



Job Recommender System User Guide

Group 7 Member

1. Daniel Tan
2. Leonard Loh
3. Aaron Kueh Hee Kheng

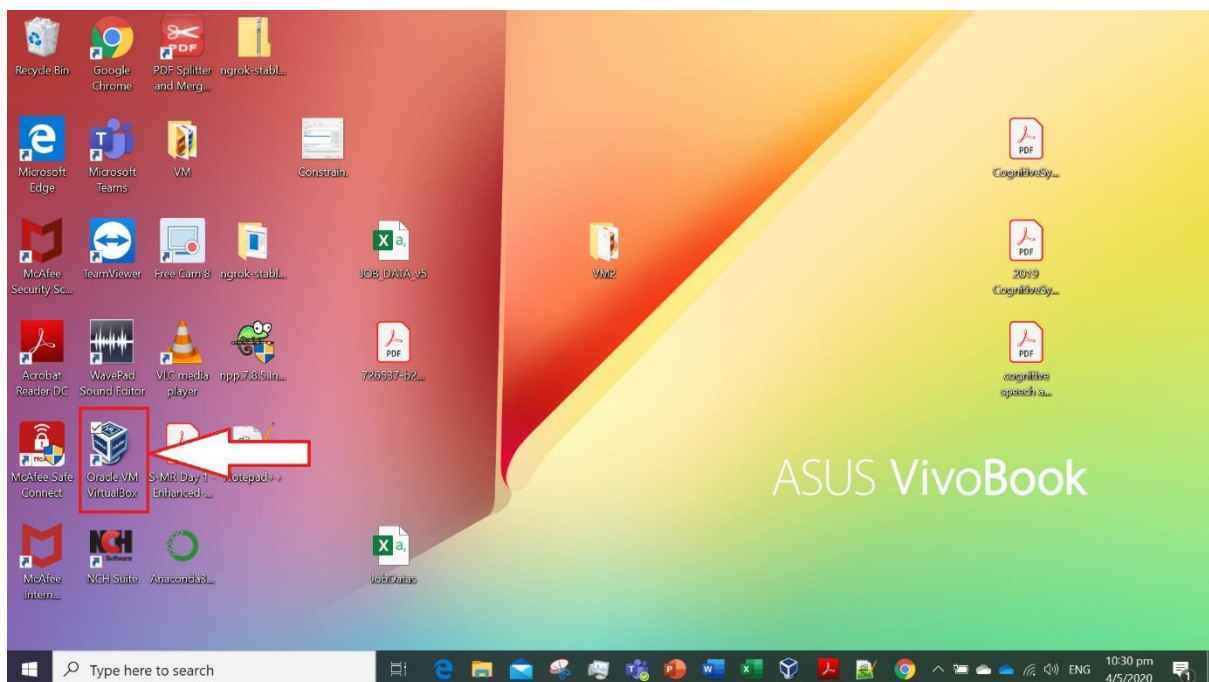
ISS-VM Installation

Requirements:

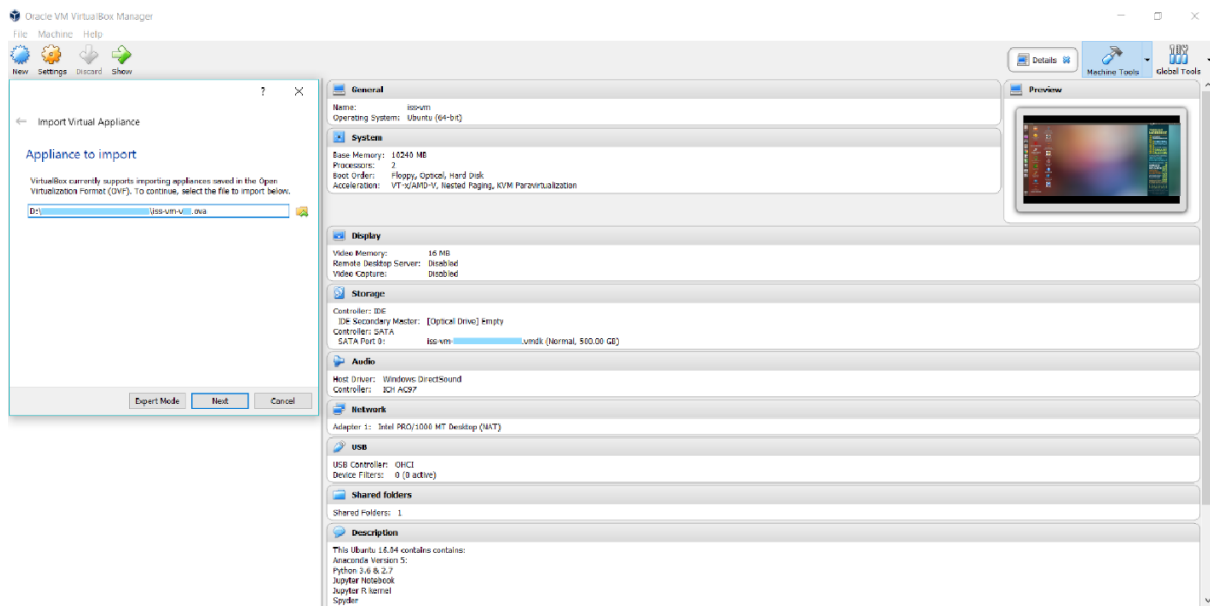
- ISS-VM Ubuntu 16.04
- Tool KIE 7.12
- Google Chrome

Procedure to install ISS-VM:

1. Download and install Virtualbox software (recommended version 5.2.20):
<https://www.virtualbox.org/wiki/Downloads>
2. Download iss-vm virtual machine (an Appliance) from:
 1. <http://bit.ly/iss-vm-v20a> (part 1 about 11 GB in file size)
 2. <http://bit.ly/iss-vm-v20b> (part 2 about 11 GB in file size)
 3. <http://bit.ly/iss-vm-v20c> (part 3 about 10 GB in file size)
3. **[Note] Please check/ensure the 'virtualization' option is enabled in your computer's BIOS/hardware**
4. Put all three zip files in the same folder; select the first file iss-vm-vNN.zip.001. Use tools like 7-zip to unzip the folder. (<https://www.7-zip.org/download.html>)
5. Start Virtualbox software



