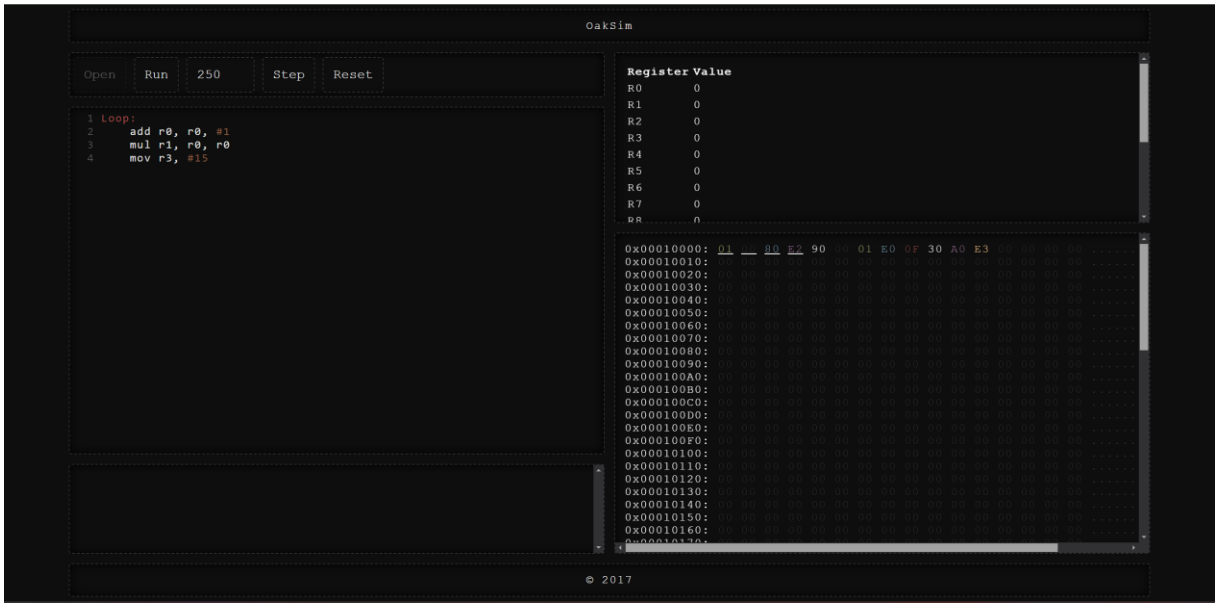
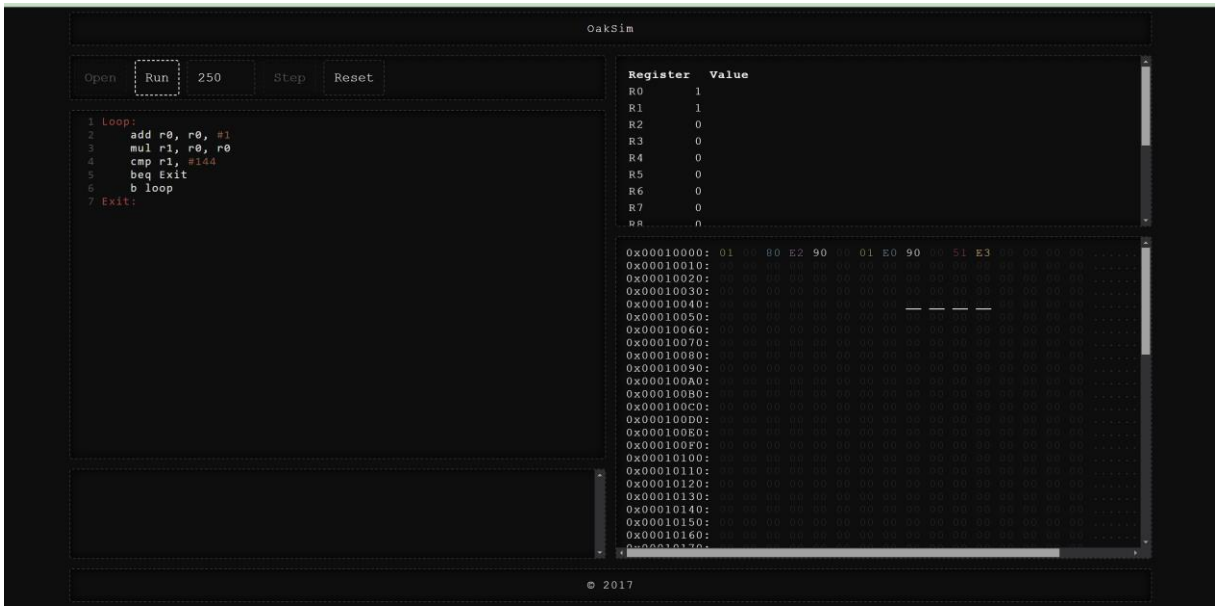
Template Week 4 – Software

Student number:566741

Assignment 4.1: ARM assembly

Screenshot of working assembly code of factorial calculation:

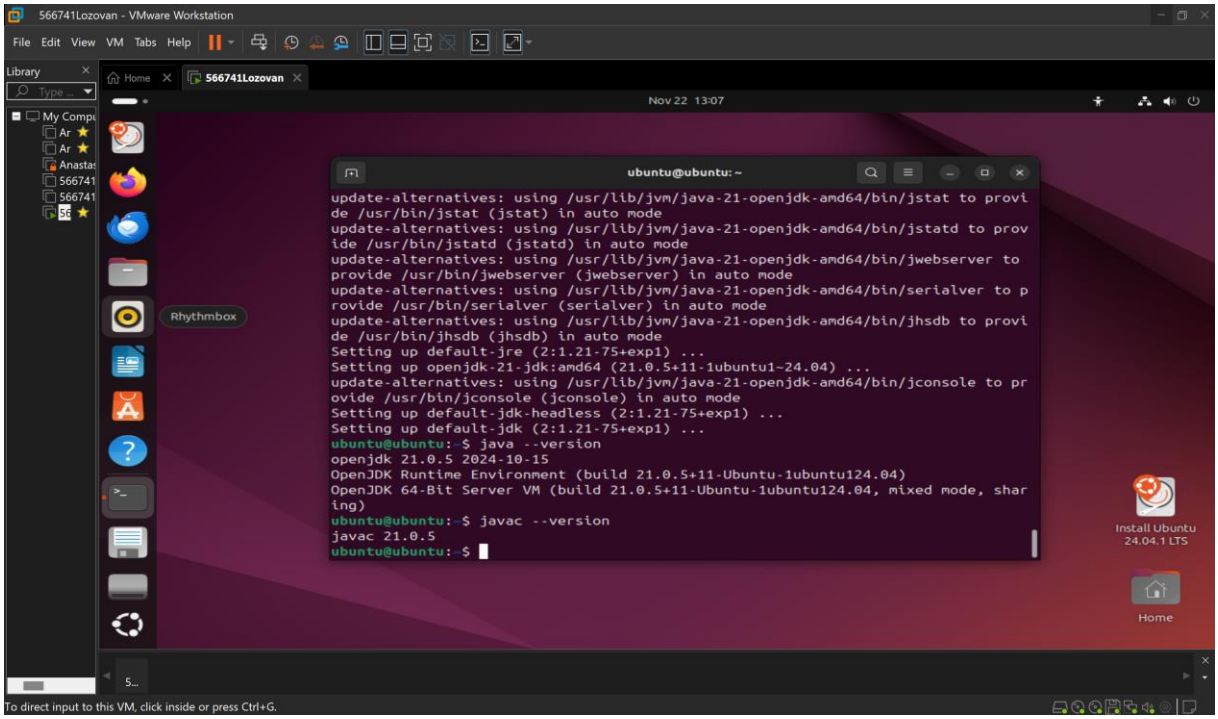




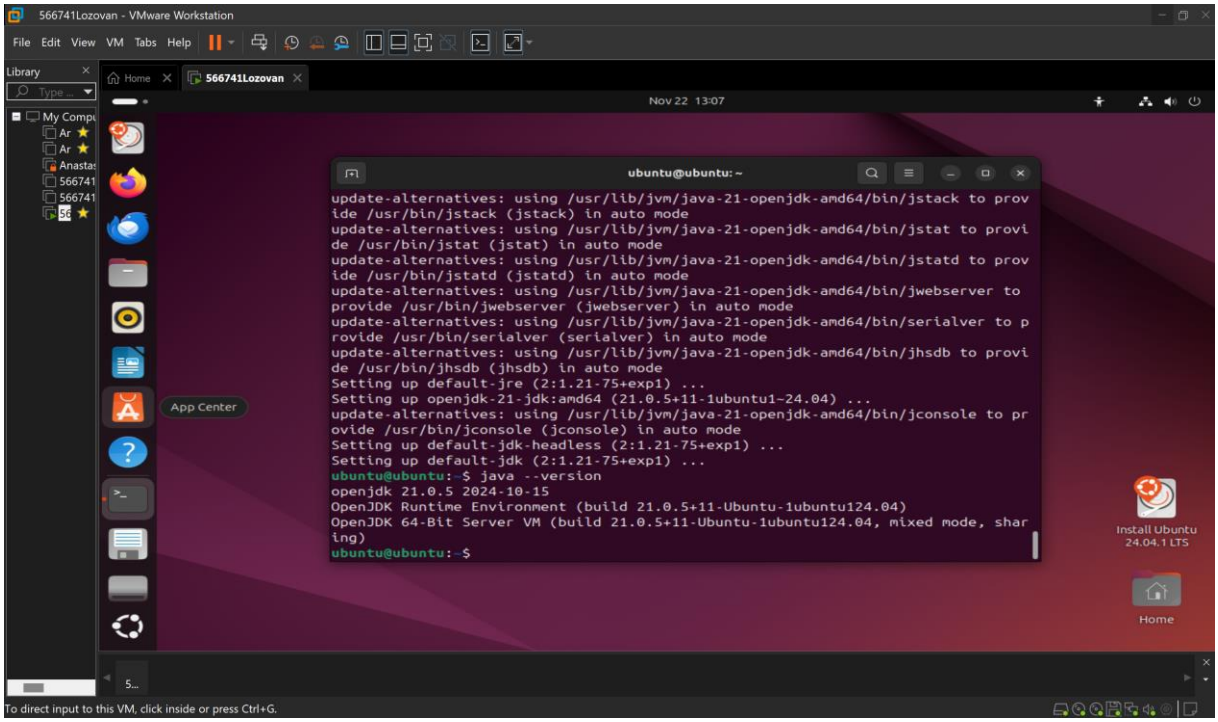
Assignment 4.2: Programming languages

Take screenshots that the following commands work:

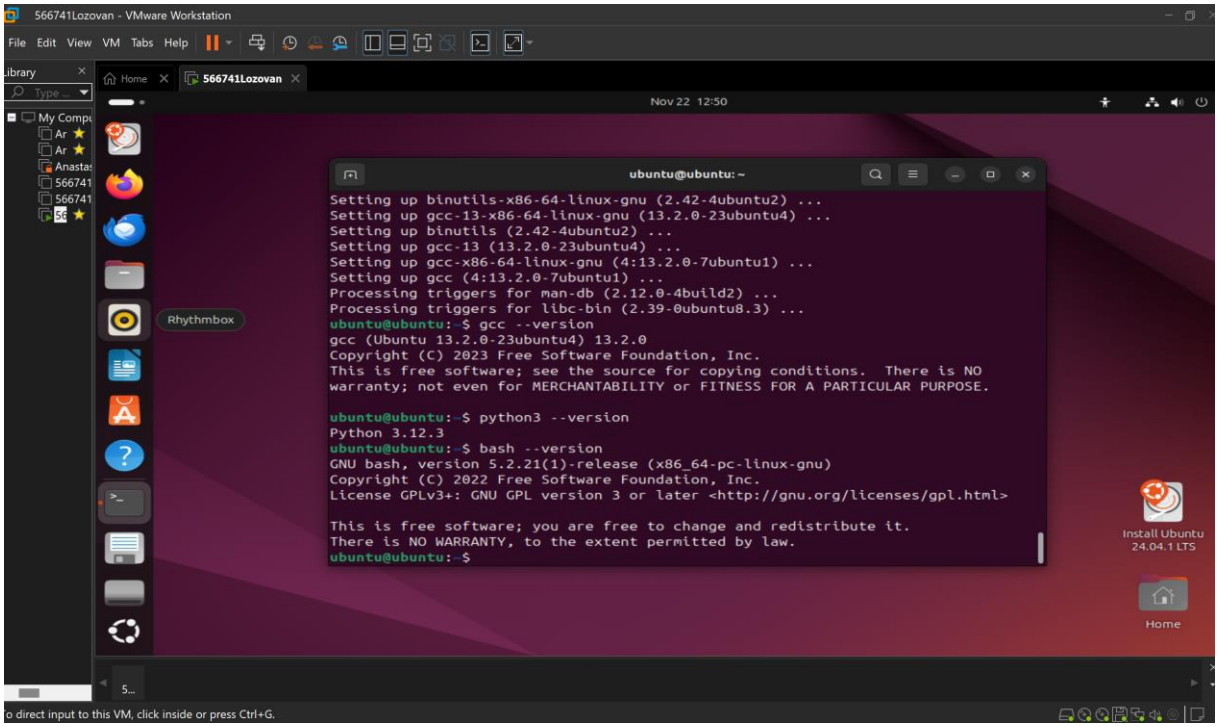
javac –version



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? I think `Fibonacci.java` and `fib.c` need to be compiled before execution.

Which source code files are compiled into machine code and then directly executable by a processor? `fib.c` is compiled into machine code using GCC and becomes a directly executable binary.

Which source code files are compiled to byte code? `Fibonacci.java` is compiled into byte code (`.class` file) and executed by the JVM.

