HITESHBHAI GELOT

GELOT82904

Design and Application of a Machine Learning System for a Practical Problem:

A case study of the hotel industry openings in new locations

INTRODUCTION

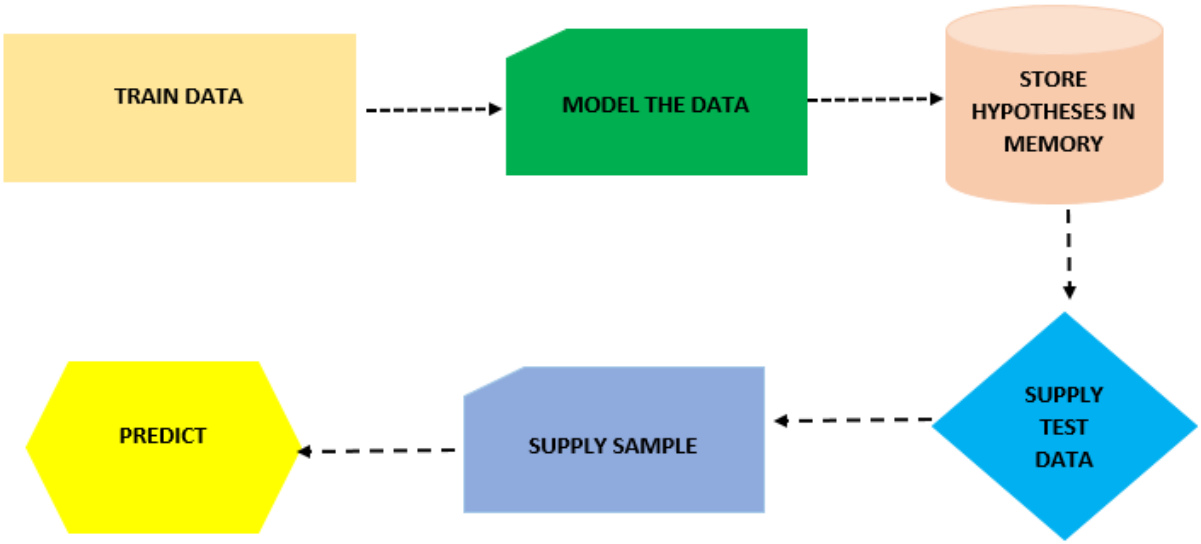
In a fast growing world and economy, organisations are finding the need to sustain data a more crucial role within their departments and other cross functional applications. Further decision support tools are not just enough to satisfy the urge that management has towards fulfilling some of the key needs that they are faced with when it comes to delay finding just the perfect tool to help them actualise decision rules. Customer relationship management systems, enterprise resource planning tools, ERP portals, knowledge management systems and bases, social media platforms and pages, are some of the avenues through which organisations acquired data.

Since big data is that which is fast moving, in large volumes, is not organised and is in many forms, there is the hidden potential behind this data that it could be carrying some of the greatest mines that need to harvested and projected for organisational performance and maintenance. Tools such as Hadoop and Apache Spark have been used before to ensure that data is mined, cleaned and trimmed for further analysis.

Further to this process, data centre infrastructure is another key proponent that needs to be taken it not key consideration by the various system engineers to ensure that there are enough physical infrastructural facilities to ensure that data is properly centres, through the various data entry points such as social media platforms, company forms and contact points and all lead generators. Once this has been done, historical partitioning of the database systems need to be done and established in a manner that can be accessed by the various data stakeholders.

In addition, Business intelligent systems are a more refined way of getting reliable decisive information. BI systems filter the data, summarise it and then present them in clear graphs and presentational formats that all managers and top decision makers can consume and act upon. Apart from just summarising and reporting the data, organisational manages need predictive analytics as part of their key decision making metrics. Meaning that, there is always the need o project and try to define what the future might look like, this depends on the application of machine learning algorithms to the dataset and then applying the relevant models to the data so that the predictive functions can be applied to the selected dataset. Usually the A/B test rule will be applied to the data where 80% of the data shall be used for training and then 20% for testing

purposes. During, the training, the machine shall learn from this set and then testing the possible outputs on the result. An illustration is given below:



.