6. Click File ->Import Appliance

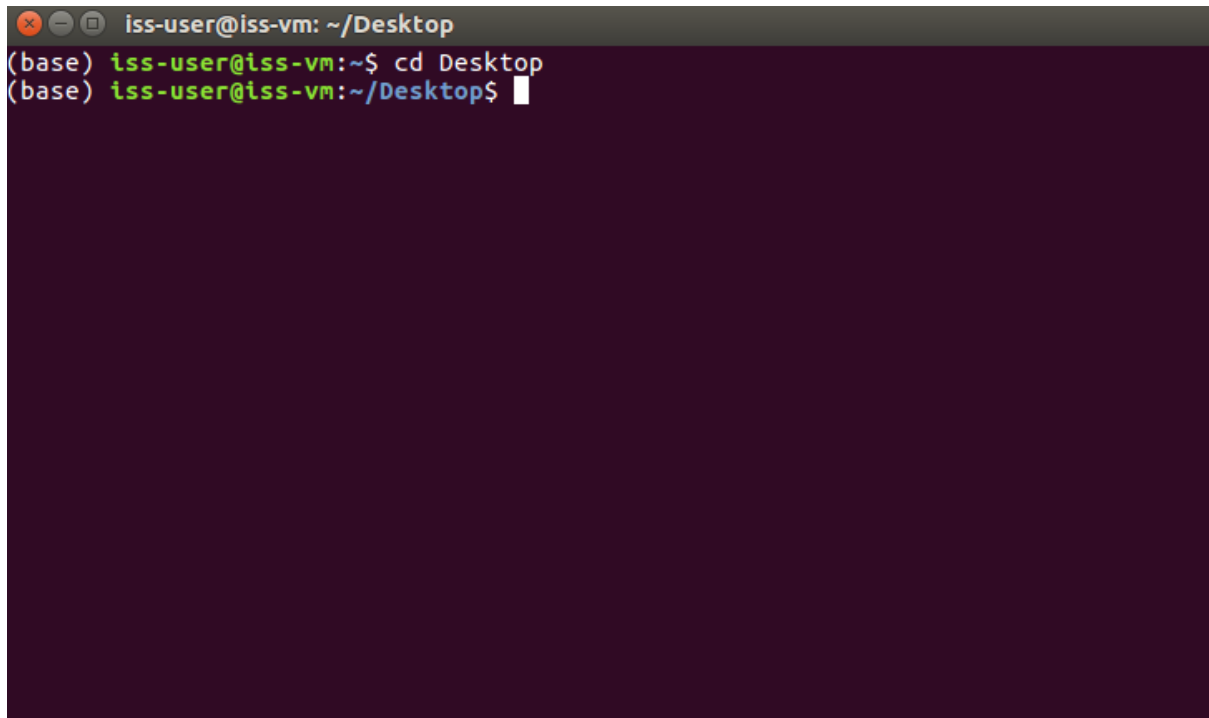


7. Click "Start" to launch issvm



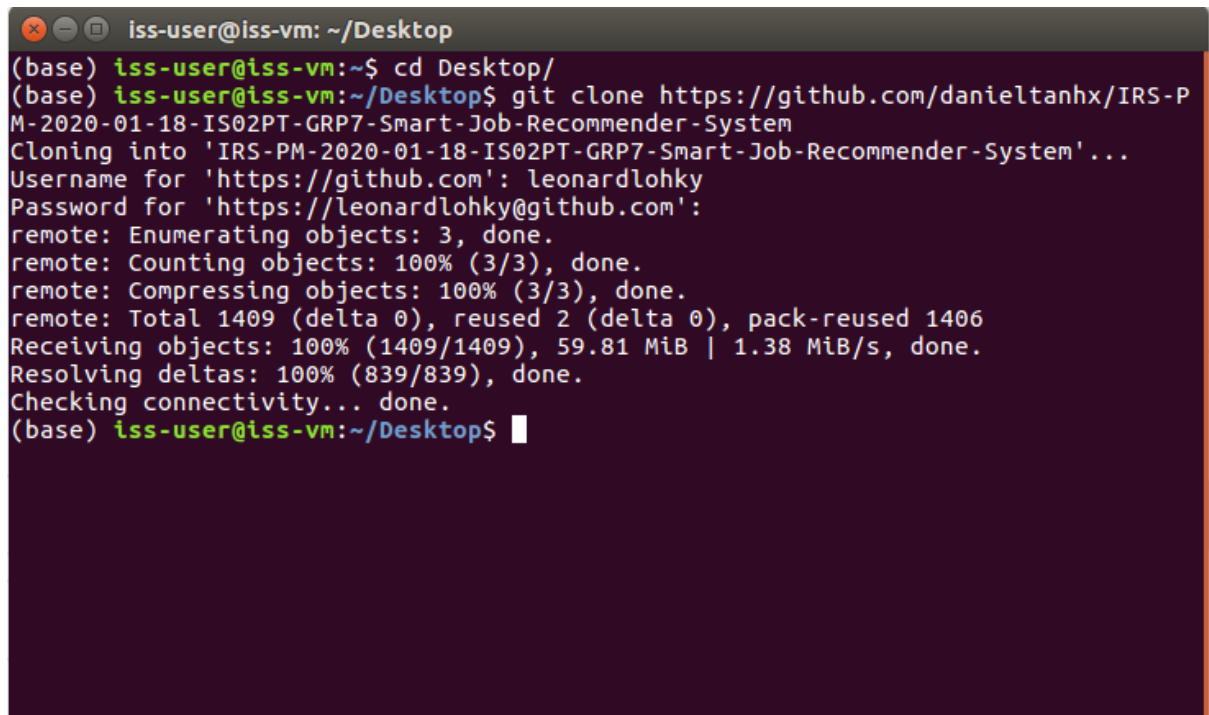
Deploying in KIE jBPM 7.12

1. Open a new terminal. Navigate to the Desktop by typing “cd Desktop” in the terminal

A terminal window titled 'iss-user@iss-vm: ~/Desktop' with a dark purple background. The prompt is '(base) iss-user@iss-vm:~\$'. The first command entered is 'cd Desktop', and the prompt changes to '(base) iss-user@iss-vm:~/Desktop\$' with a white cursor at the end.

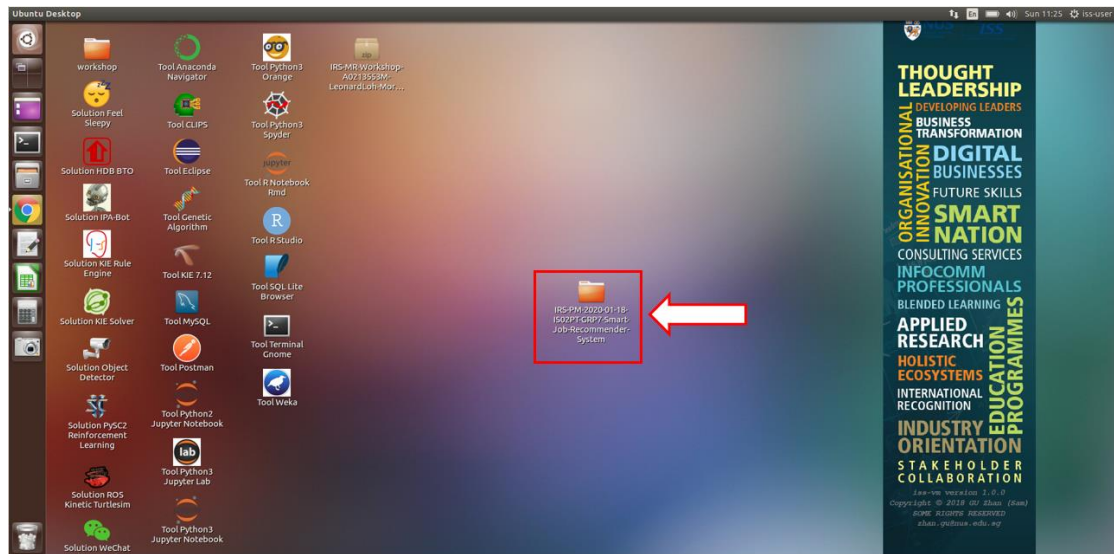
```
iss-user@iss-vm: ~/Desktop
(base) iss-user@iss-vm:~$ cd Desktop
(base) iss-user@iss-vm:~/Desktop$
```

2. Clone the Git repository by typing “git clone https://github.com/danieltanhx/IRS-PM-2020-01-18-IS02PT-GRP7-Smart-Job-Recommender-System” in the terminal

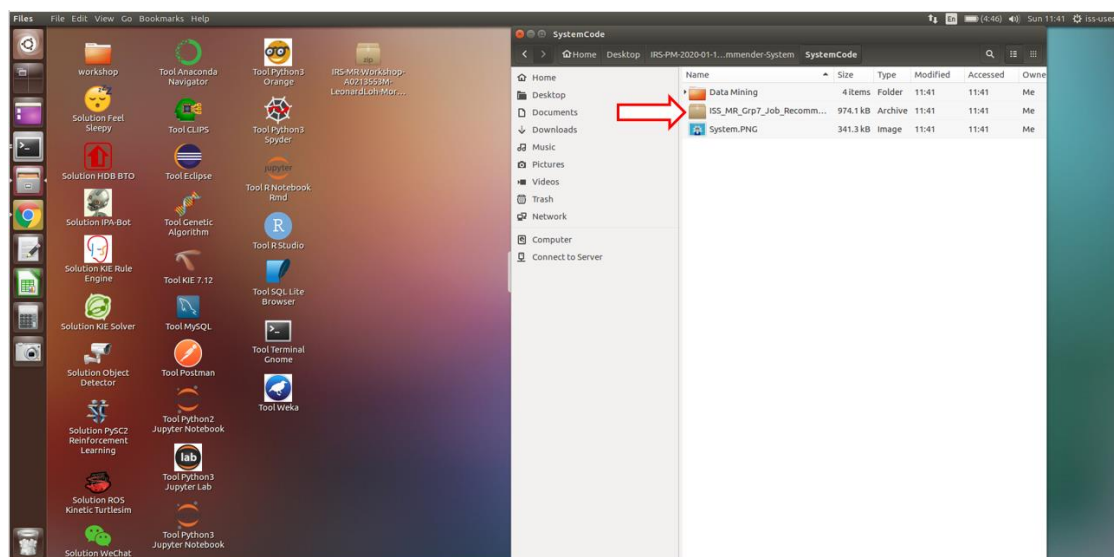
A terminal window titled 'iss-user@iss-vm: ~/Desktop' with a dark purple background. The prompt is '(base) iss-user@iss-vm:~\$'. The first command entered is 'cd Desktop/'. The second command is 'git clone https://github.com/danieltanhx/IRS-PM-2020-01-18-IS02PT-GRP7-Smart-Job-Recommender-System'. The terminal shows the output of the git clone command, including cloning progress, username/password prompts, and object counting/compression statistics. The prompt returns to '(base) iss-user@iss-vm:~/Desktop\$' with a white cursor at the end.

```
iss-user@iss-vm: ~/Desktop
(base) iss-user@iss-vm:~$ cd Desktop/
(base) iss-user@iss-vm:~/Desktop$ git clone https://github.com/danieltanhx/IRS-PM-2020-01-18-IS02PT-GRP7-Smart-Job-Recommender-System
Cloning into 'IRS-PM-2020-01-18-IS02PT-GRP7-Smart-Job-Recommender-System'...
Username for 'https://github.com': leonardlohky
Password for 'https://leonardlohky@github.com':
remote: Enumerating objects: 3, done.
remote: Counting objects: 100% (3/3), done.
remote: Compressing objects: 100% (3/3), done.
remote: Total 1409 (delta 0), reused 2 (delta 0), pack-reused 1406
Receiving objects: 100% (1409/1409), 59.81 MiB | 1.38 MiB/s, done.
Resolving deltas: 100% (839/839), done.
Checking connectivity... done.
(base) iss-user@iss-vm:~/Desktop$
```

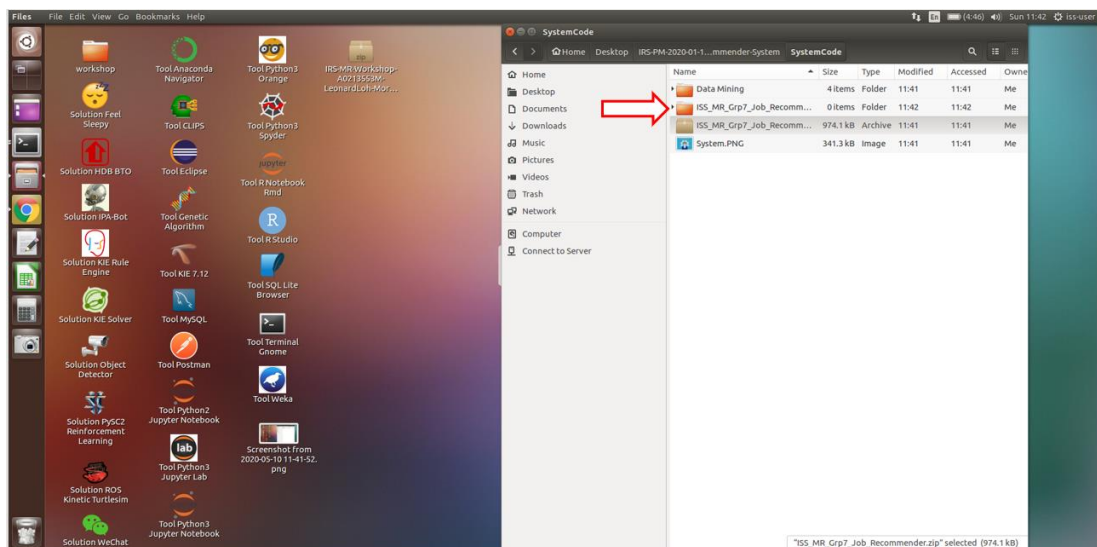
- The cloned repository will appear on the Desktop screen as a folder named “IRS-PM-2020-01-18-IS02PT-GRP7-Smart-Job-Recommender-System”



