Configuration Manual

MSc Research Project
Cloud Computing

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Project Submission Sheet
School of Computing

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Configuration Manual

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1 Introduction

This configuration manual gives a complete guide for setting up and implementing the research project ”Optimisation of Load Balancing in Fog Computing Using Bacterial Colony Optimization Algorithm.” It includes step-by-step instructions for installation of dependencies, libraries, and packages required for project implementation. The purpose of this manual is to help researchers and practitioners in understanding the research design and conducting performance analysis.

2 Software and Hardware Requirements

2.1 Software Requirements

- Eclipse Integrated Development Environment (IDE): Eclipse, a popular integrated development environment that includes a wide range of Java development tools has been used for implementation in this research project.
- iFogSim Simulation Tool: iFogSim is a toolkit that extends the CloudSim framework, specifically designed for modelling and simulating fog computing systems. In this project, iFogSim2 (the new version) is used.
- Java Development Kit (JDK): JDK is required to compile and run Java programs, including simulation code and other project components. In this research, JDK version 17.0.7 has been used.
- Other Dependencies: CloudSim is the core of iFogSim and provides the simulation framework for cloud and fog computing scenarios. It is a prerequisite for executing iFogSim-based simulations.

2.2 Hardware Specifications

- Operating System: For this research, MacOS has been used but it is compatible with multiple operating systems, including Windows and Linux.
- Processor: 1.8 GHz Dual-Core Intel Core i5
- Memory (RAM): 8 GB

3 Software Installation

3.1 Eclipse IDE Installation

- Step 1: Install eclipse as shown in Figure 1 (Eclipse IDE for Java Developers) Eclipse Foundation (2023)
- Step 2: After succesful installation, select a directory as workspace and launch as shown in Figure 2

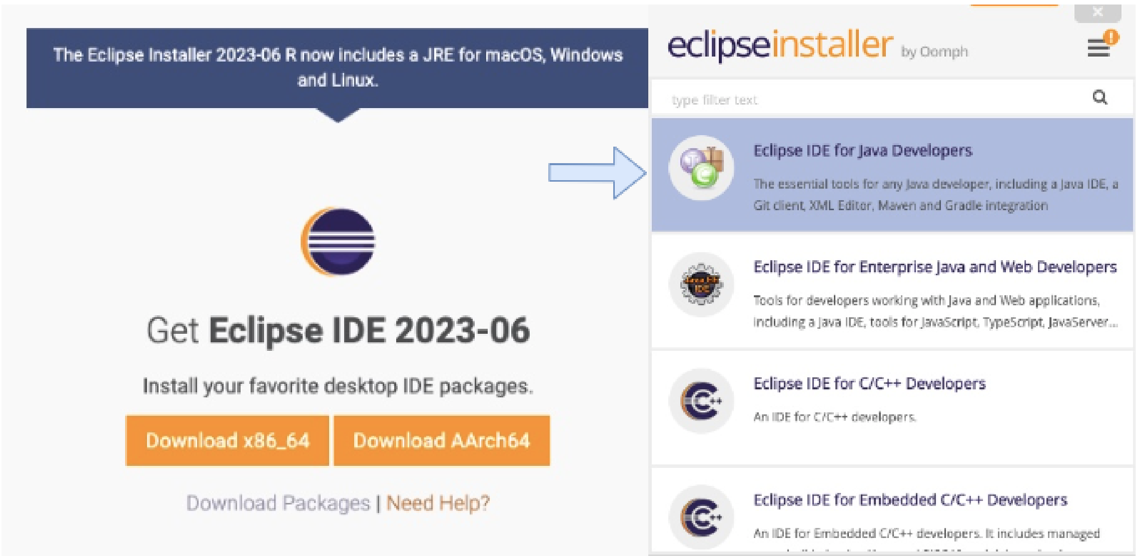


Figure 1: Step 1: Eclipse Download Eclipse Foundation (2023)

