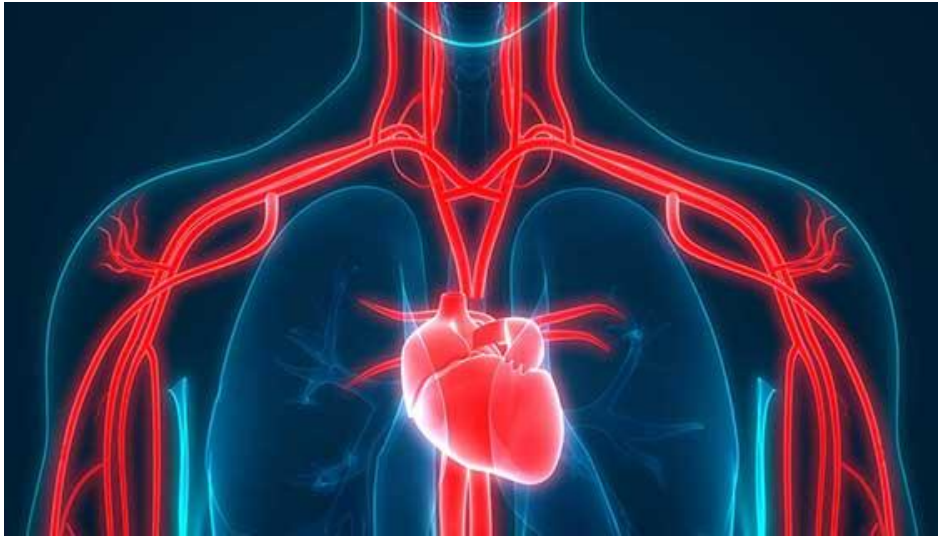
Heart Disease Detection

Metis Classification Project

Background

GOALS

- Implement classification model to predict likelihood of heart disease or a heart attack based on other health and lifestyle characteristics
- Identify who to target for early detection and intervention
- Understand feature importance to inform screening



DATA

- Obtained from Kaggle
- Comes originally from the CDC
- 21 different attributes for 253,680 individuals

Learning the heart way

- Heart disease is the leading cause of death in the United States
- ~659,000 people in the United States die from heart disease each year
- Every 40 seconds an American will have a heart attack

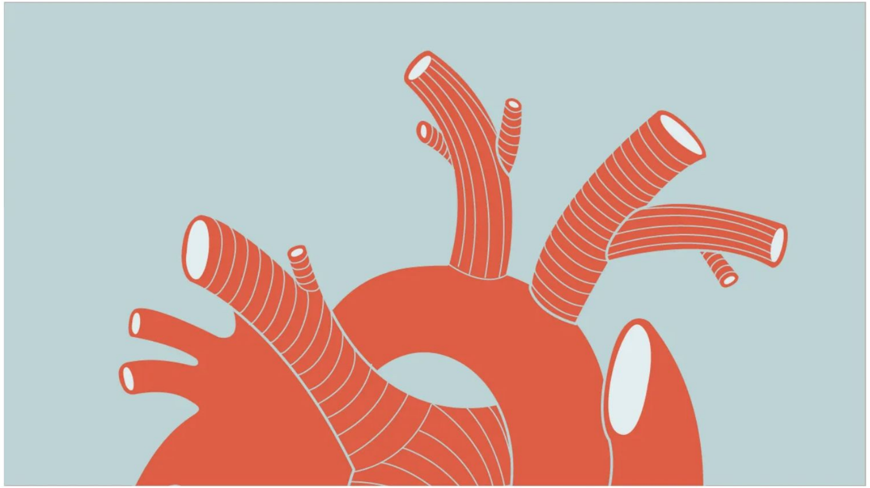
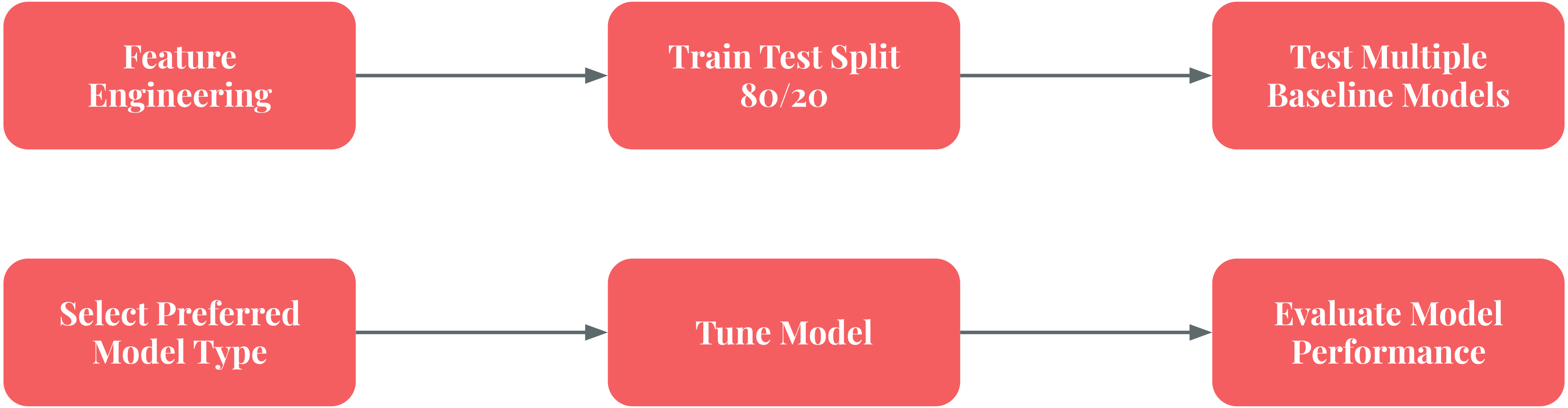


