Fuse Machines

AI FELLOWSHIP 2023

A Project Proposal on:

Wine Quality Classification

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Chapter 1

Introduction

1.1 Problem Statement

The dataset is related to red variants of the Portuguese "Vinho Verde" wine.The dataset describes the amount of various chemicals present in wine and their effect on it's quality. The datasets can be viewed as classification or regression tasks. The classes are ordered and not balanced (e.g. there are much more normal wines than excellent or poor ones).Task is to predict the quality of wine using the given data.

A simple yet challenging project, to anticipate the quality of wine.

The complexity arises due to the fact that the dataset has fewer samples, & is highly imbalanced.

Data Source : https://archive.ics.uci.edu/ml/datasets/wine+quality

1.2 About Dataset

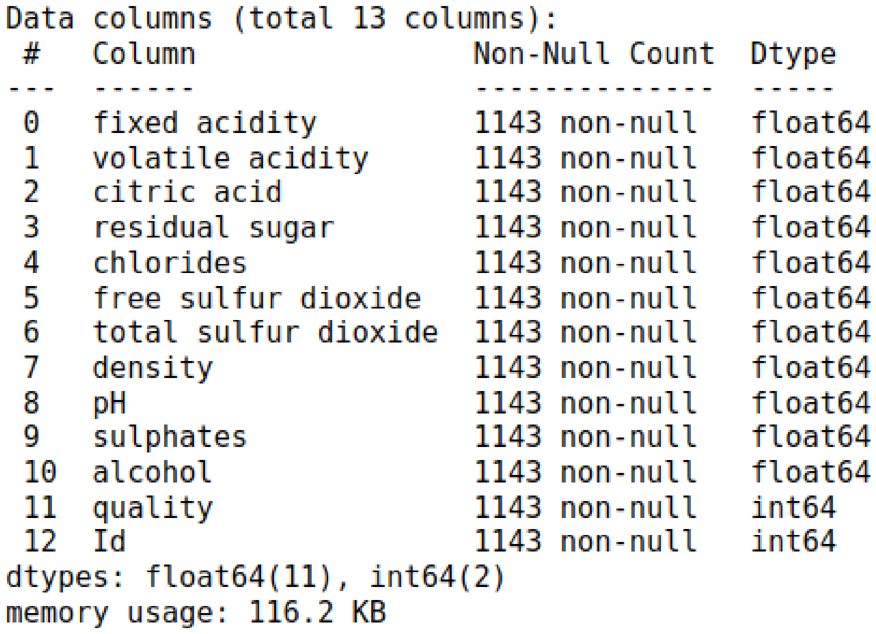
The dataset contains the following columns:

1. fixed acidity
2. volatile acidity
3. citric acid
4. residual sugar
5. chlorides
6. free sulfur dioxide
7. total sulfur dioxide
8. density
9. pH
10. sulphates

11. alcohol

12. quality (Targe Variable) : ranges from 0 to 10

The data information is as follow:



```
Data columns (total 13 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   fixed acidity         1143 non-null   float64
 1   volatile acidity      1143 non-null   float64
 2   citric acid           1143 non-null   float64
 3   residual sugar        1143 non-null   float64
 4   chlorides             1143 non-null   float64
 5   free sulfur dioxide   1143 non-null   float64
 6   total sulfur dioxide  1143 non-null   float64
 7   density               1143 non-null   float64
 8   pH                    1143 non-null   float64
 9   sulphates             1143 non-null   float64
 10  alcohol               1143 non-null   float64
 11  quality               1143 non-null   int64
 12  Id                    1143 non-null   int64
dtypes: float64(11), int64(2)
memory usage: 116.2 KB
```

Figure 1.1: Data Information

Description of each column is shown below:

stats	fixed acidity	volatile acidity	citric acid	residual sugar	chlorides	free sulfur dioxide
mean	8.311	0.5313	0.264	2.532	0.0869	15.615
std	1.747	0.179	0.196	1.355	0.0477	10.250
min	4.600	0.120000	0.000	0.900	0.0120	1.00
25%	7.100	0.39250	0.0900	1.900	0.070	7.000
50%	7.900	0.5200	0.2500	2.200	0.0790	13.000
75%	9.100	0.6400	0.4200	2.6000	0.090	21.000
max	15.900	1.580	1.00	15.50	0.6110	68.00