Which source code files are interpreted by an interpreter? fib.py is interpreted by the Python interpreter. fib.sh is interpreted by the Bash shell.

These source code files will perform the same calculation after compilation/interpretation. Which one is expected to do the calculation the fastest? `fib.c` will perform the fastest because it is compiled into native machine code, which the processor executes directly.

How do I run a Java program? You have to compile the file in terminal: javac Fibonacci.java, java Fibonacci

How do I run a Python program? python3 fib.py

How do I run a C program? gcc fib.c -o fib, ./fib

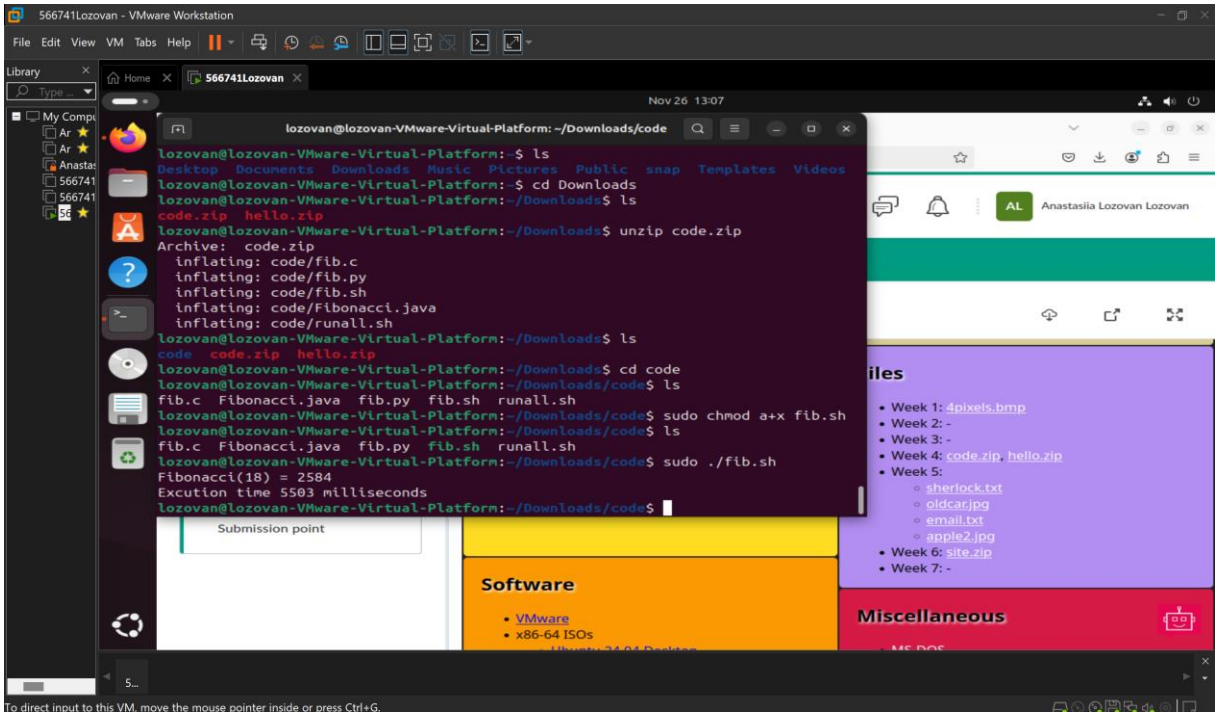
How do I run a Bash script? chmod +x fib.sh, ./fib.sh

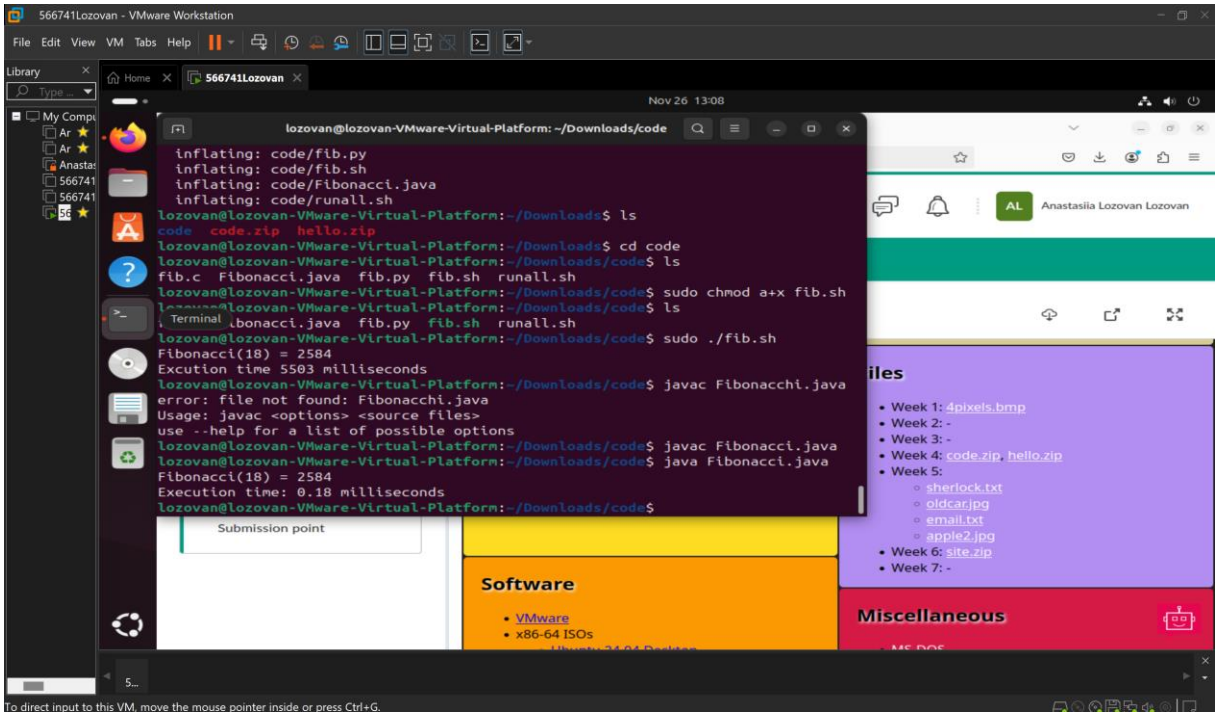
If I compile the above source code, will a new file be created? If so, which file? Java: Compiling Fibonacci.java creates Fibonacci.class (bytecode).

