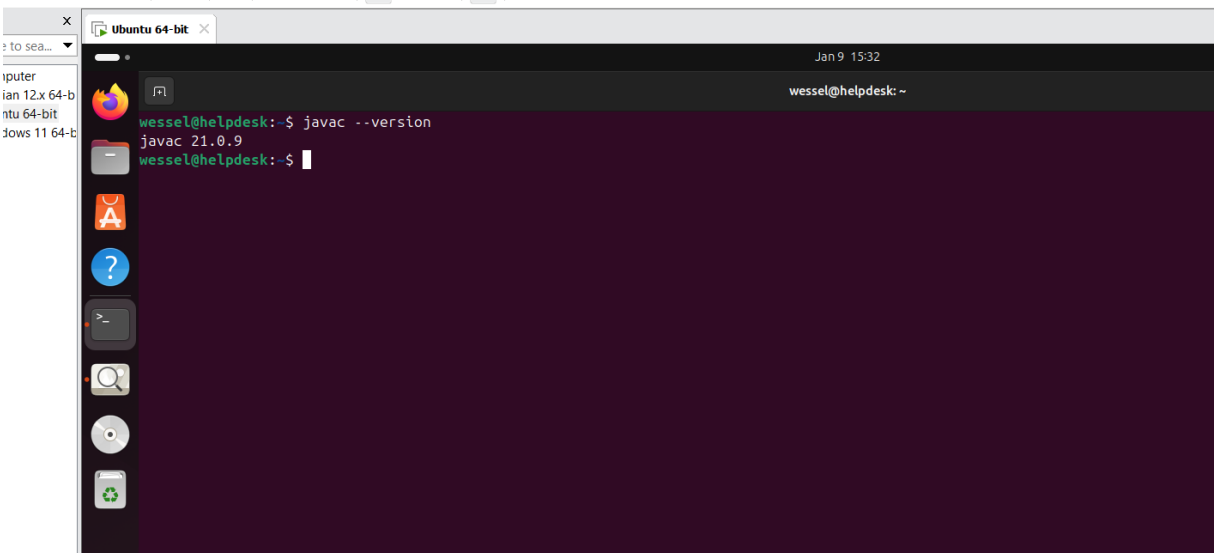
Screenshot of working assembly code of factorial calculation:



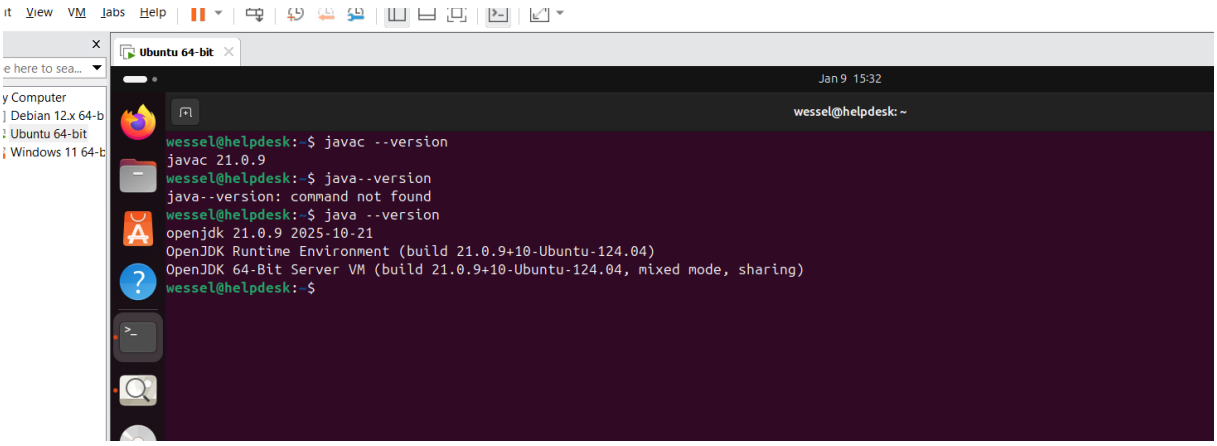
Assignment 4.2: Programming languages

Take screenshots that the following commands work:

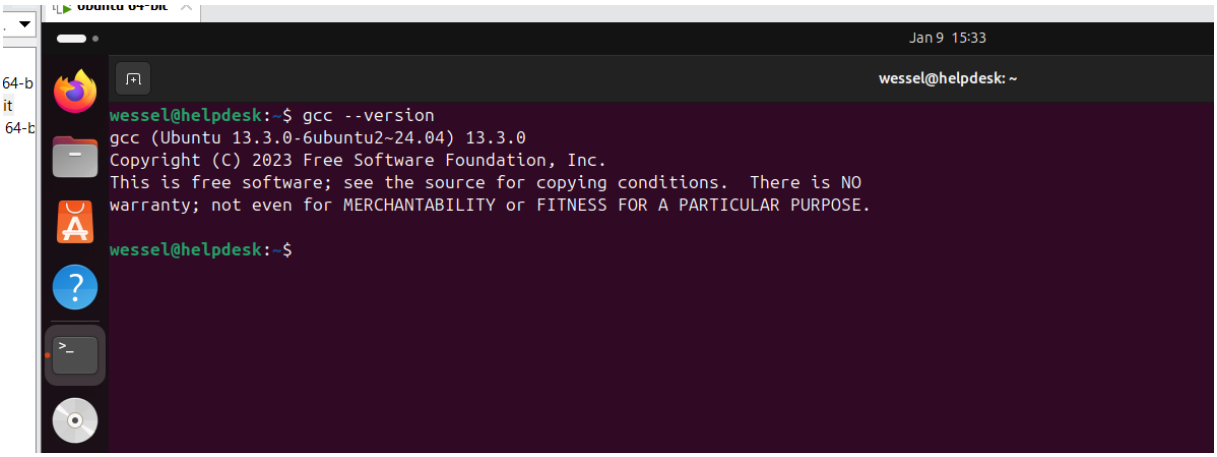
javac –version



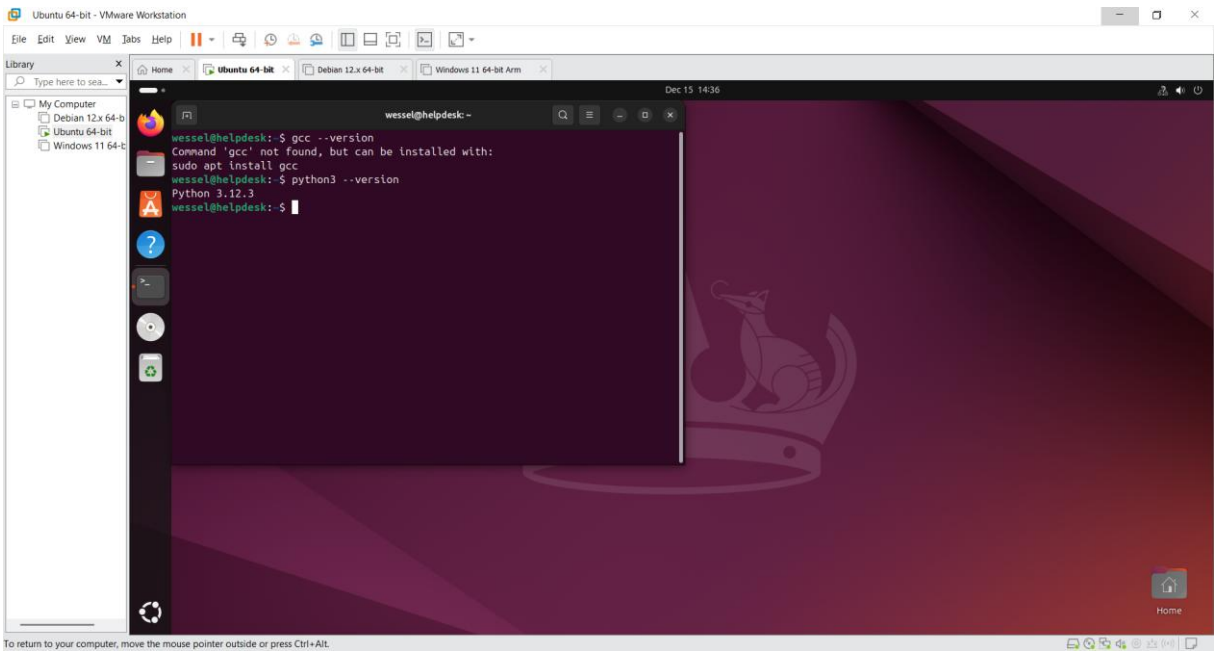
java –version



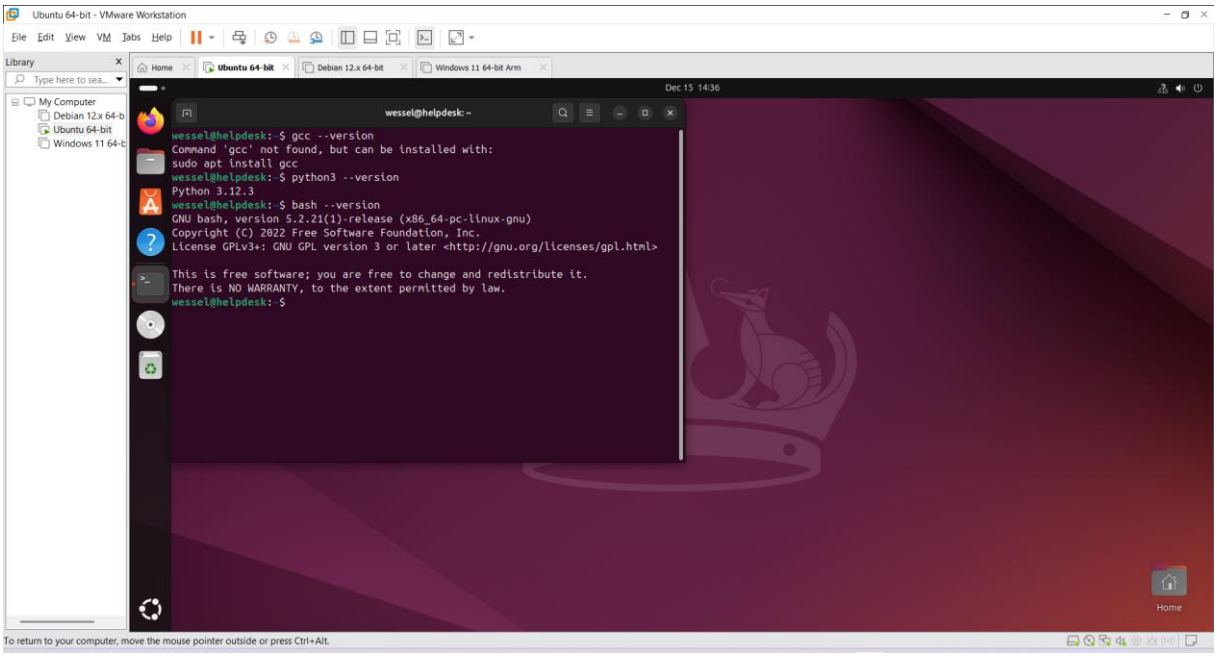
gcc –version



python3 –version



bash –version


Ubuntu 64-bit - VMware Workstation
File Edit View VM Tabs Help
Library
Type here to sea...
My Computer
Debian 12.x 64-b
Ubuntu 64-bit
Windows 11 64-b
Home
Ubuntu 64-bit
Debian 12.x 64-bit
Windows 11 64-bit Arm
Dec 15 14:36
wessel@helpdesk: ~
wessel@helpdesk:~$ gcc --version
Command 'gcc' not found, but can be installed with:
sudo apt install gcc
wessel@helpdesk:~$ python3 --version
Python 3.12.3
wessel@helpdesk:~$ bash --version
GNU bash, version 5.2.21(1)-release (x86_64-pc-linux-gnu)
Copyright (C) 2022 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software; you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
wessel@helpdesk:~$
Home
To return to your computer, move the mouse pointer outside or press Ctrl+Alt.

