Configuration Manual

MSc Research Project
Cloud Computing

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MSc Project Submission Sheet

School of Computing

Student Name:	Haritha Raguram
Student ID:	22110003
Programme:	MSc in Cloud Computing **Year:** 2023
Module:	Cloud Research Project
Lecturer:	14/12/2023
Submission Due Date:	14/12/2023
Project Title:	Evaluating the impact of Energy Efficient Task Consolidation Techniques on Service Latency in Multi-Cloud Environment
Word Count:	……129…………. **Page Count:** …………………7…...…...……

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.

<u>ALL</u> internet material must be referenced in the bibliography section. Students are required to use the Referencing Standard specified in the report template. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action.

Signature: …………………Haritha Raguram…………………………………………………

Date: …………………14/12/2023………………………………………………………………

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Configuration Manual

Haritha Raguram
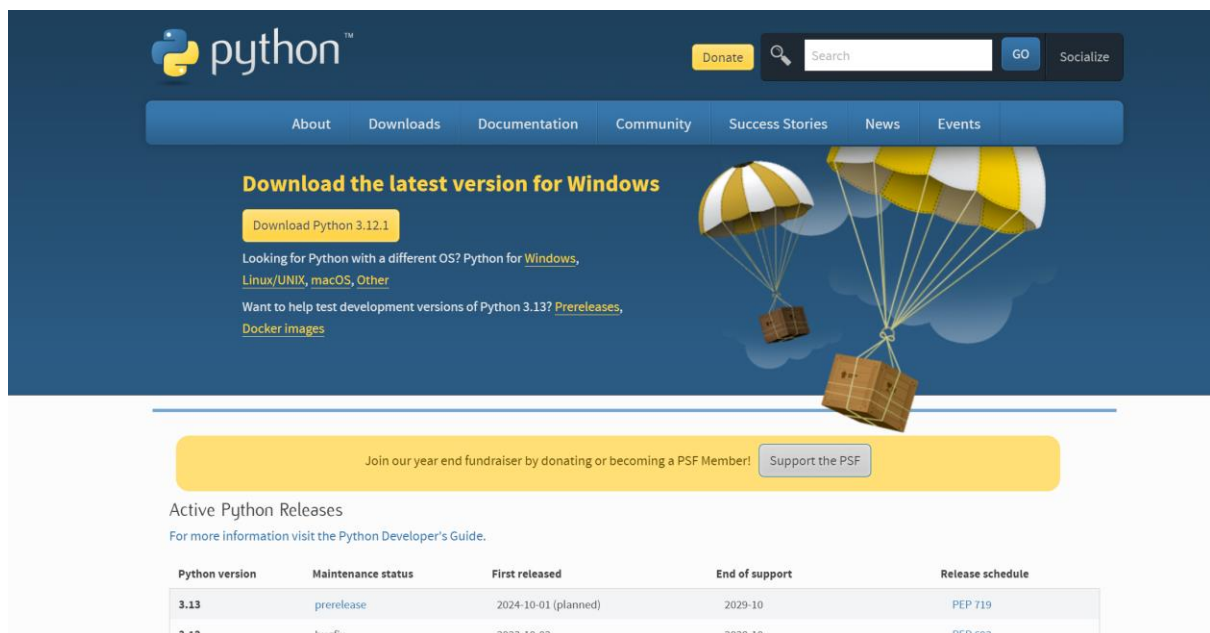Student ID: 22110003

1 Introduction

Enhanced privacy protection with nuanced security measures is implemented as shown below