Illustration by Ruth Basagoitia and Maya Chastain

https://www.cdc.gov/heartdisease/facts.htm

Modeling Approach



Features

- Heart disease or attack
- Cholesterol
- Cholesterol check
- BMI
- Smoker
- Stroke
- Diabetes
- Physical activity
- Fruits
- Vegetables
- Skipped doctor visit b/c cost
- Alcohol consumption
- Health care
- Difficulty walking
- Sex
- Age
- Education
- Income
- General health
- Mental health
- BP

Baseline Model Comparison

Model	Neg Log Loss	Precision	Recall
Logistic Regression	-0.573144	0.439604	0.135823
Random Forest	-0.585770	0.430109	0.130722
XGB	-0.580914	0.450486	0.137719
KNN	-0.566398	0.449111	0.136477

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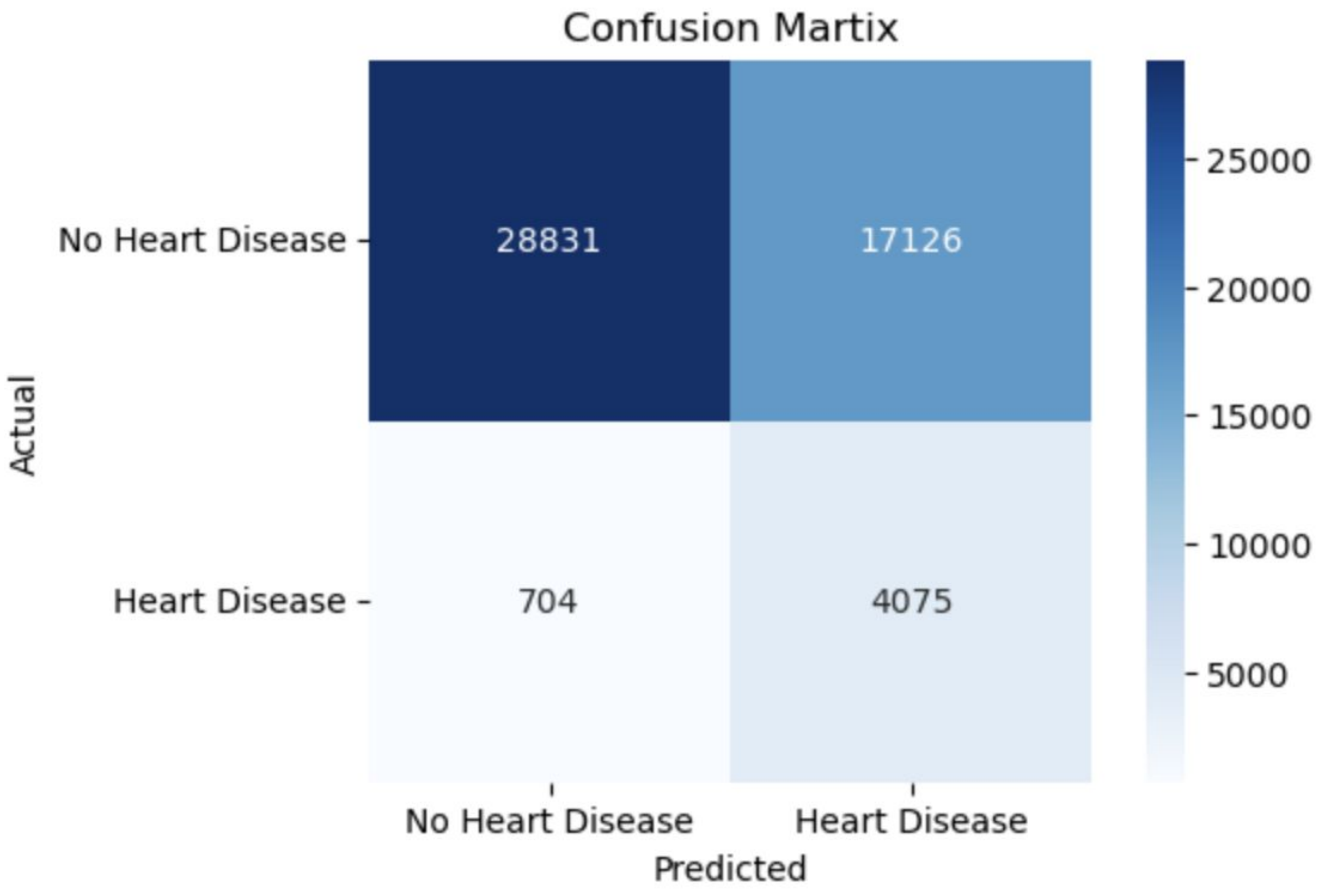
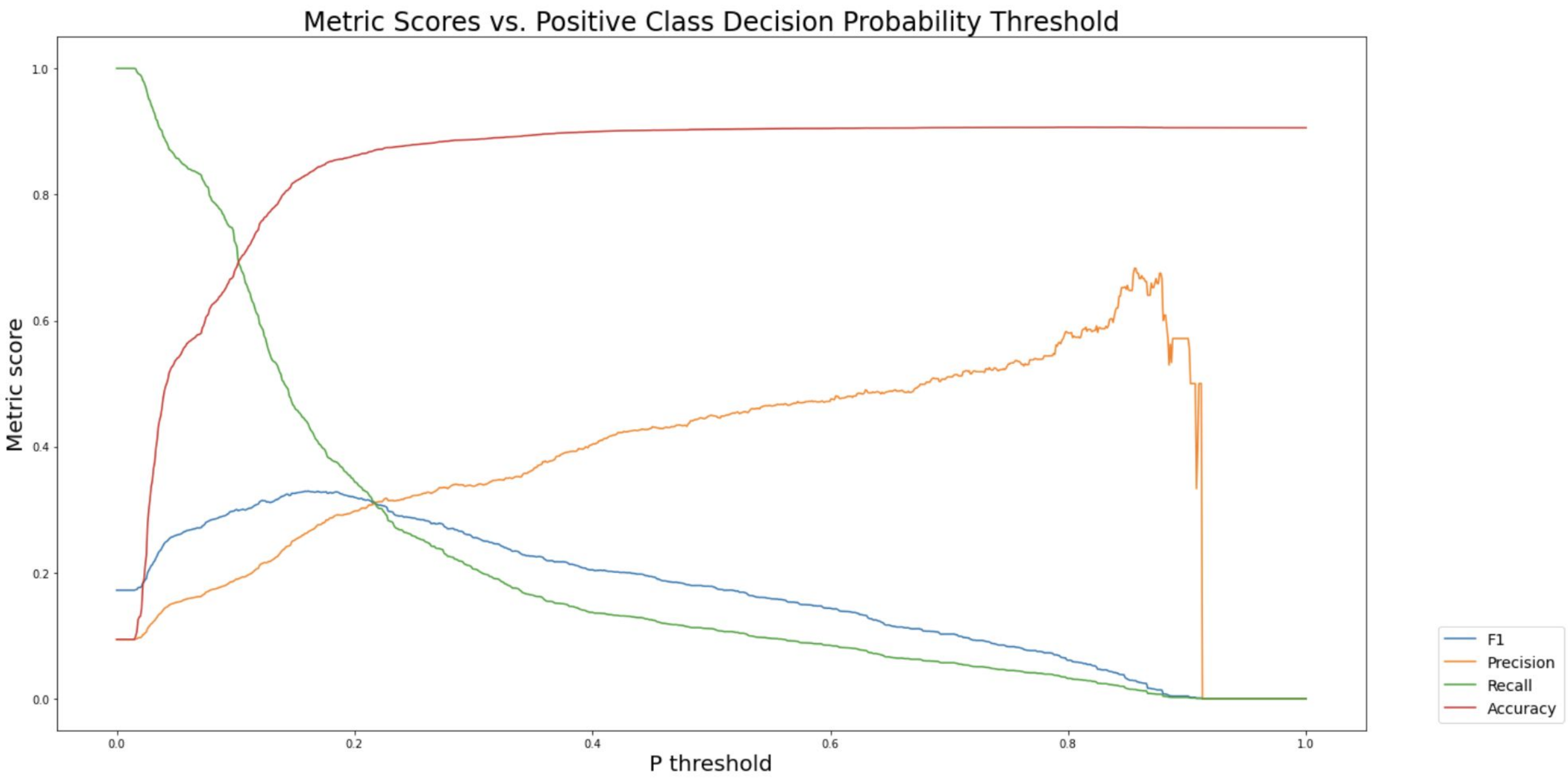
Baseline Model