Problem statement

In this exercise, the researcher established the potential of investing in a new store by trying to establish whether investing a new shop in a new location would be viable. In order to achieve this, a decision tree algorithm was supplied to the dataset and the sample data of variable population and purchase revenues used for testing, the resultant data was then predicted to establish the Boolean of TRUE for profitable and FALSE for not profitable

Project objectives and aims

- To learn to identify machine learning techniques appropriate for establishing the viability of a new store in a new location
- To undertake a comparative evaluation of several machine learning procedures when applied to the specific problem
- To predict the possibility of a new hotel branch being profitable in a new town

Research methodology and design

The dataset supplied and used for this particular analyses was obtained from the store data centres that contained information about the various store locations and sales plus population information about these store locations. A quick summary this dataset looks like below.

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21
-0.12321	2577.32	2183.52	7747.32	2.16	9693.21	-2.2498	-1381.98	3033.55	53.796	-90073.7	2.2986	6.786	1	-3.929	-0.8095	3.58	-5.9384	-9.342	1	
-2.0646	1200.12	1654.74	6027.72	2.16	9391.26	-2.742	-1336.2	2081.35	33.514	-90039.9	0.9676	5.524	0	-1.6609	-2.302	3.888	-6.564	-6.3806	1	
-0.08375	2769.35	2661.42	7798.66	2.16	9296.28	-3.213	-1531.16	3397.15	39.43	-90138.3	1.7296	10.087	0	-2.51	-2.819	2.1606	-5.234	-9.678	0	
-2.8083	3161.52	2199.12	8369.32	5.16	7990.71	-2.2703	-1397.03	3289.99	42.012	-90993.3	3.532	15.54	1	-2.2555	-0.977	8.216	-5.8166	-6.1512	0	42.06
-0.4458	2707.42	2083.62	9054.72	5.16	8691.81	-3.731	-804.04	1903.35	43.172	-90092.3	0.5662	4.5188	0	-1.7843	-1.369	0.7562	-6.406	-9.532	0	
-4.638	2716.72	2248.02	12806.92	5.16	12720.21	-1.9979	-1736.04	4614.35	41.964	-90068	0.54782	11.924	0	-1.4422	-0.4898	1.2142	-6.2044	-7.3166	1	
-0.29571	2792.12	1338.12	7499.32	2.16	9608.91	-1.7279	-1464.12	3537.65	34.556	-89874.2	1.1074	32.38	1	-2.565	-1.1173	3.638	-5.7458	-8.006	0	
-0.4449	1891.42	3179.82	8664.32	5.16	9398.88	-2.2642	-1353.14	3015.15	47.606	-90117.3	1.2584	13.707	0	-1.9235	-0.7047	1.5188	-4.8998	-6.1578	1	40.5
-1.2639	2477.32	2659.92	7834.056	5.16	10069.71	-3.137	-1413.68	3038.75	33.852	-90313.1	1.6374	14.89	0	-3.928	-0.7701	1.846	-5.106	-7.786	0	
-0.16245	2914.19	1502.7	9395.32	2.16	8930.52	-2.4263	-664.44	3268.76	30.058	-90078.6	2.1702	5.604	0	-1.561	-2.918	0.5416	-5.598	-7.792	1	40.92
-0.06085	2705.52	1513.47	9075.32	2.16	10616.01	-3.073	-1738.24	3258.56	39.696	-90132.9	1.1492	9.079	0	-1.896	-0.6148	0.4914	-5.1992	-6.777	1	
-1.7295	2648.32	2289.72	7706.42	5.16	11583.81	-2.575	-1706.44	5928.35	29.21	-90133.7	0.50936	5.621	1	-4.387	-0.6011	1.6988	-5.6096	-6.9204	0	
-5.22	691.12	1786.98	7647.82	5.16	9358.14	-2.781	-1397.71	3102.05	46.12	-90083.1	1.9466	36.75	0	-2.66	-1.612	3.696	-6.12	-5.8736	1	
-0.15285	2893.33	1582.275	8637.52	2.16	8731.41	-2.672	-856.64	3290.55	19.734	-89932.4	2.638	36.1	0	-2.1247	-1.624	0.5134	-5.491	-9.886	0	35.58
-0.5688	2238.12	3454.32	11872.92	2.16	9824.61	-3.378	-1741.44	3842.15	44.452	-89974.6	0.7786	4.32212	0	-1.475	-1.421	1.4014	-5.0624	-6.0488	0	
-0.4389	2850.23	1187.82	5144.92	2.16	9208.809	-1.7223	-1646.64	3333.45	28.672	-90119.1	2.2766	11.418	0	-1.4007	-3.027	0.5788	-5.2098	-6.4232	1	
-0.855	2045.22	3290.82	8124.32	5.16	10101.21	-2.3146	-1426.73	2920.35	37.31006	-89715	1.1158	18.74	1	-1.5898	-0.8308	2.1432	-4.87	-6.596	0	
-5.94	2756.58	4072.62	8109.12	5.16	2511.21	-2.4887	-1329.1	3132.92	27.024	-90130.1	3.882	10.839	1	-3.063	-0.42001	3.752	-4.7924	-13.178	0	42.15
-0.06878	2677.82	1897.02	8001.1	2.16	9466.74	-1.6358	-1414.13	3002.95	41.038	-89977.9	1.4156	9.473	1	-5.395	-1.872	1.9534	-7.01	-9.848	0	