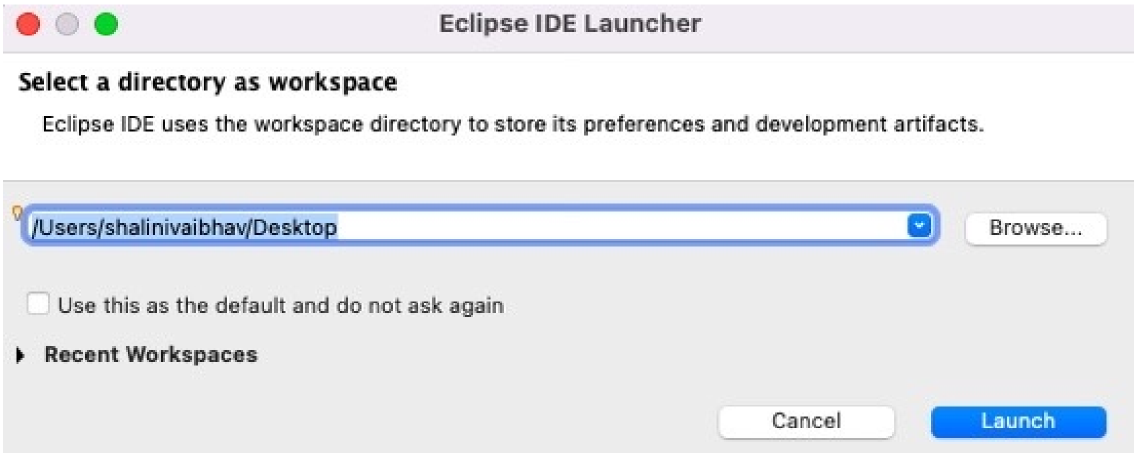


Figure 2: Step 2: Eclipse Workspace Launch

3.2 iFogSim2 (The new version)

- Step 1: Download *iFogSim GitHub Repository* (2023) and unzip the ifogsim2 folder in the system.
- Step 2: Launch the Eclipse IDE and click on new Java project and give the project a name as shown in Figure 3.
- Step 3: Uncheck the option "Use default location" and select "Browse" to the unzipped folder in the system as shown in Figure 4.
- Step 4: Click the "Next" button.
- Step 5: Under the "Libraries" tab, make sure that Cloudsim3.0 is present.
- Step 6: Click the "Finish" button.