	precision	recall	f1-score	support
0.0	0.99	0.41	0.58	45957
1.0	0.15	0.97	0.25	4779
accuracy			0.46	50736
macro avg	0.57	0.69	0.42	50736
weighted avg	0.91	0.46	0.55	50736

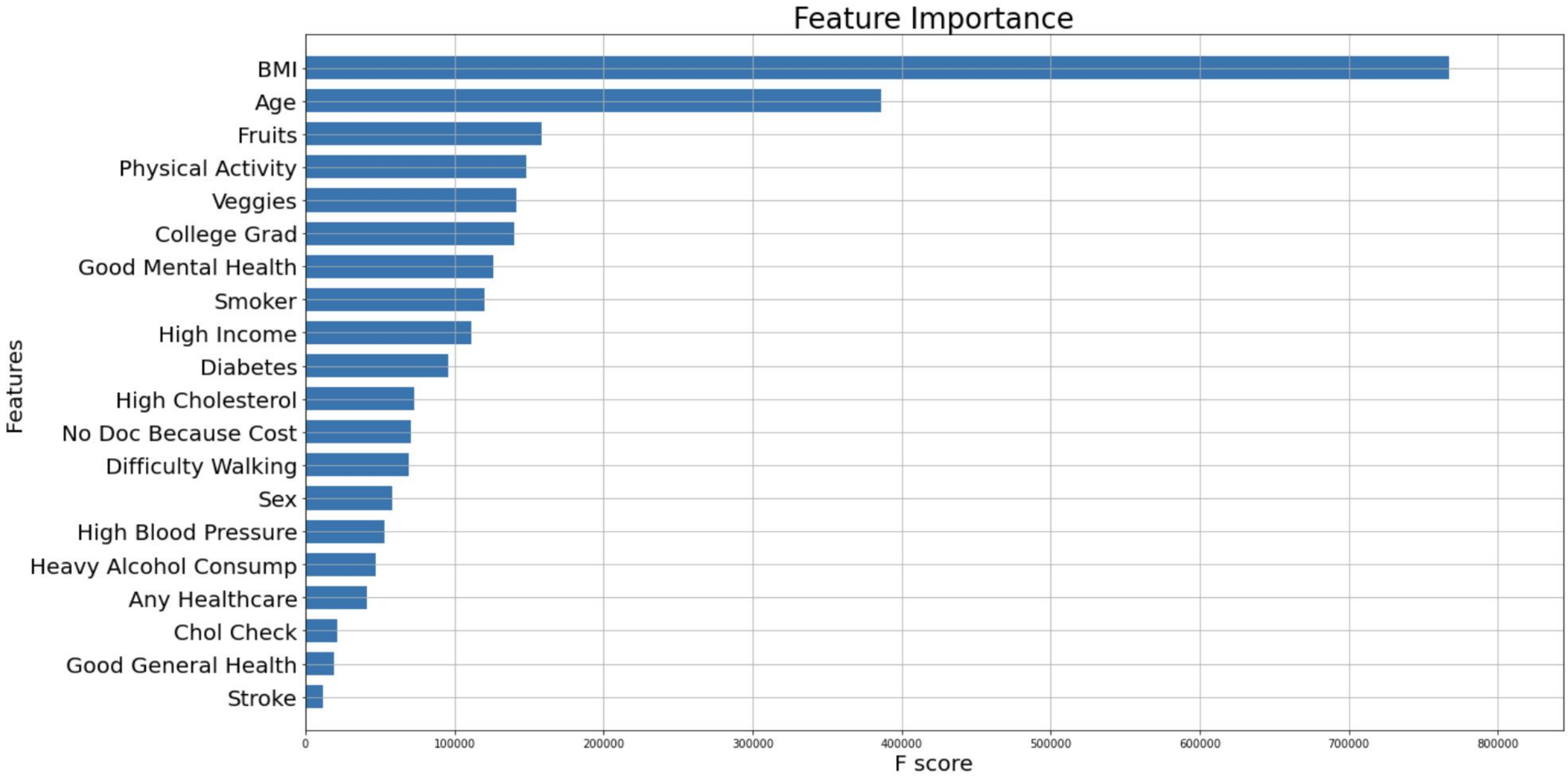
Tuned Model

	precision	recall	f1-score	support
0.0	0.98	0.63	0.76	45957
1.0	0.19	0.85	0.31	4779
accuracy			0.65	50736
macro avg	0.58	0.74	0.54	50736
weighted avg	0.90	0.65	0.72	50736


Confusion Martix
No Heart Disease
Heart Disease
Actual
28831
17126
704
4075
No Heart Disease
Heart Disease
Predicted
25000
20000
15000
10000
5000



Best F1 score 0.330 at decision threshold >= 0.161


Feature Importance
BMI
Age
Fruits
Physical Activity
Veggies
College Grad
Good Mental Health
Smoker
High Income
Diabetes
High Cholesterol
No Doc Because Cost
Difficulty Walking
Sex
High Blood Pressure
Heavy Alcohol Consump
Any Healthcare
Chol Check
Good General Health
Stroke
Features
0
100000
200000
300000
400000
500000
600000
700000
800000
F score