2 Prerequisites

1. Python 3.11.8
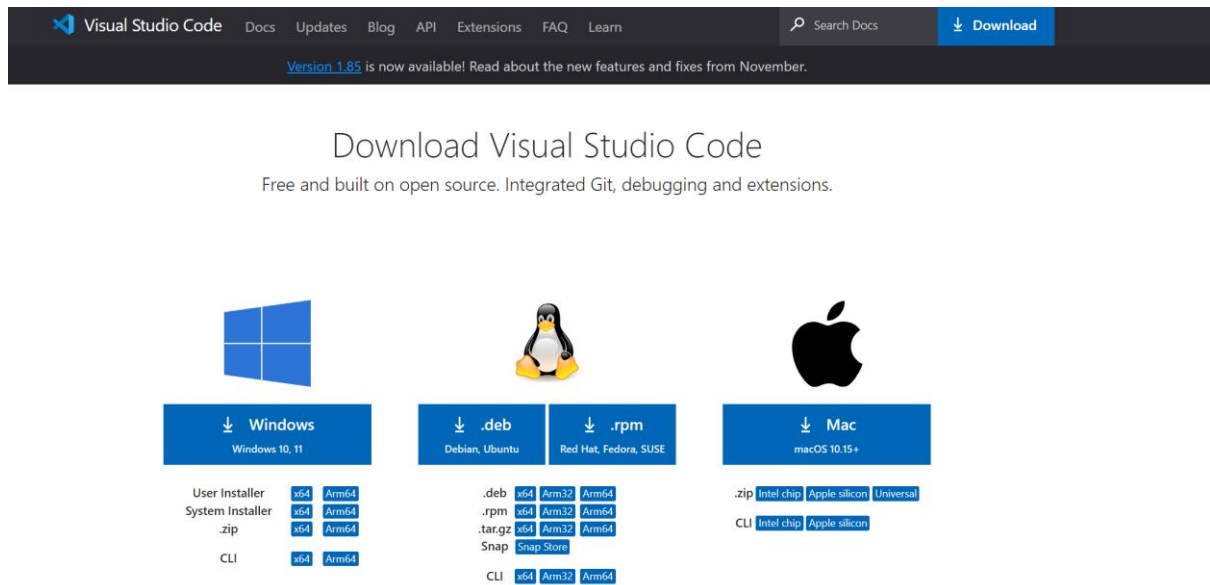2. VS Code

3 Prerequisite Installation

Step 1: https://www.python.org/downloads/
Download Python

Step 2: Install Python with Generic windows msi installer

Step3: https://code.visualstudio.com/download
Download VS code

4   Running the proposed Code

4.1   Step 4.1 Installation of Virtual Environment

pip install virtualenv

4.2   Create VENV

```
C:\Users\baner\OneDrive\Desktop\Thesis\Haritha>virtualenv venv
created virtual environment CPython3.11.4.final.0-64 in 1041ms
  creator CPython3Windows(dest=C:\Users\baner\OneDrive\Desktop\Thesis\Haritha\venv, clear=False, no_vcs_ignore=False, global=False)
  seeder FromAppData(download=False, pip=bundle, setuptools=bundle, wheel=bundle, via=copy, app_data_dir=C:\Users\baner\AppData\Local\pypa\virtualenv)
    added seed packages: pip==23.3.1, setuptools==69.0.2, wheel==0.42.0
  activators BashActivator,BatchActivator,FishActivator,NushellActivator,PowerShellActivator,PythonActivator

C:\Users\baner\OneDrive\Desktop\Thesis\Haritha>cd venv/scripts

C:\Users\baner\OneDrive\Desktop\Thesis\Haritha\venv\Scripts>ac
'ac' is not recognized as an internal or external command,
operable program or batch file.

C:\Users\baner\OneDrive\Desktop\Thesis\Haritha\venv\Scripts>activate

(venv) C:\Users\baner\OneDrive\Desktop\Thesis\Haritha\venv\Scripts>python
Python 3.11.4 (tags/v3.11.4:d2340ef, Jun  7 2023, 05:45:37) [MSC v.1934 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> []
```