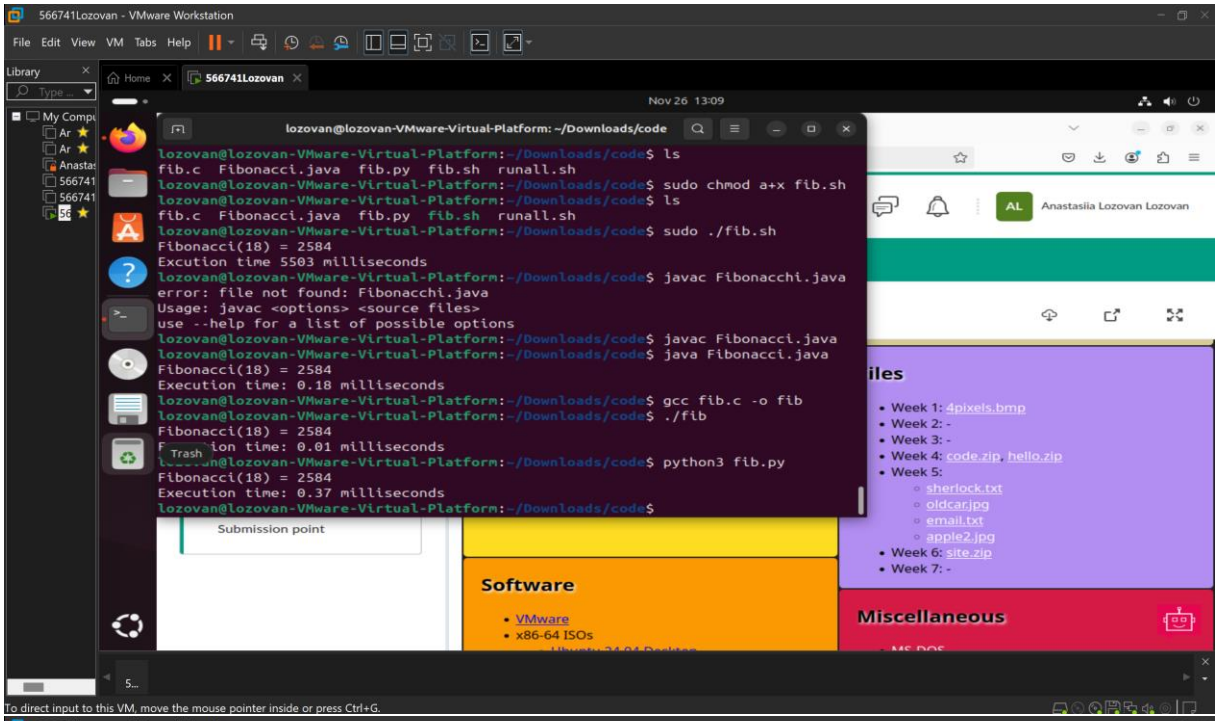
C: Compiling fib.c creates an executable file named fib.

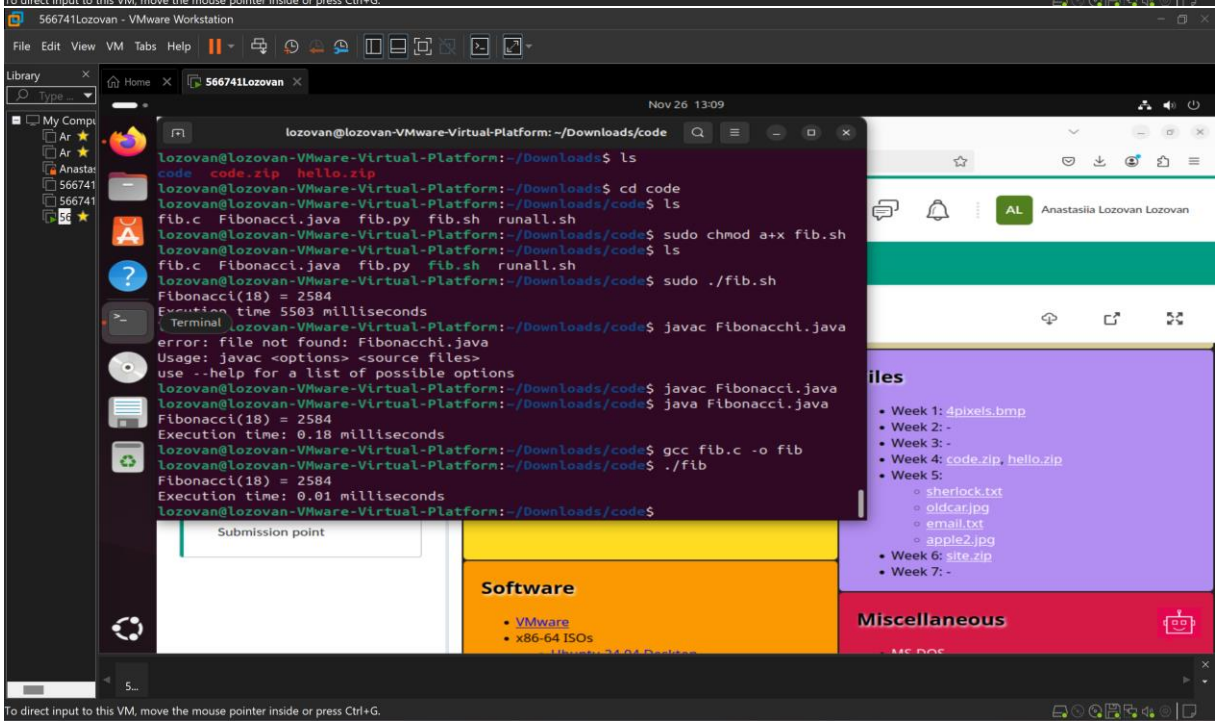
Take relevant screenshots of the following commands:

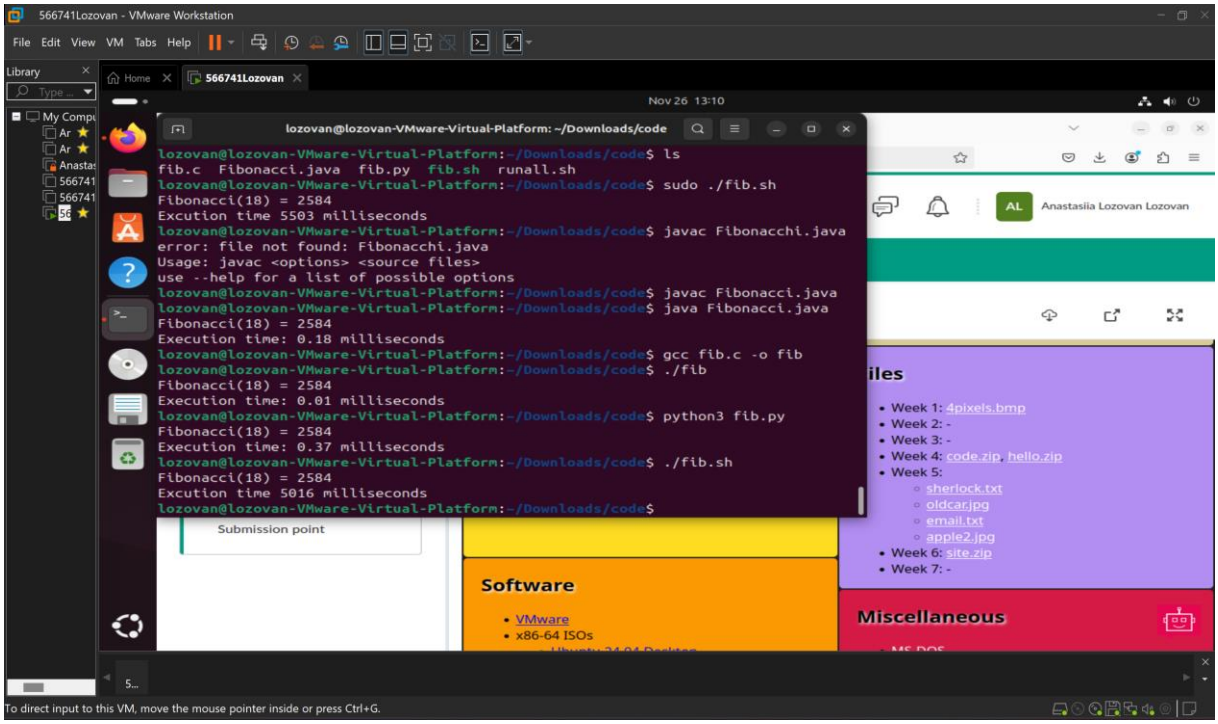
- Compile the source files where necessary
- Make them executable
- Run them
- Which (compiled) source code file performs the calculation the fastest? Fib.c is the fastest I think.

