Adappt Tasks - Machine Learning model documentations

Project: To predict the attrition risks (exited) for the employees

- The process of predicting employee attrition risks entails creating a model that calculates the probability of a worker leaving the company. This aids companies in efficiently managing their employees.

- In order to reduce the risk of attrition, the process involves gathering employee data, preprocessing it, choosing pertinent features, training a predictive model using machine learning algorithms, assessing the model's performance, deploying it for predictions, and taking the necessary actions based on the predictions.

- To guarantee the model's accuracy over time, ongoing monitoring and upgrades are required.

List of Parameters:

- corporation
- lastmonth_activity
- lastyear_activity
- number_of_employees
- exited

Steps followed while implementing the model:

- Loaded two input datasets (dataset1.csv and dataset2.csv) and combined it to one dataset (combined.csv)
- Describing the dataframes using describe function
- Checking for Null values. There were no null values.
- Checked for duplicate values. There were 10. Removed the duplicate values
- Printed the Unique values from the data frame.
- Performed Data Visualisation by plotting Histogram, Colorbar, Heatmap, Barograph, Distplot, Countplot, Scatter plot, etc.
- Number of employees are more than 100 in the corporation ‘bqlx’
- Exited employees are more than current employees
- In the last month activity the current employees are more than exited employees
- Dropping ‘exited' column for further modeling.
- Defining X and Y variables. Training a logistic regression model on the input dataset, predict the target variable for the test dataset, and print the coefficients of the trained model.
- Using sklearn-metrics the values of f1 socre, Recall, Precision and Acuracy can be seen. F1-score: 85%, Recall: 87%, Precision: 89% and Accuracy: 87%.
- Linear Support Vector Classifier was used to test further accuracy by setting the learning rate and regularisation parameters. The accuracy obtained was 75%
- Trained a decision tree classifier model using scikit-learn's DecisionTreeClassifier class with a specific maximum depth and maximum leaf nodes (2 and 7). The training score obtained was 90% and testing score was 87%

- Trained a Random Forest classifier model on this dataset using scikit-learn's RandomForestClassifier class with a specific maximum depth and maximum leaf nodes. (2 and 7). The training score obtained was 88% and testing score was 87%.
- Using pickle module, the model is saved in pkl format as ‘model_pickle_employee’.

Note:

- The accuracies obtained was 87%. It can be varied when tuning of hyper parameters are done. Kindly re-run for better results. This is because randomness in the algorithms and in the datasets.
- There are two files in the repository: employee.py and employee1.py.
- The first file has approach which is mentioned above (accuracy 87%). The testing data is merged in the input file itself.
- The second file has a slight different approach, where Validation accuracy and Testing Accuracy were added. Since the testing data was taken separately and was very small inconsistent, I tried to manage by building the model and tuned the hyper parameters. Obtained an accuracy of 65%.

Steps followed while deploying the model:

1. To run the ML model: Import all the necessary packages
Use: python3 employee.py

2. To run the Docker through CLI:
a. Open Terminal. Change the directory where it contains the model and datasets.
b. Create a docker file, by entering the below commands. Copy paste it and modify the directory

```
# Use a base image with the desired operating system and runtime
FROM python:3.9-slim-buster

# Set the working directory in the container
WORKDIR /Users/sudharmendragv/Downloads/Adappt

# Copy the ML model files to the working directory
#COPY /Users/sudharmendragv/Downloads/Adappt .
COPY requirements.txt .


# Install the required dependencies
RUN pip install --no-cache-dir -r requirements.txt

COPY . .

# Expose any necessary ports (if applicable)
#EXPOSE 8000

# Define the command to run your ML model
CMD ["python", "employee.py"]
```

c. Save the dockerfile in the same directory and create a requirement file with all the necessary packages details. This should look like below.
requirements.txt

numpy==1.19.5
pandas==1.3.4
scikit-learn==1.0
matplotlib==3.4.3
seaborn==0.11.2
scipy==1.7.1

d. Save the requirements.txt file and run the below command.
3. Build the docker image: "docker build -t ml_model ."
Note: "ml_model" - Name of the docker image. Any name can be provided
Run the docker image: docker run ml_model

Optimisations:

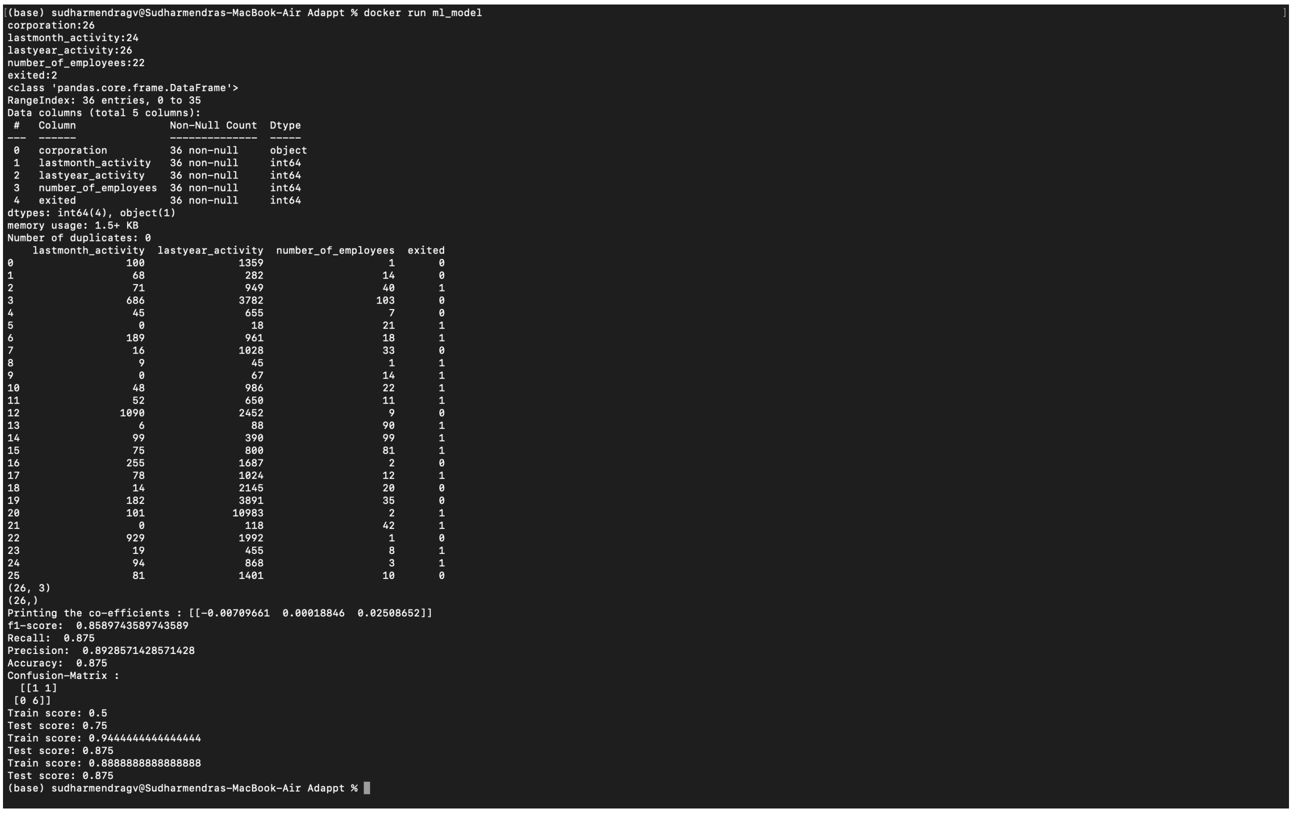
Implemented couple of models: Logistic Regression, Linear SVM, Decision Tree and Random Forest. Obtained an accuracy of 87%

Inorder to obtain the same accuracy, hypertuning of the parameters were done like:

- For Logistic Regression: Tuning the RandomState value
- For Linear SVC: Tuning the learning rate and regularization parameters