4.3   Install python dependencies from the requirement.txt

pip install -r requirement.txt

Step 1: verify the requirement.txt file

```
1    absl-py==2.0.0
2    anyio==4.1.0
3    argon2-cffi==23.1.0
4    argon2-cffi-bindings==21.2.0
5    arrow==1.3.0
6    asttokens==2.4.1
7    astunparse==1.6.3
8    async-lru==2.0.4
9    attrs==23.1.0
10   Babel==2.13.1
11   beautifulsoup4==4.12.2
12   bleach==6.1.0
13   cachetools==5.3.2
14   certifi==2023.11.17
15   cffi==1.16.0
16   charset-normalizer==3.3.2
17   colorama==0.4.6
18   comm==0.2.0
19   debugpy==1.8.0
20   decorator==5.1.1
21   defusedxml==0.7.1
22   executing==2.0.1
```

PROBLEMS (5)   OUTPUT   DEBUG CONSOLE   TERMINAL   PORTS

```
Downloading jupyterlab_server-2.25.2-py3-none-any.whl (58 kB)
                                          58.9/58.9 kB 3.2 MB/s eta 0:00:00
Downloading keras-2.15.0-py3-none-any.whl (1.7 MB)
                                          1.7/1.7 MB 5.4 MB/s eta 0:00:00
Downloading libclang-16.0.6-py2.py3-none-win_amd64.whl (24.4 MB)
                                          24.4/24.4 MB 5.5 MB/s eta 0:00:00
Downloading Markdown-3.5.1-py3-none-any.whl (102 kB)
                                          102.2/102.2 kB 5.7 MB/s eta 0:00:00
Downloading MarkupSafe-2.1.3-cp311-cp311-win_amd64.whl (17 kB)
Downloading mistune-3.0.2-py3-none-any.whl (47 kB)
                                          48.0/48.0 kB 2.5 MB/s eta 0:00:00
Downloading ml_dtypes-0.2.0-cp311-cp311-win_amd64.whl (938 kB)
                                          938.7/938.7 kB 5.4 MB/s eta 0:00:00
Downloading nbclient-0.9.0-py3-none-any.whl (24 kB)
Downloading nbconvert-7.11.0-py3-none-any.whl (256 kB)
                                          256.6/256.6 kB 7.9 MB/s eta 0:00:00
Downloading nbformat-5.9.2-py3-none-any.whl (77 kB)
                                          77.6/77.6 kB 4.2 MB/s eta 0:00:00
Downloading nest_asyncio-1.5.8-py3-none-any.whl (5.3 kB)
Downloading notebook-7.0.6-py3-none-any.whl (4.0 MB)
                                          2.1/4.0 MB 5.8 MB/s eta 0:00:01
```

