

Template Week 4 – Software

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Assignment 4.1: ARM assembly

Screenshot of working assembly code of factorial calculation:

The screenshot shows a debugger interface with the following details:

- Registers:** A table showing register values from R0 to R11. All registers contain 0 except R1 which contains 78.
- Memory Dump:** Hex dump of memory starting at address 0x00010000. The dump shows the assembly code for the factorial program.
- Assembly Code:** The code is a C-like pseudocode converted to ARM assembly. It initializes R1 to 1, R2 to 5, and then enters a loop where it multiplies R1 by R2, subtracts 1 from R2, and checks if R2 is 0. If not, it loops back. Once R2 reaches 0, it exits the loop.

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

Assignment 4.2: Programming languages

Take screenshots that the following commands work:

javac –version

The screenshot shows a terminal window on an Ubuntu 64-bit VM. The user runs the command `javac --version`. The output shows that Java 17 is not found, so the system installs Java 17.0.1+124.04, or Java 17.0.5+124.04. Other Java versions listed include 11.0.11+124.04, 11.0.17+17.75, 11.0.19+17.75, 11.0.21+17.75, 11.0.23+17.75, 11.0.25+17.75, 11.0.27+17.75, 11.0.29+17.75, 11.0.31+17.75, 11.0.33+17.75, 11.0.35+17.75, 11.0.37+17.75, 11.0.39+17.75, 11.0.41+17.75, 11.0.43+17.75, 11.0.45+17.75, 11.0.47+17.75, 11.0.49+17.75, 11.0.51+17.75, 11.0.53+17.75, 11.0.55+17.75, 11.0.57+17.75, 11.0.59+17.75, 11.0.61+17.75, 11.0.63+17.75, 11.0.65+17.75, 11.0.67+17.75, 11.0.69+17.75, 11.0.71+17.75, 11.0.73+17.75, 11.0.75+17.75, 11.0.77+17.75, 11.0.79+17.75, 11.0.81+17.75, 11.0.83+17.75, 11.0.85+17.75, 11.0.87+17.75, 11.0.89+17.75, 11.0.91+17.75, 11.0.93+17.75, 11.0.95+17.75, 11.0.97+17.75, 11.0.99+17.75, 11.0.101+17.75, 11.0.103+17.75, 11.0.105+17.75, 11.0.107+17.75, 11.0.109+17.75, 11.0.111+17.75, 11.0.113+17.75, 11.0.115+17.75, 11.0.117+17.75, 11.0.119+17.75, 11.0.121+17.75, 11.0.123+17.75, 11.0.125+17.75, 11.0.127+17.75, 11.0.129+17.75, 11.0.131+17.75, 11.0.133+17.75, 11.0.135+17.75, 11.0.137+17.75, 11.0.139+17.75, 11.0.141+17.75, 11.0.143+17.75, 11.0.145+17.75, 11.0.147+17.75, 11.0.149+17.75, 11.0.151+17.75, 11.0.153+17.75, 11.0.155+17.75, 11.0.157+17.75, 11.0.159+17.75, 11.0.161+17.75, 11.0.163+17.75, 11.0.165+17.75, 11.0.167+17.75, 11.0.169+17.75, 11.0.171+17.75, 11.0.173+17.75, 11.0.175+17.75, 11.0.177+17.75, 11.0.179+17.75, 11.0.181+17.75, 11.0.183+17.75, 11.0.185+17.75, 11.0.187+17.75, 11.0.189+17.75, 11.0.191+17.75, 11.0.193+17.75, 11.0.195+17.75, 11.0.197+17.75, 11.0.199+17.75, 11.0.201+17.75, 11.0.203+17.75, 11.0.205+17.75, 11.0.207+17.75, 11.0.209+17.75, 11.0.211+17.75, 11.0.213+17.75, 11.0.215+17.75, 11.0.217+17.75, 11.0.219+17.75, 11.0.221+17.75, 11.0.223+17.75, 11.0.225+17.75, 11.0.227+17.75, 