National College of Ireland

Configuration Manual

MSc Research Project
Cloud Computing

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Configuration Manual

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1 Introduction

This configuration manual provides detailed instructions for configuring and running the research simulation experiment. It highlights steps taken to reproduce the simulation from data ingestion, execution of simulation experiment with custom algorithm up to the result evaluation analysis.

2 System Requirements

The experiment was focused on testing the ability of the proposed algorithm to improve cold start latency, execution time, and resource consumption of serverless functions primarily based on simulation with the iFogSim simulator toolkit (Buyya and Srirama; 2019) using the IntelliJ IDEA CE IDE. The table below illustrates the main components such as programming languages, tools, and libraries used.

Table 1: Tools and Technologies

Type	Tool/Technology	Description
Simulation framework	iFogSim	Simulation framework for cloud & edge computing
Programming Language	Java	For implementing simulation environment and location-aware algorithm and resources
Data Preparation	Python, Pandas, Google Colab	Used for preprocessing and visualization datasets
Version Control	Git & Github	Managing source code

3 Installation and Setup

3.1 Data Preparation Setup

The data preprocessing was carried out using Python scripts with Jupytar Notebook in Visual Studio IDE and the cleaned datasets used as input data to the simulation can be retrieved from this repository `https://github.com/oluademola/dataset-prep`. The raw datasets can be retrieved from (Microsoft-Research; 2019) and (Microsoft-Research; 2011) for the Azure functions and T-Drive datasets respectively. The dataset should be placed following the file structure illustrated in Figure 1 to run the data preprocessing.

