How to get drunk in style!

supervised machine learning algorithms to predict wine quality

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Ironhack Bootcamp
Februray 2025

Project Overview

How to get drunk in style:

- dataset of wine features chosen
- quality of the wine rated according to these features
- decisive features selected and normalized
- supervised machine learning algorithms implemented to predict wine quality.

objective: allow users to select best wines for maximum pleasure

impact: everyone shall can get drunk in style!

Data Set

dataset: Wine Quality Prediction

from kaggle by M Yasser H: **1143 entries** (Usability Score: 10.0)
https://www.kaggle.com/datasets/yasserh/wine-quality-dataset

11 key wine characteristics:

fixed acidity: non-volatile acids (e.g. tartaric, malic acids) -> moderate levels contribute to crisp & fresh taste, too much can make the wine overly sour.
volatile acidity: mainly acetic acid -> give undesirable vinegar taste
citric acid: enhances freshness, contributes to fruity taste.
residual sugar: sugar left unfermented, affects sweetness
chlorides: salt content, high levels give salty taste = undesirable
free sulfur dioxide: free SO_2 = prevents oxidation & microbial growth, preserves freshness, but excess gives unpleasant smell.
total sulfur dioxide: free + bound SO_2, preserve wine, very high levels cause a pungent odor.
density: Mass per unit volume, influenced by sugar and alcohol content.
Higher density indicates sweeter wine, lower density indicates drier wines.
pH: Low pH (acidic, 0-6) improves stability & freshness, high pH (alkaline, 8-14) leads to flat & dull flavors.
sulphates: Sulfur compounds act as preservatives, enhance antimicrobial properties, but excessive amounts can negatively affect taste.
alcohol: Ethanol percentage, higher alcohol correlates with better balance and richness in flavor, making it a strong predictor of quality.

Quality score (based on sensory data): 0 - 10

No name of the wines given! :-(

Comment: Portugese wines from Vinho Verde

https://en.wikipedia.org/wiki/Vinho_Verde

Data Cleaning & Preparation

Preprocessing of data for modelling:

- all column names conclusive & lower case
- all values numerical
- no null values
- no duplicated values

--> No extensive cleaning needed

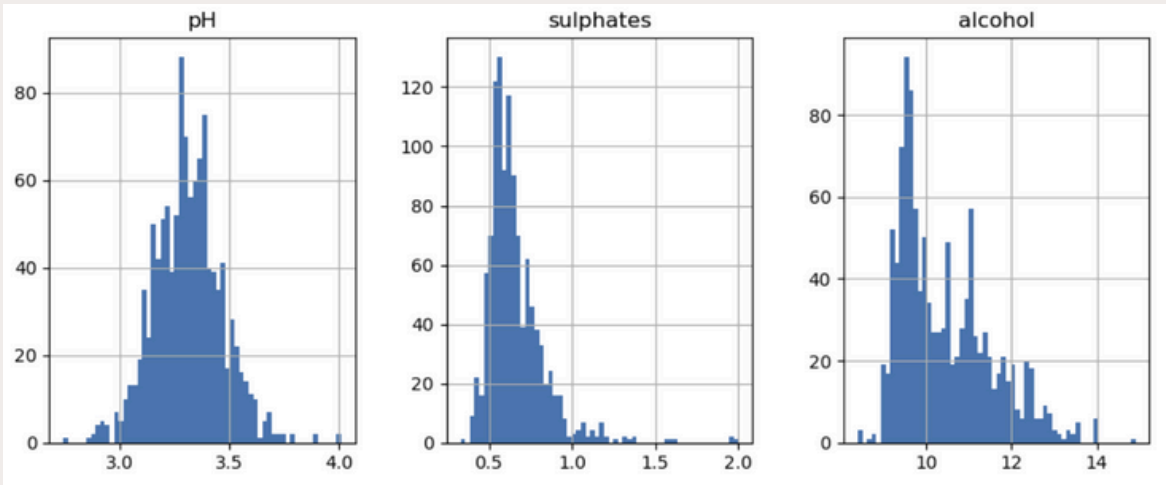
--> More free time to get drunk early on Monday