11.0.229+17.75, 11.0.231+17.75, 11.0.233+17.75, 11.0.235+17.75, 11.0.237+17.75, 11.0.239+17.75, 11.0.241+17.75, 11.0.243+17.75, 11.0.245+17.75, 11.0.247+17.75, 11.0.249+17.75, 11.0.251+17.75, 11.0.253+17.75, 11.0.255+17.75, 11.0.257+17.75, 11.0.259+17.75, 11.0.261+17.75, 11.0.263+17.75, 11.0.265+17.75, 11.0.267+17.75, 11.0.269+17.75, 11.0.271+17.75, 11.0.273+17.75, 11.0.275+17.75, 11.0.277+17.75, 11.0.279+17.75, 11.0.281+17.75, 11.0.283+17.75, 11.0.285+17.75, 11.0.287+17.75, 11.0.289+17.75, 11.0.291+17.75, 11.0.293+17.75, 11.0.295+17.75, 11.0.297+17.75, 11.0.299+17.75, 11.0.301+17.75, 11.0.303+17.75, 11.0.305+17.75, 11.0.307+17.75, 11.0.309+17.75, 11.0.311+17.75, 11.0.313+17.75, 11.0.315+17.75, 11.0.317+17.75, 11.0.319+17.75, 11.0.321+17.75, 11.0.323+17.75, 11.0.325+17.75, 11.0.327+17.75, 11.0.329+17.75, 11.0.331+17.75, 11.0.333+17.75, 11.0.335+17.75, 11.0.337+17.75, 11.0.339+17.75, 11.0.341+17.75, 11.0.343+17.75, 11.0.345+17.75, 11.0.347+17.75, 11.0.349+17.75, 11.0.351+17.75, 11.0.353+17.75, 11.0.355+17.75, 11.0.357+17.75, 11.0.359+17.75, 11.0.361+17.75, 11.0.363+17.75, 11.0.365+17.75, 11.0.367+17.75, 11.0.369+17.75, 11.0.371+17.75, 11.0.373+17.75, 11.0.375+17.75, 11.0.377+17.75, 11.0.379+17.75, 11.0.381+17.75, 11.0.383+17.75, 11.0.385+17.75, 11.0.387+17.75, 11.0.389+17.75, 11.0.391+17.75, 11.0.393+17.75, 11.0.395+17.75, 11.0.397+17.75, 11.0.399+17.75, 11.0.401+17.75, 11.0.403+17.75, 11.0.405+17.75, 11.0.407+17.75, 11.0.409+17.75, 11.0.411+17.75, 11.0.413+17.75, 11.0.415+17.75, 11.0.417+17.75, 11.0.419+17.75, 11.0.421+17.75, 11.0.423+17.75, 11.0.425+17.75, 11.0.427+17.75, 11.0.429+17.75, 11.0.431+17.75, 11.0.433+17.75, 11.0.435+17.75, 11.0.437+17.75, 11.0.439+17.75, 11.0.441+17.75, 11.0.443+17.75, 11.0.445+17.75, 11.0.447+17.75, 11.0.449+17.75, 11.0.451+17.75, 11.0.453+17.75, 11.0.455+17.75, 11.0.457+17.75, 11.0.459+17.75, 11.0.461+17.75, 11.0.463+17.75, 11.0.465+17.75, 11.0.467+17.75, 11.0.469+17.75, 11.0.471+17.75, 11.0.473+17.75, 11.0.475+17.75, 11.0.477+17.75, 11.0.479+17.75, 11.0.481+17.75, 11.0.483+17.75, 11.0.485+17.75, 11.0.487+17.75, 11.0.489+17.75, 11.0.491+17.75, 11.0.493+17.75, 11.0.495+17.75, 11.0.497+17.75, 11.0.499+17.75, 11.0.501+17.75, 11.0.503+17.75, 11.0.505+17.75, 11.0.507+17.75, 11.0.509+17.75, 11.0.511+17.75, 11.0.513+17.75, 11.0.515+17.75, 11.0.517+17.75, 11.0.519+17.75, 11.0.521+17.75, 11.0.523+17.75, 11.0.525+17.75, 11.0.527+17.75, 11.0.529+17.75, 11.0.531+17.75, 11.0.533+17.75, 11.0.535+17.75, 11.0.537+17.75, 11.0.539+17.75, 11.0.541+17.75, 11.0.543+17.75, 11.0.545+17.75, 11.0.547+17.75, 11.0.549+17.75, 11.0.551+17.75, 11.0.553+17.75, 11.0.555+17.75, 11.0.557+17.75, 11.0.559+17.75, 11.0.561+17.75, 11.0.563+17.75, 11.0.565+17.75, 11.0.567+17.75, 11.0.569+17.75, 11.0.571+17.75, 11.0.573+17.75, 11.0.575+17.75, 11.0.577+17.75, 11.0.579+17.75, 11.0.581+17.75, 11.0.583+17.75, 