Step 2: Installing the requirements from the file

```
Collecting anyio==4.1.0 (from -r requirement.txt (line 2))
  Downloading anyio-4.1.0-py3-none-any.whl.metadata (4.5 kB)
Collecting argon2-cffi==23.1.0 (from -r requirement.txt (line 3))
  Downloading argon2_cffi-23.1.0-py3-none-any.whl.metadata (5.2 kB)
Collecting argon2-cffi-bindings==21.2.0 (from -r requirement.txt (line 4))
  Downloading argon2_cffi_bindings-21.2.0-cp36-abi3-win_amd64.whl (30 kB)
Collecting arrow==1.3.0 (from -r requirement.txt (line 5))
  Downloading arrow-1.3.0-py3-none-any.whl.metadata (7.5 kB)
Collecting asttokens==2.4.1 (from -r requirement.txt (line 6))
  Downloading asttokens-2.4.1-py2.py3-none-any.whl.metadata (5.2 kB)
Collecting astunparse==1.6.3 (from -r requirement.txt (line 7))
  Downloading astunparse-1.6.3-py2.py3-none-any.whl (12 kB)
Collecting async-lru==2.0.4 (from -r requirement.txt (line 8))
  Downloading async_lru-2.0.4-py3-none-any.whl.metadata (4.5 kB)
Collecting attrs==23.1.0 (from -r requirement.txt (line 9))
  Downloading attrs-23.1.0-py3-none-any.whl (61 kB)
                                          61.2/61.2 kB ? eta 0:00:00
Collecting Babel==2.13.1 (from -r requirement.txt (line 10))
  Downloading Babel-2.13.1-py3-none-any.whl.metadata (1.6 kB)
Collecting beautifulsoup4==4.12.2 (from -r requirement.txt (line 11))
  Downloading beautifulsoup4-4.12.2-py3-none-any.whl (142 kB)
                                          143.0/143.0 kB 2.8 MB/s eta 0:00:00
Collecting bleach==6.1.0 (from -r requirement.txt (line 12))
  Downloading bleach-6.1.0-py3-none-any.whl.metadata (30 kB)
Collecting cachetools==5.3.2 (from -r requirement.txt (line 13))
  Downloading cachetools-5.3.2-py3-none-any.whl.metadata (5.2 kB)
Collecting certifi==2023.11.17 (from -r requirement.txt (line 14))
  Downloading certifi-2023.11.17-py3-none-any.whl.metadata (2.2 kB)
Collecting cffi==1.16.0 (from -r requirement.txt (line 15))
  Downloading cffi-1.16.0-cp311-cp311-win_amd64.whl.metadata (1.5 kB)
Collecting charset-normalizer==3.3.2 (from -r requirement.txt (line 16))
  Downloading charset_normalizer-3.3.2-cp311-cp311-win_amd64.whl.metadata (34 kB)
Collecting colorama==0.4.6 (from -r requirement.txt (line 17))
  Downloading colorama-0.4.6-py2.py3-none-any.whl (25 kB)
Collecting comm==0.2.0 (from -r requirement.txt (line 18))
  Downloading comm-0.2.0-py3-none-any.whl.metadata (3.7 kB)
Collecting debugpy==1.8.0 (from -r requirement.txt (line 19))
  Downloading debugpy-1.8.0-cp311-cp311-win_amd64.whl.metadata (1.1 kB)
Collecting decorator==5.1.1 (from -r requirement.txt (line 20))
  Downloading decorator-5.1.1-py3-none-any.whl (9.1 kB)
Collecting defusedxml==0.7.1 (from -r requirement.txt (line 21))
  Downloading defusedxml-0.7.1-py2.py3-none-any.whl (25 kB)
Collecting executing==2.0.1 (from -r requirement.txt (line 22))
  Downloading executing-2.0.1-py2.py3-none-any.whl.metadata (9.0 kB)
Collecting fastjsonschema==2.19.0 (from -r requirement.txt (line 23))
  Downloading fastjsonschema-2.19.0-py3-none-any.whl.metadata (2.0 kB)
```