Assignment 4.3: Compile

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

Java en C

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

C C++, Assembly

Which source code files are compiled to byte code?

Java, C#

Which source code files are interpreted by an interpreter?

Py, Sh, Bash

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

C, omdat hij gelijk dan word gecompileerd naar machinecode

How do I run a Java program?

Om te compileren doe je javac hello.java

En dan uitvoeren doe je hello

How do I run a Python program?

Je kan hem direct uitvoeren met

Python3 hello.py

How do I run a C program?

Om te compileren doe je gcc hello.c -o hello

En dan uitvoeren doe je ./hello

How do I run a Bash script?

Om hem uitvoerbaar te maken doe je chmod +x hello.sh

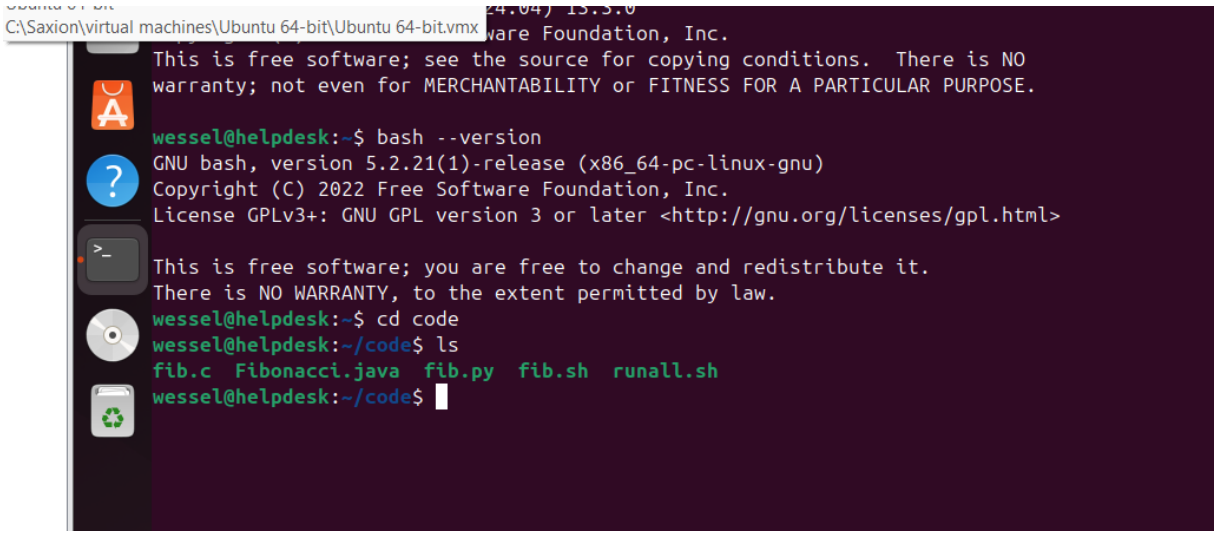
En dan uitvoeren doe je ./hello.sh

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

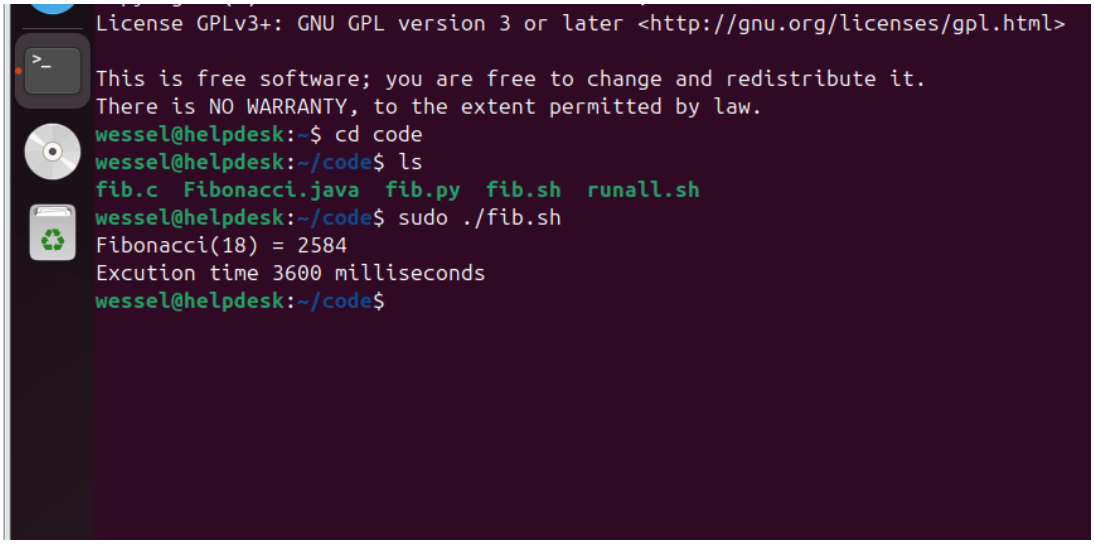
Ja runall.sh

Take relevant screenshots of the following commands:

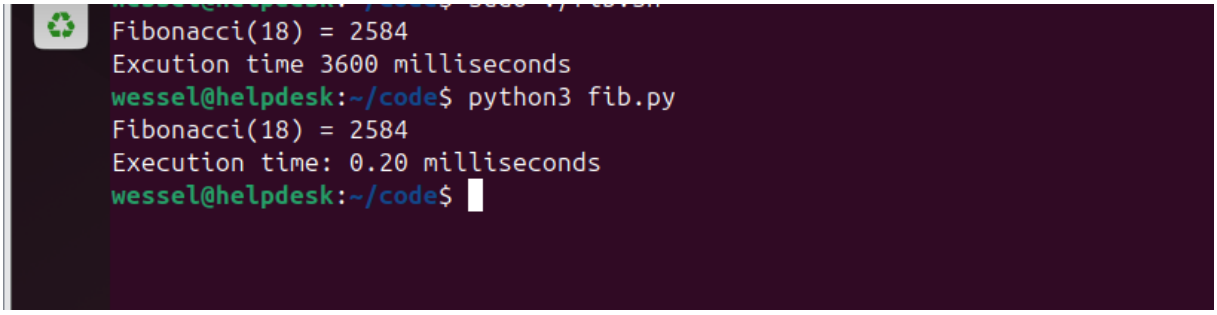
- Compile the source files where necessary
- Make them executable
- Run them