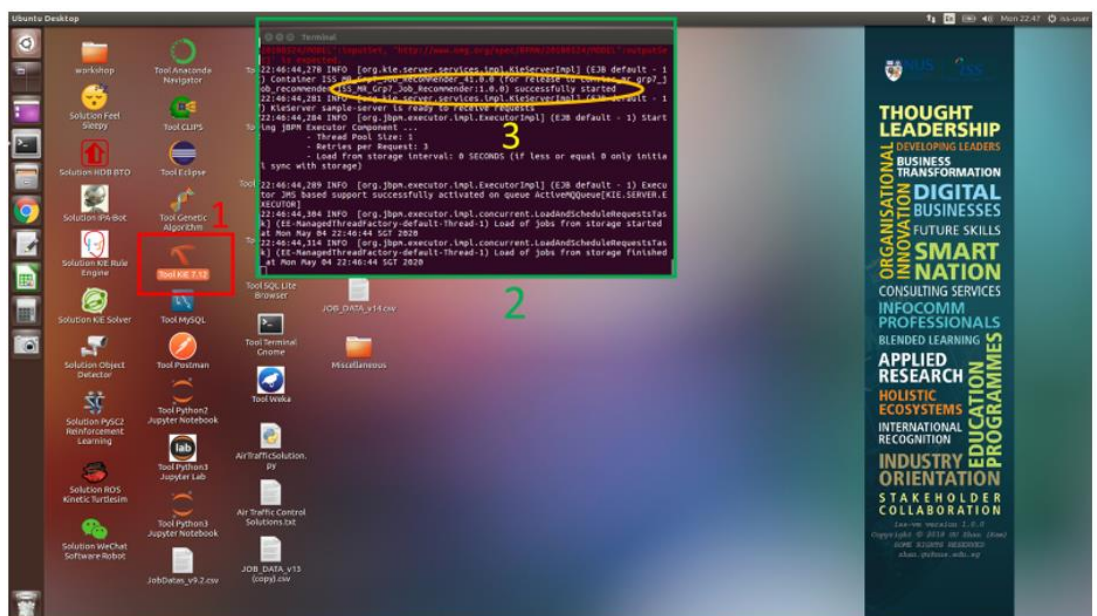
- Enter the “IRS-PM-2020-01-18-IS02PT-GRP7-Smart-Job-Recommender-System” folder and navigate to the “SystemCode” subfolder. You will find a ZIP folder named “ISS_MR_Grp7_Job_Recommender.zip”



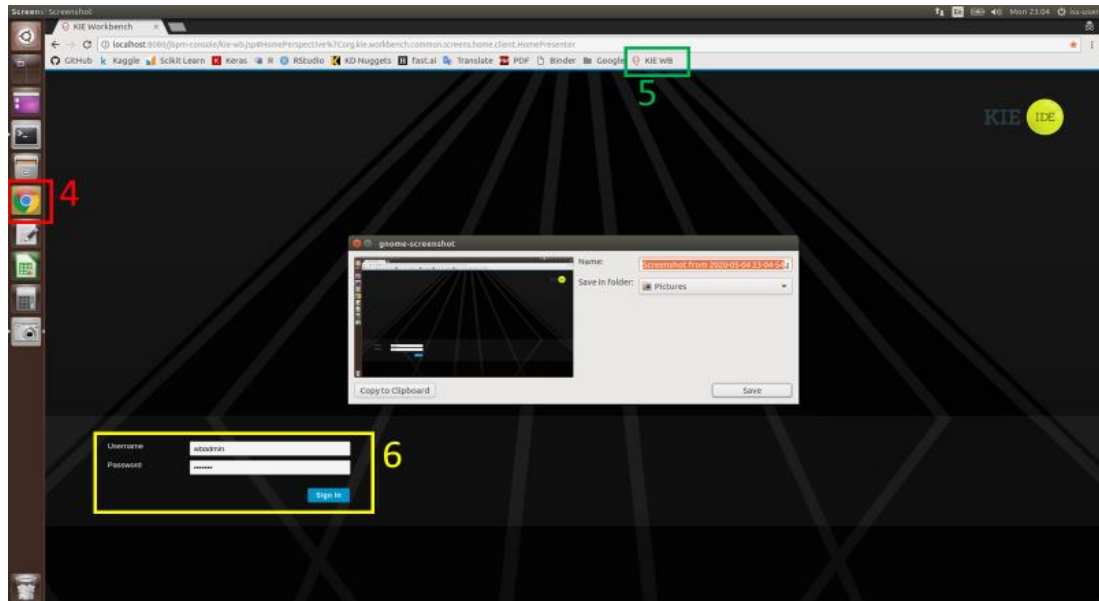
5. Extract the contents of the folder to the same location where the ZIP folder is located



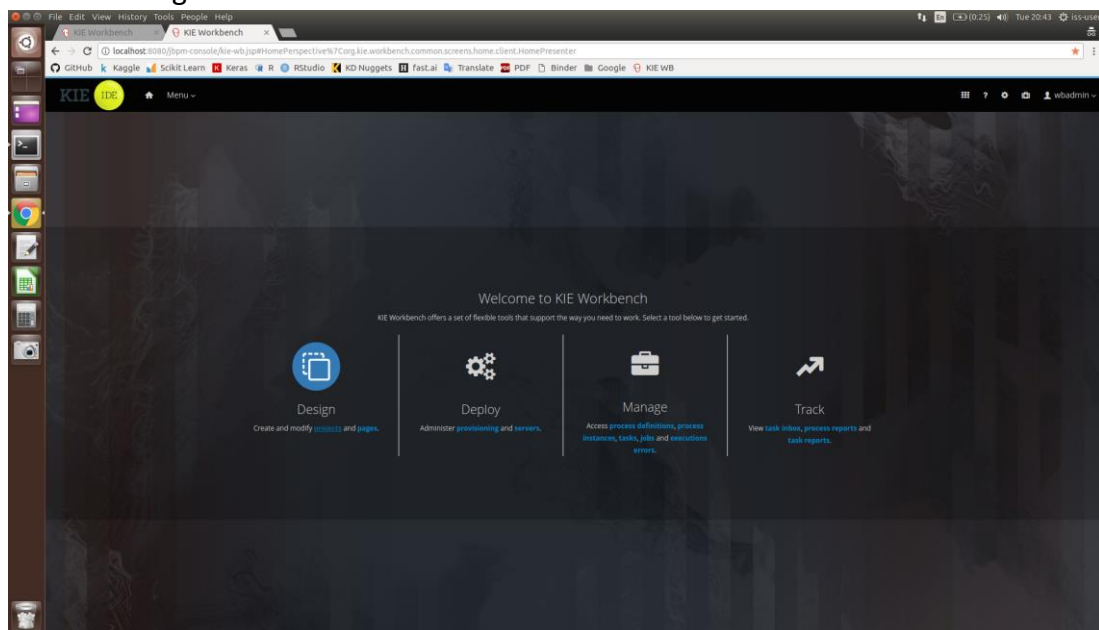
6. Click on Tool KIE 7.12, then wait for the terminal to pop out “successfully started” or “localhost:8080 successfully registered kind of words”.



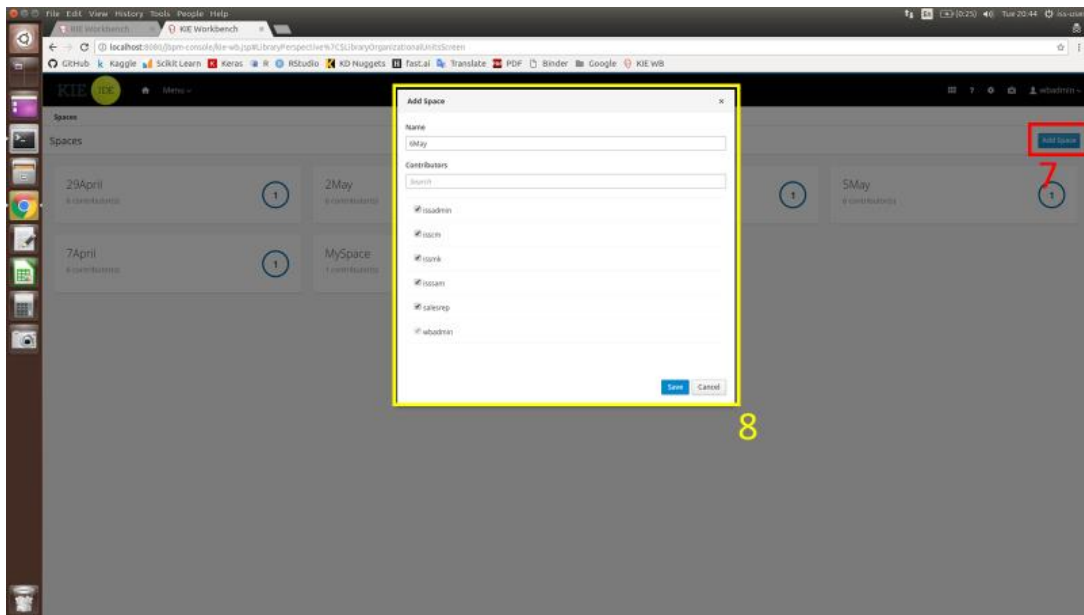
7. Launch Google Chrome and click on the KIE WB bookmark (labelled in Box 5). Once loaded, the below screen will appear. Sign in using username and password “wbadmin” and “wbadmin” respectively.