Step 3: Finished installation

```
certifi, cachetools, Babel, attrs, async-lru, absl-py, Werkzeug, terminado, scipy, rsa, rfc3339-validator, requests, referencing, QtPy, python-dateutil, pyasn1-modules,
opt-einsum, ml-dtypes, matplotlib-inline, jupyter_core, Jinja2, jedi, h5py, google-pasta, comm, cffi, bleach, beautifulsoup4, astunparse, asttokens, anyio, stack-data, r
equests-oauthlib, pandas, jupyter_server_terminals, jupyter_client, jsonschema-specifications, google-auth, arrow, argon2-cffi-bindings, jsonschema, isoduration, ipython
, google-auth-oauthlib, argon2-cffi, tensorboard, nbformat, ipywidgets, ipykernel, tensorflow-intel, qtconsole, nbclient, jupyter-events, jupyter-console, tensorflow, nb
convert, jupyter_server, notebook_shim, jupyterlab_server, jupyter-lsp, jupyterlab, notebook, jupyter
Successfully installed Babel-2.13.1 Jinja2-3.1.2 Markdown-3.5.1 MarkupSafe-2.1.3 Pygments-2.17.2 QtPy-2.4.1 Send2Trash-1.8.2 Werkzeug-3.0.1 absl-py-2.0.0 an
yio-4.1.0 argon2-cffi-23.1.0 argon2-cffi-bindings-21.2.0 arrow-1.3.0 asttokens-2.4.1 astunparse-1.6.3 async-lru-2.0.4 attrs-23.1.0 beautifulsoup4-4.12.2 bleach-6.1.0 cac
hetools-5.3.2 certifi-2023.11.17 cffi-1.16.0 charset-normalizer-3.3.2 colorama-0.4.6 comm-0.2.0 debugpy-1.8.0 decorator-5.1.1 defusedxml-0.7.1 executing-2.0.1 fastjsonsc
hema-2.19.0 flatbuffers-23.5.26 fqdn-1.5.1 gast-0.5.4 google-auth-2.24.0 google-auth-oauthlib-1.1.0 google-pasta-0.2.0 grpcio-1.59.3 h5py-3.10.0 idna-3.6 ipykernel-6.27.
1 ipython-8.18.1 ipywidgets-8.1.1 isoduration-20.11.0 jedi-0.19.1 json5-0.9.14 jsonpointer-2.4 jsonschema-4.20.0 jsonschema-specifications-2023.11.2 jupyter-1.0.0 jupyte
r-console-6.6.3 jupyter-events-0.9.0 jupyter-lsp-2.2.1 jupyter_client-8.6.0 jupyter_core-5.5.0 jupyter_server-2.11.1 jupyter_server_terminals-0.4.4 jupyterlab-4.0.9 jupy
terlab-widgets-3.0.9 jupyterlab_pygments-0.3.0 jupyterlab_server-2.25.2 keras-2.15.0 libclang-16.0.6 matplotlib-inline-0.1.6 mistune-3.0.2 ml-dtypes-0.2.0 nbclient-0.9.0
 nbconvert-7.11.0 nbformat-5.9.2 nest-asyncio-1.5.8 notebook-7.0.6 notebook_shim-0.2.3 numpy-1.26.2 oauthlib-3.2.2 opt-einsum-3.3.0 overrides-7.4.0 packaging-23.2 pandas
-2.1.3 pandocfilters-1.5.0 parso-0.8.3 platformdirs-4.0.0 prometheus-client-0.19.0 prompt-toolkit-3.0.41 protobuf-4.23.4 psutil-5.9.6 pure-eval-0.2.2 pyasn1-0.5.1 pyasn1
-modules-0.3.0 pycparser-2.21 python-dateutil-2.8.2 python-json-logger-2.0.7 pytz-2023.3.post1 pywin32-306 pywinpty-2.0.12 pyzmq-25.1.1 qtconsole-5.5.1 referencing-0.31.
1 requests-2.31.0 requests-oauthlib-1.3.1 rfc3339-validator-0.1.4 rfc3986-validator-0.1.1 rpds-py-0.13.2 rsa-4.9 scipy-1.11.4 six-1.16.0 sniffio-1.3.0 soupsieve-2.5 stac
k-data-0.6.3 tensorboard-2.15.1 tensorboard-data-server-0.7.2 tensorflow-2.15.0 tensorflow-estimator-2.15.0 tensorflow-intel-2.15.0 tensorflow-io-gcs-filesystem-0.31.0 t
ermcolor-2.4.0 terminado-0.18.0 tinycss2-1.2.1 tornado-6.4 traitlets-5.14.0 types-python-dateutil-2.8.19.14 typing_extensions-4.8.0 tzdata-2023.3 uri-template-1.3.0 urll
ib3-2.1.0 wcwidth-0.2.12 webcolors-1.13 webencodings-0.5.1 websocket-client-1.7.0 widgetsnbextension-4.0.9 wrapt-1.14.1
```