Fib.sh



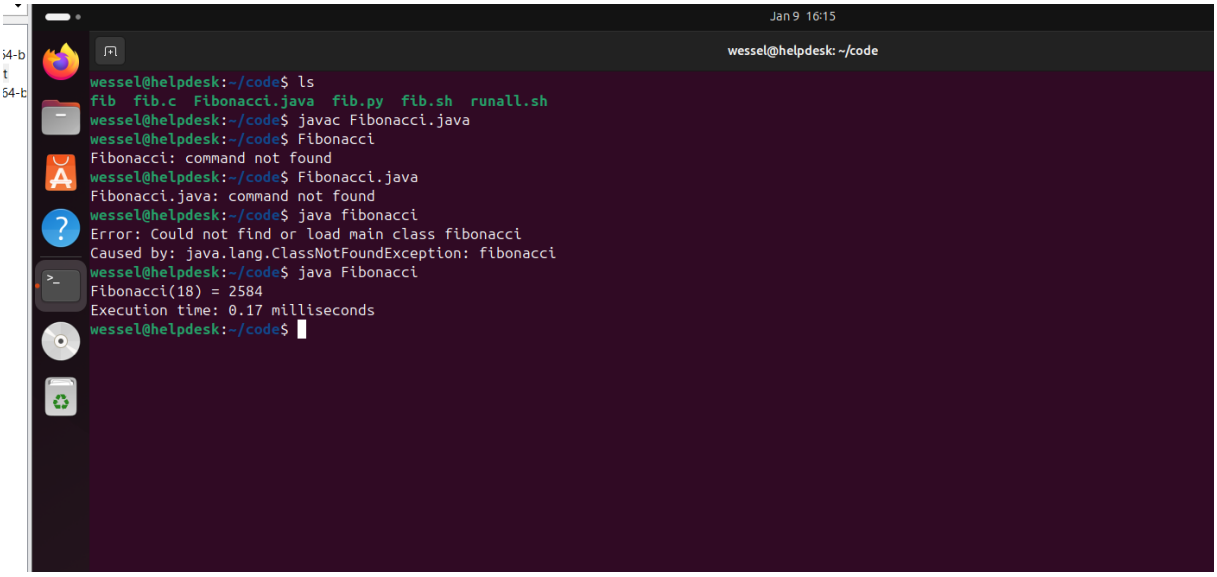
Python3



C

```
Excution time 3600 milliseconds
wessel@helpdesk:~/code$ python3 fib.py
Fibonacci(18) = 2584
Execution time: 0.20 milliseconds
wessel@helpdesk:~/code$ gcc fib.c -o fib
wessel@helpdesk:~/code$ ./fib.c
./fib.c: line 5: syntax error near unexpected token `('
./fib.c: line 5: `int fibonacci(int n) {'
wessel@helpdesk:~/code$ ./fib
Fibonacci(18) = 2584
Execution time: 0.05 milliseconds
wessel@helpdesk:~/code$
```

Java



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

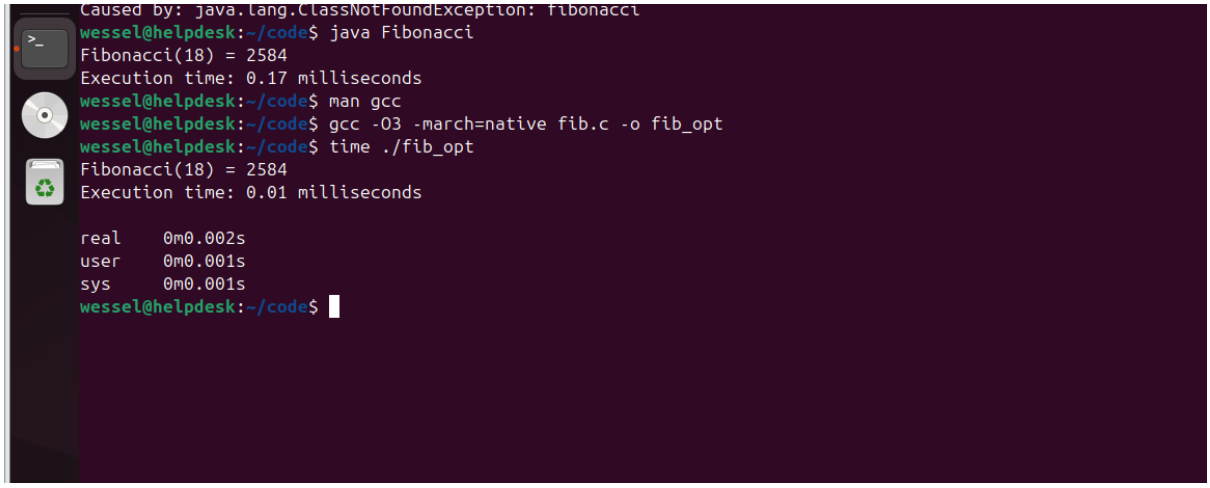
C omdat het direct naar machinecode word vertaald