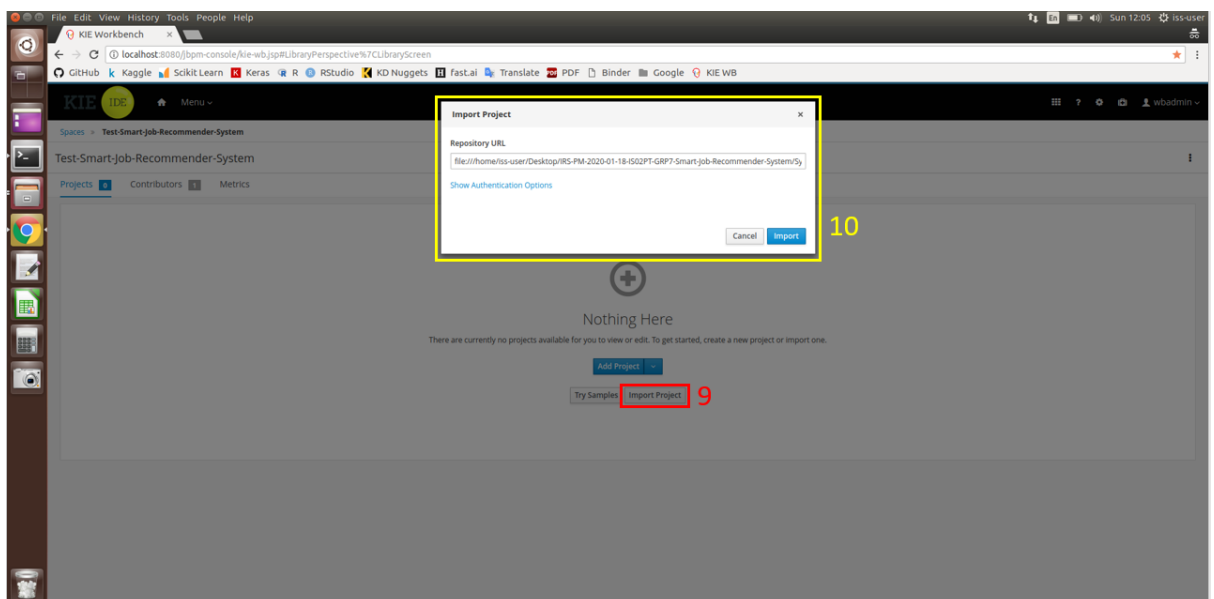
8. Click on Design



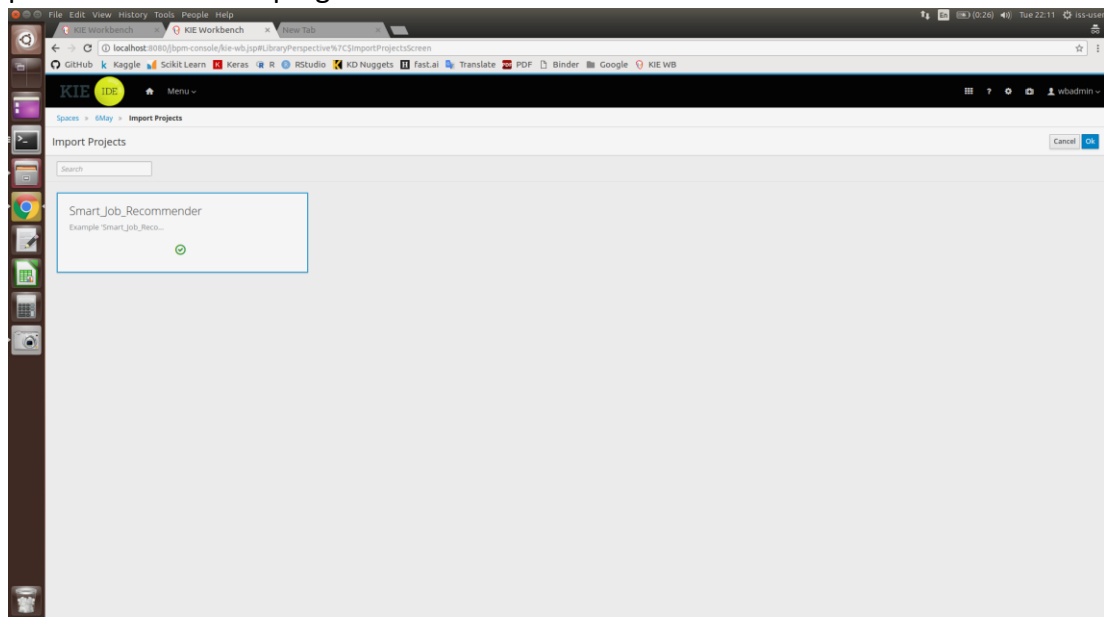
9. Press on the “Add Space” button (labelled in Box 7), then fill in the name of the space accordingly and click the necessary contributors. After all these are completed, press “Save”



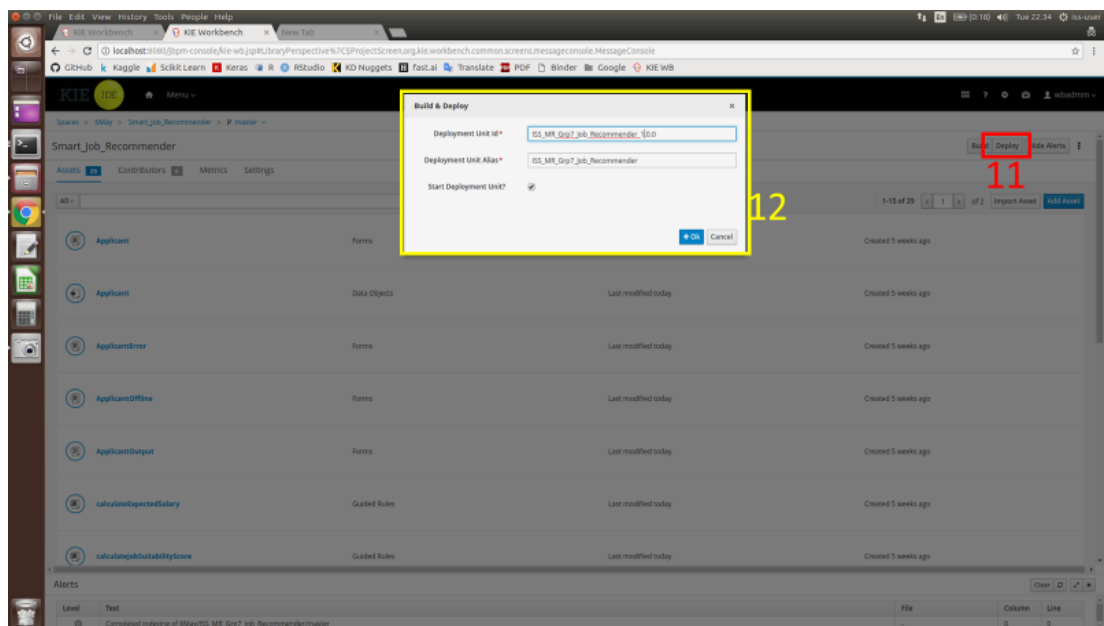
10. In the newly created space in KIE, click on "Import Project" (labelled in Box 9). Type "file:///home/iss-user/Desktop/IRS-PM-2020-01-18-IS02PT-GRP7-Smart-Job-Recommend-System/SystemCode/ISS_MR_Grp7_Job_Recommender" into the repository URL as shown in Box 10. Press "Import" after that



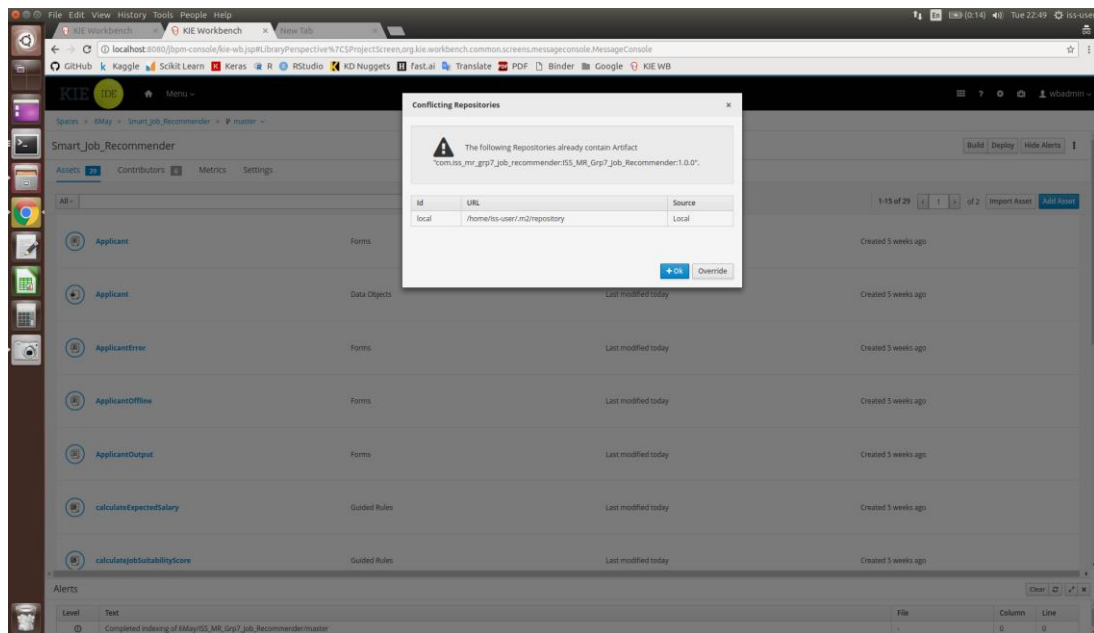
11. Once imported, click on the project “Smart_Job_Recommender” to select it. Then press “Ok” on the top right corner.



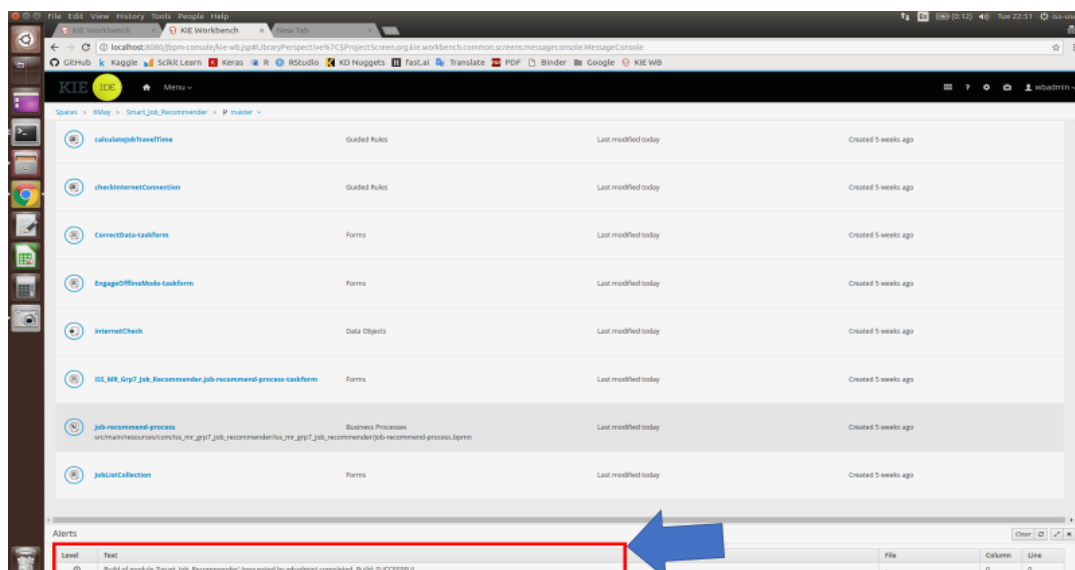
12. After importing successfully, click on the “Deploy” button (labelled in Box 11), which will bring up Box 12. Type in a Deployment Unit ID accordingly. After that, press “+Ok”.



