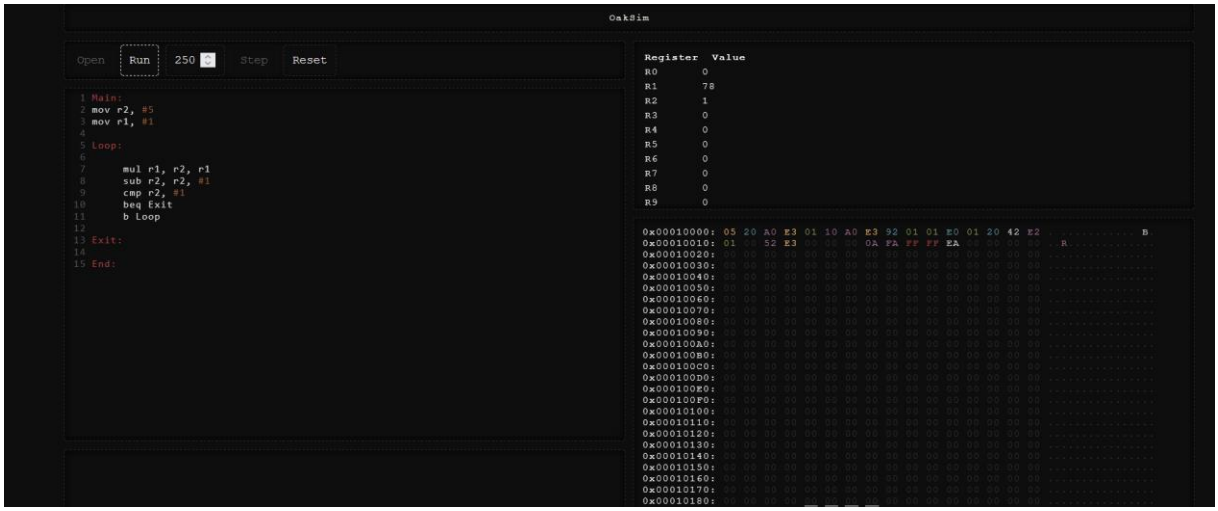
Template Week 4 – Software

Student number:592513

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:

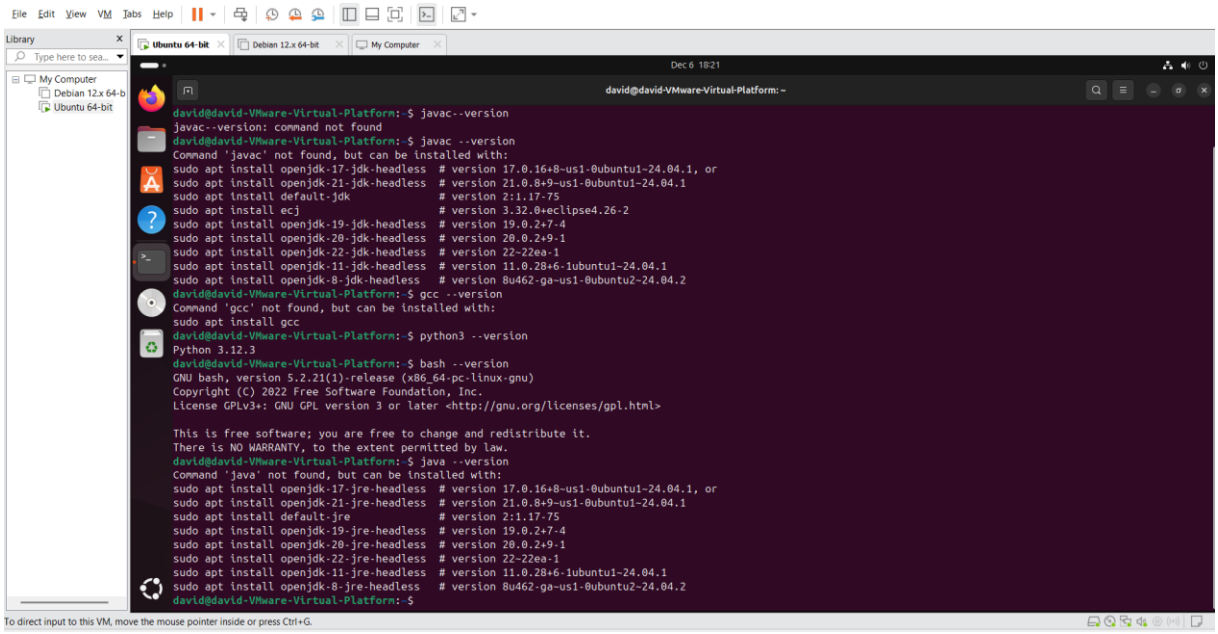
javac –version

java --version

gcc --version

python3 --version

bash --version


File Edit View VM Tabs Help
Library
Type here to sea...
My Computer
Debian 12.x 64-b
Ubuntu 64-bit
Ubuntu 64-bit
Debian 12.x 64-bit
My Computer
Dec 6 18:21
david@david-VMware-Virtual-Platform: ~
david@david-VMware-Virtual-Platform:~$ javac--version
javac--version: command not found
david@david-VMware-Virtual-Platform:~$ javac --version
Command 'javac' not found, but can be installed with:
sudo apt install openjdk-17-jdk-headless # version 17.0.16+8~us1-0ubuntu1~24.04.1, or
sudo apt install openjdk-21-jdk-headless # version 21.0.8+9~us1-0ubuntu1~24.04.1
sudo apt install default-jdk # version 2:1.17-75
sudo apt install ecj # version 3.32.0+eclipse4.26-2
sudo apt install openjdk-19-jdk-headless # version 19.0.2+7-4
sudo apt install openjdk-20-jdk-headless # version 20.0.2+9-1
sudo apt install openjdk-22-jdk-headless # version 22~22ea-1
sudo apt install openjdk-11-jdk-headless # version 11.0.28+6-1ubuntu1~24.04.1
sudo apt install openjdk-8-jdk-headless # version 8u462-ga~us1-0ubuntu2~24.04.2
david@david-VMware-Virtual-Platform:~$ gcc --version
Command 'gcc' not found, but can be installed with:
sudo apt install gcc
david@david-VMware-Virtual-Platform:~$ python3 --version
Python 3.12.3
david@david-VMware-Virtual-Platform:~$ 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.
david@david-VMware-Virtual-Platform:~$ java --version
Command 'java' not found, but can be installed with:
sudo apt install openjdk-17-jre-headless # version 17.0.16+8~us1-0ubuntu1~24.04.1, or
sudo apt install openjdk-21-jre-headless # version 21.0.8+9~us1-0ubuntu1~24.04.1
sudo apt install default-jre # version 2:1.17-75
sudo apt install openjdk-19-jre-headless # version 19.0.2+7-4
sudo apt install openjdk-20-jre-headless # version 20.0.2+9-1
sudo apt install openjdk-22-jre-headless # version 22~22ea-1
sudo apt install openjdk-11-jre-headless # version 11.0.28+6-1ubuntu1~24.04.1
sudo apt install openjdk-8-jre-headless # version 8u462-ga~us1-0ubuntu2~24.04.2
david@david-VMware-Virtual-Platform:~$
To direct input to this VM, move the mouse pointer inside or press Ctrl+G.

Assignment 4.3: Compile

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

Java

C

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

Bash

python

Which source code files are compiled to byte code?

java

Which source code files are interpreted by an interpreter?

Python

bash

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

C

How do I run a Java program?

java MyProgram

How do I run a Python program?

python3 script.py

How do I run a C program?

./program

How do I run a Bash script?