11.0.585+17.75, 11.0.587+17.75, 11.0.589+17.75, 11.0.591+17.75, 11.0.593+17.75, 11.0.595+17.75, 11.0.597+17.75, 11.0.599+17.75, 11.0.601+17.75, 11.0.603+17.75, 11.0.605+17.75, 11.0.607+17.75, 11.0.609+17.75, 11.0.611+17.75, 11.0.613+17.75, 11.0.615+17.75, 11.0.617+17.75, 11.0.619+17.75, 11.0.621+17.75, 11.0.623+17.75, 11.0.625+17.75, 11.0.627+17.75, 11.0.629+17.75, 11.0.631+17.75, 11.0.633+17.75, 11.0.635+17.75, 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11.0.885+17.75, 11.0.887+17.75, 11.0.889+17.75, 11.0.891+17.75, 11.0.893+17.75, 11.0.895+17.75, 11.0.897+17.75, 11.0.899+17.75, 11.0.901+17.75, 11.0.903+17.75, 11.0.905+17.75, 11.0.907+17.75, 11.0.909+17.75, 11.0.911+17.75, 11.0.913+17.75, 11.0.915+17.75, 11.0.917+17.75, 11.0.919+17.75, 11.0.921+17.75, 11.0.923+17.75, 11.0.925+17.75, 11.0.927+17.75, 11.0.929+17.75, 11.0.931+17.75, 11.0.933+17.75, 11.0.935+17.75, 11.0.937+17.75, 11.0.939+17.75, 11.0.941+17.75, 11.0.943+17.75, 11.0.945+17.75, 11.0.947+17.75, 11.0.949+17.75, 11.0.951+17.75, 11.0.953+17.75, 11.0.955+17.75, 11.0.957+17.75, 11.0.959+17.75, 11.0.961+17.75, 11.0.963+17.75, 11.0.965+17.75, 11.0.967+17.75, 11.0.969+17.75, 11.0.971+17.75, 11.0.973+17.75, 11.0.975+17.75, 11.0.977+17.75, 11.0.979+17.75, 11.0.981+17.75, 11.0.983+17.75, 11.0.985+17.75, 11.0.987+17.75, 11.0.989+17.75, 11.0.991+17.75, 11.0.993+17.75, 11.0.995+17.75, 11.0.997+17.75, 11.0.999+17.75, 11.0.1001+17.75, 11.0.1003+17.75, 11.0.1005+17.75, 11.0.1007+17.75, 11.0.1009+17.75, 11.0.1011+17.75, 11.0.1013+17.75, 11.0.1015+17.75, 11.0.1017+17.75, 11.0.1019+17.75, 11.0.1021+17.75, 11.0.1023+17.75, 11.0.1025+17.75, 11.0.1027+17.75, 11.0.1029+17.75, 11.0.1031+17.75, 11.0.1033+17.75, 11.0.1035+17.75, 11.0.1037+17.75, 11.0.1039+17.75, 11.0.1041+17.75, 11.0.1043+17.75, 11.0.1045+17.75, 11.0.1047+17.75, 11.0.1049+17.75, 11.0.1051+17.75, 11.0.1053+17.75, 11.0.1055+17.75, 11.0.1057+17.75, 11.0.1059+17.75, 11.0.1061+17.75, 11.0.1063+17.75, 11.0.1065+17.75, 11.0.1067+17.75, 11.0.1069+17.75, 11.0.1071+17.75, 11.0.1073+17.75, 11.0.1075+17.75, 11.0.1077+17.75, 11.0.1079+17.75, 11.0.1081+17.75, 11.0.1083+17.75, 11.0.1085+17.75, 11.0.1087+17.75, 11.0.1089+17.75, 11.0.1091+17.75, 11.0.1093+17.75, 11.0.1095+17.75, 11.0.1097+17.75, 11.0.1099+17.75, 11.0.1101+17.75, 11.0.1103+17.75, 11.0.1105+17.75, 11.0.1107+17.75, 11.0.1109+17.75, 11.0.1111+17.75, 11.0.1113+17.75, 11.0.1115+17.75, 11.0.1117+17.75, 11.0.1119+17.75, 11.0.1121+17.75, 11.0.1123+17.75, 11.0.1125+17.75, 11.0.1127+17.75, 11.0.1129+17.75, 11.0.1131+17.75, 11.0.1133+17.75, 11.0.1135+17.75, 11.0.1137+17.75, 11.0.1139+17.75, 11.0.1141+17.75, 11.0.1143+17.75, 11.0.1145+17.75, 11.0.1147+17.75, 11.0.1149+17.75, 11.0.1151+17.75, 11.0.1153+17.75, 11.0.1155+17.75, 11.0.1157+17.75, 11.0.1159+17.75, 11.0.1161+17.75, 11.0.1163+17.75, 11.0.1165+17.75, 11.0.1167+17.75, 11.0.1169+17.75, 