13. After pressing “+Ok”, the below screen will pop out. To continue, press “Override”.



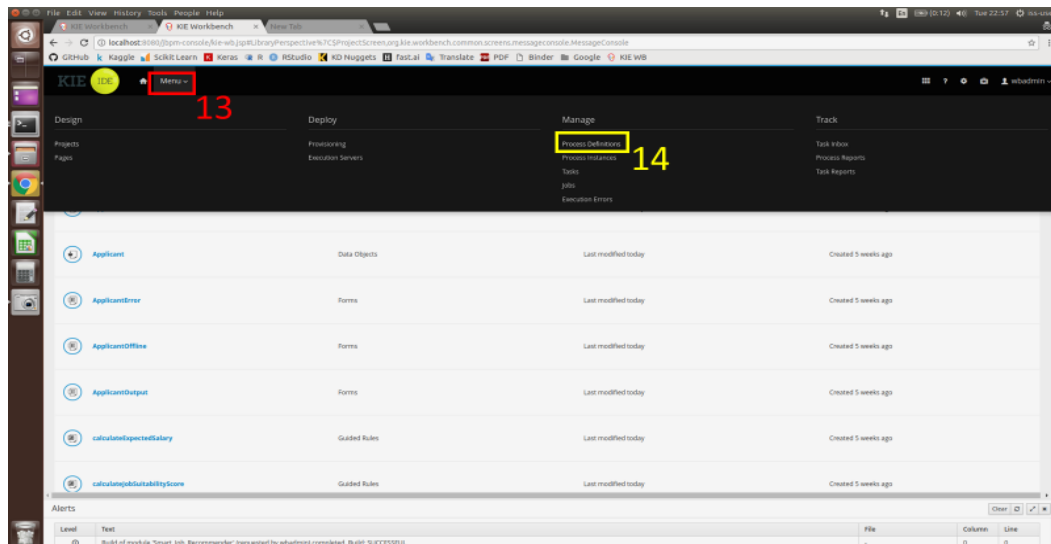
14. Once the deployment/build is completed, the text in level shown below will indicate Build: SUCCESSFUL.



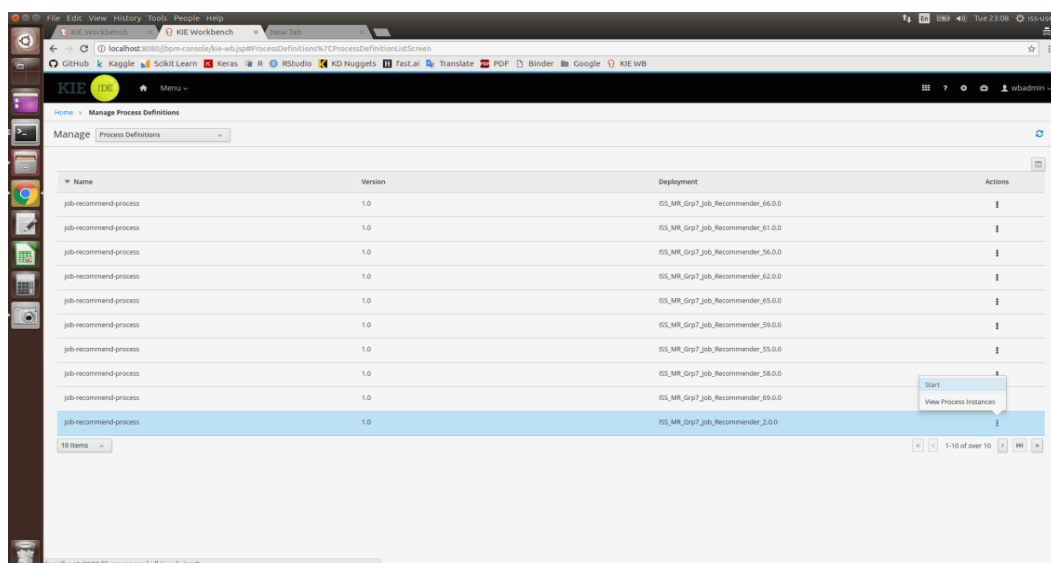
Running the System in KIE (Online Mode)

Online mode requires an internet connection. This is for the system to calculate an estimated travel time required for each job location depending on the user's ZIP code.

1. Press "Menu" (labelled in Box 13), and then click on "Process Definition" (labelled in Box 14)



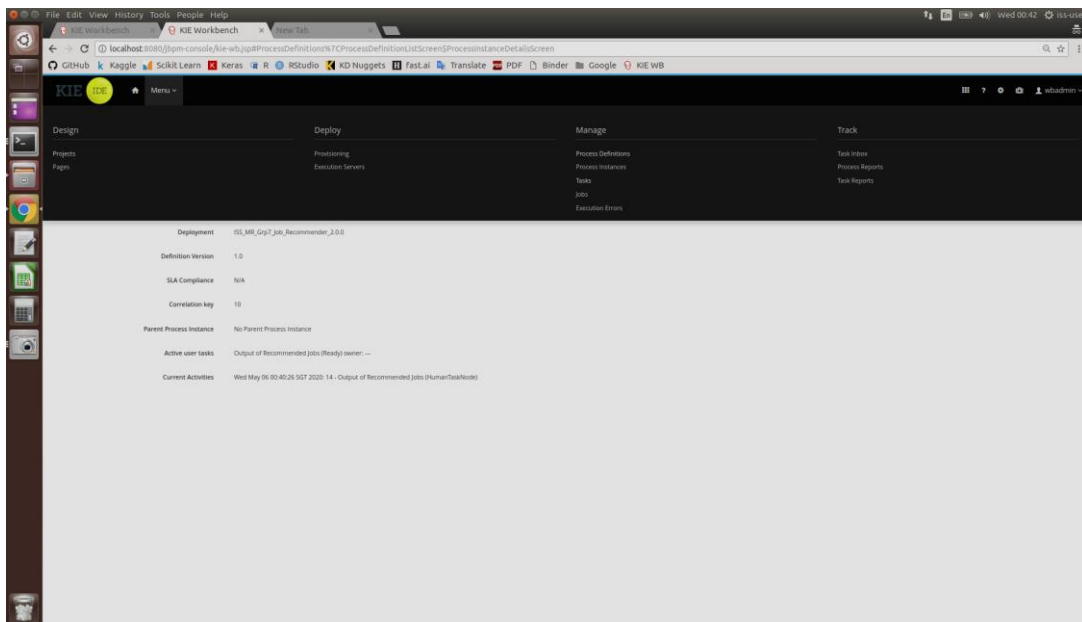
2. Select the relevant server that was deployed earlier to start the system



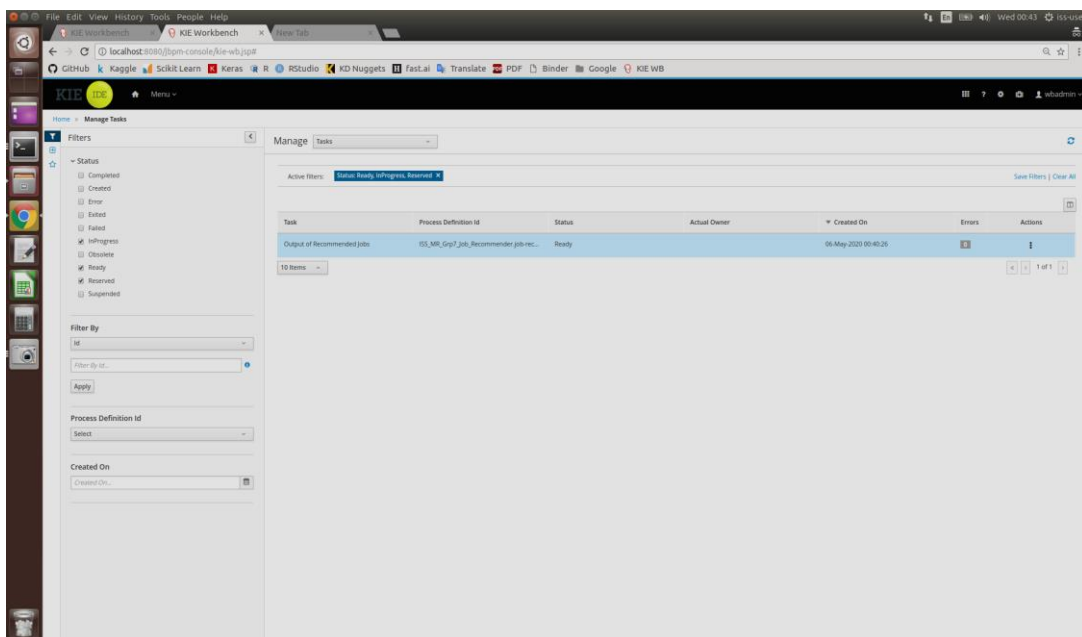
- Once started, an applicant form for the user to fill in their details will appear. After filling up the form, press the “Submit” button ONCE. This is to avoid accidentally submitting multiple copies of the same task to the system. Please wait patiently as the system is processing the submitted information.

- Once the user’s information has been processed, the below page will appear.

- Click on “Menu”, then click on “Task”.