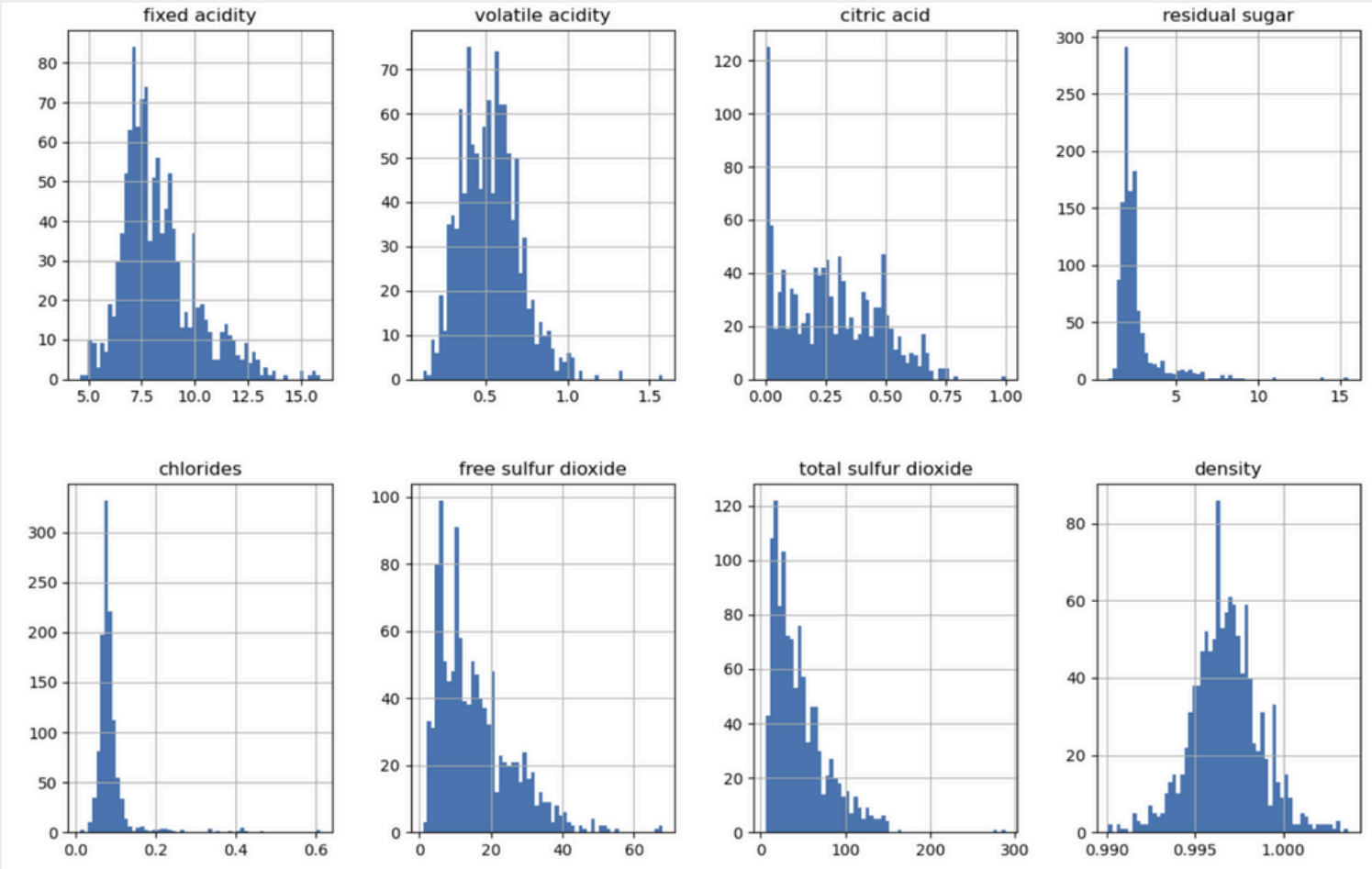
Exploratory data analysis

11 features in data

- histograms

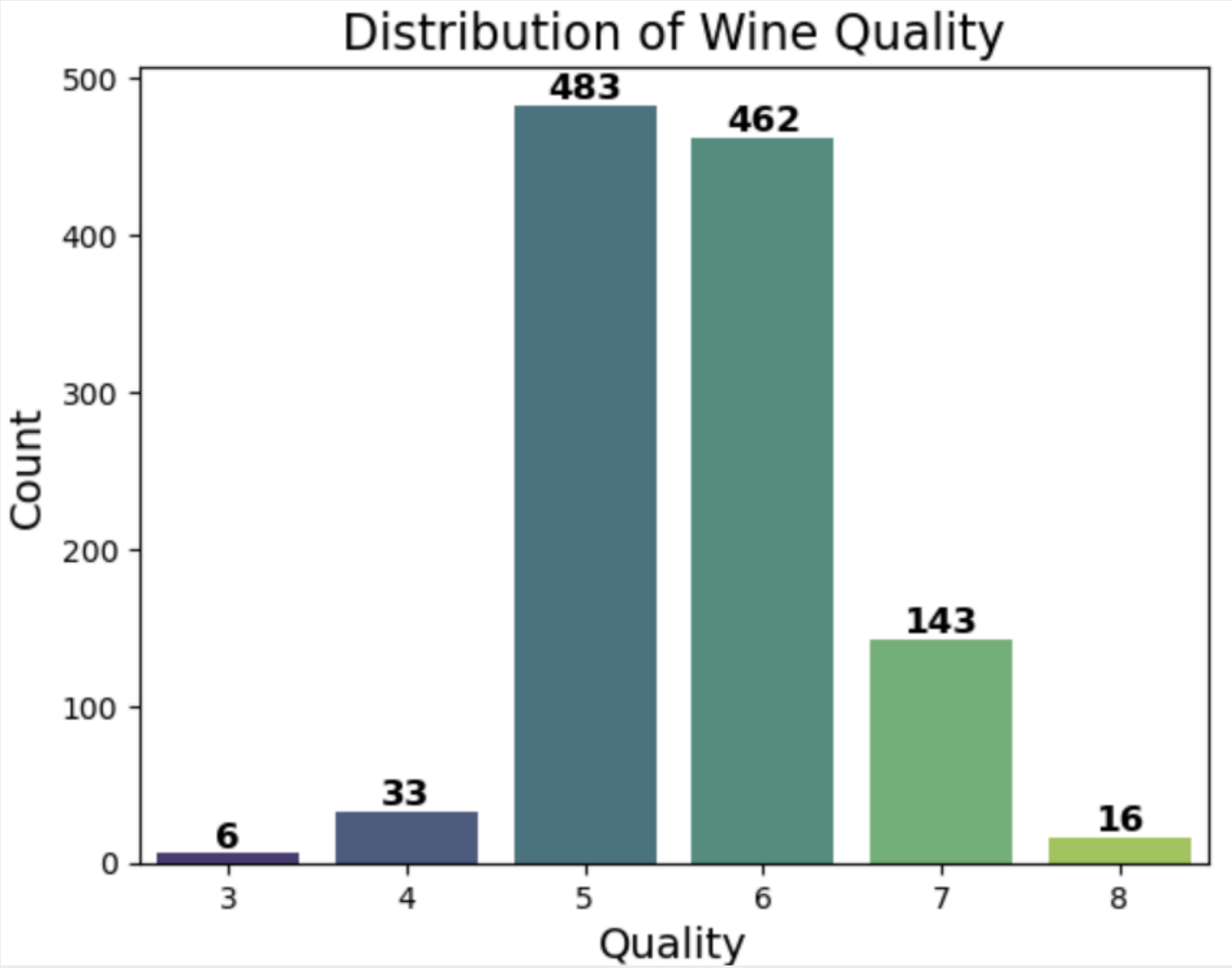
target is wine quality





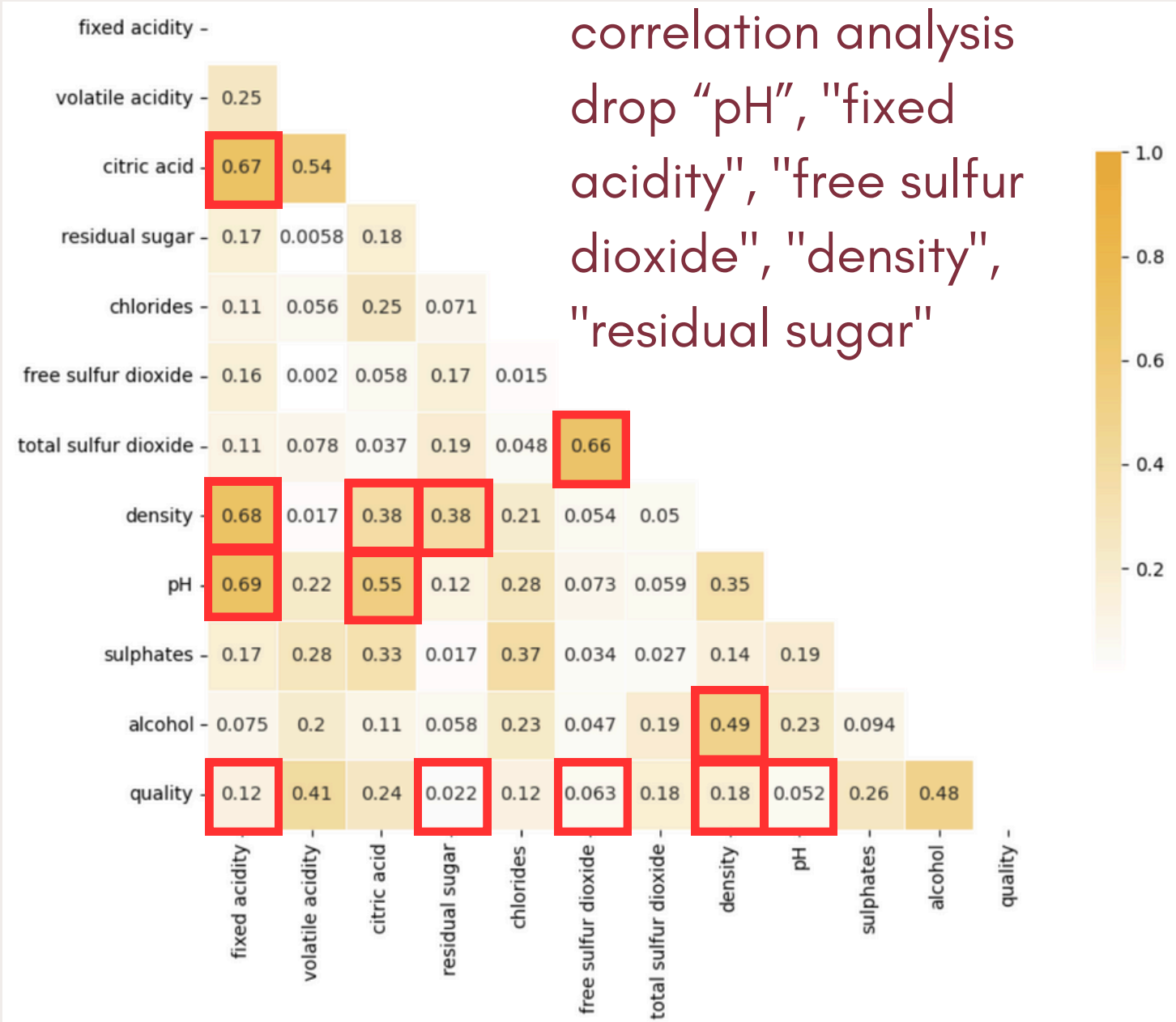
Exploratory data analysis
– wine quality –

rating based on sensory data: 0 – 10



Feature Engineering & Selection

data set split: 80% training & 20% test of total 1143 rows



correlation analysis

drop “pH”, "fixed acidity", "free sulfur dioxide", "density", "residual sugar"

Model Building

3+4 different **classification models** to predict wine quality:

- **K nearest neighbour:** 11 non-norm features, 11 min-max-norm features, or 6 selected min-max-norm features
- **Logistic regression:** 6 selected min-max-norm features
- **Decision Tree:** 6 selected min-max-norm features
- four different ensemble modelling techniques

ML Model Name	Features	Accuracy
KNN #1	11x non-normalized	45.4
KNN #2	11x MinMax-normalized	62.0
KNN #3	6x MinMax-normalized	61.6
Logistic Regression	6x MinMax-normalized	66.8
Decision Tree	6x MinMax-normalized	31.8
LogReg + Bagging	6x MinMax-normalized	65.9
Random Forest	6x MinMax-normalized	64.2
Gradient Boosting	6x MinMax-normalized	53.3
LogReg + Adapt. Boosting	6x MinMax-normalized	65.1