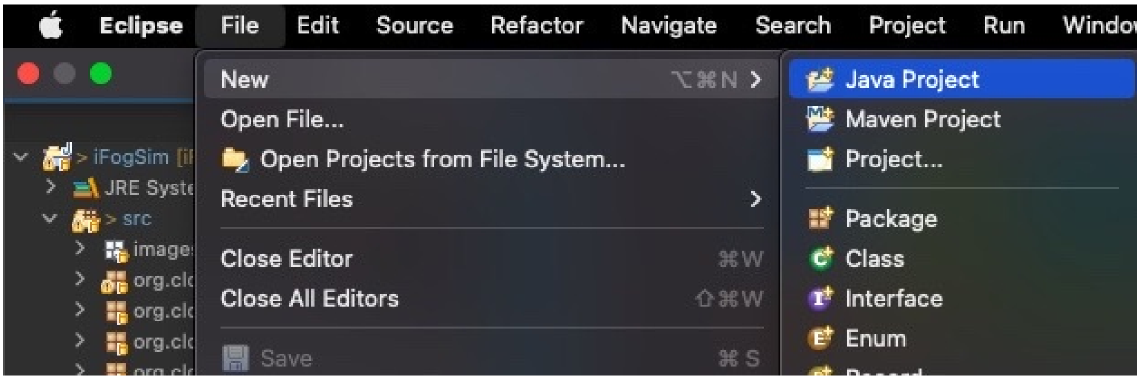
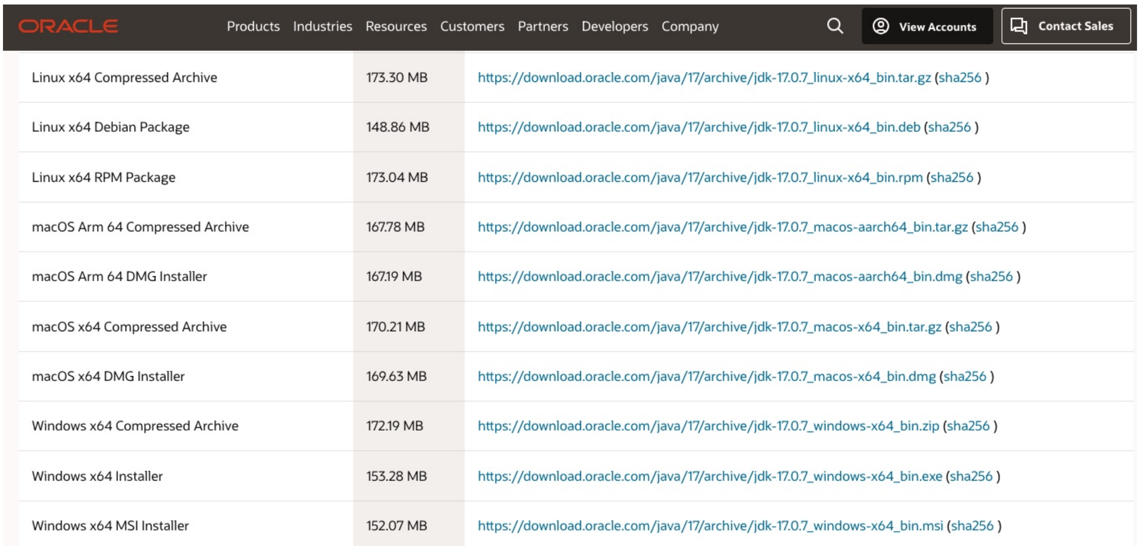


Figure 3: iFogSim project creation

Figure 4: iFogSim unzipped folder import to eclipse IDE

3.3 Java Development Kit

- Step 1: Download the JDK version *Oracle JDK 17 Archive Downloads* (2023), based on the operating system as shown in Figure 5.
- Step 2: Install it into the system as shown in Figure 6.



Linux x64 Compressed Archive	173.30 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_linux-x64_bin.tar.gz (sha256)
Linux x64 Debian Package	148.86 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_linux-x64_bin.deb (sha256)
Linux x64 RPM Package	173.04 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_linux-x64_bin.rpm (sha256)
macOS Arm 64 Compressed Archive	167.78 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_macos-aarch64_bin.tar.gz (sha256)
macOS Arm 64 DMG Installer	167.19 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_macos-aarch64_bin.dmg (sha256)
macOS x64 Compressed Archive	170.21 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_macos-x64_bin.tar.gz (sha256)
macOS x64 DMG Installer	169.63 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_macos-x64_bin.dmg (sha256)
Windows x64 Compressed Archive	172.19 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_windows-x64_bin.zip (sha256)
Windows x64 Installer	153.28 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_windows-x64_bin.exe (sha256)
Windows x64 MSI Installer	152.07 MB	https://download.oracle.com/java/17/archive/jdk-17.0.7_windows-x64_bin.msi (sha256)

Figure 5: JDK Download *Oracle JDK 17 Archive Downloads* (2023)