Table 1.1: Data Description 1

stats	total sulfur dioxide	density	pH	sulphates	alcohol
mean	45.914698	0.996730	3.311015	0.657708	10.442111
std	32.782130	0.001925	0.156664	0.170399	1.082196
min	6.000000	0.990070	2.740000	0.330000	8.400000
25%	21.000000	0.995570	3.205000	0.550000	9.500000
50%	37.000000	0.996680	3.310000	0.620000	10.200000
75%	61.000000	0.997845	3.400000	0.730000	11.100000
max	289.000000	1.003690	4.010000	2.000000	14.900000

Table 1.2: Data Description 2

1.3 Dataset Statistics

The count plot of the whole dataset on the basis of quality of wine is shown below.

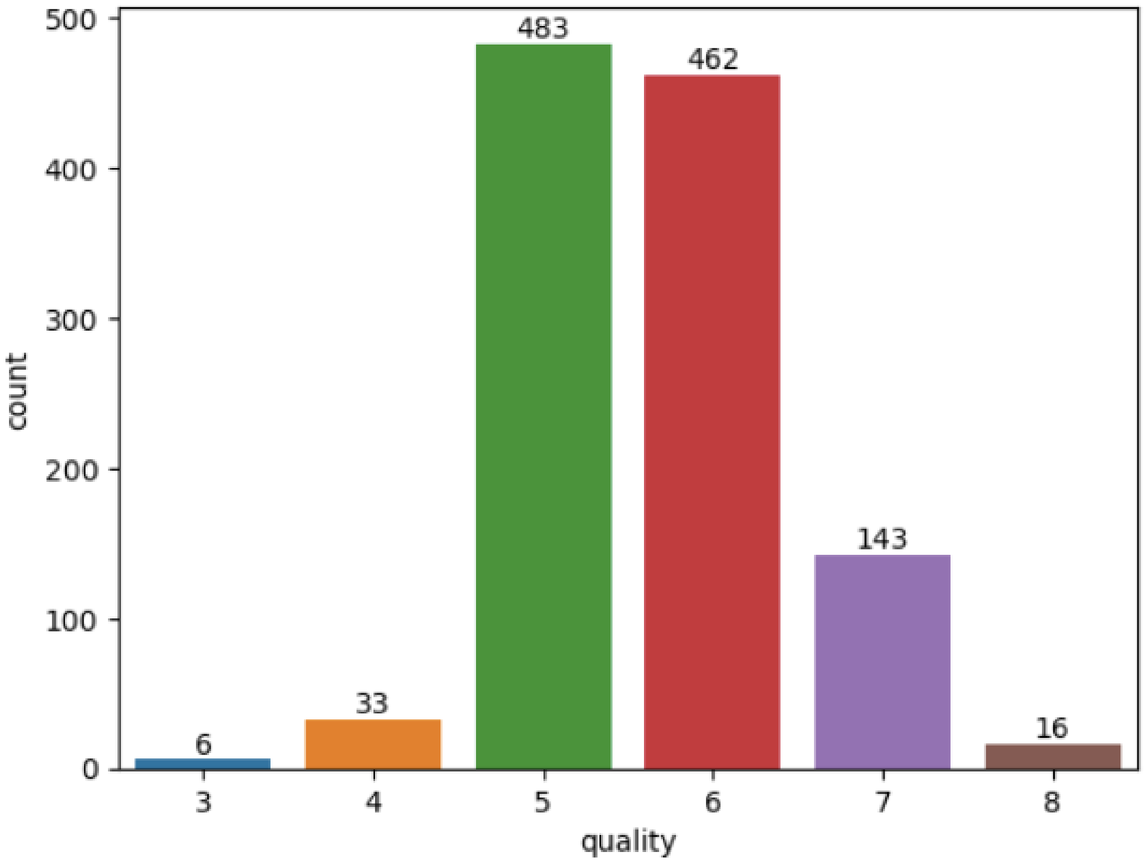
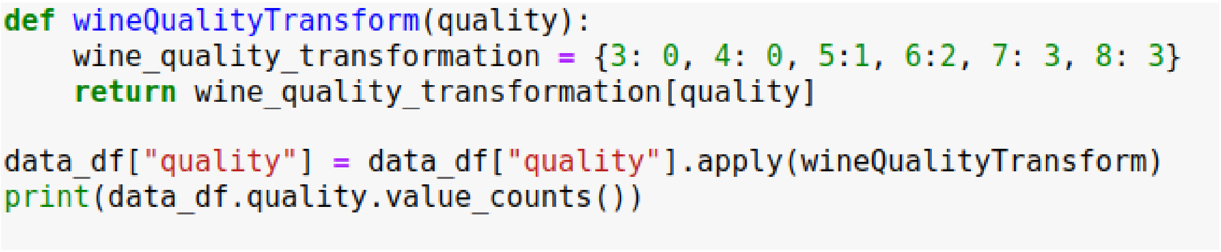