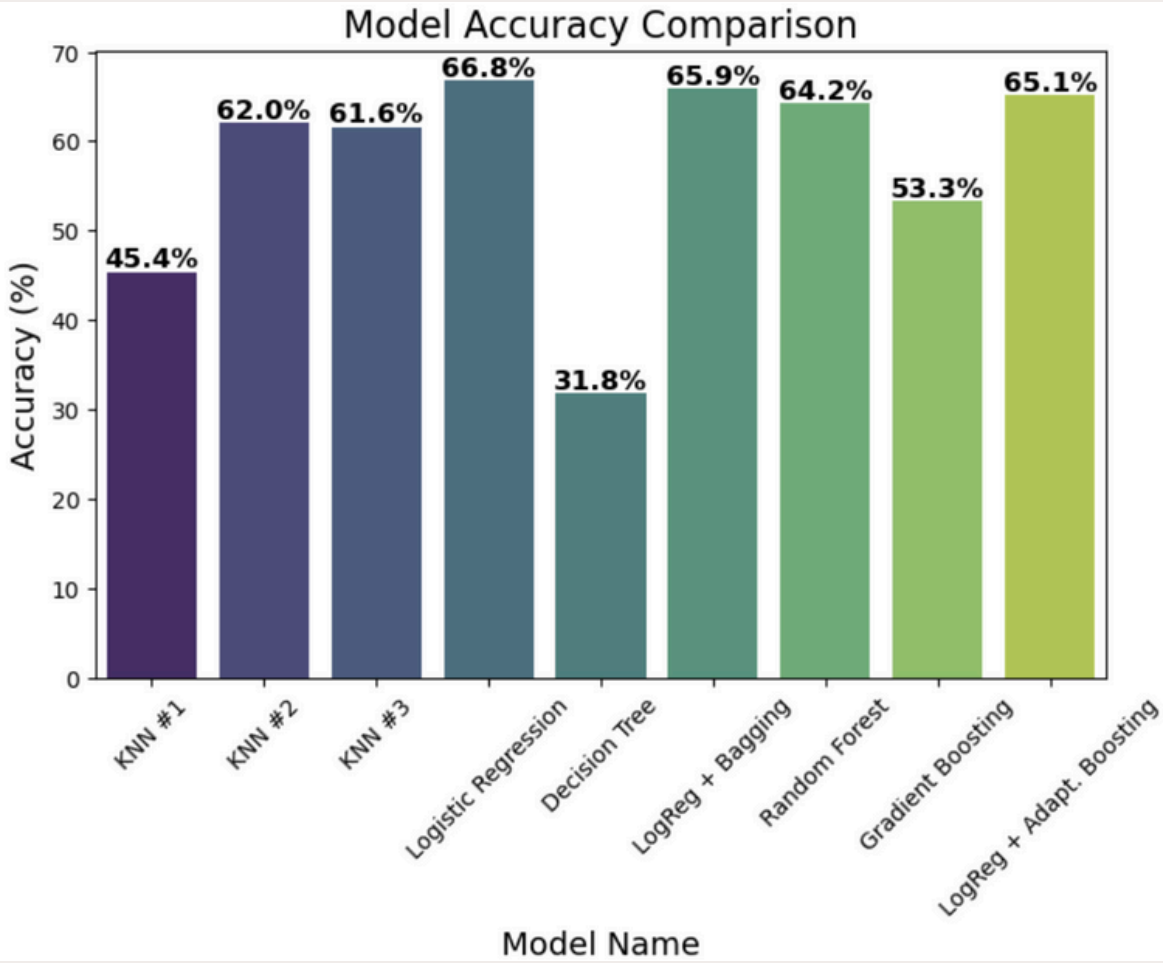
Model Evaluation

Model performance: **accuracy** of wine quality prediction:

LogReg: 66.8% > Ensemble: 53.3-65.9% >

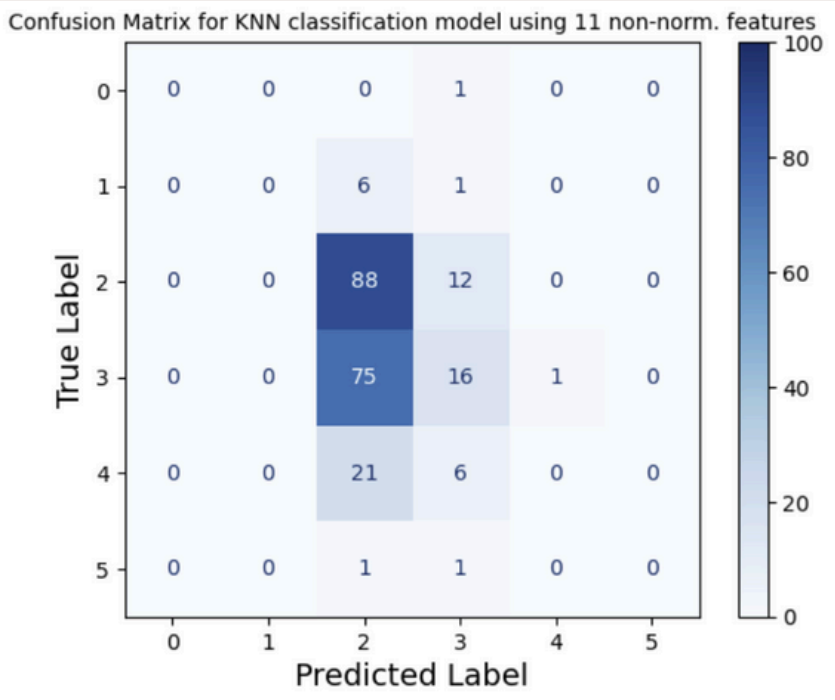
KNN: 45.4% -> **62.0%** -> **61.6%** > **Tree: 31.8%**

