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Improve Load Balancing Performance and Efficiency Using Equally Spread Current Execution Algorithm working with response time clustering in Microservices

MSc Research Project
MSc Cloud Computing

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Project Submission Sheet
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Improve Load Balancing Performance and Efficiency Using Equally Spread Current Execution Algorithm working with response time clustering in Microservices

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1 Introduction

The purpose of this document is to provide information and operating procedures required to run the code provided as a part of "Msc Research Project" submission. The entire code has been written in Python programming language.

2 Prerequisite

The user of this document requires to have basic python programming knowledge and python3(I would recommend latest stable python3 version '3.7.*' which can be downloaded from python official website) installed on his system in order to run this code.

3 Additional python packages/libraries

The user requires to install additional python packages (update them in case they are already installed on their system). Following commands would be helpful for installing/updating additional required python packages.

3.1 pandas

python3 -m pip install –upgrade pandas

```
(base) prashantagavane@Prashants-MacBook-Air ~ %
(base) prashantagavane@Prashants-MacBook-Air ~ % python3 -m pip install --upgrade pandas
Collecting pandas
  Using cached pandas-1.0.3-cp37-cp37m-macosx_10_9_x86_64.whl (10.0 MB)
Requirement already satisfied, skipping upgrade: pytz>=2017.2 in ./opt/anaconda3/lib/python3.7/site-packages (from pandas) (2019.3)
Requirement already satisfied, skipping upgrade: numpy>=1.13.3 in ./opt/anaconda3/lib/python3.7/site-packages (from pandas) (1.18.1)
Requirement already satisfied, skipping upgrade: python-dateutil>=2.6.1 in ./opt/anaconda3/lib/python3.7/site-packages (from pandas) (2.8.1)
Requirement already satisfied, skipping upgrade: six>=1.5 in ./opt/anaconda3/lib/python3.7/site-packages (from python-dateutil>=2.6.1->pandas) (1.14.0)
Installing collected packages: pandas
  Attempting uninstall: pandas
    Found existing installation: pandas 1.0.1
    Uninstalling pandas-1.0.1:
      Successfully uninstalled pandas-1.0.1
```

Figure 1: Install Panda

3.2 sklearn

python3 -m pip install –upgrade sklearn

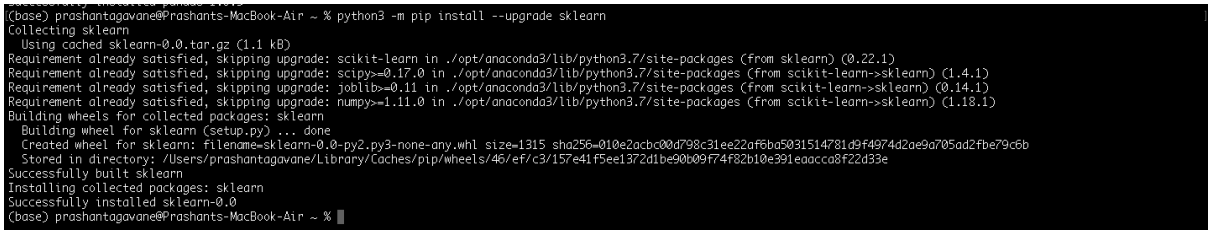

Figure 2: Install Sklearn

3.3 numpy

python3 -m pip install –upgrade numpy

Figure 3: Install Numpy

3.4 matpotlib

python3 -m pip install –upgrade matplotlib

Figure 4: Install Matplotlib

4 Comparative Analysis

The implementation of this research project is entirely based on comparative analysis between two load-balancing algorithms/techniques(detailed information has been provided in submitted report). The user needs to carry out comparative analysis on two plots produced by execution of each python script step by step in given order. The order of execution should be as following :-
1)python3 main_without_cluster.py
2)python3 main_with_cluster.py

4.1 Round Robin

In order to test the functionality of this project, first, we need to find out the response time of each microservice working with the Roundrobin algorithm. The execution of a given script will plot recorded response times against tasks allocated and load balanced to each microservice by the Roundrobin algorithm.
2)python3 main_without_cluster.py

```
(base) prashantagavane@Prashants-MacBook-Air Final_artifact % python3 main_without_cluster.py
/Users/prashantagavane/opt/anaconda3/lib/python3.7/site-packages/sklearn/externals/joblib/__init__.py:15: FutureWarning: sklearn.externals.joblib is deprecated in 0.21 and will b
e removed in 0.23. Please import this functionality directly from joblib, which can be installed with: pip install joblib. If this warning is raised when loading pickled models,
you may need to re-serialize those models with scikit-learn 0.21+.
  warnings.warn(msg, category=FutureWarning)
micro 0 starts
micro 1 starts
micro 2 starts
```

