Machine Learning Engineer Nanodegree

Capstone Proposal

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Proposal

Domain Background

Supervised learning is one of the most promising fields in Machine Learning. It is currently used in several real world applications. Customer is the focal point of any business, and his satisfaction is directly proportional to business growth. An important point that affects customers is the service they get and their level of satisfaction with this service.
Machine learning helps the business improving this issue. My personal motivation is investigating this area and provide the business with a tool that uses supervised learning and improves customer's satisfaction and push business forward.

Problem Statement

Santander Bank, started in Spain and it has been serving customers in the Northeast since 2013, cares about its customers satisfaction and work to take proactive steps to improve a customer's happiness before it's too late . From frontline support teams to C-suites, customer satisfaction is a key measure of success. Unhappy customers don't stick around, so Santander Bank posted a competition in ***Kaggle.com*** to identify dissatisfied customers.
As an input, Santander Bank provides hundreds of anonymized features to predict if a customer is satisfied or not based on their banking experience.
This task is ***a classification problem*** since customers should be classified as happy or not.

Problem link: https://www.kaggle.com/c/santander-customer-satisfaction

Datasets and Inputs

The dataset contains two csv files with anonymized features for classification.

- Data given is:
  - ID: customer id.
  - 369 numeric variables
  - Target: 0/1 variable indicates customer happiness.

- Train.csv:
  - Number of rows = 76020
  - Number of columns = 371
  - Highly relevant as this is the data for training.

- Test.csv:
  - Number of rows = 75818
  - Number of columns = 370
  - Highly relevant as this is the data for testing.

It is a Kaggle competition. Dataset link: https://www.kaggle.com/c/santander-customer-satisfaction/data

Solution Statement

First, Some data exploration and visualization will be done to understand the relation among the features and the target label. There are 369 numeric features which, due to curse of dimensionality, may result in model over-fitting, accuracy reduction and increasing training time. So, principle component analysis (PCA) will be used to *reduce the dimensionality* and *feature selection*. Then, some models will be trained and tested to get the best performance. Finally, tunning the best model and get the best *ROC AUC* score.
Models that will be used:
1- *LogisticRegression* as a base model.
2- *RandomForest* which is a great Bagging Algorithm.
3- *XGBoost* which is a great Boosting Algorithm.
4- *Deep neural network* which is a type of Deep Learning (if needed).

For tuning hyper-parameters, either *Randomized Search* or *Grid search* will be used based on a comparison.

Benchmark Model

As this is a Kaggle competition, a benchmark model would be the best Kaggle score for the test-set, which is 0.829072 of *ROC AUC score* of private leader-board. But, **for academic purposes**, a part of training data will be used as testing data. More precisely, 20% of training data will be set as a testing set.
A ***LogisticRegression*** model will be set as the benchmark model for this problem. Then, next models will be compared to it to see if they can beat it and by how much extent.

For satisfying the curiosity, The best model will be tested on the original test-set provided by Kaggle. The submission file will be uploaded on Kaggle website to check the score. A personal goal, The best model would have a score over 0.80 AUC ROC *score* in Kaggle leader-board.

Evaluation Metrics

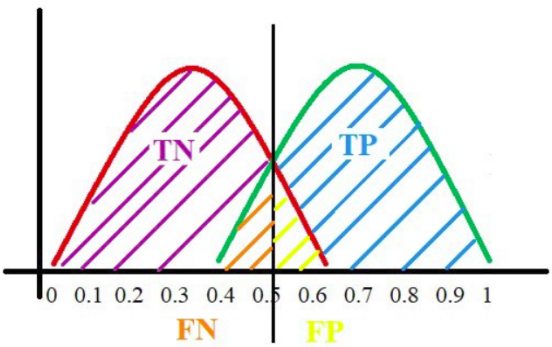
However using "A*ccuracy"* as metric is easy to understand and makes comparison of the performance of different classifiers trivial, but it ignores many of the factors which should be taken into account when honestly assessing the performance of a classifier.