Conclusion

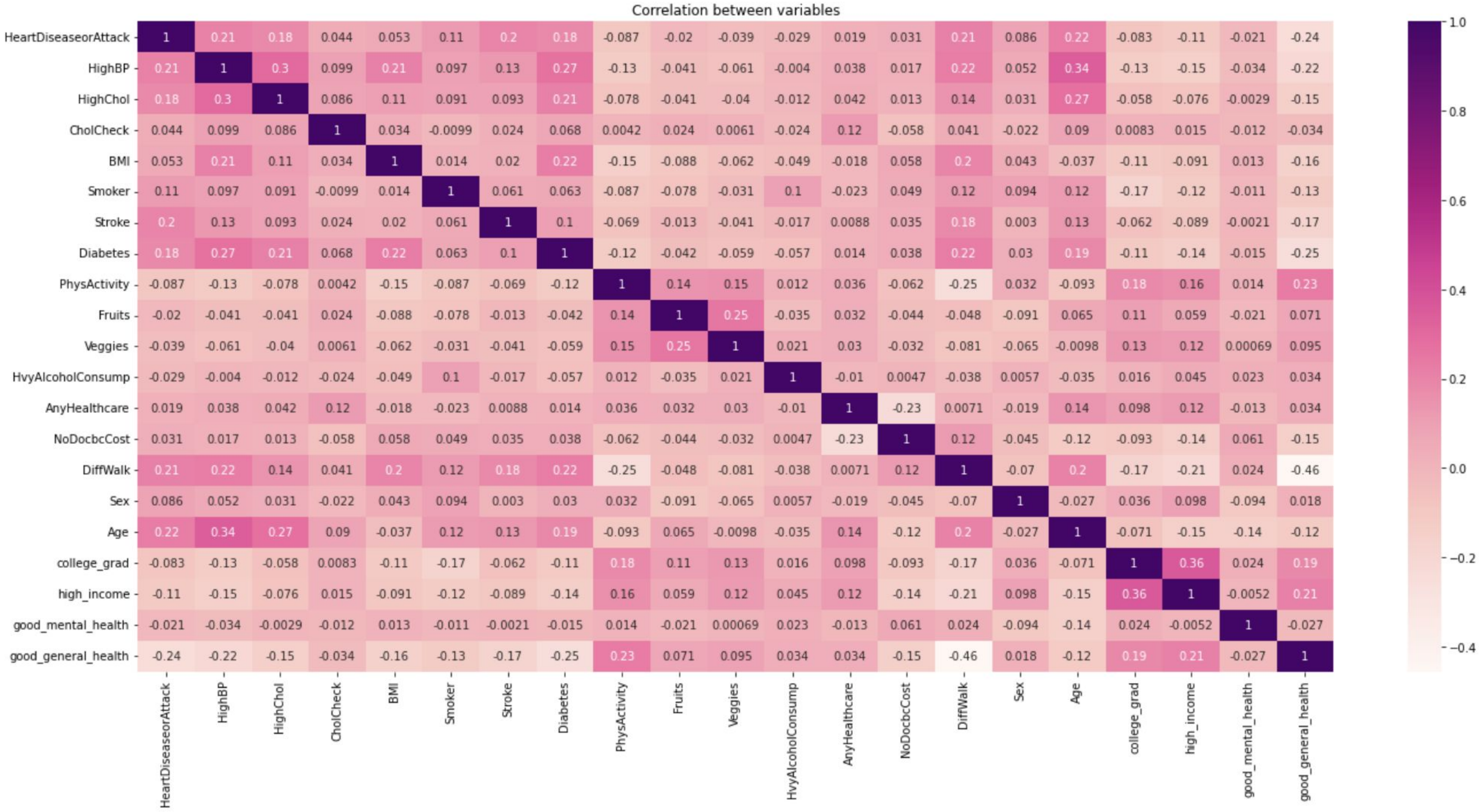
KEY TAKEAWAYS

- BMI and age are key features
- Minimizing false negatives comes with the cost of increasing false positives

NEXT STEPS

- Age for screening?
- Cost of a false positive vs a false negative?
- Could ensembling improve prediction performance?