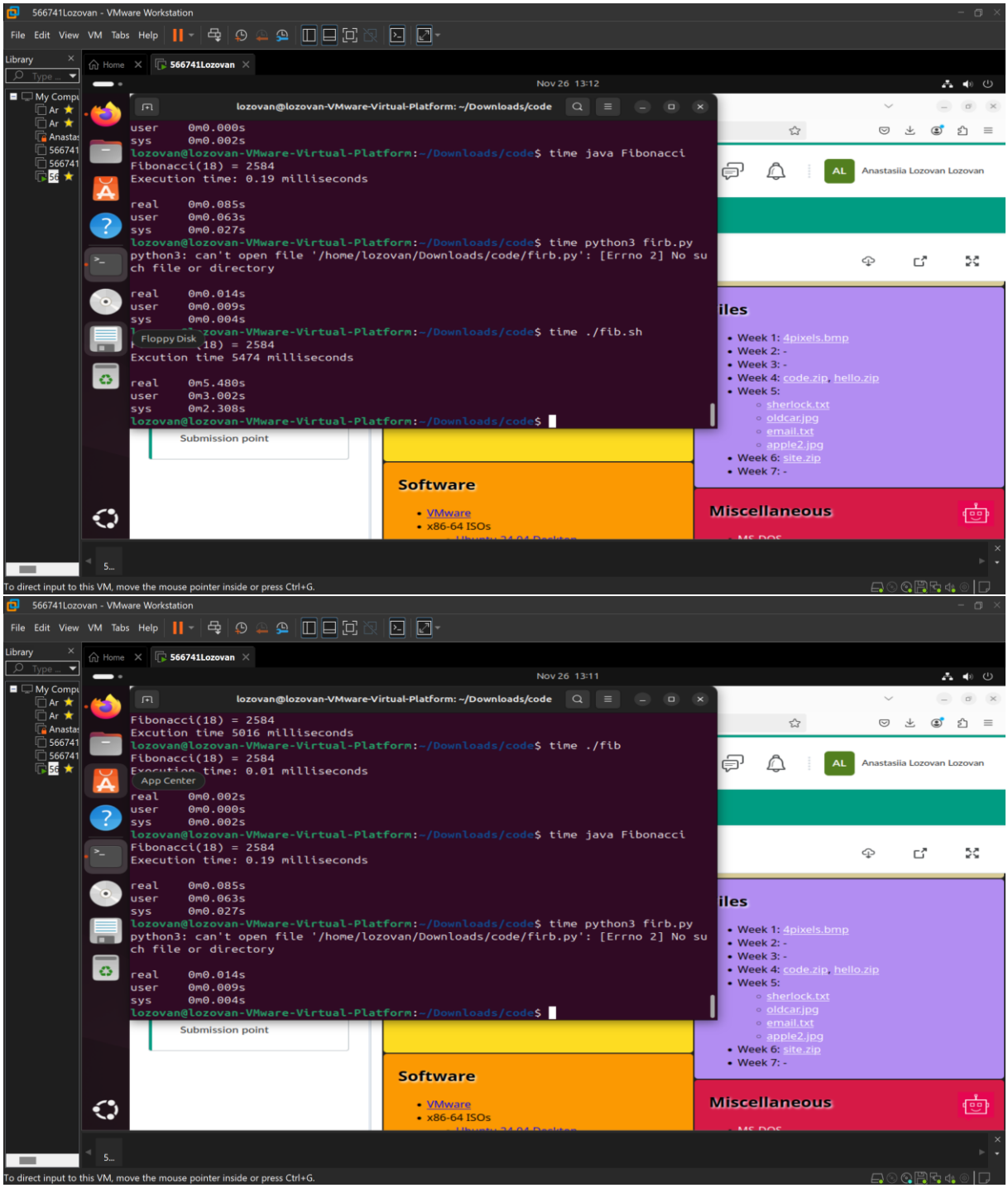

566741Lozovan - VMware Workstation
File Edit View VM Tabs Help
Library
Home
566741Lozovan
Nov 26 13:07
lozovan@lozovan-VMware-Virtual-Platform: ~/Downloads/code
lozovan@lozovan-VMware-Virtual-Platform:~$ ls
Desktop Documents Downloads Music Pictures Public snap Templates Videos
lozovan@lozovan-VMware-Virtual-Platform:~$ cd Downloads
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ ls
code.zip hello.zip
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ unzip code.zip
Archive: code.zip
inflating: code/fib.c
inflating: code/fib.py
inflating: code/fib.sh
inflating: code/Fibonacci.java
inflating: code/runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ ls
code code.zip hello.zip
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ cd code
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo chmod a+x fib.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo ./fib.sh
Fibonacci(18) = 2584
Excution time 5503 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$
Anastasiia Lozovan Lozovan
Week 1: 4pixels.bmp
Week 2: -
Week 3: -
Week 4: code.zip, hello.zip
Week 5:
sherlock.txt
oldcar.jpg
email.txt
apple2.jpg
Week 6: site.zip
Week 7: -
Submission point
Software
VMware
x86-64 ISOs
Miscellaneous
To direct input to this VM, move the mouse pointer inside or press Ctrl+G.