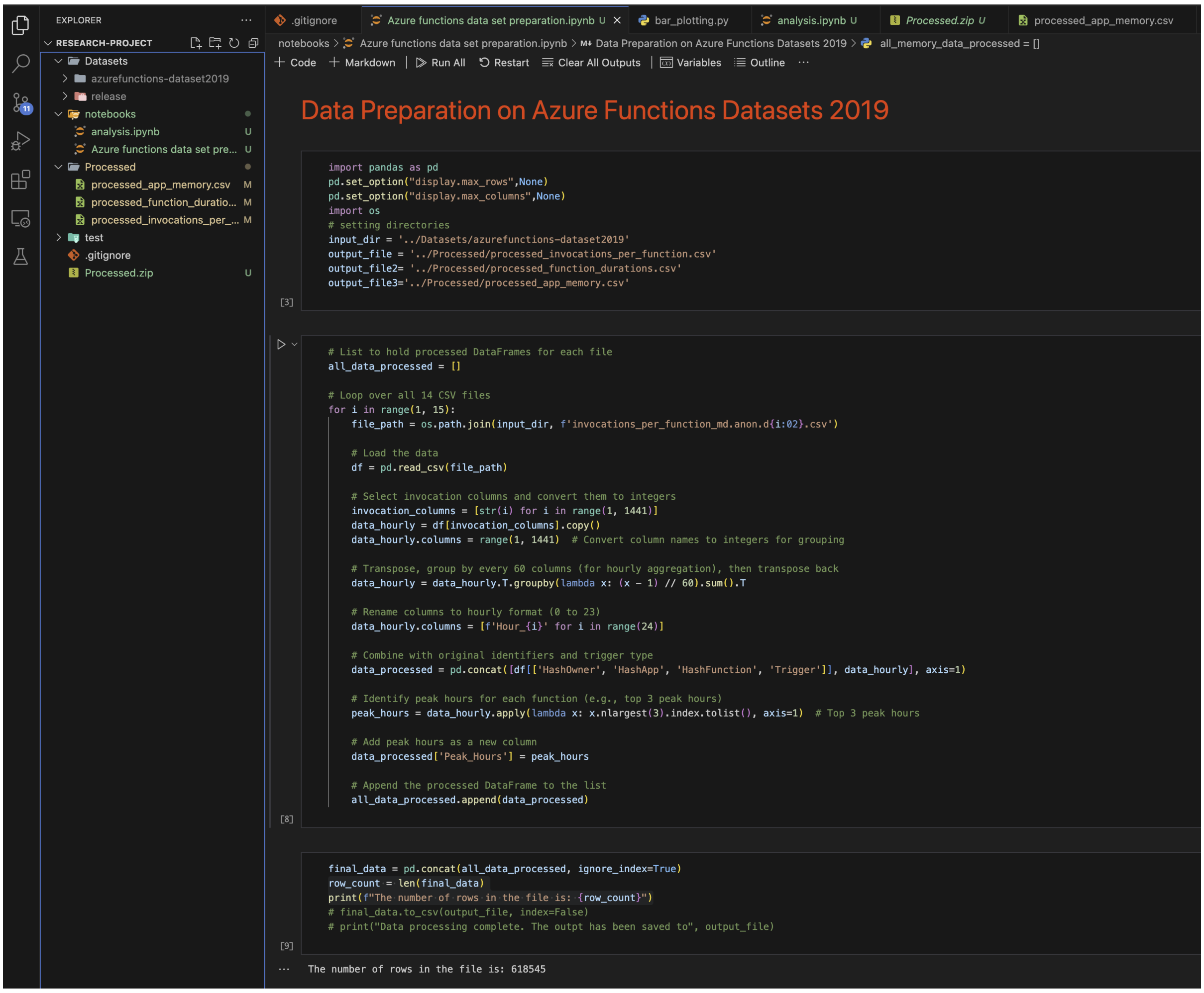

Figure 1: Data Preprocessing

3.2 iFogSim Simulation Setup

1. Clone the iFogSim simulator toolkit from its Git repository a folder:

```
git clone https://github.com/Cloudslab/iFogSim
```

2. Open the IntelliJ IDE

3. Click on the File dropdown menu and select `New > "project from existing resources"`.

4. Confirm that the Java version and external libraries are added to the project.

5. Navigate to `src > org > fog > test > perfeval` and run any of the example applications to verify the installation with the required libraries was successful. You should get a response in the console as shown in Figure 2 below.

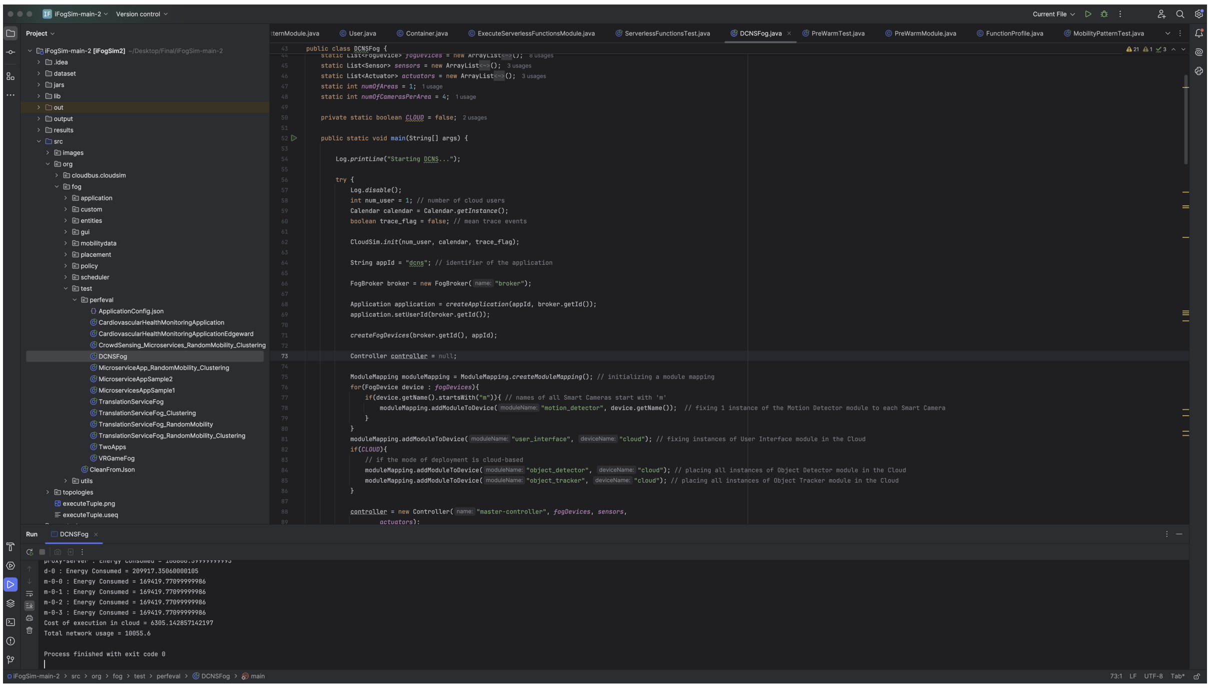

Figure 2: Example Application

4 Running Simulation Experiment

4.1 Project file setup

To configure the simulation environment. Setup the project files with the following steps:

1. Copy the preprocessed Azure Functions datasets to the project's `dataset/Processed1` folder.

2. Copy the preprocessed T-Drive datasets to the project's `dataset/T_drive` folder.

3. Copy the project codebase named `custom` to the `src > org > fog >` folder.

4. Verify the `custom` directory contains theses folders `mobility pattern, prewarm, serverlessfunctions, and test` with their appropriate java files within.