5   Running the proposed Code

```
(venv) C:\Users\baner\OneDrive\Desktop\Thesis\Haritha>python DNS_1.py
Simulation Results:
Total Users: 100
Number of Premium Users: 40
Total DNS Server Machines: 5
Total Data Centers (DCs): 5

Greedy Approach:
Average Latency (Greedy): 3935.1954740344368 km
Total Revenue (Greedy): 511.03287706021007 euros
Total Cost Incurred by Company (Greedy): -511.03287706072985 euros

Random Approach:
Average Latency (Random): 9768.889553942976 km
Total Revenue (Random): 511.03287706021007 euros
Total Cost Incurred by Company (Random): 32462.798063862072 euros

(venv) C:\Users\baner\OneDrive\Desktop\Thesis\Haritha>python ILBv1.py
Machines:
Machine 0 - Cores: 5, RAM: 15 GB, Memory: 190 GB
Machine 1 - Cores: 3, RAM: 13 GB, Memory: 173 GB
Machine 2 - Cores: 3, RAM: 4 GB, Memory: 116 GB
Machine 3 - Cores: 4, RAM: 5 GB, Memory: 91 GB
Machine 4 - Cores: 3, RAM: 8 GB, Memory: 138 GB

Users with Cost and Time:
User 0 - Processes: 2, Cost: 100 Euros
Process 0 - User 0 - Cores: 2, RAM: 7 GB, Memory: 33 GB, Execution Time: 45 min, Start Time: 32, End Time: 77
Process 1 - User 0 - Cores: 1, RAM: 1 GB, Memory: 41 GB, Execution Time: 75 min, Start Time: 1275, End Time: 1350
User 1 - Processes: 4, Cost: 100 Euros
Process 0 - User 1 - Cores: 3, RAM: 7 GB, Memory: 20 GB, Execution Time: 15 min, Start Time: 1265, End Time: 1280
Process 1 - User 1 - Cores: 2, RAM: 6 GB, Memory: 11 GB, Execution Time: 60 min, Start Time: 143, End Time: 203
Process 2 - User 1 - Cores: 1, RAM: 8 GB, Memory: 18 GB, Execution Time: 75 min, Start Time: 1013, End Time: 1088
Process 3 - User 1 - Cores: 4, RAM: 8 GB, Memory: 46 GB, Execution Time: 90 min, Start Time: 1016, End Time: 1106
User 2 - Processes: 3, Cost: 100 Euros
Process 0 - User 2 - Cores: 4, RAM: 3 GB, Memory: 41 GB, Execution Time: 90 min, Start Time: 959, End Time: 1049
```

```
Simulation Results:
Total Users: 100
Number of Premium Users: 52
Total DNS Server Machines: 7
Total Data Centers (DCs): 5

Greedy Approach:
Average Latency (Greedy): 3535.499557373025 km
Total Revenue (Greedy): 611.9369578510898 euros
Total Cost Incurred by Company (Greedy): -611.9369578510195 euros

Random Approach:
Average Latency (Random): 9941.255359125873 km
Total Revenue (Random): 611.9369578510898 euros
Total Cost Incurred by Company (Random): 68934.01190185452 euros
```

```
User 3 - Processes: 3 , Cost: 100 Euros
  Process 0 - User 3 - Cores: 1, RAM: 5 GB, Memory: 40 GB, Execution Time: 45 min
  Process 1 - User 3 - Cores: 2, RAM: 3 GB, Memory: 34 GB, Execution Time: 75 min
  Process 2 - User 3 - Cores: 4, RAM: 4 GB, Memory: 11 GB, Execution Time: 15 min
User 4 - Processes: 2 , Cost: 100 Euros
  Process 0 - User 4 - Cores: 1, RAM: 1 GB, Memory: 27 GB, Execution Time: 60 min
  Process 1 - User 4 - Cores: 2, RAM: 7 GB, Memory: 47 GB, Execution Time: 90 min
User 5 - Processes: 4 , Cost: 100 Euros