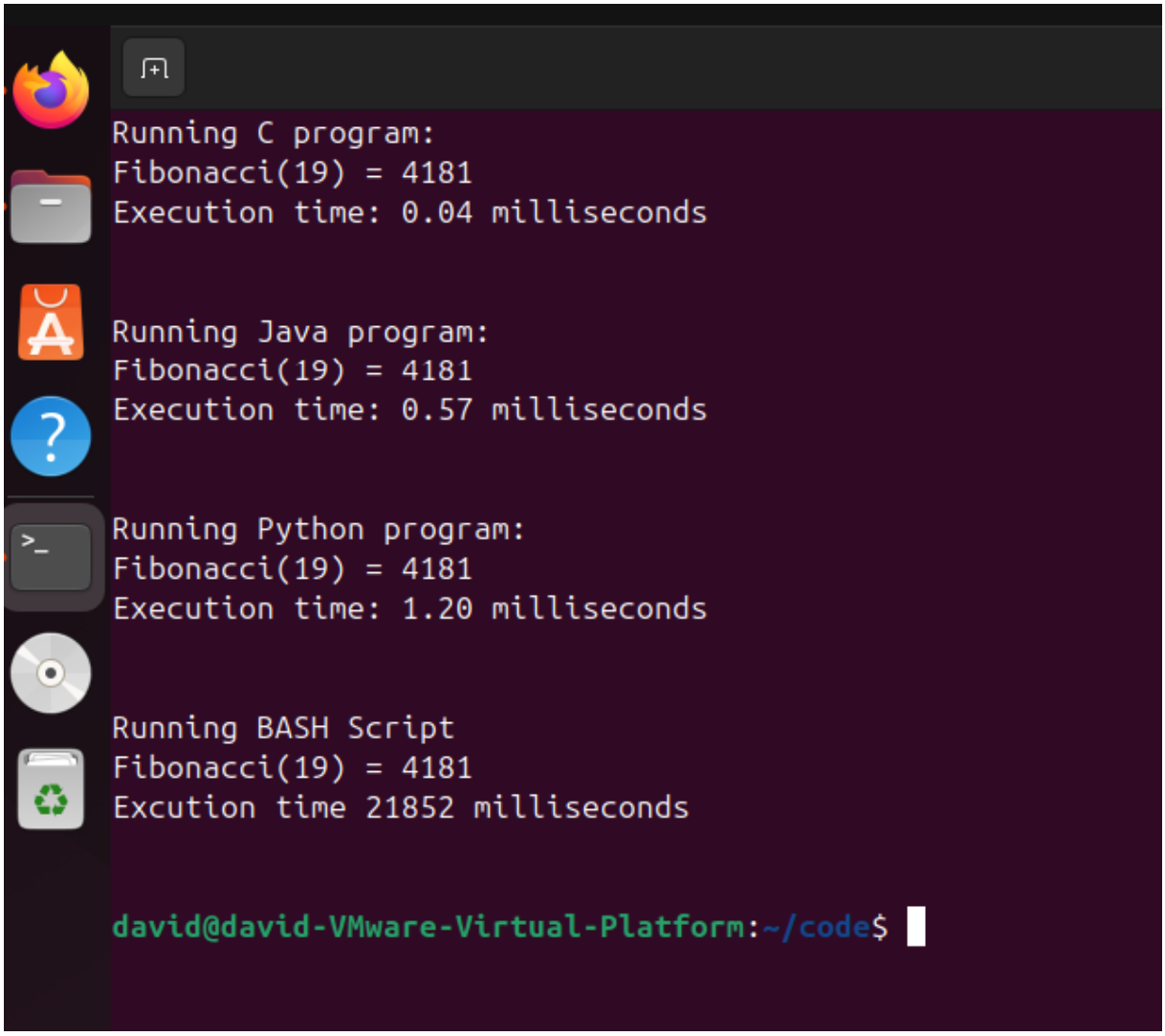
./script.sh

If I compile the above source code, will a new file be created? If so, which 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.
-O0
-O1

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?