- After completing Step 5, the below page should appear. To continue, click on on the task “Output of Recommended Jobs”



7. Press the “Claim” button at the below of the page

16 - Output of Recommended Jobs

Work Details Assignments Comments Admin Logs

Applicant

Highest Education Attained* Field of Study*

Total Work Experience*

Zip Code*

Preferred Job Scope Preferred Job Seniority Level Preferred Type of Employment* Expected Salary

Your Mode of Travel to Work* How Long Are You Willing to Travel to Work?*

Your Technical Skills

Recommended Skills to Learn

Recommended Jobs for You

Employment Type	Job Title	Company Name	Work Experience Required	Seniority Level	Job Category	Job Requirements	Min Salary	Max Salary	Job Match Score	Job ID	Estimated Travel Time
Permanent	Research Fellow	NATIONAL UNIVERSITY	1	Professional	Sciences Laboratory R&D	Artificial Intelligence Co...	5000	8250	2	MCF-2020-0009692	39
Permanent	Data Analyst	LINGACK ENGINEERING...	2	Executive	Information Technology	Perform data modelling...	5000	7000	3.5	MCF-2020-0073476	66
Contract Permanent	AI Engineer / Research...	SCIENTE INTERNATIONAL...	5	Professional	Information Technology	Degree Computer Scien...	5000	8000	2	MCF-2020-0064235	88
Contract Permanent	Research Assistant / Re...	NATIONAL UNIVERSITY...	2	Non-Executive	Engineering	BSc degree Electrical Eng...	3000	4000	2	MCF-2020-0064628	39
Permanent	Software Development...	ASUS GLOBAL PTE. LTD.	3	Executive	Engineering	Develops Smart IT syste...	4000	8000	3	MCF-2020-0003382	42

6-10 of 106

[Claim](#)

8. Press “Start”

16 - Output of Recommended Jobs

Work Details Assignments Comments Admin Logs

Applicant

Highest Education Attained* Field of Study*

Total Work Experience*

Zip Code*

Preferred Job Scope Preferred Job Seniority Level Preferred Type of Employment* Expected Salary

Your Mode of Travel to Work* How Long Are You Willing to Travel to Work?*

Your Technical Skills

Recommended Skills to Learn

Recommended Jobs for You

Employment Type	Job Title	Company Name	Work Experience Required	Seniority Level	Job Category	Job Requirements	Min Salary	Max Salary	Job Match Score	Job ID	Estimated Travel Time
Permanent	DevOps Engineer	LCARIE AD PTE. LTD.	2	Senior Executive	Information Technology	Develop lead process. D...	4000	8000	2	MCF-2020-0050895	-1
Permanent	Systems Engineer	NUTONOMY ASIA PTE. L...	4	Executive	Information Technology	Define model simulate ...	7000	13000	5	MCF-2020-0052725	40
Permanent	Research Associate (Co...	MAWANG TECHNOLOG...	1	Professional	Sciences Laboratory R&D	Develop simul SLM alg...	3500	5300	1	MCF-2020-0053873	24
Permanent	Senior IT Specialist	GERMAN INSTITUTE OF ...	3	Professional	Education Training Eng...	Mapping matrix IT cour...	5000	6000	1	MCF-2020-0056764	-1
Permanent	Software Engineer (Map...	ST ENGINEERING LAND ...	1	Professional	Information Technology	Design localization base...	4000	6000	3	MCF-2020-0059189	32

1-5 of 106

[Release](#) [Start](#)

- After reviewing the output of recommended jobs, press “Complete” to end the task instance.

16 - Output of Recommended Jobs

Work Details Assignments Comments Admin Logs

Applicant

Highest Education Attained * Field of Study *

Total Work Experience *

Zip Code *

Preferred Job Scope Preferred Job Seniority Level Preferred Type of Employment * Expected Salary

Your Mode of Travel to Work * How Long Are You Willing to Travel to Work? *

Your Technical Skills

Recommended Skills to Learn

Recommended Jobs for You

Employment Type	Job Title	Company Name	Work Experience Required	Seniority Level	Job Category	Job Requirements	Min Salary	Max Salary	Job Match Score	Job ID	Estimated Travel Time
Permanent	DevOps Engineer	UCABE JO PTE. LTD.	2	Senior Executive	Information Technology	Develop lead process. D...	4000	8000	2	MCF-2020-0050095	-1
Permanent	Systems Engineer	MUTONCHAI ADAR PTE. L.	4	Executive	Information Technology	Define master simula...	7000	15000	5	MCF-2020-0052725	40
Permanent	Research Associate (Ca...	NANWANG TECHNOLOG...	1	Professional	Sciences Laboratory R&D	Develop visual SLAM alg...	3500	1300	1	MCF-2020-0051873	24
Permanent	Senior IT Specialist	GERMAN INSTITUTE OF ...	3	Professional	Education Training Eng...	Mapping matrix IT-cour...	5000	6000	1	MCF-2020-0058784	-1
Permanent	Software Engineer (Map...	ST ENGINEERING LAND ...	1	Professional	Information Technology	Design localization base...	4000	8000	3	MCF-2020-0059189	32

Save Release Complete

- Process completed

Manage Tasks

Active filters: Status: Ready InProgress, Reopened [Save Filters](#) [Clear All](#)

Task	Process Definition Id	Status	Actual Owner	Created On	Errors	Actions
No tasks found						

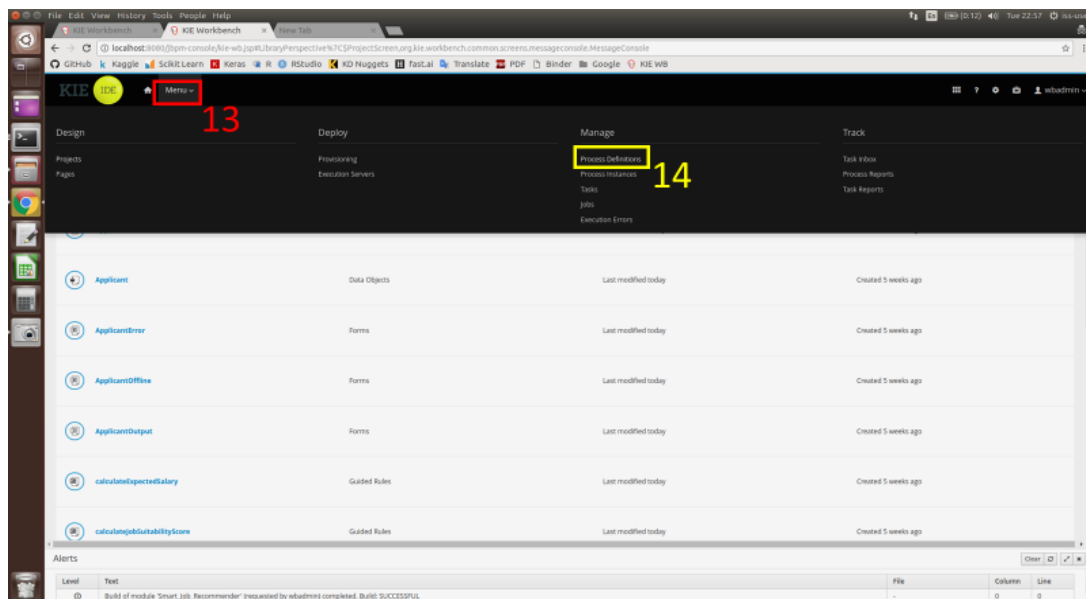
10 items [1 of 10](#)

Running the System in KIE (Offline Mode)

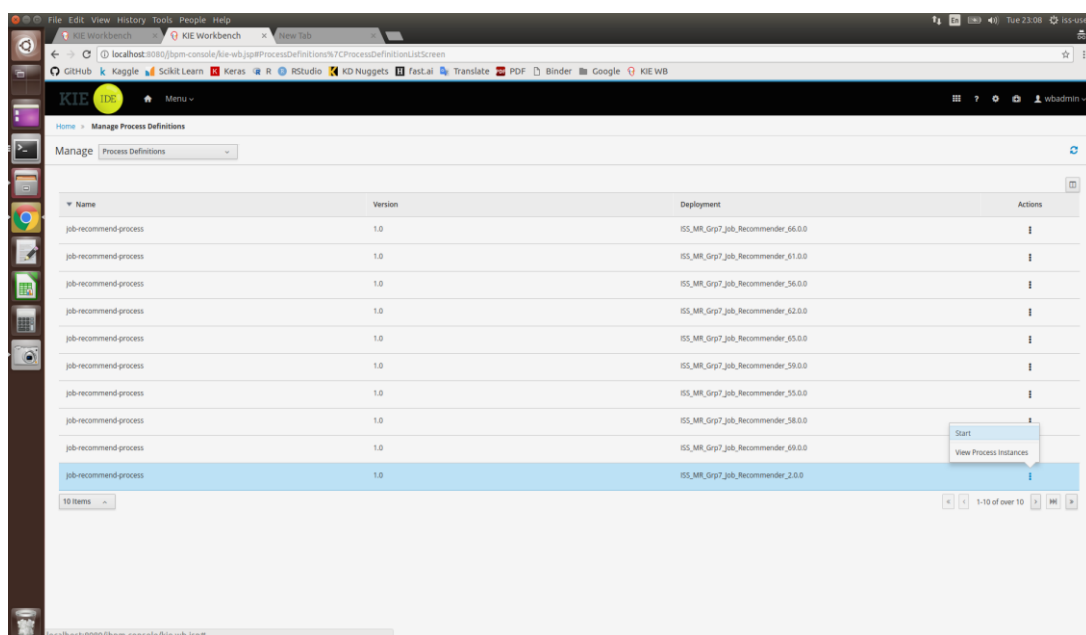
In the event an internet connection cannot be established, the system will run in Offline Mode. In this mode, the system will not be able to calculate an estimated travel time required for each job location according to the user's chosen ZIP code. Instead, users will be prompted to select one of three possible ZIP codes available in the system's database.