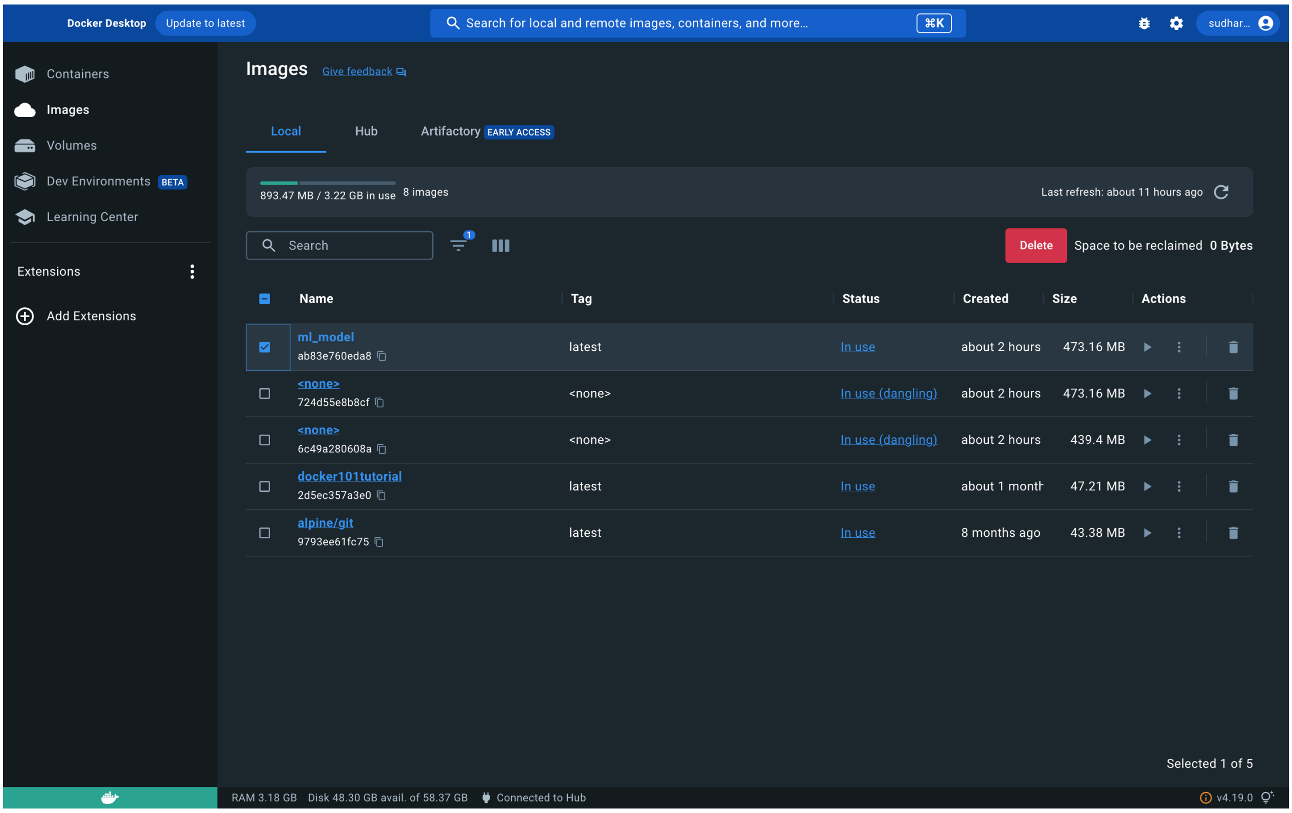
Output screenshots:

1. CLI Output:



```
(base) sudharmendragv@Sudharmendras-MacBook-Air Adappt % docker run ml_model
corporation:26
lastmonth_activity:24
lastyear_activity:26
number_of_employees:22
exited:2
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 36 entries, 0 to 35
Data columns (total 5 columns):
 #   Column               Non-Null Count  Dtype 
---  ------               --------------  ----- 
 0   corporation          36 non-null     object
 1   lastmonth_activity   36 non-null     int64 
 2   lastyear_activity    36 non-null     int64 
 3   number_of_employees  36 non-null     int64 
 4   exited               36 non-null     int64 
dtypes: int64(4), object(1)
memory usage: 1.5+ KB
Number of duplicates: 0
    lastmonth_activity  lastyear_activity  number_of_employees  exited
0                  100               1359                    1       0
1                   68                282                   14       0
2                   71                949                   40       1
3                  686               3782                  103       0
4                   45                655                    7       0
5                    0                 18                   21       1
6                  189                961                   18       1
7                   16               1028                   33       0
8                    9                 45                    1       1
9                    0                 67                   14       1
10                  48                986                   22       1
11                  52                650                   11       1
12                1090               2452                    9       0
13                   6                 88                   90       1
14                  99                390                   99       1
15                  75                800                   81       1
16                 255               1687                    2       0
17                  78               1024                   12       1
18                  14               2145                   20       0
19                 182               3891                   35       0
20                 101              10983                    2       1
21                   0                118                   42       1
22                 929               1992                    1       0
23                  19                455                    8       1
24                  94                868                    3       1
25                  81               1401                   10       0
(26, 3)
(26,)
Printing the co-efficients : [[-0.00709661  0.00018846  0.02508652]]
f1-score:  0.8589743589743589
Recall:  0.875
Precision:  0.8928571428571428
Accuracy:  0.875
Confusion-Matrix :
  [[1 1]
 [0 6]]
Train score: 0.5
Test score: 0.75
Train score: 0.9444444444444444
Test score: 0.875
Train score: 0.8888888888888888
Test score: 0.875
(base) sudharmendragv@Sudharmendras-MacBook-Air Adappt % 
```