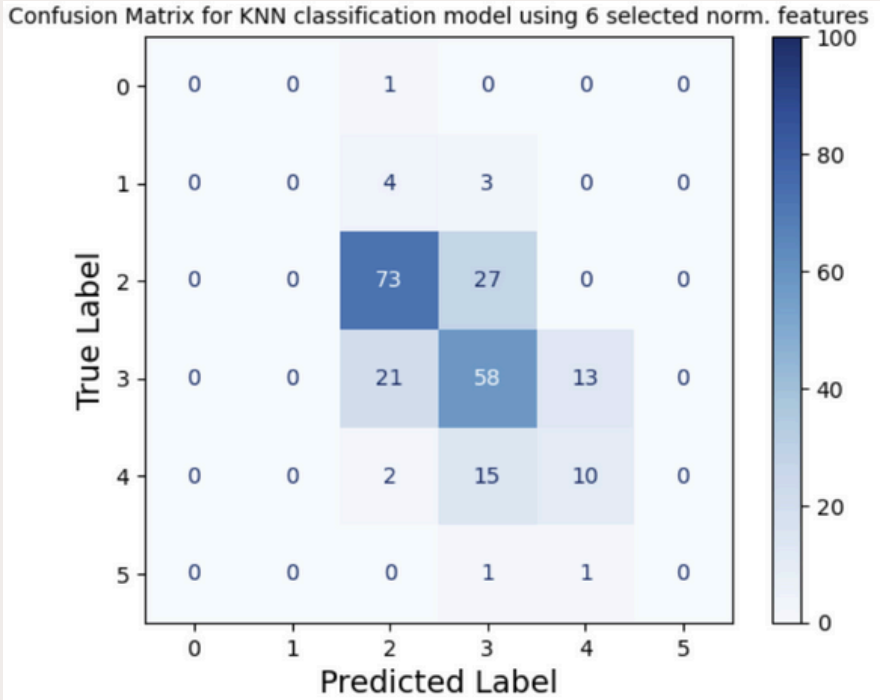
-> Logistic regression model results in best prediction!