11.0.1171+17.75, 11.0.1173+17.75, 11.0.1175+17.75, 11.0.1177+17.75, 11.0.1179+17.75, 11.0.1181+17.75, 11.0.1183+17.75, 11.0.1185+17.75, 11.0.1187+17.75, 11.0.1189+17.75, 11.0.1191+17.75, 11.0.1193+17.75, 11.0.1195+17.75, 11.0.1197+17.75, 11.0.1199+17.75, 11.0.1201+17.75, 11.0.1203+17.75, 11.0.1205+17.75, 11.0.1207+17.75, 11.0.1209+17.75, 11.0.1211+17.75, 11.0.1213+17.75, 11.0.1215+17.75, 11.0.1217+17.75, 11.0.1219+17.75, 11.0.1221+17.75, 11.0.1223+17.75, 11.0.1225+17.75, 11.0.1227+17.75, 11.0.1229+17.75, 11.0.1231+17.75, 11.0.1233+17.75, 11.0.1235+17.75, 11.0.1237+17.75, 11.0.1239+17.75, 11.0.1241+17.75, 11.0.1243+17.75, 11.0.1245+17.75, 11.0.1247+17.75, 11.0.1249+17.75, 11.0.1251+17.75, 11.0.1253+17.75, 11.0.1255+17.75, 11.0.1257+17.75, 11.0.1259+17.75, 11.0.1261+17.75, 11.0.1263+17.75, 11.0.1265+17.75, 11.0.1267+17.75, 11.0.1269+17.75, 11.0.1271+17.75, 11.0.1273+17.75, 11.0.1275+17.75, 11.0.1277+17.75, 11.0.1279+17.75, 11.0.1281+17.75, 11.0.1283+17.75, 11.0.1285+17.75, 11.0.1287+17.75, 11.0.1289+17.75, 11.0.1291+17.75, 11.0.1293+17.75, 11.0.1295+17.75, 11.0.1297+17.75, 11.0.1299+17.75, 11.0.1301+17.75, 11.0.1303+17.75, 11.0

```
rzwolle@zuolleubuntu:~$ javac --version
Command 'javac' not found, but can be installed with:
sudo apt install openjdk-17-jdk-headless # version 11.0.17+post-1~24.04, or
sudo apt install openjdk-17-jre-headless # version 11.0.17+post-1~24.04
sudo apt install default-jdk # version 21:1.17~75
sudo apt install openjdk-11-jdk-headless # version 11.0.29+7~ubuntu1~24.04
sudo apt install openjdk-11-jre-headless # version 11.0.29+7~ubuntu1~24.04
sudo apt install openjdk-12-jdk-headless # version 12.0.1+8~ubuntu1~24.04
sudo apt install openjdk-12-jre-headless # version 12.0.1+8~ubuntu1~24.04
sudo apt install ecl
sudo apt install openjdk-15-jdk-headless # version 19.0.2+7~4
sudo apt install openjdk-15-jre-headless # version 19.0.2+7~4
sudo apt install openjdk-16-jdk-headless # version 19.0.2+9~1
sudo apt install openjdk-16-jre-headless # version 19.0.2+9~1
rzwolle@zuolleubuntu:~$ java --version
Command 'java' not found, but can be installed with:
sudo apt install openjdk-17-jre-headless # version 17.0.17+10-1~24.04, or
sudo apt install openjdk-21-jdk-headless # version 21:0.5+10-1~24.04
sudo apt install default-jre # version 21:1.17~75
sudo apt install openjdk-17-jre-headless # version 17.0.17+10-1~24.04
sudo apt install openjdk-21-jre-headless # version 21:0.5+10-1~24.04
sudo apt install openjdk-11-jdk-headless # version 25.0.1+8~1~24.04
sudo apt install openjdk-11-jre-headless # version 25.0.1+8~1~24.04
sudo apt install openjdk-19-jre-headless # version 19.0.2+7~4
sudo apt install openjdk-20-jdk-headless # version 20.0.2+9~1
sudo apt install openjdk-20-jre-headless # version 20.0.2+9~1
sudo apt install openjdk-22-jdk-headless # version 22+226+1
rzwolle@zuolleubuntu:~$ _
```