566741Lozovan - VMware Workstation
File Edit View VM Tabs Help
Library
Home
566741Lozovan
Nov 26 13:08
lozovan@lozovan-VMware-Virtual-Platform: ~/Downloads/code
inflating: code/fib.py
inflating: code/fib.sh
inflating: code/Fibonacci.java
inflating: code/runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ ls
code code.zip hello.zip
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ cd code
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo chmod a+x fib.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
Terminal
bonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo ./fib.sh
Fibonacci(18) = 2584
Excution time 5503 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacchi.java
error: file not found: Fibonacchi.java
Usage: javac <options> <source files>
use --help for a list of possible options
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacci.java
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ java Fibonacci.java
Fibonacci(18) = 2584
Execution time: 0.18 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$
Anastasiia Lozovan Lozovan
Week 1: 4pixels.bmp
Week 2: -
Week 3: -
Week 4: code.zip, hello.zip
Week 5:
sherlock.txt
oldcar.jpg
email.txt
apple2.jpg
Week 6: site.zip
Week 7: -
Submission point
Software
VMware
x86-64 ISOs
Miscellaneous
To direct input to this VM, move the mouse pointer inside or press Ctrl+G.


566741Lozovan - VMware Workstation
File Edit View VM Tabs Help
Library
Home
566741Lozovan
Nov 26 13:09
lozovan@lozovan-VMware-Virtual-Platform: ~/Downloads/code
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo chmod a+x fib.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo ./fib.sh
Fibonacci(18) = 2584
Excution time 5503 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacchi.java
error: file not found: Fibonacchi.java
Usage: javac <options> <source files>
use --help for a list of possible options
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacci.java
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ java Fibonacci.java
Fibonacci(18) = 2584
Execution time: 0.18 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ gcc fib.c -o fib
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ./fib
Fibonacci(18) = 2584
Execution time: 0.01 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ python3 fib.py
Fibonacci(18) = 2584
Execution time: 0.37 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$
Trash
Anastasiia Lozovan Lozovan
Week 1: 4pixels.bmp
Week 2: -
Week 3: -
Week 4: code.zip, hello.zip
Week 5:
sherlock.txt
oldcar.jpg
email.txt
apple2.jpg
Week 6: site.zip
Week 7: -
Submission point
Software
VMware
x86-64 ISOs
Miscellaneous
To direct input to this VM, move the mouse pointer inside or press Ctrl+G.


566741Lozovan - VMware Workstation
File Edit View VM Tabs Help
Library
Home
566741Lozovan
Nov 26 13:09
lozovan@lozovan-VMware-Virtual-Platform: ~/Downloads/code
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ ls
code code.zip hello.zip
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads$ cd code
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo chmod a+x fib.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo ./fib.sh
Fibonacci(18) = 2584
Execution time 5503 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacchi.java
error: file not found: Fibonacchi.java
Usage: javac <options> <source files>
use --help for a list of possible options
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacci.java
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ java Fibonacci.java
Fibonacci(18) = 2584
Execution time: 0.18 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ gcc fib.c -o fib
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ./fib
Fibonacci(18) = 2584
Execution time: 0.01 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$
Terminal
Anastasiia Lozovan Lozovan
Week 1: 4pixels.bmp
Week 2: -
Week 3: -
Week 4: code.zip, hello.zip
Week 5:
sherlock.txt
oldcar.jpg
email.txt
apple2.jpg
Week 6: site.zip
Week 7: -
Submission point
Software
VMware
x86-64 ISOs
Miscellaneous
To direct input to this VM, move the mouse pointer inside or press Ctrl+G.


566741Lozovan - VMware Workstation
File Edit View VM Tabs Help
Library
Home
566741Lozovan
Nov 26 13:10
lozovan@lozovan-VMware-Virtual-Platform: ~/Downloads/code
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ls
fib.c Fibonacci.java fib.py fib.sh runall.sh
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ sudo ./fib.sh
Fibonacci(18) = 2584
Excution time 5503 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacchi.java
error: file not found: Fibonacchi.java
Usage: javac <options> <source files>
use --help for a list of possible options
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ javac Fibonacci.java
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ java Fibonacci.java
Fibonacci(18) = 2584
Execution time: 0.18 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ gcc fib.c -o fib
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ./fib
Fibonacci(18) = 2584
Execution time: 0.01 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ python3 fib.py
Fibonacci(18) = 2584
Execution time: 0.37 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$ ./fib.sh
Fibonacci(18) = 2584
Excution time 5016 milliseconds
lozovan@lozovan-VMware-Virtual-Platform:~/Downloads/code$
Anastasiia Lozovan Lozovan
Week 1: 4pixels.bmp
Week 2: -
Week 3: -
Week 4: code.zip, hello.zip
Week 5:
sherlock.txt
oldcar.jpg
email.txt
apple2.jpg
Week 6: site.zip
Week 7: -
Submission point
Software
VMware
x86-64 ISOs
Miscellaneous
To direct input to this VM, move the mouse pointer inside or press Ctrl+G.