For the sample the sake of machine learning predictions, a snippet of the above dataset was selected split for training and test before applying decision trees on the same set.

population	amount $ '000	profitable
2577	2183.52	TRUE
1200	1654.74	FALSE
2769	2661.42	FALSE
3162	2199.12	TRUE
2707	2083.62	TRUE
2717	2248.02	TRUE
2792	1338.12	FALSE
1891	3179.82	TRUE
2477	2659.92	FALSE
2914	1502.7	TRUE
2706	1513.47	TRUE
2648	2289.72	TRUE
691	1786.98	TRUE
2893	1582.275	TRUE
2238	3454.32	TRUE
2850	1187.82	FALSE
2045	3290.82	TRUE
2757	4072.62	TRUE
2678	1897.02	TRUE

Further the dataset contains a total of 1000 instances and three columns of variable type character, float and Boolean.

Analysis and presentations

Load and preview of the dataset on Jupyter IDE appears as below:

```
In [3]: import pandas as pd
        sales_data_project = pd.read_csv('store_sales.csv')
        sales_data_project
```

Out[3]:

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	...	F13	F14	F15	F16	F17	F18	F19	F2
0	-0.123210	2577.3200	2183.52	7747.32	2.16	9693.21	-2.24980	-1381.98	3033.55	53.796	...	6.7860	1	-3.9290	-0.8095	3.5800	-5.9384	-9.3420	
1	-2.064600	1200.1200	1654.74	6027.72	2.16	9391.26	-2.74200	-1336.20	2081.35	33.514	...	5.5240	0	-1.6609	-2.3020	3.8880	-6.5640	-6.3806	
2	-0.083748	2769.3500	2661.42	7798.66	2.16	9296.28	-3.21300	-1531.16	3397.15	39.430	...	10.0870	0	-2.5100	-2.8190	2.1606	-5.2340	-9.6780	
3	-2.808300	3161.5200	2199.12	8369.32	5.16	7990.71	-2.27030	-1397.03	3289.99	42.012	...	15.5400	1	-2.2555	-0.9770	8.2160	-5.8166	-6.1512	
4	-0.445800	2707.4200	2083.62	9054.72	5.16	8691.81	-3.73100	-804.04	1903.35	43.172	...	4.5188	0	-1.7843	-1.3690	0.7562	-6.4060	-9.5320	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
995	-0.637200	2575.9200	1493.97	7726.38	2.16	8822.31	-2.27120	-1052.44	2790.55	56.832	...	5.8160	0	-2.0949	-1.9290	1.3156	-6.3420	-6.9018	
996	-0.062512	2713.8200	1484.64	7529.12	2.16	9395.07	-2.43980	-1279.56	3143.73	49.938	...	13.6120	1	-1.6278	-0.5306	0.7642	-6.1828	-8.1960	
997	-0.458100	2827.8675	1539.30	7463.92	5.16	9285.81	-2.71500	-1503.12	3497.55	20.112	...	5.0459	0	-1.8705	-2.7190	2.2880	-5.9302	-8.0580	
998	-0.323700	2681.1200	2399.52	8268.92	2.16	10062.51	-2.79400	-1387.82	3001.85	32.880	...	7.8240	1	-3.1360	-0.9401	4.0980	-5.7562	-12.4580	
999	-2.061000	4034.1200	1041.12	9405.32	5.16	8583.51	-1.64566	-1311.16	3986.95	29.592	...	7.8380	0	-1.8624	-1.8080	1.5582	-4.6114	-6.1788	