5. Ensure OpenCSV library use is less than version 5.0

4.2 Running the Experiment with the Algorithm

1. Run the first component of the algorithm by navigating to the `src > org > fog > custom > test > MobilityPatternTest` to run the mobility pattern module. It generates events that'd be used in the final execution of the functions for the effective execution of functions closer to the user.

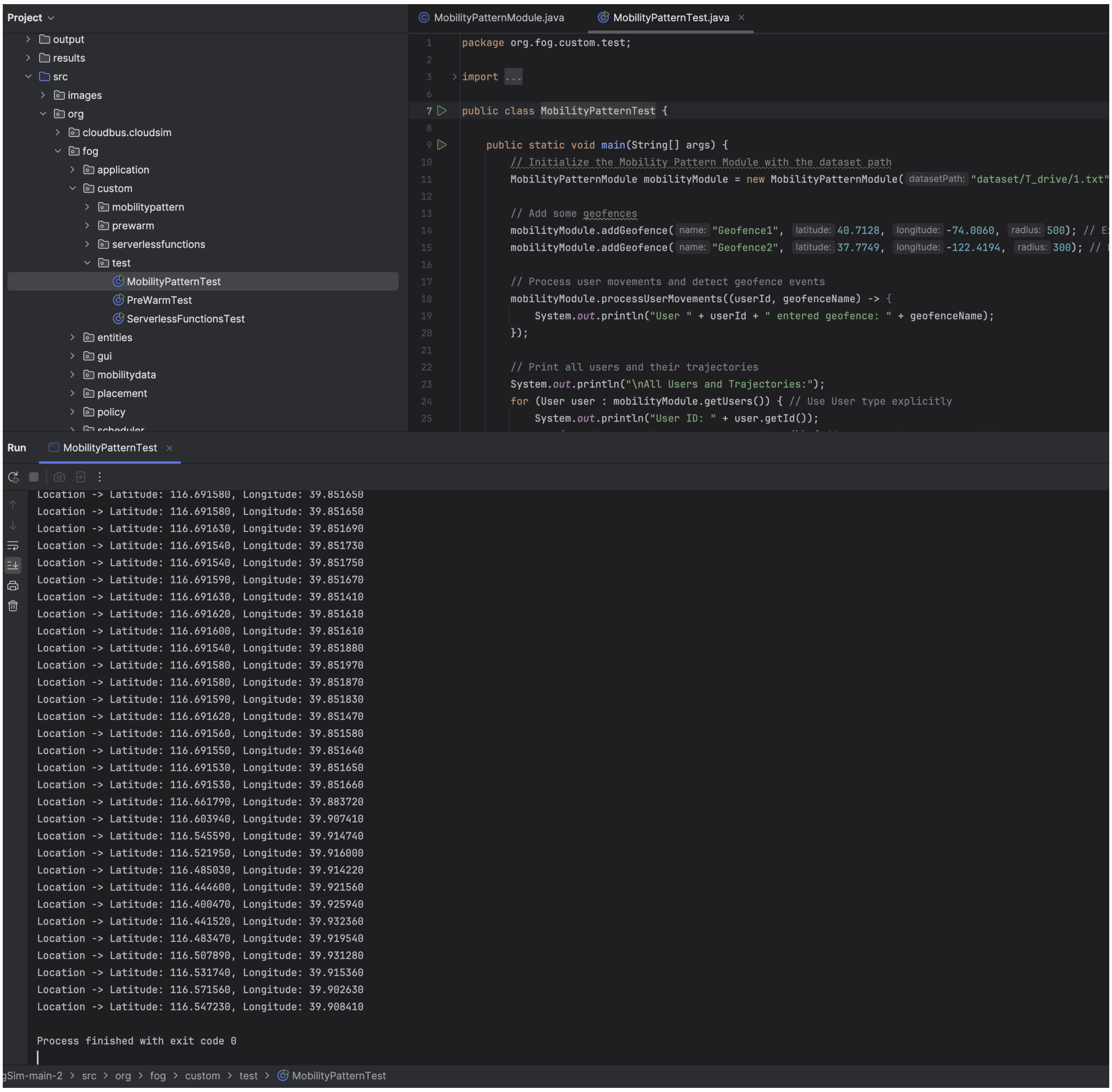

Figure 3: Mobility Pattern Events

2. Run the Prwarm module that handles the container pre-warming based on geofence entry events by navigating to the `src > org > fog > custom > test > PreWarmTest`.