Instead, Area under the ROC Curve (AUC ROC) metric handles this issue. AUC ROC indicates how well the probabilities from the positive classes are separated from the negative classes. For any binary classification, the following terms are important:

- Sensitivity: out of the points that are labeled positive, how many of them are correctly predicted as positive = TP/(TP + FN)
- Specificity: out of all the points predicted to be positive, how many of them are actually positive = TN/(TN + FP)

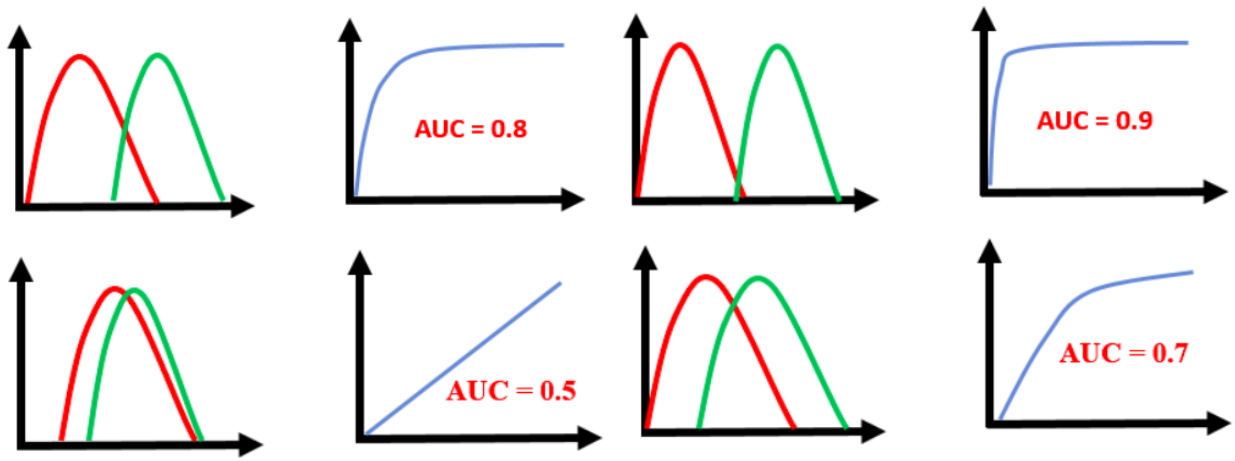
ROC curve is obtained by plotting Sensitivity on y-axis aganist (1-Specificity) on x-axis at several thresholds.

The area under curve is the model's performance. The closer it gets to the top left corner, the better the model is doing at distinguishing the two classes apart.



		Predicted class: P	Predicted class: N
Actual Class	P	True Positives (TP)	False Negatives (FN)
	N	False Positives (FP)	True Negatives (TN)

Here’s an example:



So AUC ROC score will be used a the evaluation metric of this binary classification problem.

Project Design

- Programming Language and Libraries:

- Python 3.
- Jupyter Notebook.
- Pandas.
- Numpy
- Scikit-learn: open-source machine learning library for Python.
- Xgboost: package for gradient boosted decision trees implementation.
- Keras: open-source neural network library written in Python.
- Other libraries will be added if needed.

- Work-flow:
The general sequence of steps are as follows:
<u>Data Exploration and Visualization:</u>

- Reading the data and providing some statistics.
- Provide some visual representation of data to find the degree of correlations between features and target variable
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<u>Data Preprocessing</u>

- Scaling the data as preprocessing step as all features are numeric variables.
- Splitting the data to training and testing sets.

<u>Set the Benchmark:</u>

- Using LogisticRegression as a benchmark model.

Feature Engineering:

- Doing dimensionality reduction and feature selection using PCA.

Model Selection:

- Building several models (RandomForest, XGBoost and Deep neural network) and testing their accuracy against the benchmark model.

Model Tuning:

- Tuning the best model using either Randomized Search or Grid search.

Testing:

- Test the best model on testing dataset.

References

- Kaggle, Santander Customer Satisfaction competition: https://www.kaggle.com/c/santander-customer-satisfaction
- Santander web site: https://www.santanderbank.com/us/personal
- Supervised learning Wikipedia page: https://en.wikipedia.org/wiki/Supervised_learning