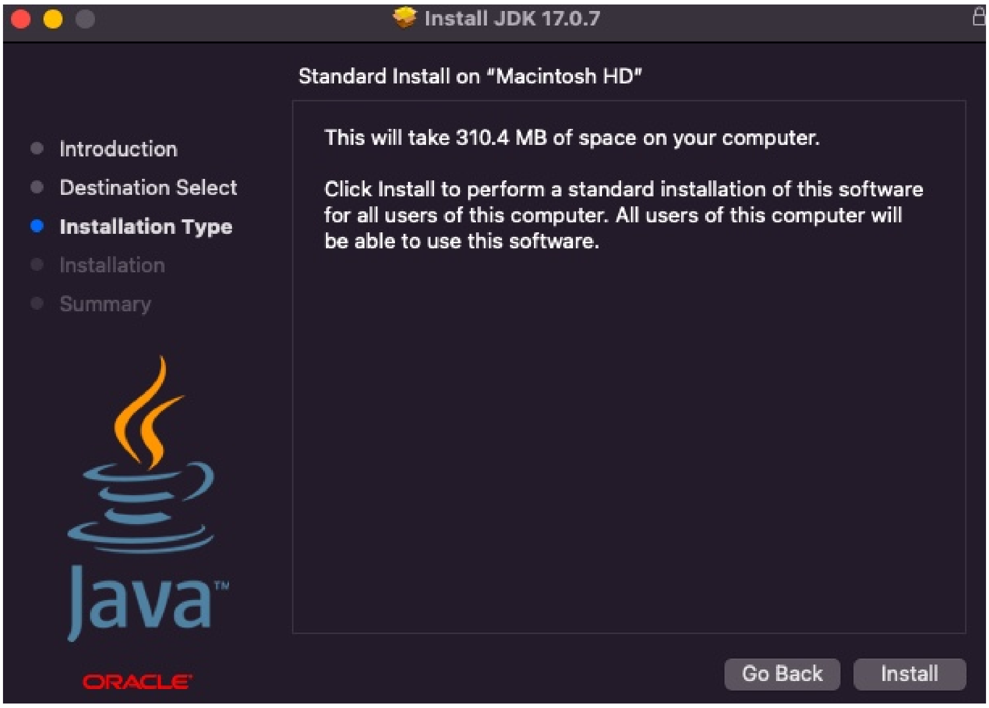


Figure 6: JDK Installation

4 Algorithm Implementation: Bacterial Colony Optimization (BCO)

4.1 Data Collection

For using load balancing algorithms in fog computing, the Cloud-Fog computing dataset available on Kaggle *Vehicular Fog Computing Dataset* (n.d.) is useful . It is publicly available as shown in Figure 7 with its source paper Nguyen et al. (2019) having licenced under the Creative Commons Attribution 4.0 International (CC BY 4.0) protocol, which regulates its use and permits sharing and customization of datasets for any purpose with appropriate citation as shown in Figure 8. There are 13 nodes in the collection, 10 of which are called fog nodes and 3 cloud nodes. It has 7 files, each with a different task count ranging from 40 to 280 tasks, going up in increments of 40 tasks.