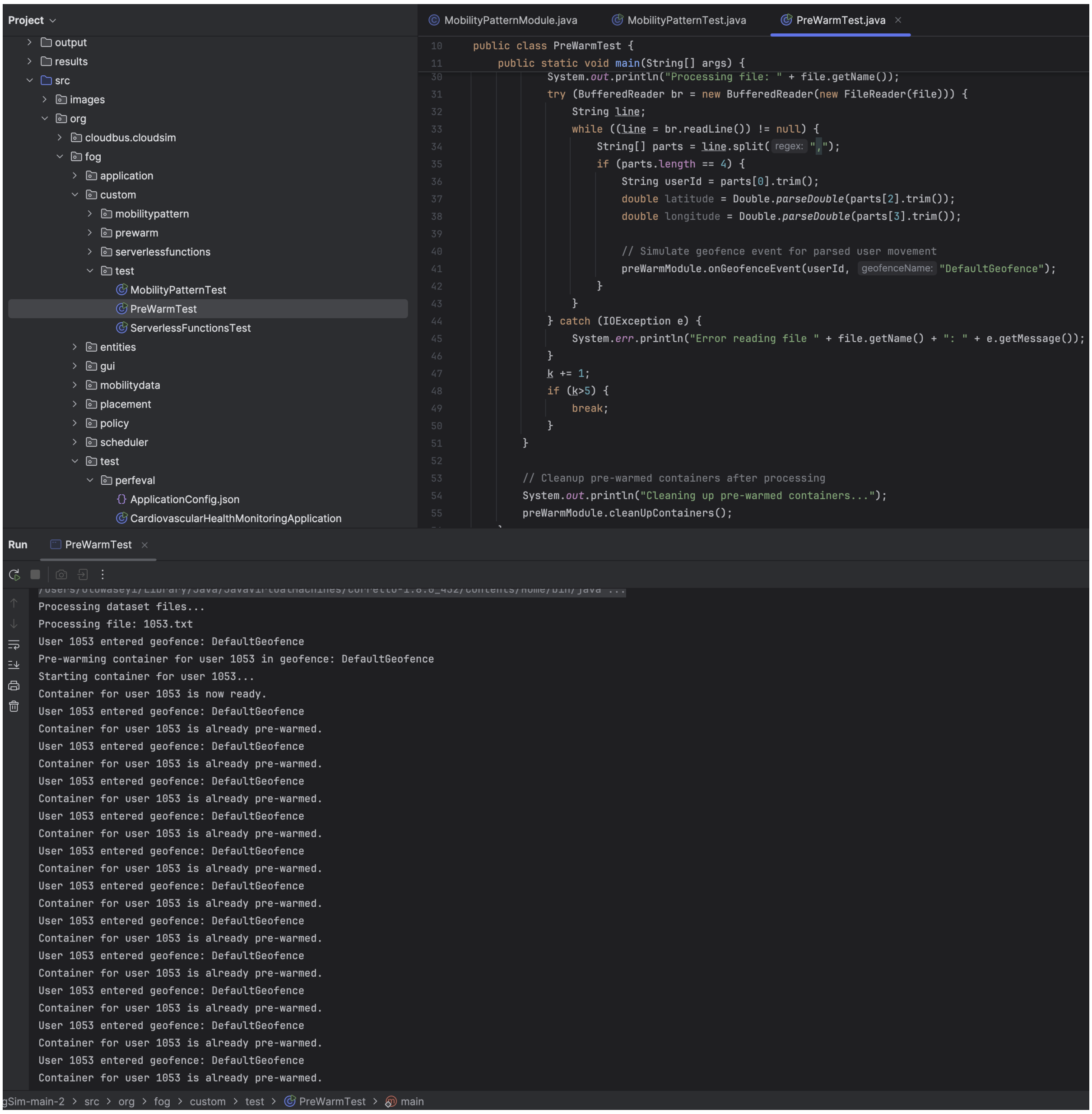

Figure 4: Prewarm module of the Algorithm

3. Run the complete simulation of serverless functions under both vanilla and custom location-aware configurations navigating to the `src > org > fog > custom > test > ServerlessFunctionsTest`. It generates the performance metrics across peak and non-peak hours for cold start latency, execution time, and resource consumption which are exported and analyzed in the next section