Figure 1.2: Quality Count plot

We can see from above countplot, that the data is highly imbalanced and quality of wine(0, 1, 2, 9, 10) are not present in the dataset.

In order to deal with this imbalanced, at first we are going to merge the quality labels (3 and 4) and (7 and 8) as shown below.



```
def wineQualityTransform(quality):
    wine_quality_transformation = {3: 0, 4: 0, 5:1, 6:2, 7: 3, 8: 3}
    return wine_quality_transformation[quality]

data_df["quality"] = data_df["quality"].apply(wineQualityTransform)
print(data_df.quality.value_counts())
```

Figure 1.3: Code for transformation of quality attribute

The resulting count plot is as shown below:

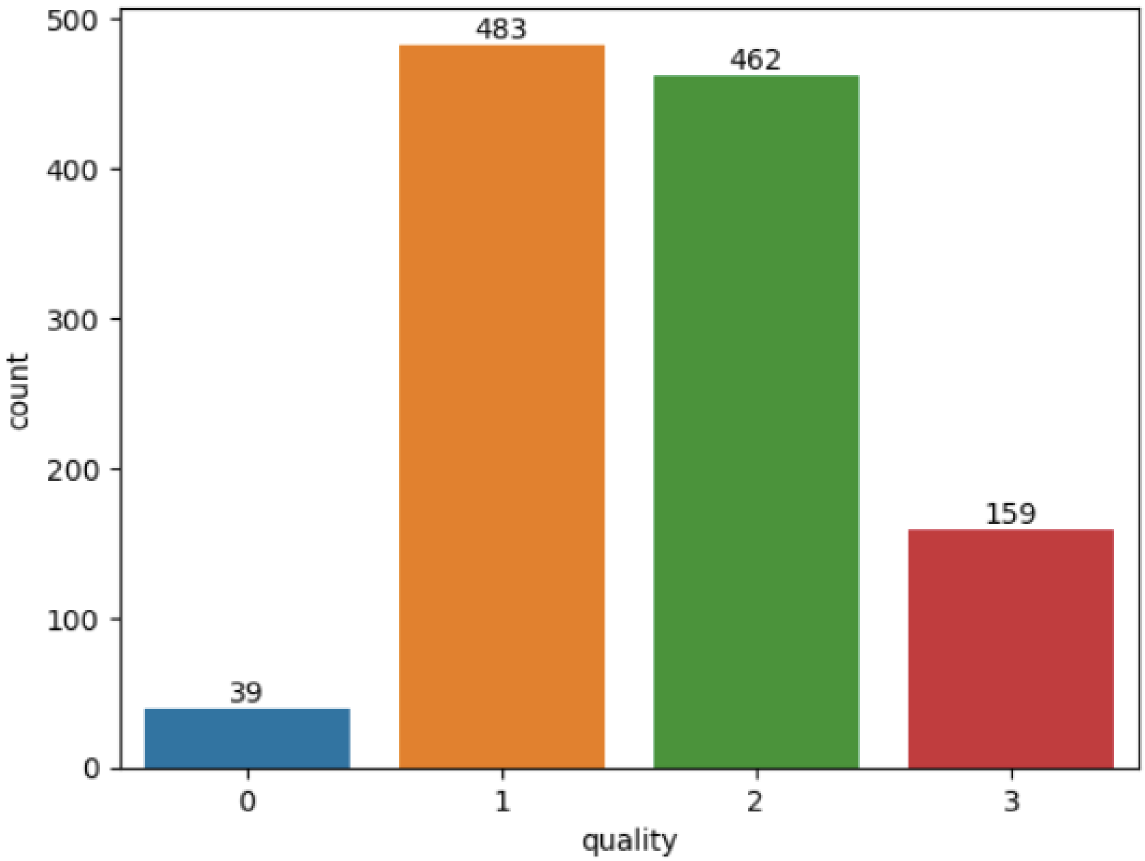


Figure 1.4: Quality Count plot after transformation

1.3.1 Train, validation and test dataset

We are going to use 80%, 20% and 20% of the dataset as training, validation and test data. The countplot are as shown below:

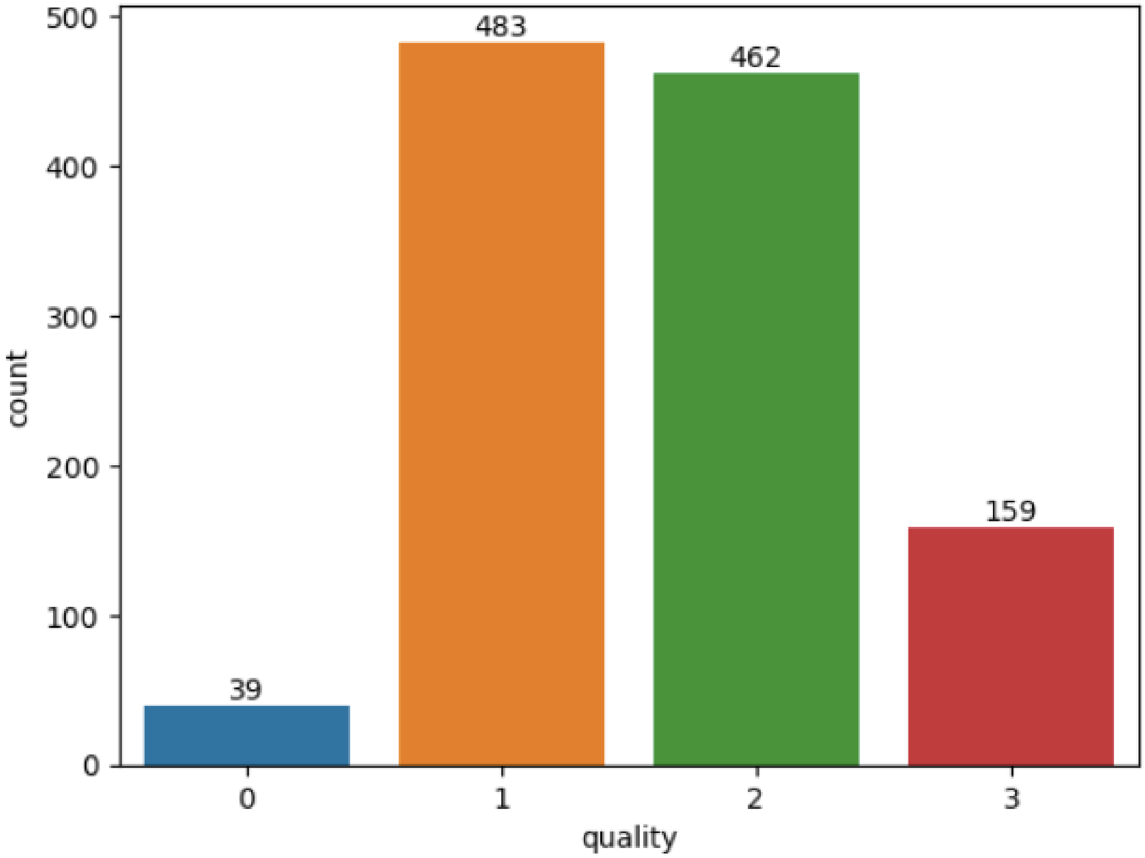


Figure 1.5: Train Quality Count plot after transformation

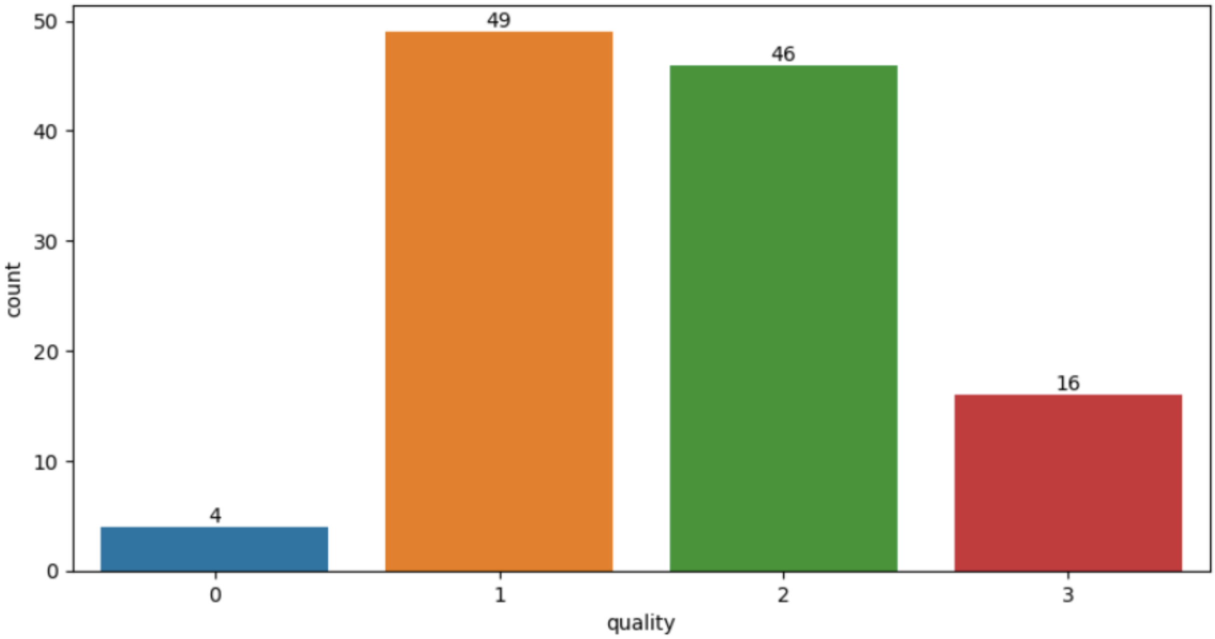


Figure 1.6: Validation Quality Count plot after transformation

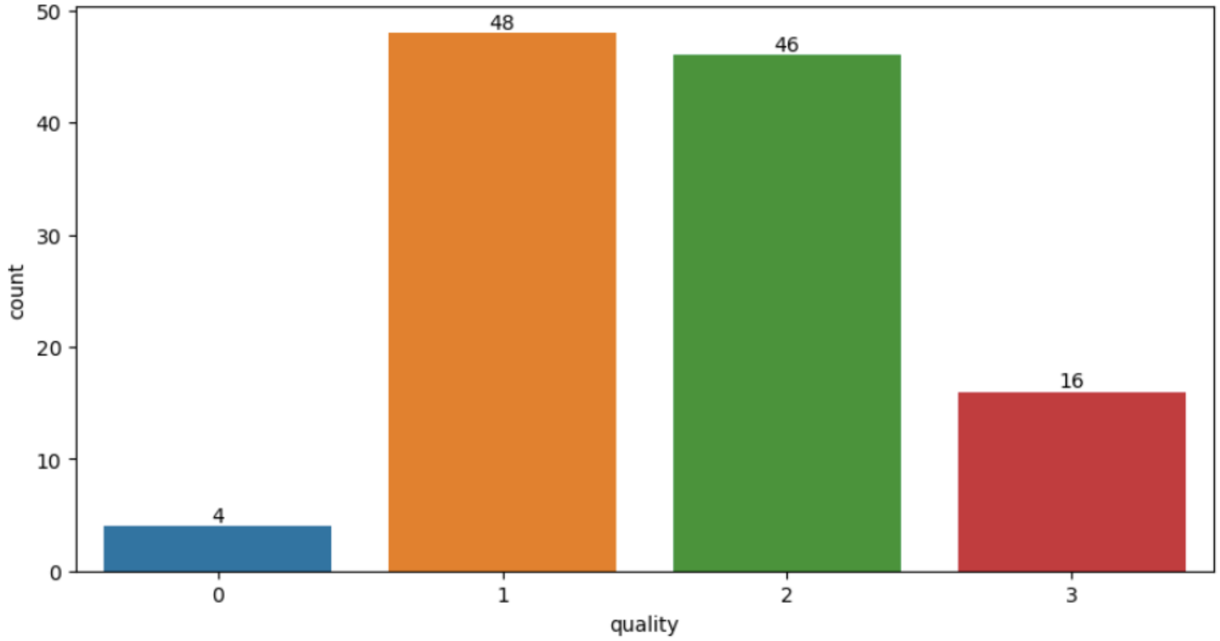


Figure 1.7: Test Quality Count plot after transformation

1.4 Expected Outcome