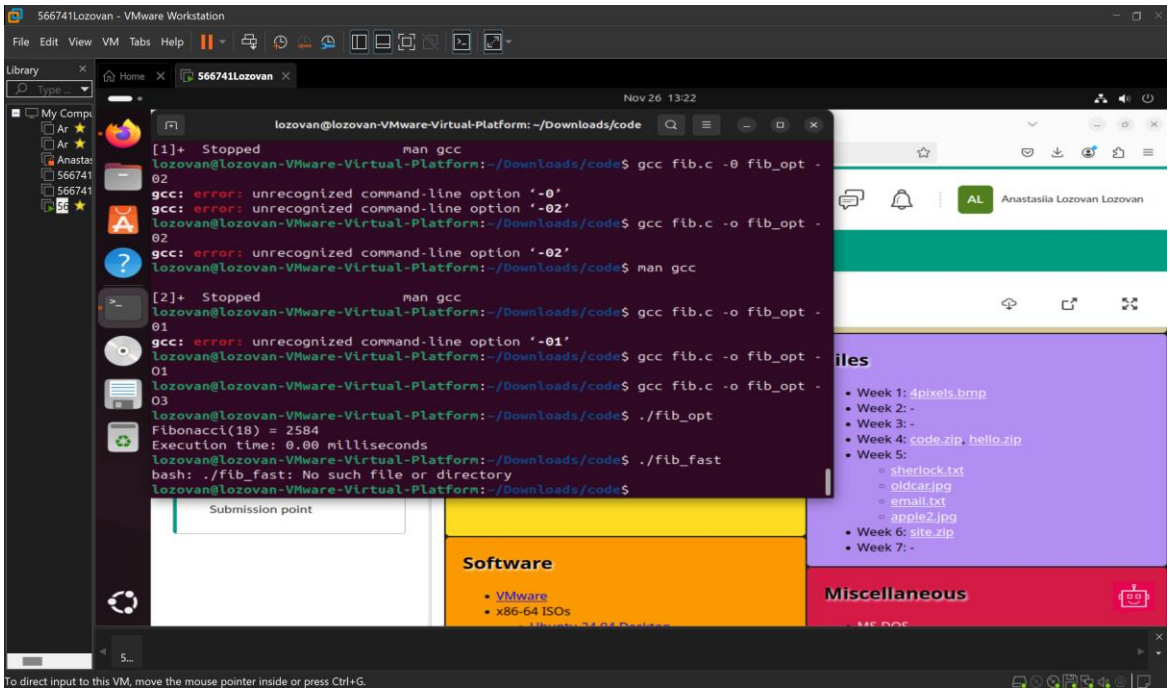


Assignment 4.4: Optimize

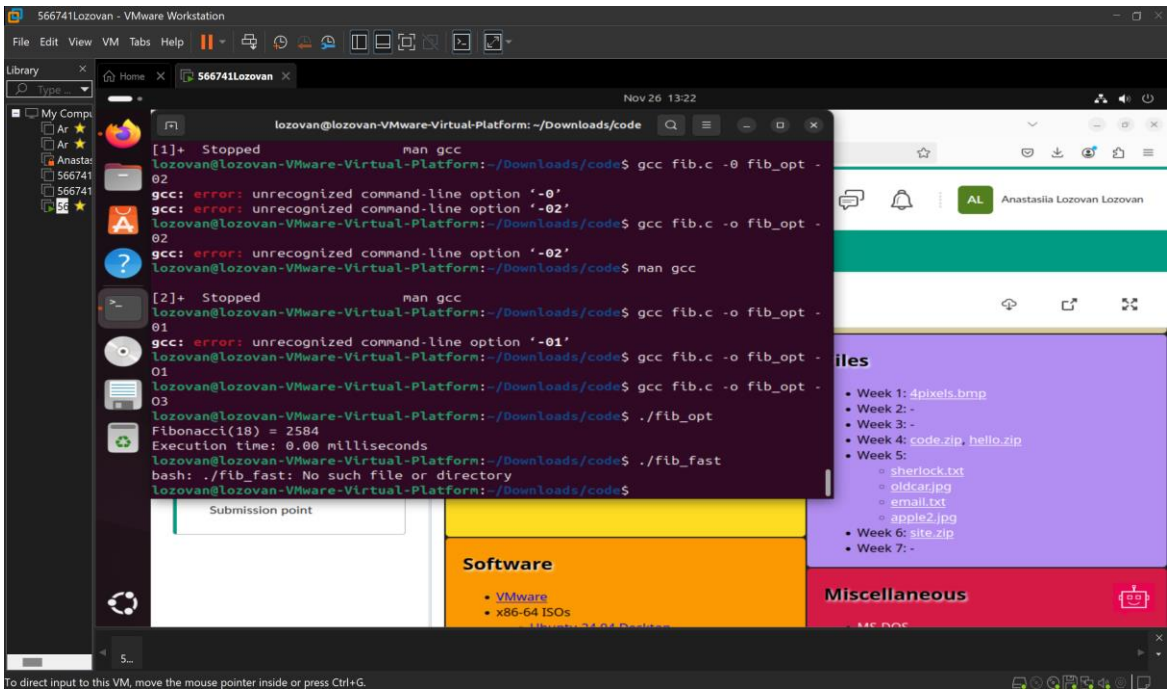
Take relevant screenshots of the following commands:

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

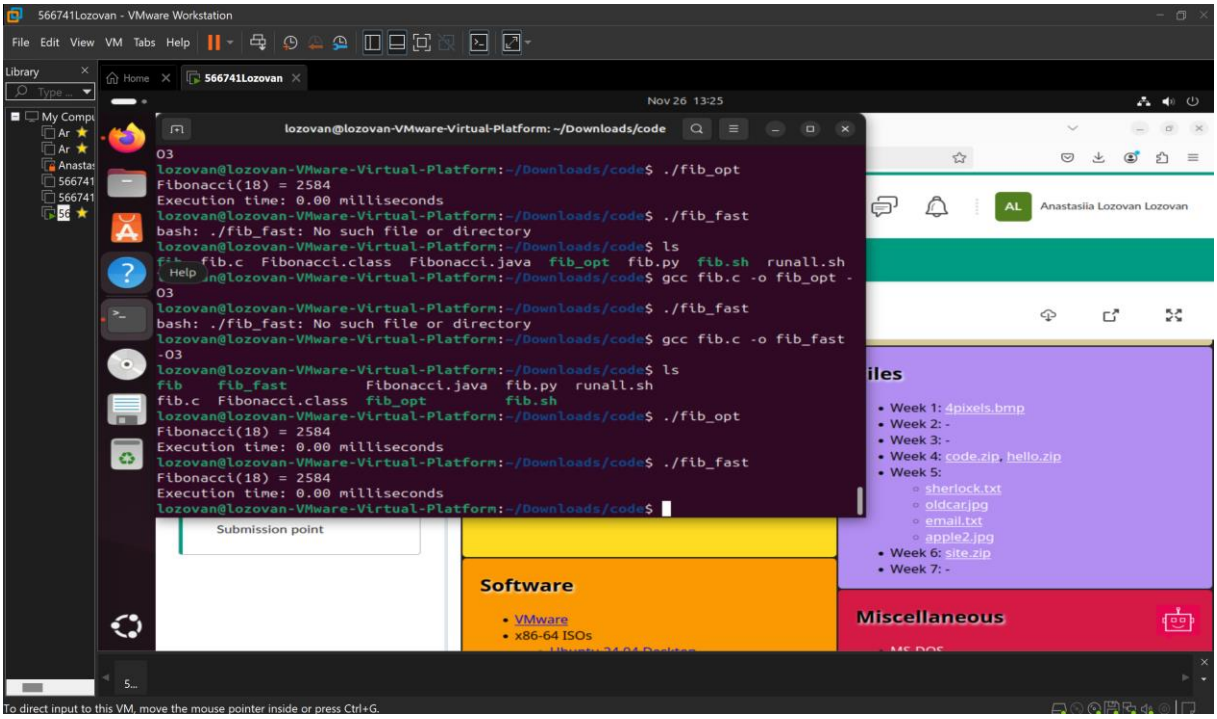
sensitive.