Appendix


Correlation between variables
HeartDiseaseorAttack 1 0.21 0.18 0.044 0.053 0.11 0.2 0.18 -0.087 -0.02 -0.039 -0.029 0.019 0.031 0.21 0.086 0.22 -0.083 -0.11 -0.021 -0.24
HighBP 0.21 1 0.3 0.099 0.21 0.097 0.13 0.27 -0.13 -0.041 -0.061 -0.004 0.038 0.017 0.22 0.052 0.34 -0.13 -0.15 -0.034 -0.22
HighChol 0.18 0.3 1 0.086 0.11 0.091 0.093 0.21 -0.078 -0.041 -0.04 -0.012 0.042 0.013 0.14 0.031 0.27 -0.058 -0.076 -0.0029 -0.15
CholCheck 0.044 0.099 0.086 1 0.034 -0.0099 0.024 0.068 0.0042 0.024 0.0061 -0.024 0.12 -0.058 0.041 -0.022 0.09 0.0083 0.015 -0.012 -0.034
BMI 0.053 0.21 0.11 0.034 1 0.014 0.02 0.22 -0.15 -0.088 -0.062 -0.049 -0.018 0.058 0.2 0.043 -0.037 -0.11 -0.091 0.013 -0.16
Smoker 0.11 0.097 0.091 -0.0099 0.014 1 0.061 0.063 -0.087 -0.078 -0.031 0.1 -0.023 0.049 0.12 0.094 0.12 -0.17 -0.12 -0.011 -0.13
Stroke 0.2 0.13 0.093 0.024 0.02 0.061 1 0.1 -0.069 -0.013 -0.041 -0.017 0.0088 0.035 0.18 0.003 0.13 -0.062 -0.089 -0.0021 -0.17
Diabetes 0.18 0.27 0.21 0.068 0.22 0.063 0.1 1 -0.12 -0.042 -0.059 -0.057 0.014 0.038 0.22 0.03 0.19 -0.11 -0.14 -0.015 -0.25
PhysActivity -0.087 -0.13 -0.078 0.0042 -0.15 -0.087 -0.069 -0.12 1 0.14 0.15 0.012 0.036 -0.062 -0.25 0.032 -0.093 0.18 0.16 0.014 0.23
Fruits -0.02 -0.041 -0.041 0.024 -0.088 -0.078 -0.013 -0.042 0.14 1 0.25 -0.035 0.032 -0.044 -0.048 -0.091 0.065 0.11 0.059 -0.021 0.071
Veggies -0.039 -0.061 -0.04 0.0061 -0.062 -0.031 -0.041 -0.059 0.15 0.25 1 0.021 0.03 -0.032 -0.081 -0.065 -0.0098 0.13 0.12 0.00069 0.095
HvyAlcoholConsump -0.029 -0.004 -0.012 -0.024 -0.049 0.1 -0.017 -0.057 0.012 -0.035 0.021 1 -0.01 0.0047 -0.038 0.0057 -0.035 0.016 0.045 0.023 0.034
AnyHealthcare 0.019 0.038 0.042 0.12 -0.018 -0.023 0.0088 0.014 0.036 0.032 0.03 -0.01 1 -0.23 0.0071 -0.019 0.14 0.098 0.12 -0.013 0.034
NoDocbcCost 0.031 0.017 0.013 -0.058 0.058 0.049 0.035 0.038 -0.062 -0.044 -0.032 0.0047 -0.23 1 0.12 -0.045 -0.12 -0.093 -0.14 0.061 -0.15
DiffWalk 0.21 0.22 0.14 0.041 0.2 0.12 0.18 0.22 -0.25 -0.048 -0.081 -0.038 0.0071 0.12 1 -0.07 0.2 -0.17 -0.21 0.024 -0.46
Sex 0.086 0.052 0.031 -0.022 0.043 0.094 0.003 0.03 0.032 -0.091 -0.065 0.0057 -0.019 -0.045 -0.07 1 -0.027 0.036 0.098 -0.094 0.018
Age 0.22 0.34 0.27 0.09 -0.037 0.12 0.13 0.19 -0.093 0.065 -0.0098 -0.035 0.14 -0.12 0.2 -0.027 1 -0.071 -0.15 -0.14 -0.12