We expect the output to be the list of probabilites of belonging to a class[0, 1, 2 or 3]. Among these, the class with higher probability is out predicted class.

Chapter 2

Project Management

2.1 Agile Development Methodology

Teams use the agile development methodology to minimize risk (such as bugs, cost overruns, and changing requirements) when adding new functionality. In all agile methods, teams develop the software in iterations that contain mini-increments of the new functionality. There are many different forms of the agile development method, including scrum, crystal, extreme programming (XP), and feature-driven development (FDD).

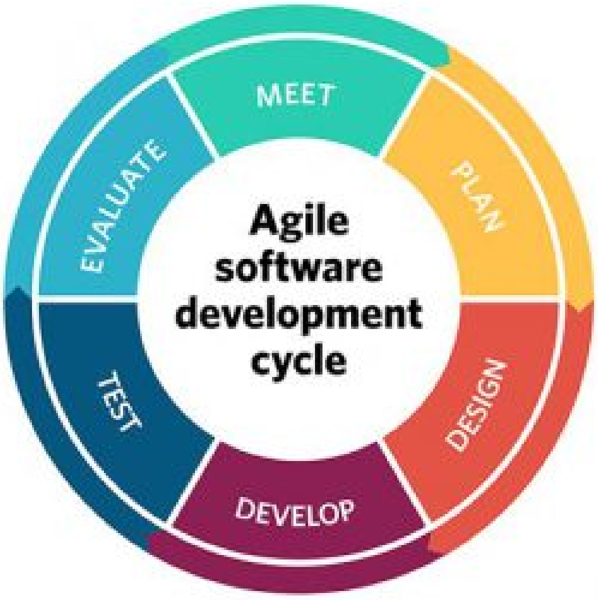
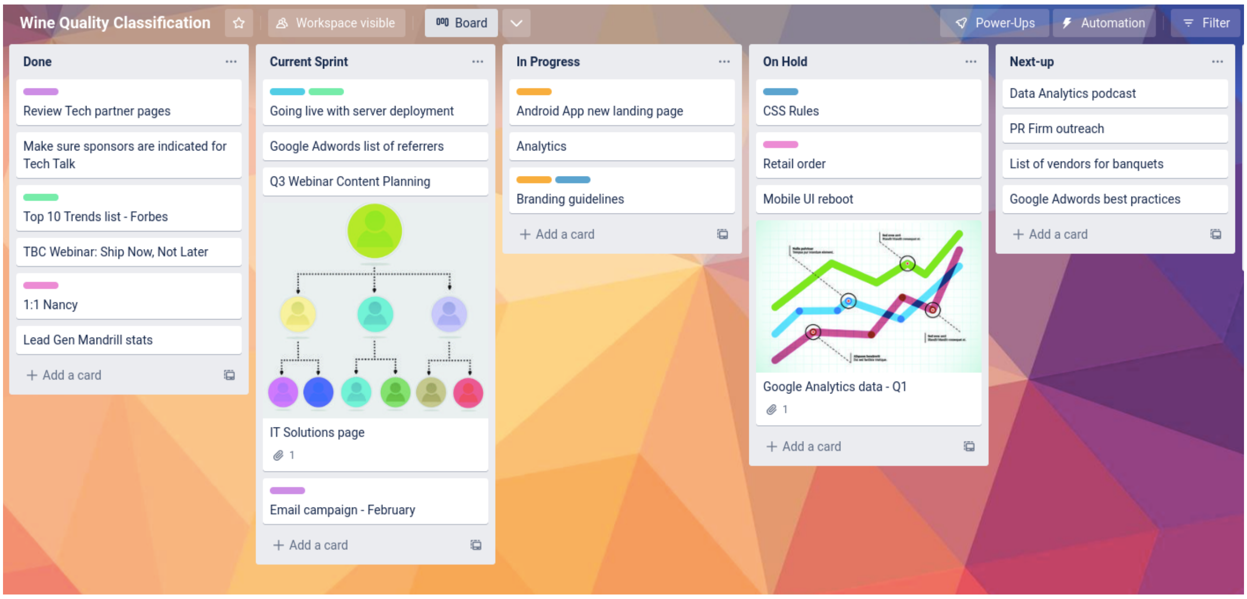