The procedure to operate the system in Offline Mode is as follows:

1. Press "Menu" (labelled in Box 13), and then click on "Process Definition" (labelled in Box 14)



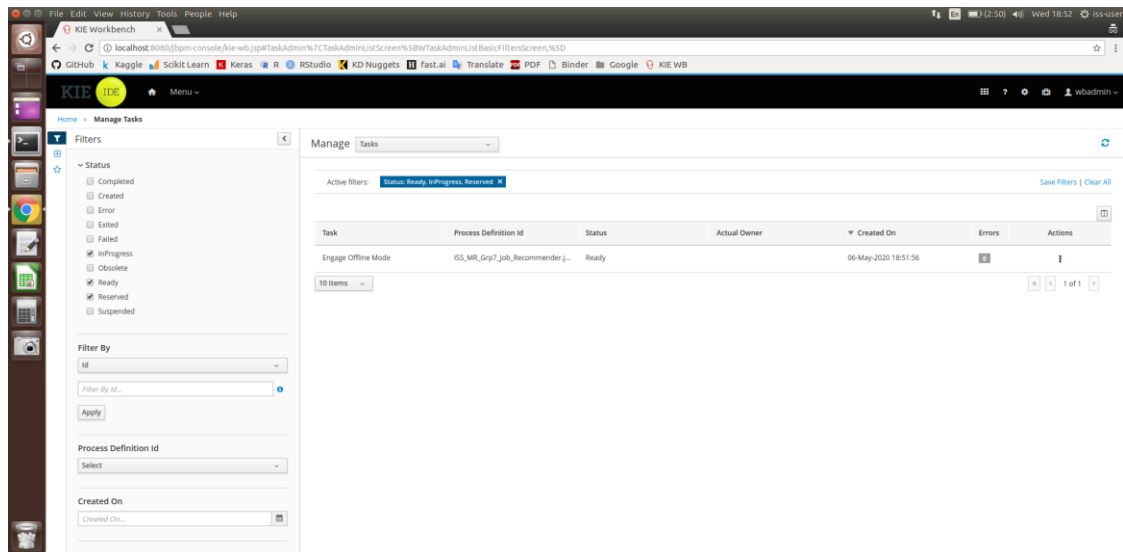
2. Select the relevant server that was deployed earlier to start the system



- Once started, an applicant form for the user to fill in their details will appear. After filling up the form, press the “Submit” button ONCE. This is to avoid accidentally submitting multiple copies of the same task to the system. Please wait patiently as the system is processing the submitted information

- As no internet connection is established, the system will notify the user that it will be running in Offline Mode as shown in the page below

5. Click on “Menu”, then click on “Task”. This will cause the following page to appear. To continue, click on the task “Engage Offline Mode”



6. After Step 5, the following form will appear. Click on “Claim”

The screenshot shows the '1 - Engage Offline Mode' form. At the top, there is a 'Work' tab and a 'Details' tab. Below the tabs, there is a section for 'Applicant' with a message 'No Internet Connection Detected'. This is followed by an 'Error and Cause' section with a message 'No internet connection detected. System will run in offline mode. Please select a new ZIP code from the drop down selection box.' The form then contains several input fields: 'Highest Education Attained' (with a dropdown menu showing 'PhD'), 'Field of Study' (with a dropdown menu showing 'Computer Science'), 'Total Work Experience' (with a dropdown menu showing '8'), 'Zip Code' (with a dropdown menu showing 'null'), 'Preferred Job Scope' (with a dropdown menu showing 'Information Technology'), 'Preferred Job Seniority Level' (with a dropdown menu showing 'Non-Executive'), 'Preferred Type of Employment' (with a dropdown menu showing 'Permanent'), 'Expected Salary' (with a dropdown menu showing 'High'), 'Your Mode of Travel to Work' (with a dropdown menu showing 'Public Transport'), and 'How Long Are You Willing to Travel to Work?' (with a dropdown menu showing '80'). At the bottom, there is a 'Your Technical Skills' section with a dropdown menu showing 'python, java, C#, SQL, Hadoop, Linux'. A 'Claim' button is located at the bottom left of the form.

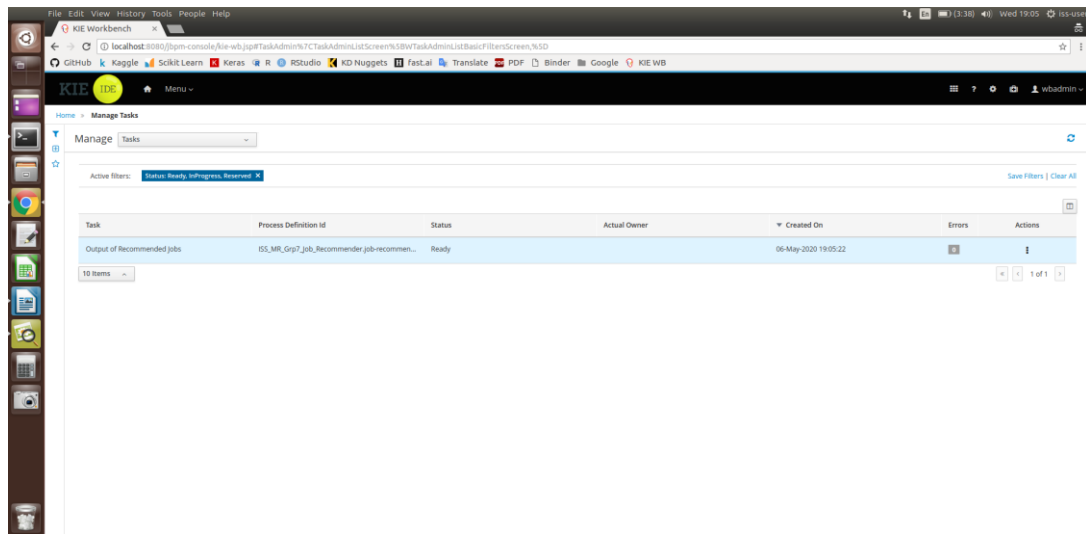
7. Click on “Start”

The screenshot shows the KIE Workbench interface with the 'Engage Offline Mode' form. The form includes fields for 'Applicant', 'Error and Cause', 'Highest Education Attained', 'Field of Study', 'Total Work Experience', 'Zip Code', 'Preferred Job Scope', 'Preferred Job Seniority Level', 'Preferred Type of Employment', 'Expected Salary', 'Your Mode of Travel to Work', 'How Long Are You Willing to Travel to Work?', and 'Your Technical Skills'. The 'Zip Code' field is currently empty, and the 'Start' button is visible at the bottom.

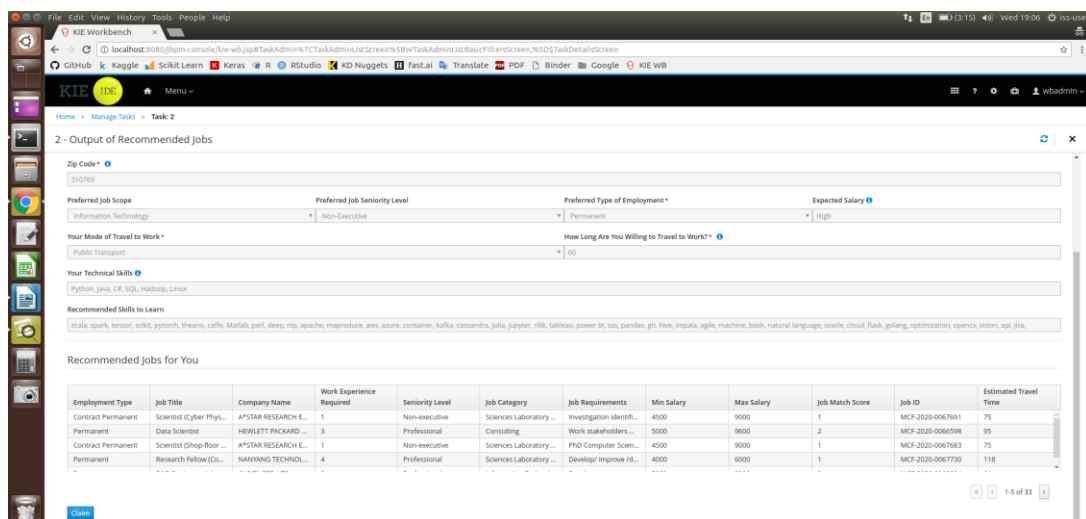
8. Click on the “Zip Code” box, which will cause a drop down menu to appear. Select one of three possible ZIP codes. Once done, click on “Complete”

The screenshot shows the KIE Workbench interface with the 'Engage Offline Mode' form. The 'Zip Code' dropdown menu is open, showing three options: '310709', '140132', and '641518'. The 'Complete' button is visible at the bottom.

9. Click on “Menu”, then click on “Task”. This will cause the following page to appear. To continue, click on the task “Output of Recommended Jobs”



10. Press the “Claim” button at the below of the page



11. Press “Start”

2 - Output of Recommended Jobs

Zip Code* 510769

Preferred Job Scope Information Technology Preferred Job Seniority Level Non-Executive Preferred Type of Employment* Permanent Expected Salary High

Your Mode of Travel to Work* Public Transport How Long Are You Willing to Travel to Work?* 60

Your Technical Skills Python, java, C#, SQL, Hadoop, Linux

Recommended Skills to Learn scala, spark, tensor, scikit, pytorch, theano, caffe, Matlab, perl, deep, rlp, apache, mapreduce, aws, azure, container, kafka, cassandra, julia, jupyter, rtk, tableau, power bi, sas, pandas, git, hive, impala, agile, machine, bash, natural language, oracle, cloud, flask, golang, optimization, opencv, vision, api, jira

Recommended Jobs for You

Employment Type	Job Title	Company Name	Work Experience Required	Seniority Level	Job Category	Job Requirements	Min Salary	Max Salary	Job Match Score	Job ID	Estimated Travel Time
Contract Permanent	Scientist (Cyber Phys...	A*STAR RESEARCH E...	1	Non-executive	Sciences Laboratory...	Investigation identifi...	4500	9000	1	MCF-2020-0067691	75
Permanent	Data Scientist	HEWLETT PACKARD ...	3	Professional	Consulting	Work stakeholders ...	5000	9600	2	MCF-2020-0066598	95
Contract Permanent	Scientist (Shop-floor ...	A*STAR RESEARCH E...	1	Non-executive	Sciences Laboratory...	PHD Computer Scien...	4500	9000	1	MCF-2020-0067683	75
Permanent	Research Fellow (Co...	NANYANG TECHNOL...	4	Professional	Sciences Laboratory...	Develop/ improve id...	4000	6000	1	MCF-2020-0067730	118

Release Start

12. After reviewing the output of recommended jobs, press “Complete” to end the task instance.

2 - Output of Recommended Jobs

Zip Code* 510769

Preferred Job Scope Information Technology Preferred Job Seniority Level Non-Executive Preferred Type of Employment* Permanent Expected Salary High