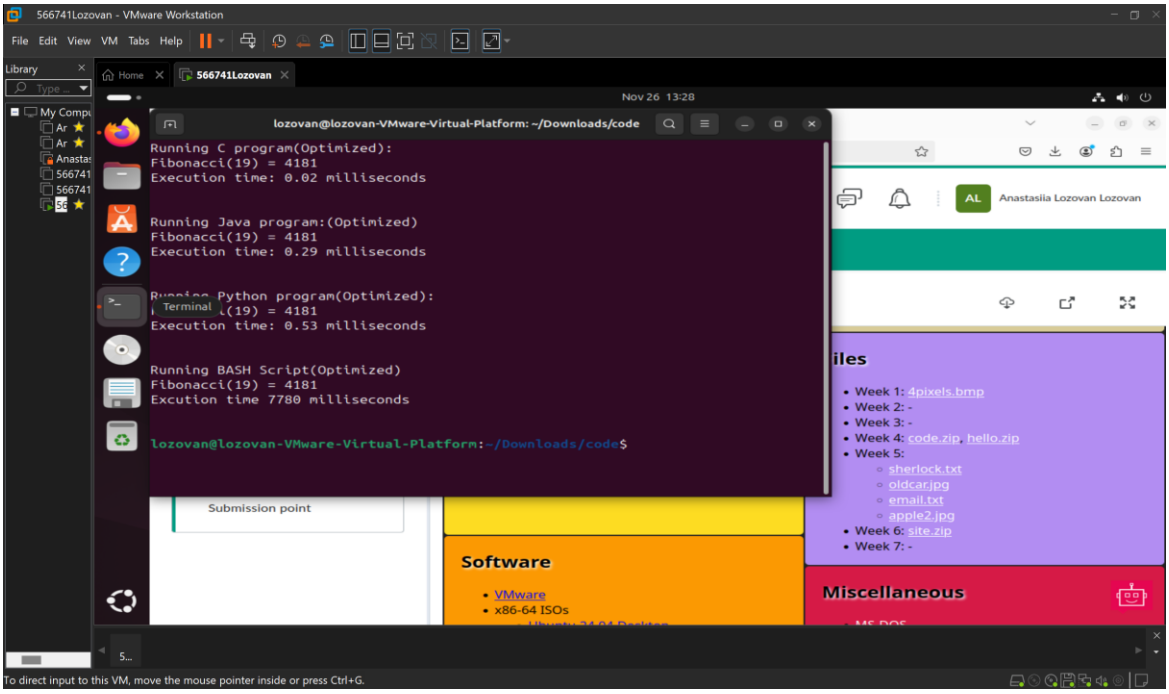
b) Compile **fib.c** again with the optimization parameters

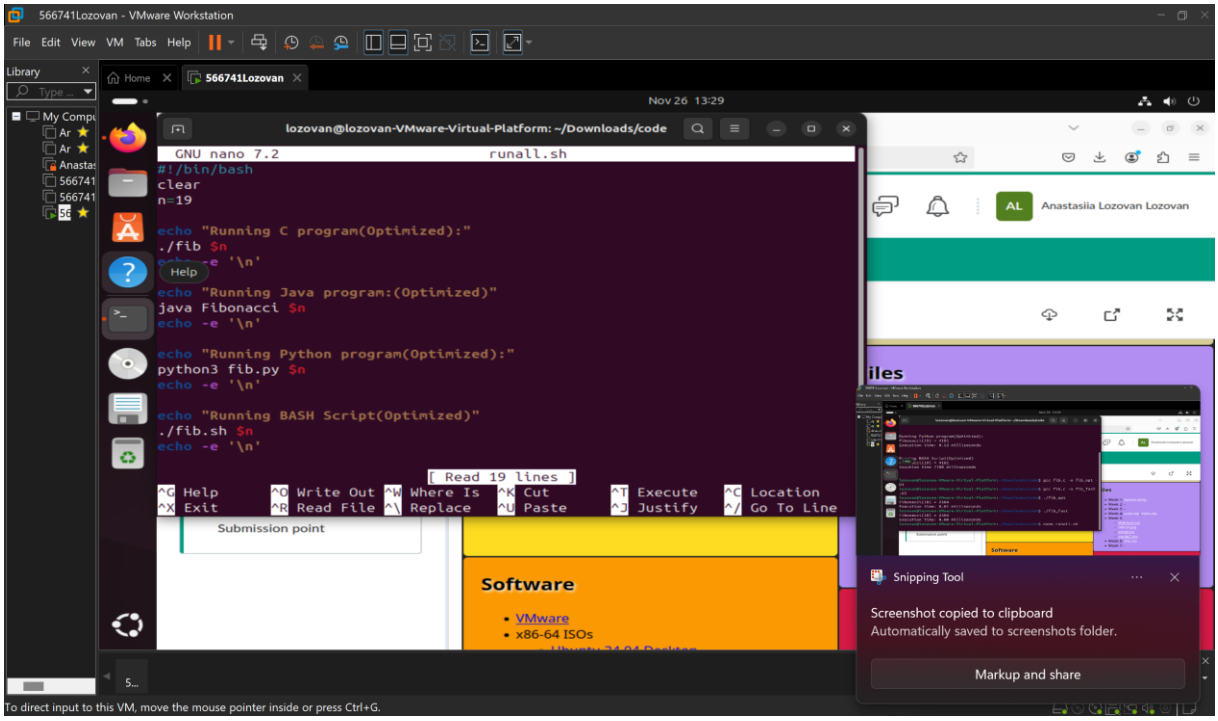


c) Run the newly compiled program. Is it true that it now performs the calculation faster?



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.





Bonus point assignment – week 4

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.

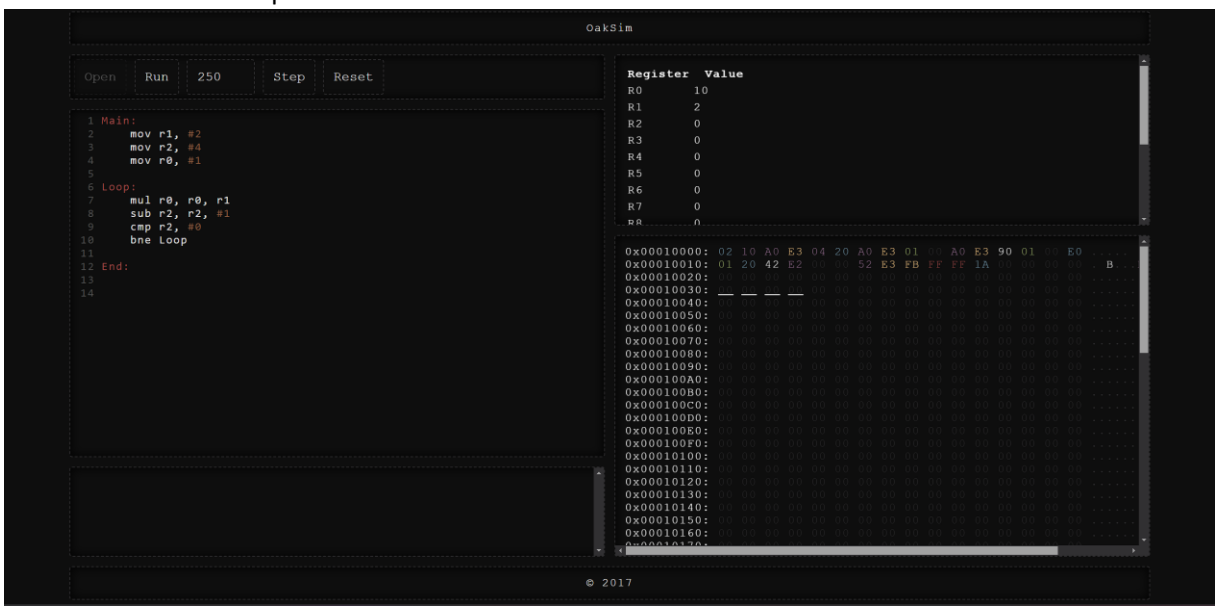
```
Main:
mov r1, #2
mov r2, #4

Loop:

End:
```

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

Screenshot of the completed code here.



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