2. Docker Image:



893.47 MB / 3.22 GB in use 8 images

Last refresh: about 11 hours ago

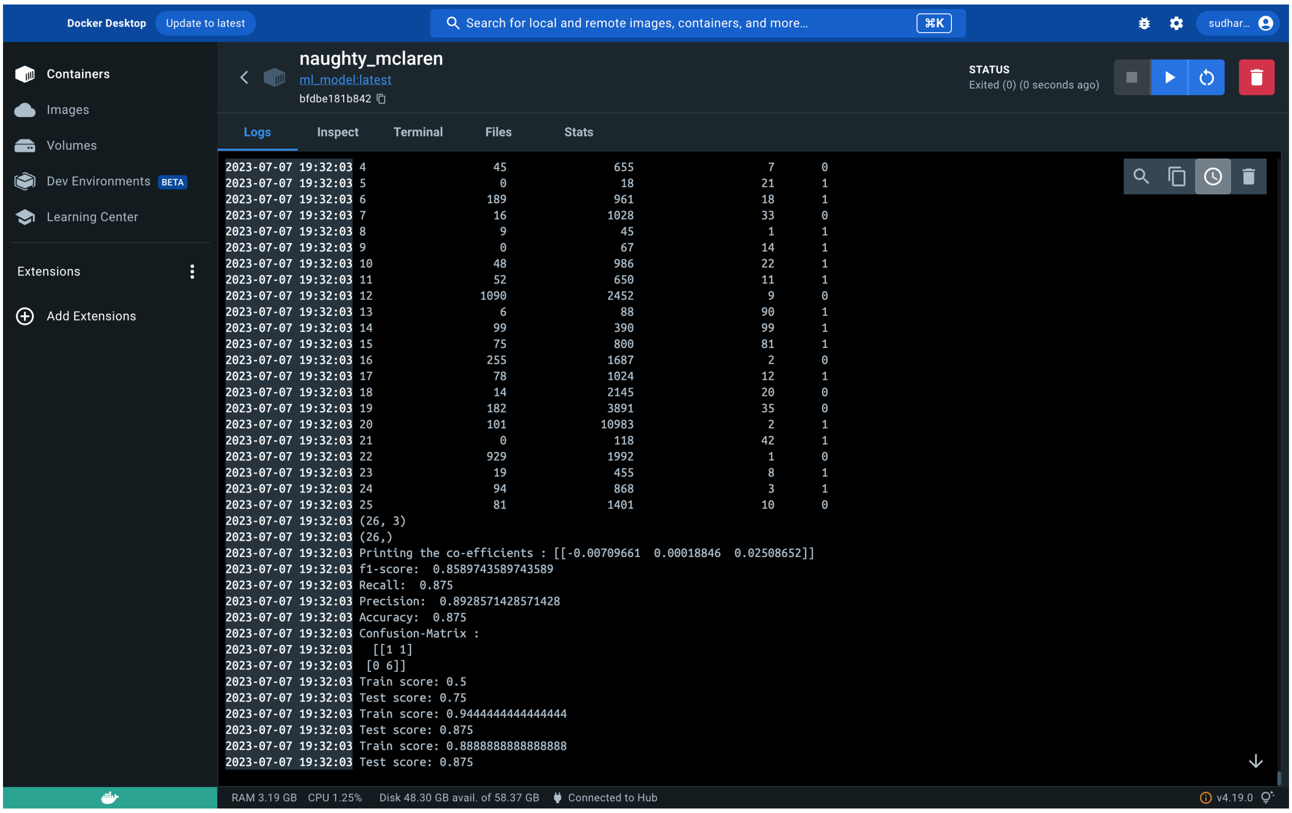
Space to be reclaimed 0 Bytes

☐	Name	Tag	Status	Created	Size	Actions
☑	ml_model ab83e760eda8	latest	In use	about 2 hours	473.16 MB	
☐	<none> 724d55e8b8cf	<none>	In use (dangling)	about 2 hours	473.16 MB	
☐	<none> 6c49a280608a	<none>	In use (dangling)	about 2 hours	439.4 MB	
☐	docker101tutorial 2d5ec357a3e0	latest	In use	about 1 month	47.21 MB	
☐	alpine/git 9793ee61fc75	latest	In use	8 months ago	43.38 MB	

Selected 1 of 5

RAM 3.18 GB Disk 48.30 GB avail. of 58.37 GB Connected to Hub v4.19.0

3. Docker Output:



naughty_mclaren

ml_model:latest

bfdbe181b842

STATUS

Exited (0) (0 seconds ago)

```
2023-07-07 19:32:03 4                  45               655                   7       0
2023-07-07 19:32:03 5                   0                18                  21       1
2023-07-07 19:32:03 6                 189               961                  18       1
2023-07-07 19:32:03 7                  16              1028                  33       0
2023-07-07 19:32:03 8                   9                45                   1       1
2023-07-07 19:32:03 9                   0                67                  14       1
2023-07-07 19:32:03 10                 48               986                  22       1
2023-07-07 19:32:03 11                 52               650                  11       1
2023-07-07 19:32:03 12               1090              2452                   9       0
2023-07-07 19:32:03 13                  6                88                  90       1
2023-07-07 19:32:03 14                 99               390                  99       1
2023-07-07 19:32:03 15                 75               800                  81       1
2023-07-07 19:32:03 16                255              1687                   2       0
2023-07-07 19:32:03 17                 78              1024                  12       1
2023-07-07 19:32:03 18                 14              2145                  20       0
2023-07-07 19:32:03 19                182              3891                  35       0
2023-07-07 19:32:03 20                101             10983                   2       1
2023-07-07 19:32:03 21                  0               118                  42       1
2023-07-07 19:32:03 22                929              1992                   1       0
2023-07-07 19:32:03 23                 19               455                   8       1
2023-07-07 19:32:03 24                 94               868                   3       1
2023-07-07 19:32:03 25                 81              1401                  10       0
2023-07-07 19:32:03 (26, 3)
2023-07-07 19:32:03 (26,)
2023-07-07 19:32:03 Printing the co-efficients : [[-0.00709661  0.00018846  0.02508652]]
2023-07-07 19:32:03 f1-score:  0.8589743589743589
2023-07-07 19:32:03 Recall:  0.875
2023-07-07 19:32:03 Precision:  0.8928571428571428
2023-07-07 19:32:03 Accuracy:  0.875
2023-07-07 19:32:03 Confusion-Matrix :
2023-07-07 19:32:03   [[1 1]
2023-07-07 19:32:03  [0 6]]
2023-07-07 19:32:03 Train score: 0.5
2023-07-07 19:32:03 Test score: 0.75
2023-07-07 19:32:03 Train score: 0.9444444444444444
2023-07-07 19:32:03 Test score: 0.875
2023-07-07 19:32:03 Train score: 0.8888888888888888
2023-07-07 19:32:03 Test score: 0.875
```

RAM 3.19 GB CPU 1.25% Disk 48.30 GB avail. of 58.37 GB Connected to Hub v4.19.0