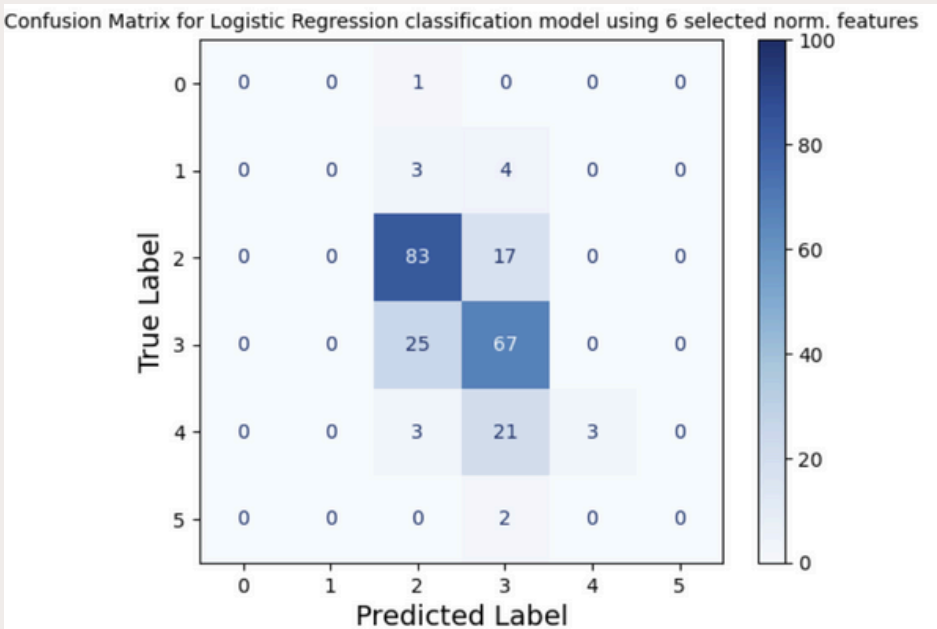


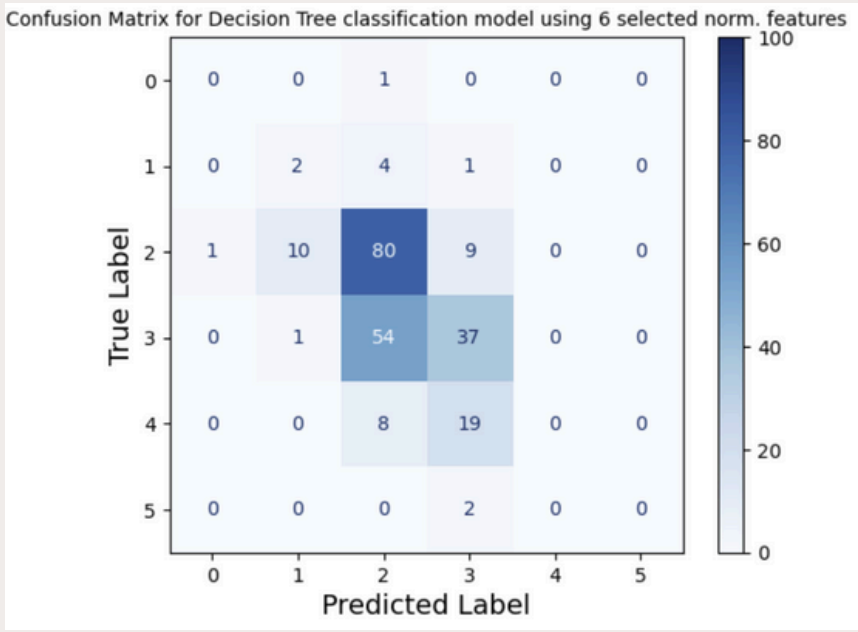
Model Evaluation

CONFUSION MATRICES









Model Optimization

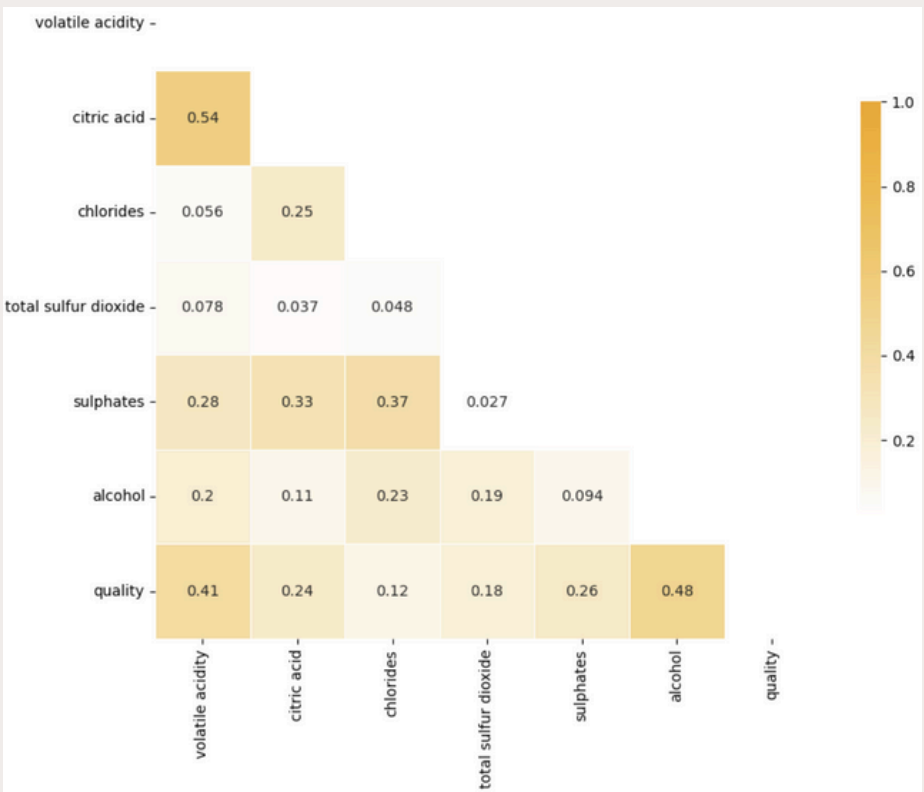
Hyperparameters = settings that control the training process of a machine learning model