1000 rows × 22 columns

Further, the selected dataset was loaded and using pandas previewed the dataset as below showing the instances as 1000 with the expected 3 columns of variable names.

```
In [8]: import pandas as pd
        #import sklearn.
        sales_data_project = pd.read_csv('store_v2.csv')
        sales_data_project.shape

Out[8]: (1000, 3)

In [ ]:
```

In [5]:
```
import pandas as pd
sales_data_project = pd.read_csv('store_v2.csv')
sales_data_project
```

Out[5]:

	population	amount $ '000	profitable
0	2577	2183.52	True
1	1200	1654.74	False
2	2769	2661.42	False
3	3162	2199.12	True
4	2707	2083.62	True
...	...	...	...
995	2576	1493.97	False
996	2714	1484.64	False
997	2828	1539.30	False
998	2681	2399.52	True
999	4034	1041.12	True

1000 rows × 3 columns

In [ ]:

A quick summary of the dates was also established by getting the total count the min value, the maximum value, the mean, standard deviation and the 25^{th} and 75^{th} percentile values of the dataset respectively

```
In [6]: import pandas as pd
sales_data_project = pd.read_csv('store_v2.csv')
sales_data_project.describe()
```

Out[6]:

	population	amount $ '000
count	1000.000000	1000.000000
mean	2520.915000	2120.448916
std	747.502021	1587.054314
min	-2460.000000	-7321.080000
25%	2440.000000	1505.370000
50%	2709.500000	1762.455000
75%	2836.000000	2227.920000
max	6563.000000	18814.920000

Prediction with Decision trees

The selected dataset was then supplied into the sklearn algorithm system to try to establish the expected values from the inputs. Given the trends established from the machine learns in the 1000 instances of train data. The researcher supplied two case scenarios of data containing the population of the area and the possible sales revenue of the location and tried to predict what would be the possible outcome of the supplied datasets and the results were as follows:

Supplied data	**Predicted output**
100,5000	TRUE
3500, 600	FALSE

In [11]:
```
import pandas as pd
from sklearn.tree import DecisionTreeClassifier
sales_data_project = pd.read_csv('store_v2.csv')
X = sales_data_project.drop(columns=['profitable'])
Y = sales_data_project['profitable']
model = DecisionTreeClassifier()
model.fit(X, Y)
predictions = model.predict([ [100,5000],[3500, 600]  ])
predictions
```

```
C:\Users\2395648\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.9_qbz5n2kfra8p0\LocalCache\local-packages\Python39\site-packages\sklearn\base.py:445: UserWarning: X does not have valid feature names, but DecisionTreeClassifier was fitted with feature names
  warnings.warn(
```

Out[11]:
```
array([ True, False])
```

In [ ]:

Interpretation and conclusion

From this predictive analysis, it can be observed that there is no direct relationship between the population and the sales revenues of the particular locations. The two variables are inversely related and none depends an on the other. Actually if a correlation coefficient was done on this data, it would produce negative value of say -0.60, to jus show that a change in the population or the revenue collections of the shop location does not in any way affect the performance of the shop in that particular location. Perhaps other factors such as market forces, legal implications and price demand variations of goods and products could be studied or looked at further in the next research.