

Template Week 4 – Software

Student number: 565228

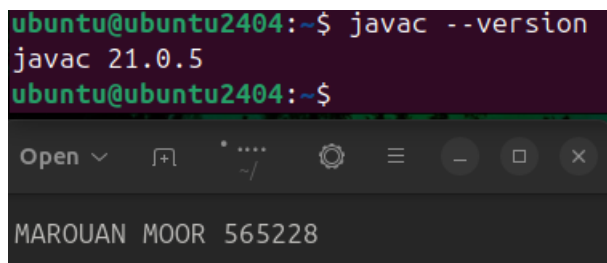
Assignment 4.1: ARM assembly

Screenshot of working assembly code of factorial calculation:

Assignment 4.2: Programming languages

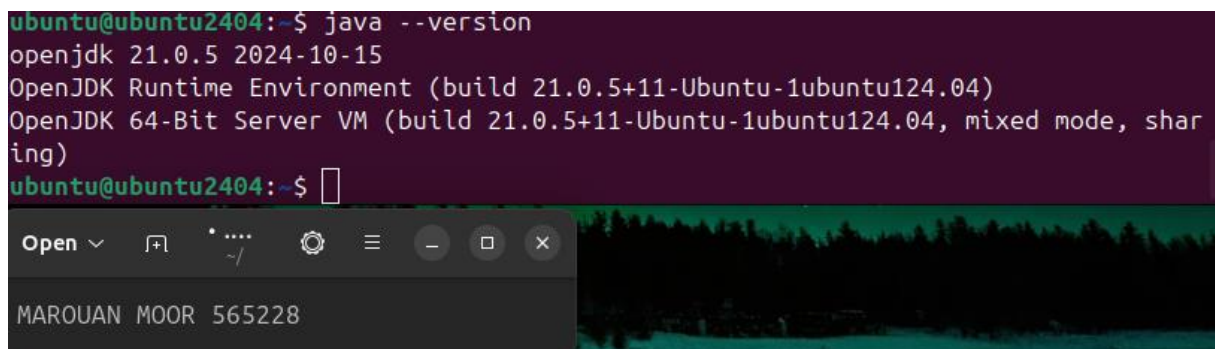
Take screenshots that the following commands work:

`javac --version`

A terminal window with a dark purple background. The prompt is 'ubuntu@ubuntu2404:~\$'. The command 'javac --version' has been entered and executed. The output is 'javac 21.0.5'. The prompt is now 'ubuntu@ubuntu2404:~\$'. Below the terminal window is a dark grey bar with the text 'MAROUAN MOOR 565228'.

```
ubuntu@ubuntu2404:~$ javac --version
javac 21.0.5
ubuntu@ubuntu2404:~$
```

`java --version`

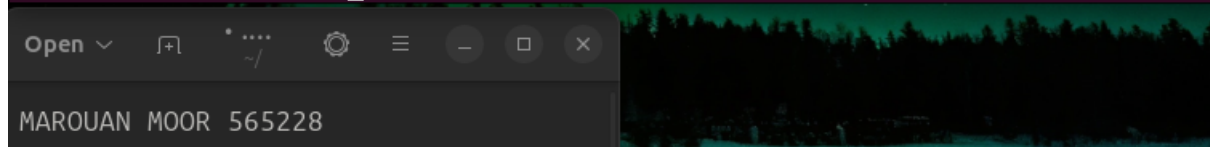
A terminal window with a dark purple background. The prompt is 'ubuntu@ubuntu2404:~\$'. The command 'java --version' has been entered and executed. The output is 'openjdk 21.0.5 2024-10-15', 'OpenJDK Runtime Environment (build 21.0.5+11-Ubuntu-1ubuntu124.04)', and 'OpenJDK 64-Bit Server VM (build 21.0.5+11-Ubuntu-1ubuntu124.04, mixed mode, sharing)'. The prompt is now 'ubuntu@ubuntu2404:~\$'. Below the terminal window is a dark grey bar with the text 'MAROUAN MOOR 565228'.

```
ubuntu@ubuntu2404:~$ java --version
openjdk 21.0.5 2024-10-15
OpenJDK Runtime Environment (build 21.0.5+11-Ubuntu-1ubuntu124.04)
OpenJDK 64-Bit Server VM (build 21.0.5+11-Ubuntu-1ubuntu124.04, mixed mode, sharing)
ubuntu@ubuntu2404:~$
```

gcc --version

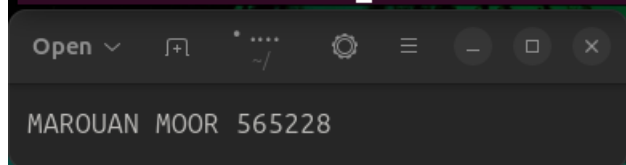
```
ubuntu@ubuntu2404:~$ gcc --version
gcc (Ubuntu 13.2.0-23ubuntu4) 13.2.0
Copyright (C) 2023 Free Software Foundation, Inc.
This is free software; see the source for copying conditions.  There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

ubuntu@ubuntu2404:~$
```



python3 --version

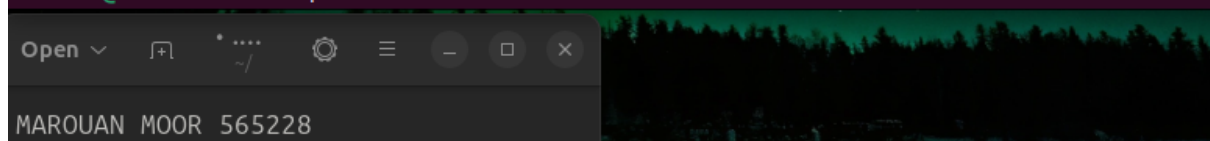
```
ubuntu@ubuntu2404:~$ python3 --version
Python 3.12.3
ubuntu@ubuntu2404:~$
```



bash --version

```
ubuntu@ubuntu2404:~$ 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.
ubuntu@ubuntu2404:~$
```



Assignment 4.3: Compile

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

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

Which source code files are compiled to byte code?

Which source code files are interpreted by an interpreter?

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

How do I run a Java program?

How do I run a Python program?

How do I run a C program?

How do I run a Bash script?

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.
- 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.

```
1 Main:
2     mov r1, #2
3     mov r0, #1
4     mov r2, #4
5
6 Loop:
7     cmp r2, #0
8     beq End
9     mul r0, r0, r1
10    sub r2, r2, #1
11    b Loop
12
13 End:
14
```

Returns 10 in r0

10 in hex is 16 in decimal

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