Your Mode of Travel to Work* Public Transport How Long Are You Willing to Travel to Work?* 60

Your Technical Skills Python, java, C#, SQL, Hadoop, Linux

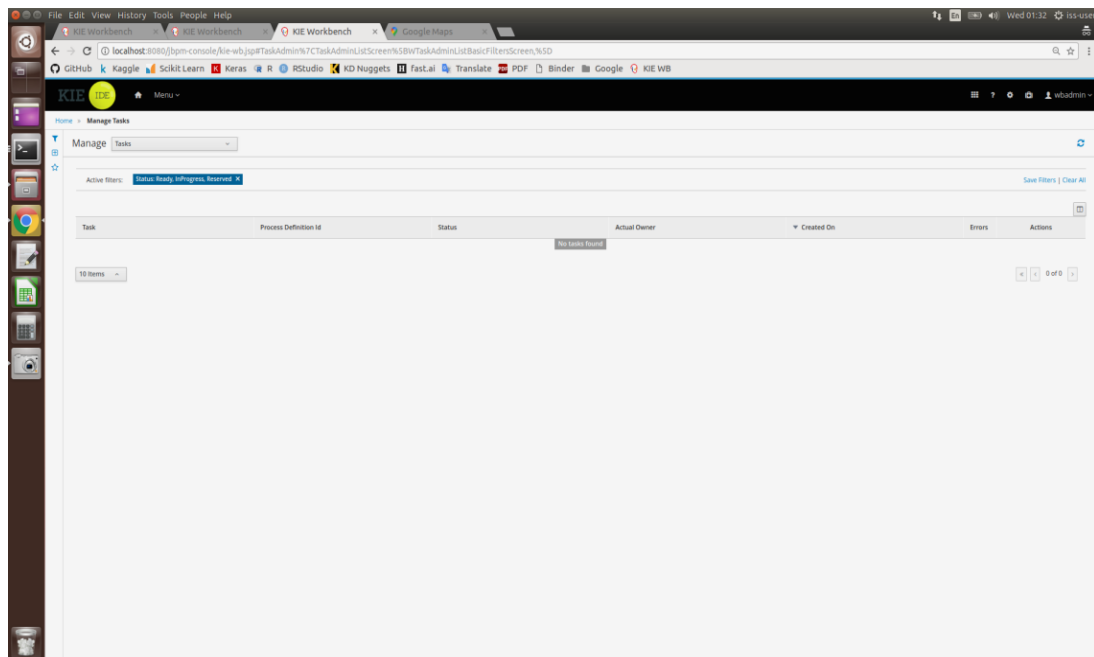
Recommended Skills to Learn scala, spark, tensor, scikit, pytorch, theano, caffe, Matlab, perl, deep, rlp, apache, mapreduce, aws, azure, container, kafka, cassandra, julia, jupyter, rtk, tableau, power bi, sas, pandas, git, hive, impala, agile, machine, bash, natural language, oracle, cloud, flask, golang, optimization, opencv, vision, api, jira

Recommended Jobs for You

Employment Type	Job Title	Company Name	Work Experience Required	Seniority Level	Job Category	Job Requirements	Min Salary	Max Salary	Job Match Score	Job ID	Estimated Travel Time
Contract Permanent	Scientist (Cyber Phys...	A*STAR RESEARCH E...	1	Non-executive	Sciences Laboratory...	Investigation identifi...	4500	9000	1	MCF-2020-0067691	75
Permanent	Data Scientist	HEWLETT PACKARD ...	3	Professional	Consulting	Work stakeholders ...	5000	9600	2	MCF-2020-0066598	95
Contract Permanent	Scientist (Shop-floor ...	A*STAR RESEARCH E...	1	Non-executive	Sciences Laboratory...	PHD Computer Scien...	4500	9000	1	MCF-2020-0067683	75
Permanent	Research Fellow (Co...	NANYANG TECHNOL...	4	Professional	Sciences Laboratory...	Develop/ improve id...	4000	6000	1	MCF-2020-0067730	118

Save Release Complete

13. Process completed



Running Data Mining algorithm in Python

Requirements:

- Anaconda3
- Jupyter Lab
- Google Chrome browser version 81.0.4044
- Chromedriver version 81.0.4044
 - Saved to (\SystemCode\Data Mining\code\chromedriver)
- Anaconda Python3 environment and Library
 - Selenium
 - BeautifulSoup4
 - Scikit-learn

Web Crawling (online)

1. Open anaconda3 prompt
2. Navigate to project source code folder (..\SystemCode\Data Mining\code)
3. Type python "Web Crawling.py" to run program

```
*****
*                                     *
*       NUS ISS Group 7 Web-Crawling Program       *
*                                     *
*****

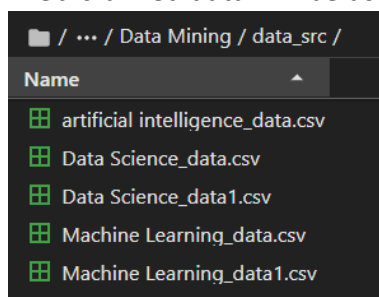
Enter job keyword or type quit to exit
Please re-run program if encounter chrome session error

Please enter:
```

4. Enter job search keyword or type quit to exit the program
5. Job crawled will be saved inside data_src folder

```
Please enter: chiropractor
Job keyword entered: chiropractor
number of job found: 6
Number of job link extracted: 6
File saved
```

6. If encounter chrome session error, please re-run the program
7. Web-crawled data will be used for data mining and machine learning part.



8. Please take note popular job keyword might have few hundreds of records. Web-crawling will need few hours to crawl all records.
9. If Job not found, user will have to key in with another keyword.

```
Enter job keyword or type quit to exit
Please re-run program if encounter chrome session error

Please enter: Astronaut
Job keyword entered: Astronaut
Job not found, please try with other keyword
Job not found, please re-run
```

Data Mining (Offline)

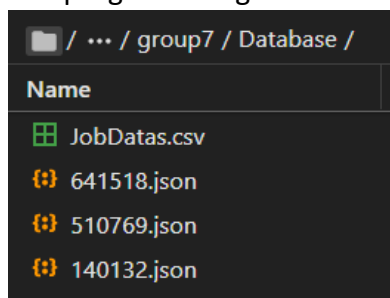
1. Open anaconda3 prompt
2. Navigate to project source code folder (..\SystemCode\Data Mining\code)
3. Type python "Data Mining.py" to run program
4. Program will ingest all crawled file inside the data_src folder to perform data mining process.

```
*****
*
*           NUS ISS Group 7 Data Mining Program           *
*
*****

Source file(s) loaded: ['../data_src\\artificial intelligence_data.csv', '../data_src\\Data
Science_data.csv', '../data_src\\Data Science_data1.csv', '../data_src\\Machine Learning_dat
a.csv', '../data_src\\Machine Learning_data1.csv']

Data ingestion and cleaning: Complete
Salary feature: Complete
Skills and qualification extraction: Complete
Number of words before filter: 68149
Number of words after filter: 45953
File saved
```

5. The program will generate an csv file named "JobDatas.csv" to the Database folder



6. The "JobDatas.csv" file will be consumed by the KIE program

Machine Learning (Offline)

1. Open anaconda3 prompt.
2. Navigate to project source code folder (..\SystemCode\Data Mining\code)
3. Type python "Machine Learning.py" to run program.
4. Program will consume the crawled data from data_src folder, process and predict the salary range.

```
*****
*                                     *
*           NUS ISS Group 7 Salary Prediction ML           *
*                                     *
*****

Data ingestion and cleaning: Complete
Feature engineering: Complete

Salary prediction: Complete
```

5. Model prediction report (classification report, confusion matrix and feature importance) will be generated.

```
Classification report:

```

	precision	recall	f1-score	support
Low	0.81	0.97	0.88	231
Med	0.72	0.62	0.67	37
High	0.80	0.44	0.57	89
accuracy			0.80	357
macro avg	0.78	0.68	0.71	357
weighted avg	0.80	0.80	0.78	357

```

Confusion matrix:

```

	Pred Low	Pred Med	Pred High
Actual Low	224	3	4
Actual Med	8	23	6
Actual High	44	6	39

```

Feature Importances

```

	coef	abs coef
Year_Experience	0.433057	0.433057
java scala	0.093971	0.093971
engineering	0.076283	0.076283
phd	0.067935	0.067935
design	0.050304	0.050304
statistical	0.047727	0.047727
architecture	0.047501	0.047501
Executive	0.043291	0.043291
master	0.043003	0.043003
perl	0.023512	0.023512
implementations	0.021084	0.021084
optimization	0.019473	0.019473
automation	0.017714	0.017714
python	0.015145	0.015145

6. Decision tree rule will be generated and saved as .txt file inside output folder (\Data Mining\output). Figure below shows the example of tree rules generated.

```
Decision tree rules:
|--- Year_Experience <= 3.50
|   |--- java scala <= 0.50
|   |   |--- phd <= 0.50
|   |   |   |--- Year_Experience <= 1.50
|   |   |   |   |--- Executive <= 0.50
|   |   |   |   |   |--- class: Low
|   |   |   |   |   |--- Executive > 0.50
|   |   |   |   |   |   |--- class: Med
|   |   |   |   |--- Year_Experience > 1.50
|   |   |   |   |   |--- architecture <= 0.50
|   |   |   |   |   |   |--- class: High
|   |   |   |   |   |   |--- architecture > 0.50
|   |   |   |   |   |   |   |--- class: Med
|   |   |   |   |--- phd > 0.50
|   |   |   |   |   |--- engineering <= 0.50
|   |   |   |   |   |   |--- statistical <= 0.50
|   |   |   |   |   |   |   |--- class: Med
|   |   |   |   |   |   |   |--- statistical > 0.50
|   |   |   |   |   |   |   |   |--- class: High
|   |   |   |   |   |--- engineering > 0.50
|   |   |   |   |   |   |--- Year_Experience <= 1.50
|   |   |   |   |   |   |   |--- class: High
|   |   |   |   |   |   |   |--- Year_Experience > 1.50
|   |   |   |   |   |   |   |   |--- class: High
|   |   |   |--- java scala > 0.50
|   |   |   |   |--- class: High
```