college_grad -0.083 -0.13 -0.058 0.0083 -0.11 -0.17 -0.062 -0.11 0.18 0.11 0.13 0.016 0.098 -0.093 -0.17 0.036 -0.071 1 0.36 0.024 0.19
high_income -0.11 -0.15 -0.076 0.015 -0.091 -0.12 -0.089 -0.14 0.16 0.059 0.12 0.045 0.12 -0.14 -0.21 0.098 -0.15 0.36 1 -0.0052 0.21
good_mental_health -0.021 -0.034 -0.0029 -0.012 0.013 -0.011 -0.0021 -0.015 0.014 -0.021 0.00069 0.023 -0.013 0.061 0.024 -0.094 -0.14 0.024 -0.0052 1 -0.027
good_general_health -0.24 -0.22 -0.15 -0.034 -0.16 -0.13 -0.17 -0.25 0.23 0.071 0.095 0.034 0.034 -0.15 -0.46 0.018 -0.12 0.19 0.21 -0.027 1
HeartDiseaseorAttack HighBP HighChol CholCheck BMI Smoker Stroke Diabetes PhysActivity Fruits Veggies HvyAlcoholConsump AnyHealthcare NoDocbcCost DiffWalk Sex Age college_grad high_income good_mental_health good_general_health
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4

```python
#create dummy variable to indicate whether someone has a college degree
df['college_grad']= (df['Education'] == 6 ).astype(int)

#create variable to indicate whether someone makes more than $50,000 annually
df['high_income']= (df['Income'].isin([8,9]).astype(int))

#create variable to indicate whether people reported having poor mental health in more than 15 of the past 30 days
few_days = []
few_days.extend(range(1,15))
few_days.append(88)
df['good_mental_health']= (df['MentHlth'].isin(few_days).astype(int)) #88 is "None"

#create variable to indicate whether people report health as good/very good/excellent (1) vs fair/poor (0)
df['good_general_health']= (df['GenHlth'].isin([1,2,3]).astype(int))

```

```
y_test  rf and xgb agree
0.0     True                30214
        False               15743
1.0     False                3319
        True                 1460
```

	variables	vif
0	HighBP	2.302320
1	HighChol	2.033872
2	CholCheck	21.481795
3	BMI	16.239262
4	Smoker	1.933629
5	Stroke	1.104151
6	Diabetes	1.416915
7	PhysActivity	4.581396
8	Fruits	3.022398
9	Veggies	5.701816
10	HvyAlcoholConsump	1.082131
11	AnyHealthcare	19.026871
12	NoDocbcCost	1.168536
13	DiffWalk	1.687309
14	Sex	1.872135
15	Age	9.822311
16	college_grad	2.112582
17	high_income	1.953899
18	good_mental_health	1.309966
19	good_general_health	7.375602