Figure 2.1: Agile Development Methodology

2.2 Trello

We are going to use Trello's default agile board for task management.



Done
- Review Tech partner pages
- Make sure sponsors are indicated for Tech Talk
- Top 10 Trends list - Forbes
- TBC Webinar: Ship Now, Not Later
- 1:1 Nancy
- Lead Gen Mandrill stats
- + Add a card

Current Sprint
- Going live with server deployment
- Google Adwords list of referrers
- Q3 Webinar Content Planning
- IT Solutions page 1
- Email campaign - February
- + Add a card

In Progress
- Android App new landing page
- Analytics
- Branding guidelines
- + Add a card

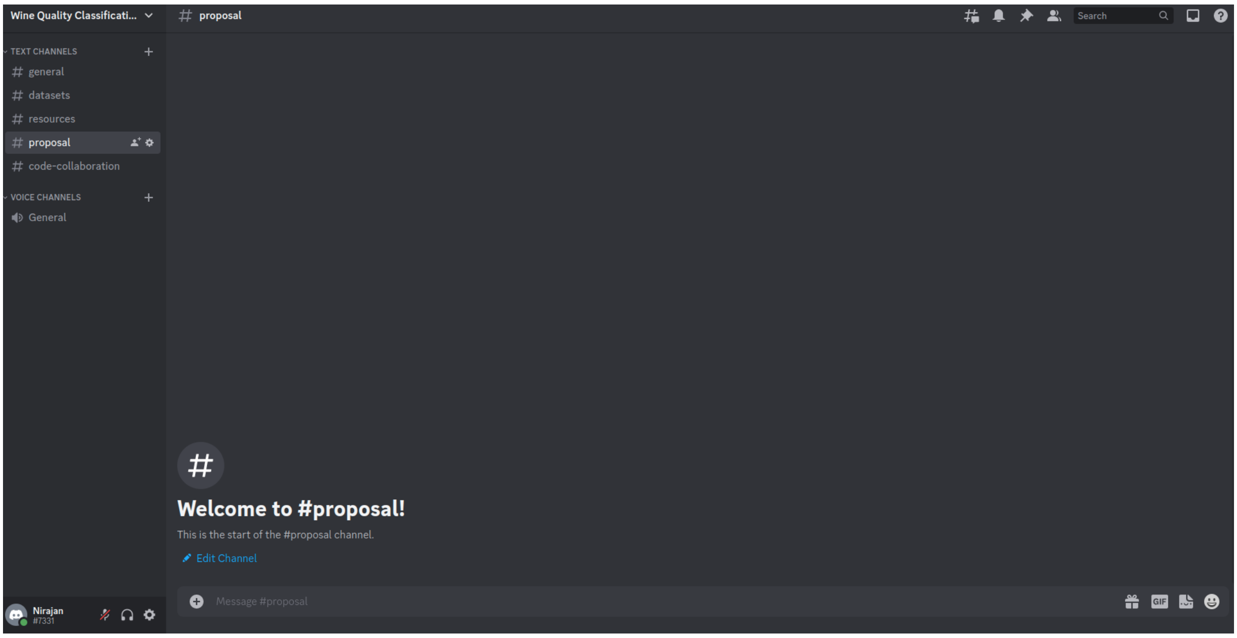
On Hold
- CSS Rules
- Retail order
- Mobile UI reboot
- Google Analytics data - Q1 1
- + Add a card

Next-up
- Data Analytics podcast
- PR Firm outreach
- List of vendors for banquets
- Google Adwords best practices
- + Add a card

Figure 2.2: Trello

2.3 Discord

We are going to use Discord server for effective communication and team meetings.



