95-702 Distributed Systems **Lab 1**

In this lab, you will install Open JDK, IntelliJ, and TomEE Plus. These tools will be used throughout much of the course. You will also solve some Raft puzzles and answer a question about proof of work and SHA256.

For those using a Windows operating system, you will need to show your TA that you are using a "Pro" version of Windows (not a "Home" version).

Part 1. Installation of Open JDK

Visit https://adoptopenjdk.net/archive.html.
Do **not** choose the defaults, rather be sure to choose Open JDK12 and Open J9.
Download and run the JDK installer for jdk-12.0.2+10.2_openj9-0.15.1
Download and run the JRE installer for jdk-12.0.2+10.2_openj9-0.15.1
Set your JAVA_HOME environment variable.
On a MAC, JAVA_HOME is set within the .bash_profile of your home directory.
exportJAVA_HOME=/Library/Java/JavaVirtualMachines/adoptopenjdk-12-openj9.jdk/Contents/Home

From the command line, javac -version and java -version should both report the version number as 12.

Show your TA that your command line java commands are correct.

Part 2. Installation of IntelliJ IDEA Ultimate

Establish your student credentials with JetBrains for the free version of IntelliJ for educational use: https://www.jetbrains.com/student/. Download and install IntelliJ IDEA Ultimate. We need to use the "Intellij 2019.2" version.

Write a Java program that displays "Hello World".

Show this running program to your TA.

Part 3. Installation of TomEE+

Visit http://tomee.apache.org/download-ng.html and download the TomEE 8.x.x (e.g 8.0.4) version of **TomEE Plus** (Note: "Plus", not "Plume".)

Copy the TomEE directory to an appropriate directory on your file system. The directory path should contain no spaces. Do not change the name of the TomEE Plus directory.

1. Open IntelliJ and create a new project.
2. Under Java/ Java EE /select Web Application
3. Select Next and name your project TestWebApp
4. Right click src and create a new servlet

5. Give it the name TestServlet in the package edu.cmu.andrew.yourAndrewID
6. Select OK
7. In the web.xml file, after the servlet element, create a servlet mapping element as shown here:

```
<servlet-mapping>
        <servlet-name>TestServlet</servlet-name>
        <url-pattern>/*</url-pattern>
</servlet-mapping>
```

8. Open the TestServlet in the src directory. Within the doGet method, add this line of code:

```
response.getWriter().append("Hello from TestServlet ");
```

9. Select Run/Edit Configurations/+/TomEE Server/Local
10. Name the server MyTomEE
11. Select Configure
12. In TomEE text box, select the folder on the far right.
13. Select open after browsing to the apache-tomee-plus directory. Select OK.
14. Select Deployment and click Fix in the bottom right and then OK.
15. Select File/Project Structure/Project Settings/Libraries/+/Java
16. Navigate to TomEE plus directory and select lib/apply/OK
17. Select the green Run triangle.
18. A browser runs and you should see Hello from TestServlet.

Show your TA your browser visiting the TestServlet.

This is the checkmark for this lab.

While testing, leave the following settings alone. You should just work from the defaults provided.

You can set the URL with:
Run/Edit Configurations/Deployment/Application Context

The test browser visits the location specified at:
Run/Edit Configurations/Server/Open browser/URL

Part 4. Working with Raft

1) Visit https://raft.github.io/raftscope/index.html and play with the Raft simulator.
2) Show your TA that you were able to get the Raft simulator to show the following replicated logs. Note, the final server need not be S1. The only requirement is that each log is identical to the one shown in Figure 1.

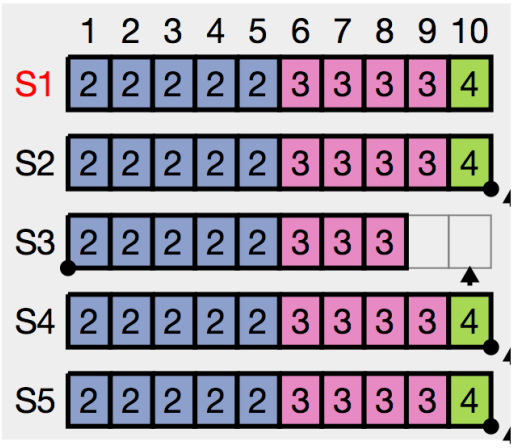

Figure 1: Answer to question 7

3) Working with a fresh copy of the Raft simulator, do the following:
   A. Send two requests from the leader to all followers.
   B. Stop one of the followers.
   C. Send four requests from the leader to the remaining followers.
   D. Resume the stopped follower. Explain to your TA what happened.

4) Working with a fresh copy of the Raft simulator, do the following:
   A. Wait until a single leader is established.
   B. Stop three of the four followers.
   C. Send three requests from the leader, one after the other.
   D. Explain to your TA what happened.

Part 5. Working with hashes

In the slides on Nakamoto consensus, see 1_Blockchain_Raft_and_Nakamoto.pdf, there is a quiz question that asks:

Quiz: Which of the blocks on the right can be
the next block in the chain of length 2?
Format: Nonce, Difficulty, id, Tx1, Tx2, HashPointer

Use the SHA256 calculator at this URL:
https://www.xorbin.com/tools/sha256-hash-calculator,

Show your TA, by referring to the hash, that you have chosen the correct answer.

Note: There are no newlines or return characters in the correct answer.