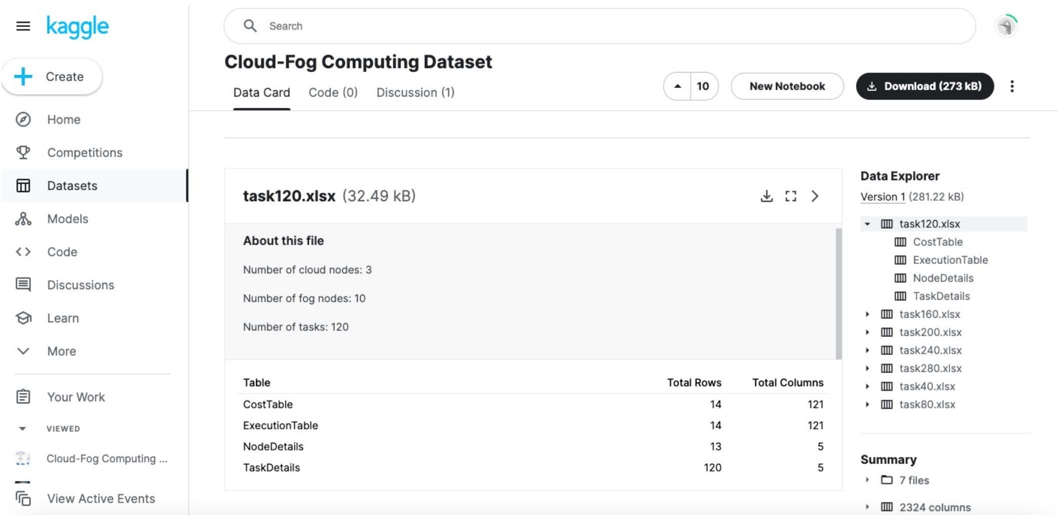


Figure 7: The Cloud-Fog computing dataset

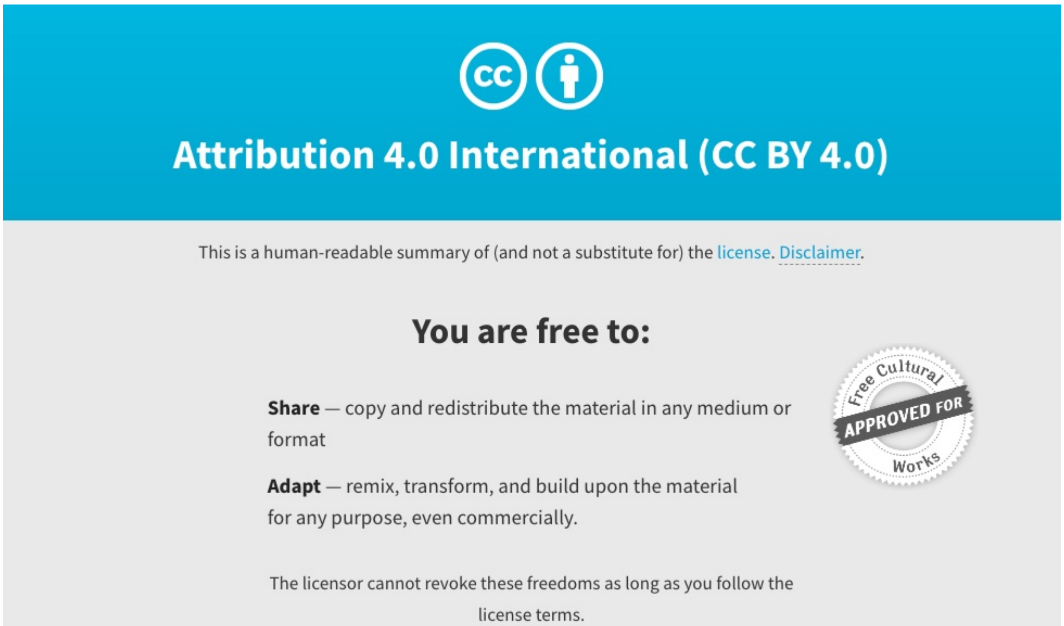


Figure 8: The Creative Commons Attribution 4.0 International (CC BY 4.0) license

4.2 BCO Algorithm Code Development and Implementation

- Create the file (LBAlgorithm.java) and code the BCO algorithm logic for the fog computing setup as shown in Figure 9.