TEXT CHANNELS
- # general
- # datasets
- # resources
- # proposal
- # code-collaboration

VOICE CHANNELS
- General

proposal

Welcome to #proposal!

This is the start of the #proposal channel.

Edit Channel

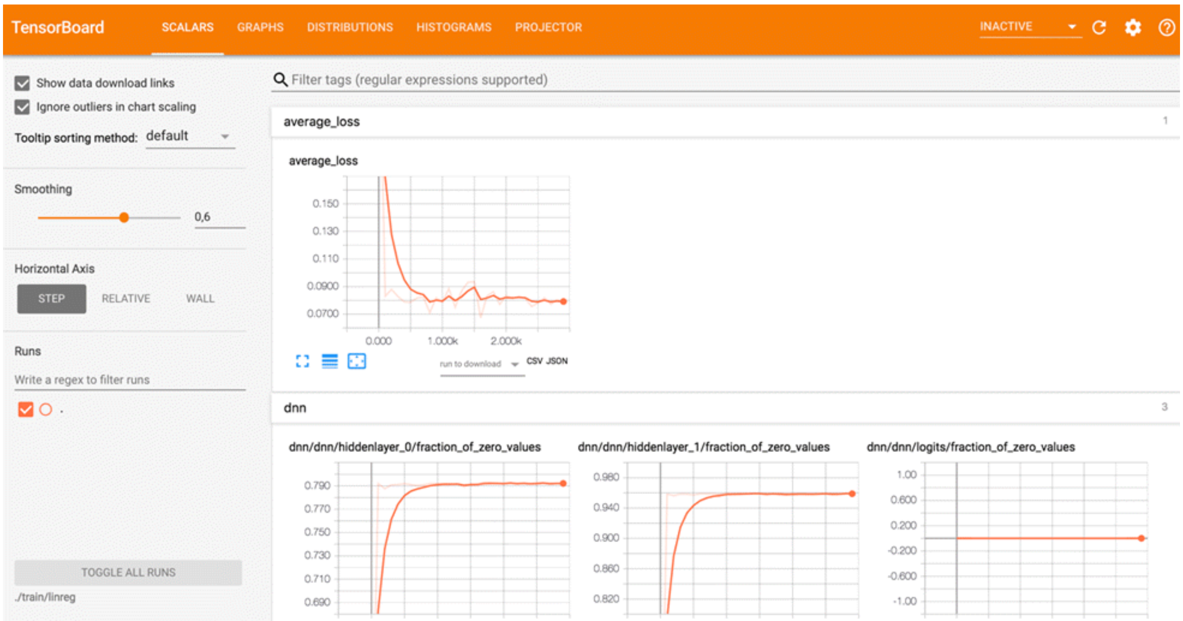
Message #proposal

Nirajan
#7331

Figure 2.3: Discord

2.4 Tensorboard

Tensorboard will be used for experiment tracking.



☑ Show data download links

☑ Ignore outliers in chart scaling

Tooltip sorting method: default

Smoothing 0,6

Horizontal Axis: STEP

Figure 2.4: Tensorboard

Chapter 3

Model Development and Evaluation

3.1 Model Development

Our data is highly imbalanced as discussed in chapter 1. So, we are going to use different methods like undersampling, oversampling, smote and class weights to handle the imbalanced data.

Since this is a classification task, we can use various machine learning models (e.g : Logistic regression, Decision Trees, Ensemble methods, etc.)

3.2 Model Evaluation

We have highly imbalanced data, so we are going to use macro F1-score as the primary model evaluation metrics. Different other evaluation like roc, auc-score, precision and recall, etc. will also be studied.