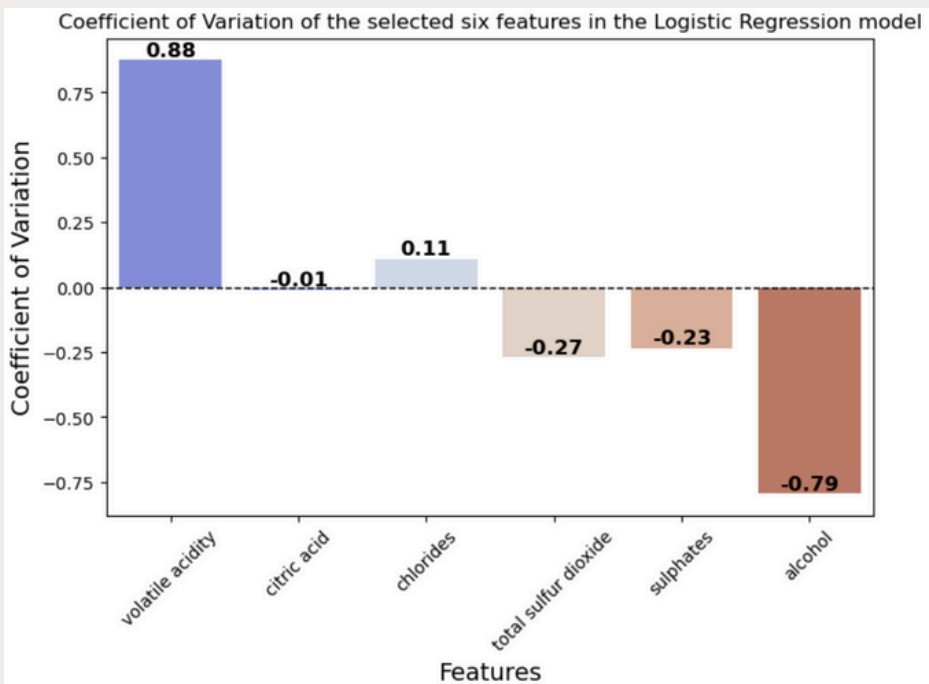
Hyperparameter tuning techniques employed:

- Grid Search (not covered)
- Cross-Validation (not covered)
  - KNN: n_neighbors=20
  - LogReg: default
  - DecTree: max_depth=5
  - Bagging: n_estimators=100, max_samples = 500
  - RandForest: n_estimators=100, max_depth=20
  - GradBoost: max_depth=20, n_estimators=100
  - AdaptBoost: n_estimators=50, learning_rate=1.0

Key Findings & Insights

- MinMax normalization improved prediction
- Model accuracy: **LogReg > 4x Ensemble > KNN > Tree**
- Feature effectiveness: correlation with wine quality
  %alc > vol.ac. > sulph. > cit.ac. > tot. sulf. diox. > chlor.
- LogReg model Coeff.Var:
  vol.ac. > %alc > tot. sulf. diox. > sulph. > chlor. > cit.ac.





Real-World Application & Impact

Application of wine quality prediction:

- Making informed decision when buying wine is possible now
- Getting drunk using good quality wine is getting easier now

Ethical considerations & limitations:

- higher prevalence of wine quality 5-7
- no normal distribution of wine qualities
- low quality wines may turn sour in shelves

Challenges & Learnings

Challenges faced:

- depression cause working alone -> drink wine
- developing ideas -> drink wine
- getting info & advice -> ask ChatGPT
- time management

Key learnings:

- Chillax! Focus!
- You can do it if you really want,
- but you must try...

Future Work & Improvements

Future Work & Expansion of Project:

- Add wine names
- Add distributers

-> facilitate access

- Increase number of wines listed
- Increase number of features (possible?)
- Model optimization applying hyperparameter tuning techniques

-> increase accuracy

-

->

Now you know what to consider when you want to get drunk in style!

Thank you !

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