Figure 5: The Command to Execute first Experiment

Figure 6: The Round-Robin Algorithm Results

4.2 The proposed load balancing

In the next step, we need to find out the response time of each microservice working with the proposed load-balancing technique (Equally spread Current Execution algorithm working with response time clustering technique). The execution of a given script will plot

recorded response times against tasks allocated and load-balanced to each microservice by the proposed load balancing technique.
python3 main_with_cluster.py

```
(base) prashantagavane@Prashants-MacBook-Air Final_artifact % python3 main_with_cluster.py
/Users/prashantagavane/opt/anaconda3/lib/python3.7/site-packages/sklearn/externals/joblib/__init__.py:15: FutureWarning: sklearn.externals.joblib is deprecated in 0.21 and will b
e removed in 0.23. Please import this functionality directly from joblib, which can be installed with: pip install joblib. If this warning is raised when loading pickled models,
you may need to re-serialize those models with scikit-learn 0.21+.
  warnings.warn(msg, category=FutureWarning)
micro 0 starts
micro 1 starts
micro 2 starts
Exception in thread micro 1:
```

Figure 7: The Command to Execute Second Experiment

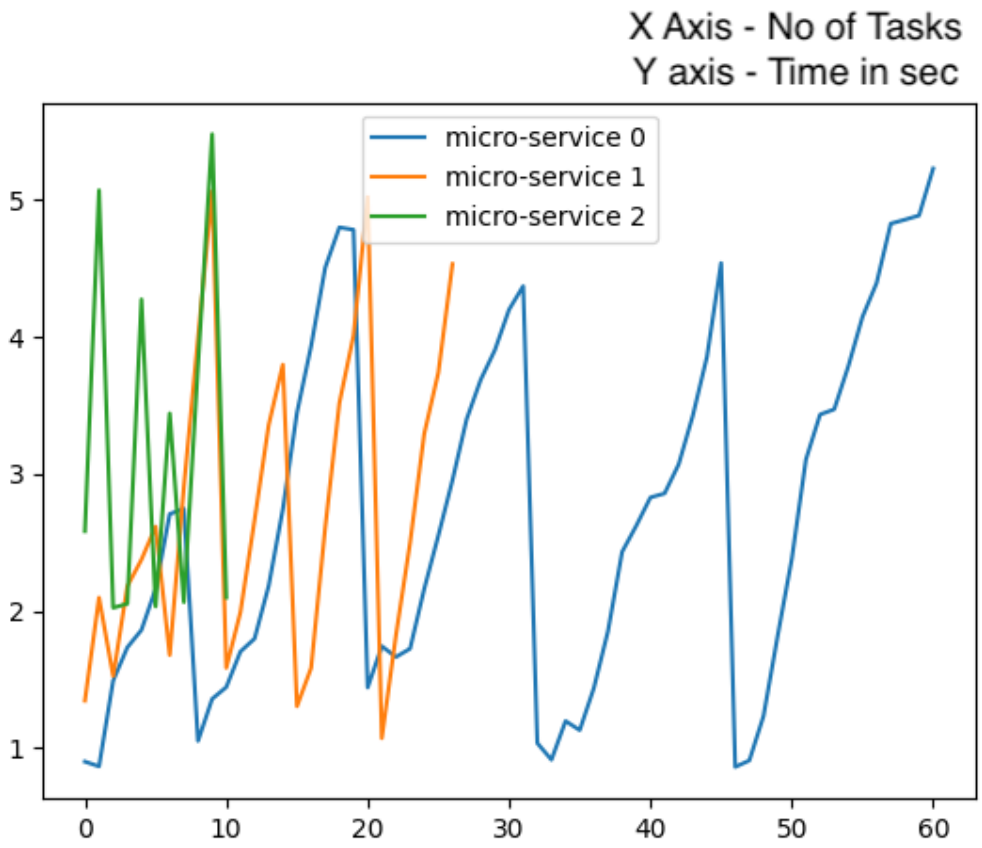

Figure 8: The Proposed Design Results