  Process 0 - User 5 - Cores: 4, RAM: 7 GB, Memory: 12 GB, Execution Time: 45 min
  Process 1 - User 5 - Cores: 3, RAM: 5 GB, Memory: 31 GB, Execution Time: 30 min
  Process 2 - User 5 - Cores: 1, RAM: 6 GB, Memory: 27 GB, Execution Time: 45 min
  Process 3 - User 5 - Cores: 1, RAM: 6 GB, Memory: 40 GB, Execution Time: 90 min
User 6 - Processes: 4 , Cost: 100 Euros
  Process 0 - User 6 - Cores: 1, RAM: 7 GB, Memory: 13 GB, Execution Time: 30 min
  Process 1 - User 6 - Cores: 2, RAM: 6 GB, Memory: 21 GB, Execution Time: 60 min
  Process 2 - User 6 - Cores: 2, RAM: 7 GB, Memory: 45 GB, Execution Time: 30 min
  Process 3 - User 6 - Cores: 2, RAM: 7 GB, Memory: 44 GB, Execution Time: 15 min
User 7 - Processes: 4 , Cost: 100 Euros
  Process 0 - User 7 - Cores: 3, RAM: 5 GB, Memory: 11 GB, Execution Time: 90 min
  Process 1 - User 7 - Cores: 4, RAM: 7 GB, Memory: 24 GB, Execution Time: 60 min
  Process 2 - User 7 - Cores: 2, RAM: 2 GB, Memory: 18 GB, Execution Time: 30 min
  Process 3 - User 7 - Cores: 2, RAM: 7 GB, Memory: 17 GB, Execution Time: 30 min
User 8 - Processes: 4 , Cost: 100 Euros
  Process 0 - User 8 - Cores: 3, RAM: 2 GB, Memory: 28 GB, Execution Time: 45 min
  Process 1 - User 8 - Cores: 3, RAM: 4 GB, Memory: 29 GB, Execution Time: 30 min
  Process 2 - User 8 - Cores: 1, RAM: 7 GB, Memory: 33 GB, Execution Time: 90 min
  Process 3 - User 8 - Cores: 3, RAM: 4 GB, Memory: 38 GB, Execution Time: 75 min
User 9 - Processes: 2 , Cost: 100 Euros
  Process 0 - User 9 - Cores: 4, RAM: 5 GB, Memory: 35 GB, Execution Time: 90 min
  Process 1 - User 9 - Cores: 2, RAM: 4 GB, Memory: 42 GB, Execution Time: 15 min
Allocating User 5 to Machine 0 - Cores: 16, RAM: 24 GB, Memory: 134 GB - Cost: 100 Euros
Allocating User 6 to Machine 4 - Cores: 14, RAM: 28 GB, Memory: 150 GB - Cost: 100 Euros
Allocating User 7 to Machine 2 - Cores: 14, RAM: 28 GB, Memory: 106 GB - Cost: 100 Euros
Allocating User 8 to Machine 1 - Cores: 15, RAM: 18 GB, Memory: 158 GB - Cost: 100 Euros
Allocating User 3 to Machine 3 - Cores: 16, RAM: 15 GB, Memory: 180 GB - Cost: 100 Euros
Allocating User 0 to Machine 5 - Cores: 15, RAM: 29 GB, Memory: 112 GB - Cost: 100 Euros
Allocating User 2 to Machine 5 - Cores: 11, RAM: 19 GB, Memory: 50 GB - Cost: 100 Euros
Allocating User 4 to Machine 6 - Cores: 12, RAM: 27 GB, Memory: 181 GB - Cost: 100 Euros
Allocating User 9 to Machine 6 - Cores: 9, RAM: 19 GB, Memory: 107 GB - Cost: 100 Euros
Allocating User 1 to Machine 7 - Cores: 13, RAM: 19 GB, Memory: 154 GB - Cost: 100 Euros
```

References

Microsoft. (2021). *Visual Studio Code*. Available at: https://github.com/microsoft/vscode

Baxter, J. (Year). 10Dataset - Text Document Classification. *Available at: https://www.kaggle.com/datasets/jensenbaxter/10dataset-text-document-classificationFeng, G. and Buyya, R. (2016). Maximum revenue-oriented resource allocation in cloud, IJGUC 7(1): 12–21.*