Assignment 4.4: Optimize

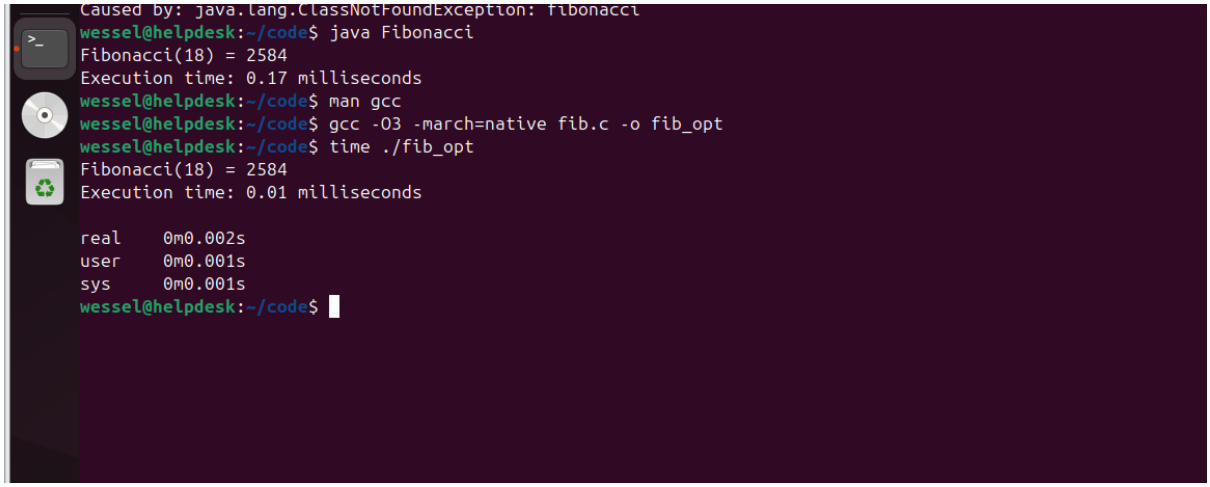
Take relevant screenshots of the following commands:

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.
O3 – march=native

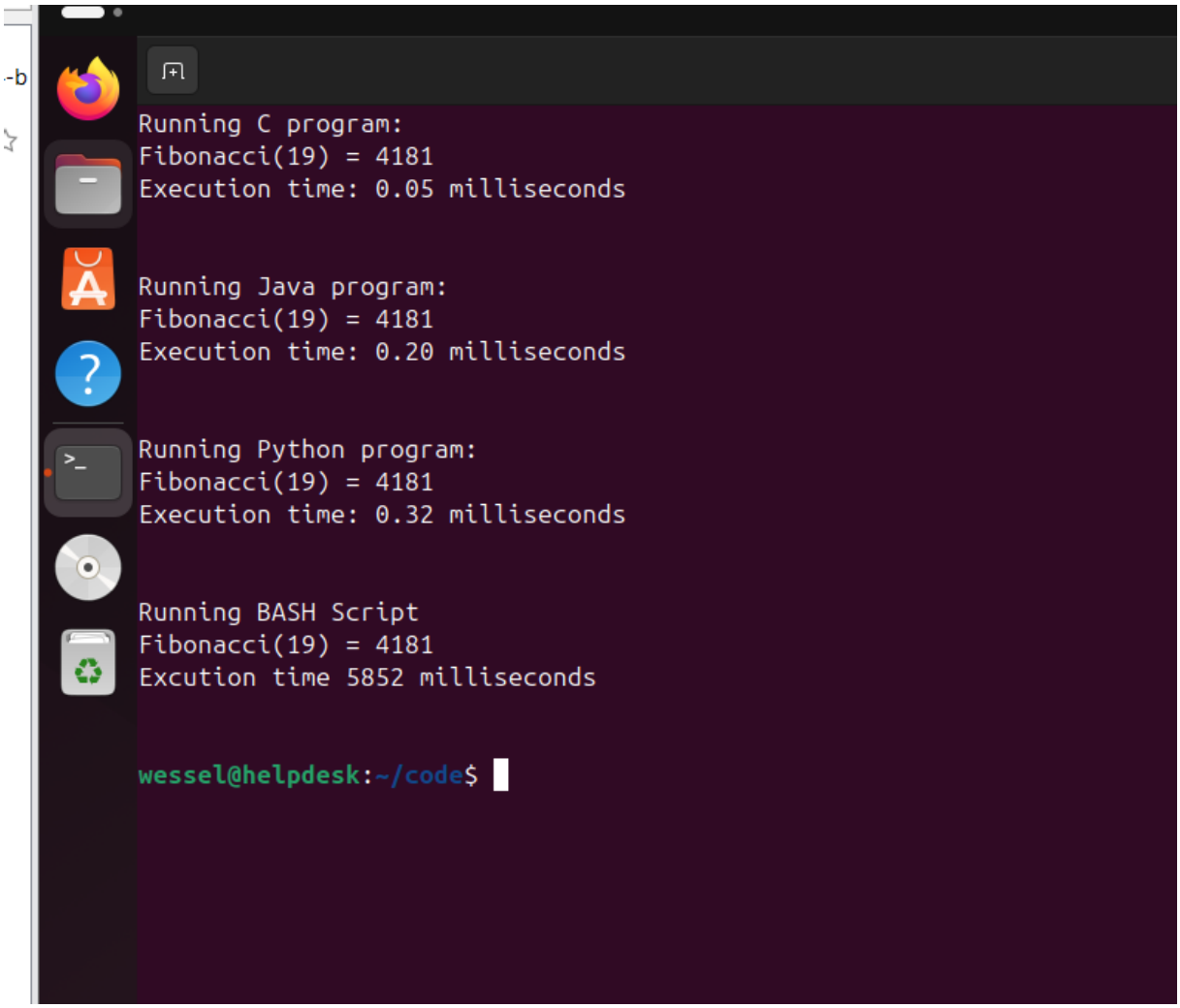
b) Compile **fib.c** again with the optimization parameters



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

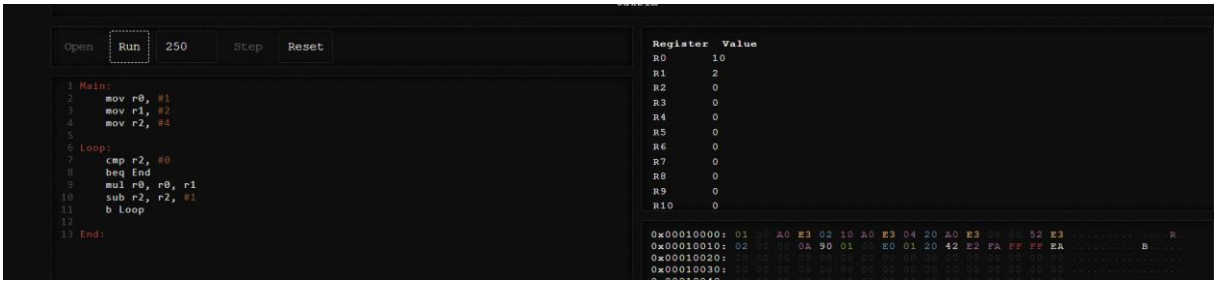
Like the factorial example, you can also implement the calculation of a power of 2 in assembly. For example you want to calculate $2^4 = 16$. Use iteration to calculate the result. Store the result in r0.

```
Main:
    mov r0, #1
    mov r1, #2
    mov r2, #4

Loop:
    cmp r2, #0
    beq End
    mul r0, r0, r1
```

```
    sub r2, r2, #1
    b Loop

End:
```

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

Screenshot of the completed code here.



Ready? Save this file and export it as a pdf file with the name: **week4.pdf**