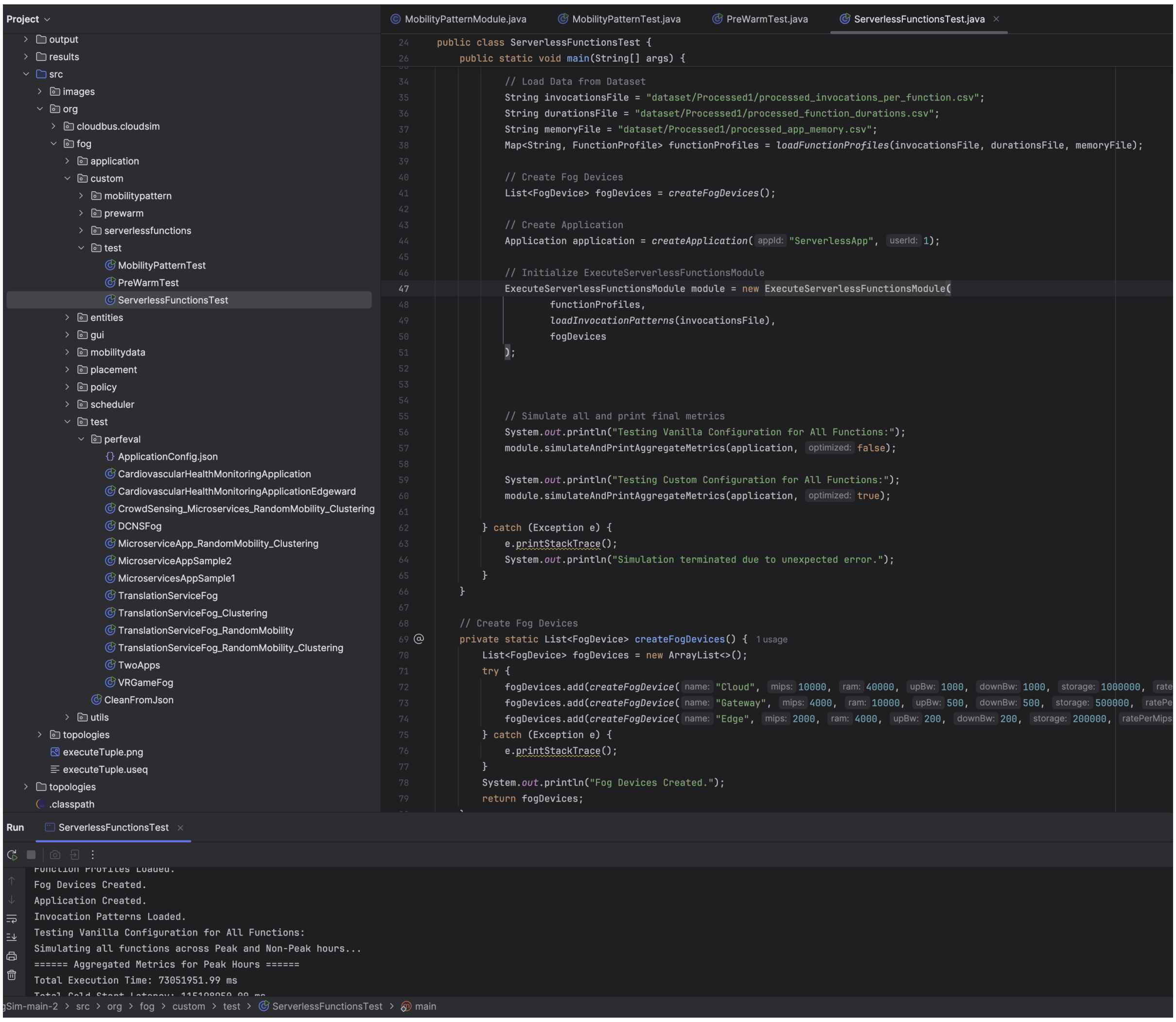

Figure 5: Simulation execution

5 Evaluating the Results

1. Results are collected through the console of the execution of the `ServerlessTestFunction` module.
2. The results are analyzed in the `analysis` notebook file using `numpy` and `matplotlib`
3. Run the `analysis` notebook file to see the analyzed results in charts

Figure 6: Result Analysis

References

Buyya, R. and Srirama, S. N. (2019). *Modeling and Simulation of Fog and Edge Computing Environments Using iFogSim Toolkit*, Wiley, pp. 433–465.

Microsoft-Research (2011). T-drive trajectory dataset. Licensed under the Microsoft Research License Agreement.
URL: *https://www.kaggle.com/datasets/arashnic/tdriver/data*

Microsoft-Research (2019). Azure functions dataset. Licensed under CC BY 4.0.
URL: *https://github.com/Azure/AzurePublicDataset/blob/master/AzureFunctionsDataset2019.md*