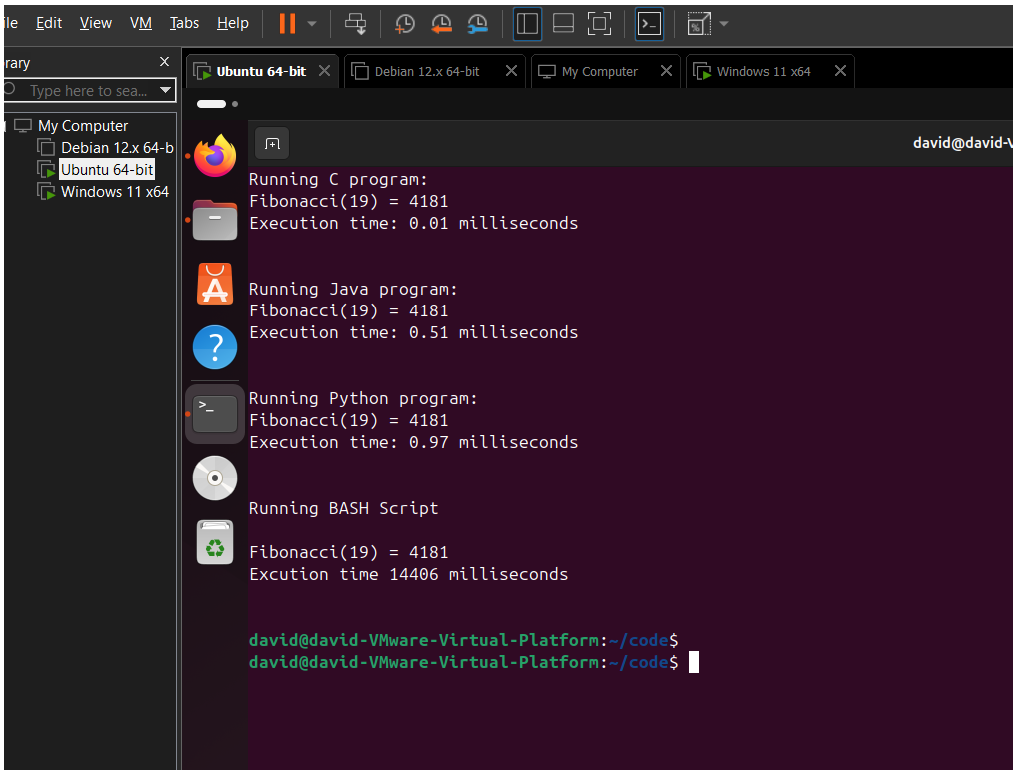
```
Running Python program:
Fibonacci(19) = 4181
Execution time: 1.20 milliseconds


Running BASH Script
Fibonacci(19) = 4181
Excution time 21852 milliseconds


david@david-VMware-Virtual-Platform:~/code$ man gcc
david@david-VMware-Virtual-Platform:~/code$ gcc -O2 fib.c -o fi
david@david-VMware-Virtual-Platform:~/code$ ./fib
Fibonacci(18) = 2584
Execution time: 0.01 milliseconds
david@david-VMware-Virtual-Platform:~/code$
```

It is a lot faster than before

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.

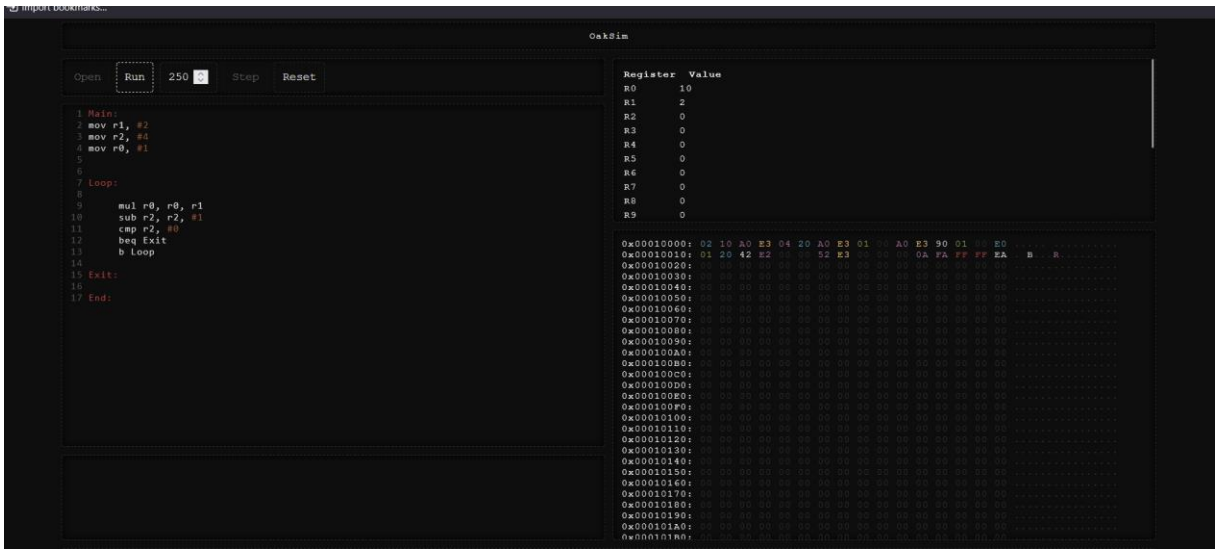
```
Main:
mov r1, #2
mov r2, #4

Loop:

End:
```

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

Screenshot of the completed code here.



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