gcc --version

```
rzwolle@zuolleubuntu:~$ gcc --version
Command 'gcc' not found, but can be installed with:
sudo apt install gcc
rzwolle@zuolleubuntu:~$ _
```

python3 --version

```
rzwolle@zuolleubuntu:~$ python3 --version
Python 3.12.3
rzwolle@zuolleubuntu:~$
```

bash –version

```
rzwolle@zuolleubuntu:~$ bash --version
GNU bash, Version 5.2.11(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.
rzwolle@zuolleubuntu:~$
```

Assignment 4.3: Compile

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

Fib.c en Fibonacci.java moeten worden gecompileerd

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

.C files

Which source code files are compiled to byte code?

.Java

Which source code files are interpreted by an interpreter?

.py en .sh

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?

1. Compilieren met javac in ubuntu of met een andere compiler. 2. runnen

How do I run a Python program?

Kan gewoon gerunt worden zonder compilatie met python3 fib.py of ./fib.py

How do I run a C program?

Compileren met gcc fib.c -o fib en daarna runnen met ./fib

How do I run a Bash script?

Runnen met ./fib.sh

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

Bij een c programma krijg je een machinecodebestand dat je kan uitvoeren en bij java krijg je een bytecode .class 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?

C

Compile en run c file:

Compile en run java file

```
Ubuntu 64-bit - VMware Workstation
File Edit View VM Tabs Help || ■ ○ □ △ ▶ ▷ TrueNAS | Ubuntu 64-bit

Home 424-LTS-S-BKR-001 424-LTS-S-MKC-001 TrueNAS Ubuntu 64-bit

Adding debian:xRamp_Global_CA_Root.pem
done
Setting up openjdk-17-jdk-headless (17.0.1+7-0ubuntu1~22.04) ...
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jar to provide /usr/bin/jar (jar) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jarsigner to provide /usr/bin/jarsigner (jarsigner) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/javac to provide /usr/bin/javac (javac) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/javadoc to provide /usr/bin/javadoc (javadoc) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/javap to provide /usr/bin/javap (javap) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jcmd to provide /usr/bin/jcmd (jcmd) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jdeps to provide /usr/bin/jdeps (jdeps) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jfr to provide /usr/bin/jfr (jfr) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jhat to provide /usr/bin/jhat (jhat) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jinfo to provide /usr/bin/jinfo (jinfo) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jlink to provide /usr/bin/jlink (jlink) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jmap to provide /usr/bin/jmap (jmap) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jps to provide /usr/bin/jps (jps) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jrunscript to provide /usr/bin/jrunscript (jrunscript) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jstack to provide /usr/bin/jstack (jstack) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jstat to provide /usr/bin/jstat (jstat) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/jstatck to provide /usr/bin/jstatck (jstatck) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/kill to provide /usr/bin/kill (kill) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/killall to provide /usr/bin/killall (killall) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/killall5 to provide /usr/bin/killall5 (killall5) in auto mode
update-alternatives: using /usr/lib/jvm/java-17-openjdk-amd64/bin/ls to provide /usr/bin/ls (ls) in auto mode
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
rzwillie@rzwillieubuntu:~/codes$ ls
fib fib.java fib.py fib.sh runall.sh
rzwillie@rzwillieubuntu:~/codes$ javac Fibonacci.java
rzwillie@rzwillieubuntu:~/codes$ java Fibonacci
rzwillie@rzwillieubuntu:~/codes$ rm Fibonacci.class
rzwillie@rzwillieubuntu:~/codes$ javac Fibonacci.class
Error: Could not find or load main class Fibonacci.class
Caused by: java.lang.ClassNotFoundException: Fibonacci.class
rzwillie@rzwillieubuntu:~/codes$ java Fibonacci
Fibonacci(10) = 2584
Execution time: 0.64 milliseconds
rzwillie@rzwillieubuntu:~/codes$
```

Runall.sh (compiled en runt alle bestanden via bash script)

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.

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.

```
1 Main:  
2     MOV r1, #2  
3     MOV r2, #4  
4     MOV r0, #1  
5  
6 Loop:  
7     MUL r0, r0, r1  
8     SUB r2, r2, #1  
9     CMP r2, #0  
10    BEQ End  
11    B Loop  
12  
13 End:
```

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