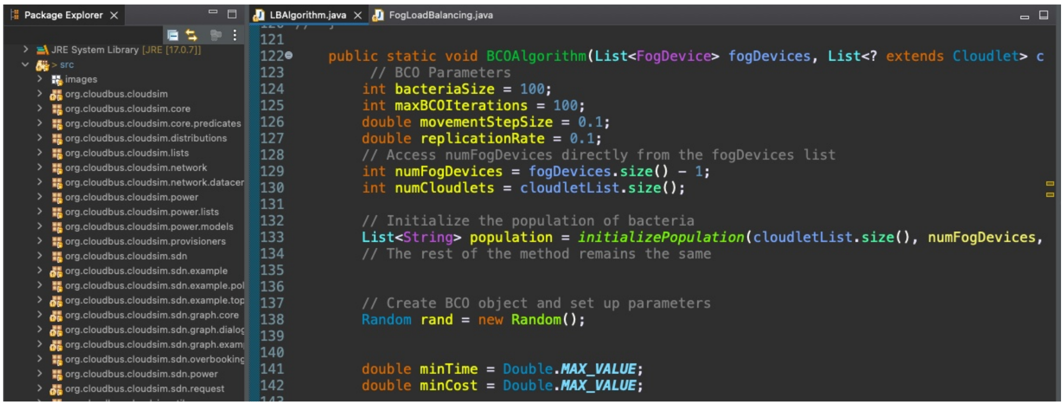


Figure 9: The code development for BCO algorithm

- Create another file (FogLoadBalancing.java) for calling the BCO algorithm to implement it as shown in Figure 10. Please include the dataset file for nodes and tasks configuration.

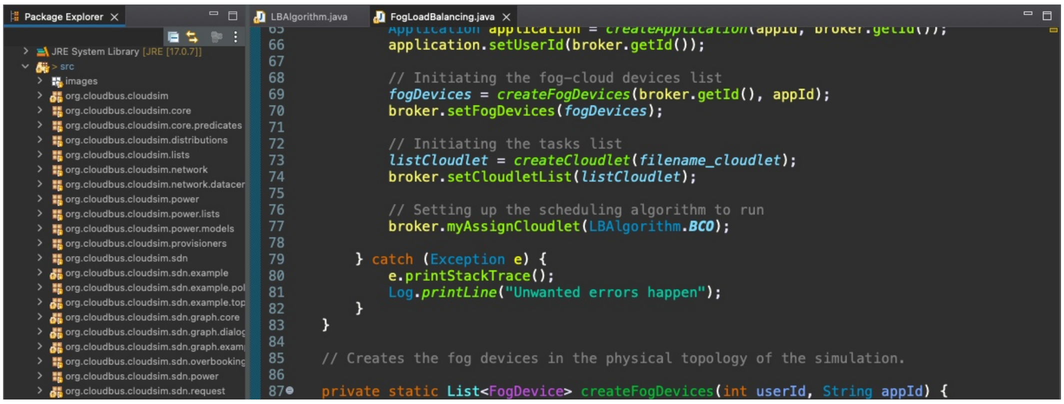


Figure 10: The code for load balancing algorithm implementation

- Update the file to include the other two load balancing algorithms for comparison with BCO algorithms. Here we are comparing the BCO algorithm with Round-Robin (RR) as shown in Figure 11 and Throttle Load Balancing (TLB) algorithm as shown in Figure 12.

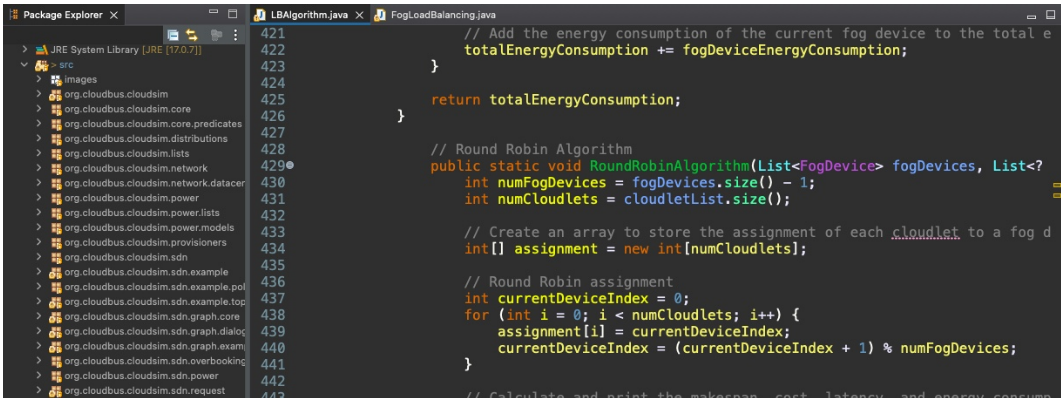


Figure 11: The code for Round-Robin algorithm

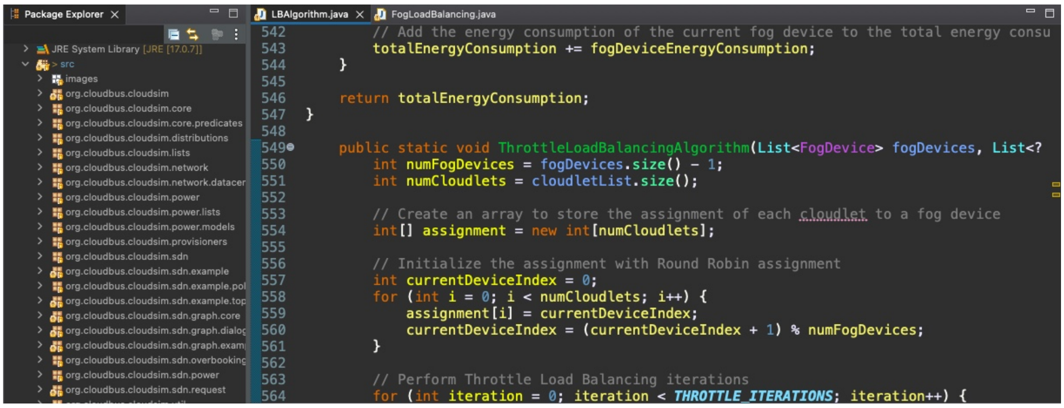


Figure 12: The code for Throttle Load Balancing algorithm

- Run the simulation : Run the FogLoadBalancing.java file to implement the BCO, RR and TLB algorithms and obtain the simulation results according to the configurations setup. The output console gives the performance metrics value in terms of latency, energy consumption, makespan and cost as shown in Figure 13.

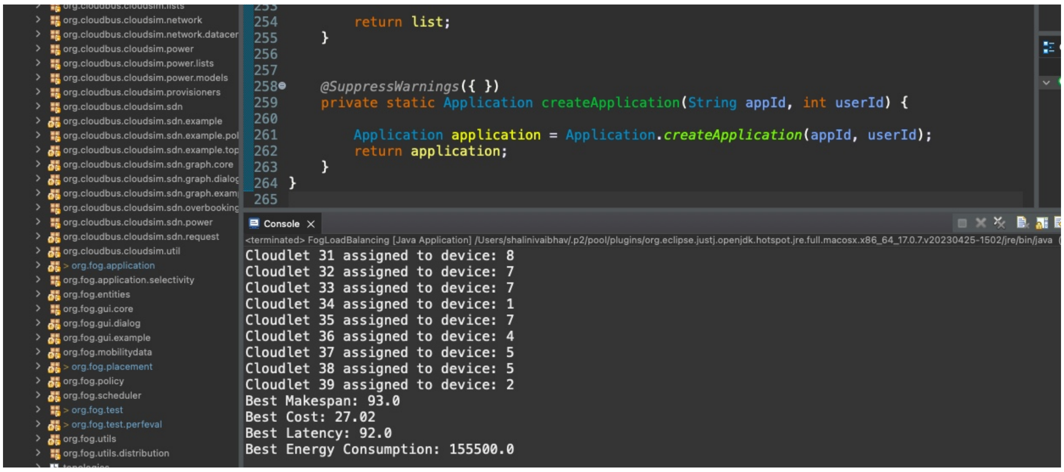


Figure 13: Simulation Output

5 Presentation and Demo Video

Please refer this link for presentation and demo video.

References

Eclipse Foundation (2023). Eclipse downloads, `https://www.eclipse.org/downloads/`.

iFogSim GitHub Repository (2023). `https://github.com/Cloudslab/iFogSim/archive/refs/heads/main.zip`.

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