An ML Tool to Detect Heart Disease

CIND-820: Big Data Analytics Project
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Why Heart Disease?

365 x 24 x 14

Every hour, 14 adults die in Canada due to heart disease[1]

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1: Public-Health-Agency-of-Canada. (2022)

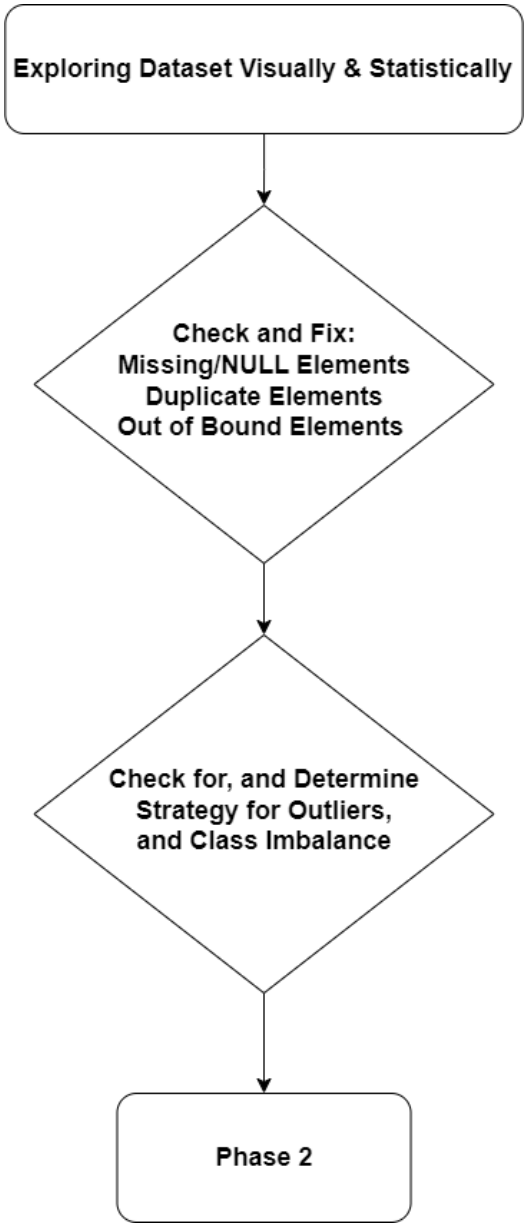
The Data:

https://ieee-dataport.org/open-access/heart-disease-dataset-comprehensive

Heart Disease Dataset Attribute Description

S.No.	Attribute	Code given	Unit	Data type
1	age	Age	in years	Numeric
2	sex	Sex	1, 0	Binary
3	chest pain type	chest pain type	1,2,3,4	Nominal
4	resting blood pressure	resting bp s	in mm Hg	Numeric
5	serum cholesterol	cholesterol	in mg/dl	Numeric
6	fasting blood sugar	fasting blood sugar	1,0 > 120 mg/dl	Binary
7	resting electrocardiogram results	resting ecg	0,1,2	Nominal
8	maximum heart rate achieved	max heart rate	71–202	Numeric
9	exercise induced angina	exercise angina	0,1	Binary
10	oldpeak =ST	oldpeak	depression	Numeric
11	the slope of the peak exercise ST segment	ST slope	0,1,2	Nominal
12	class	target	0,1	Binary

Phase-1:



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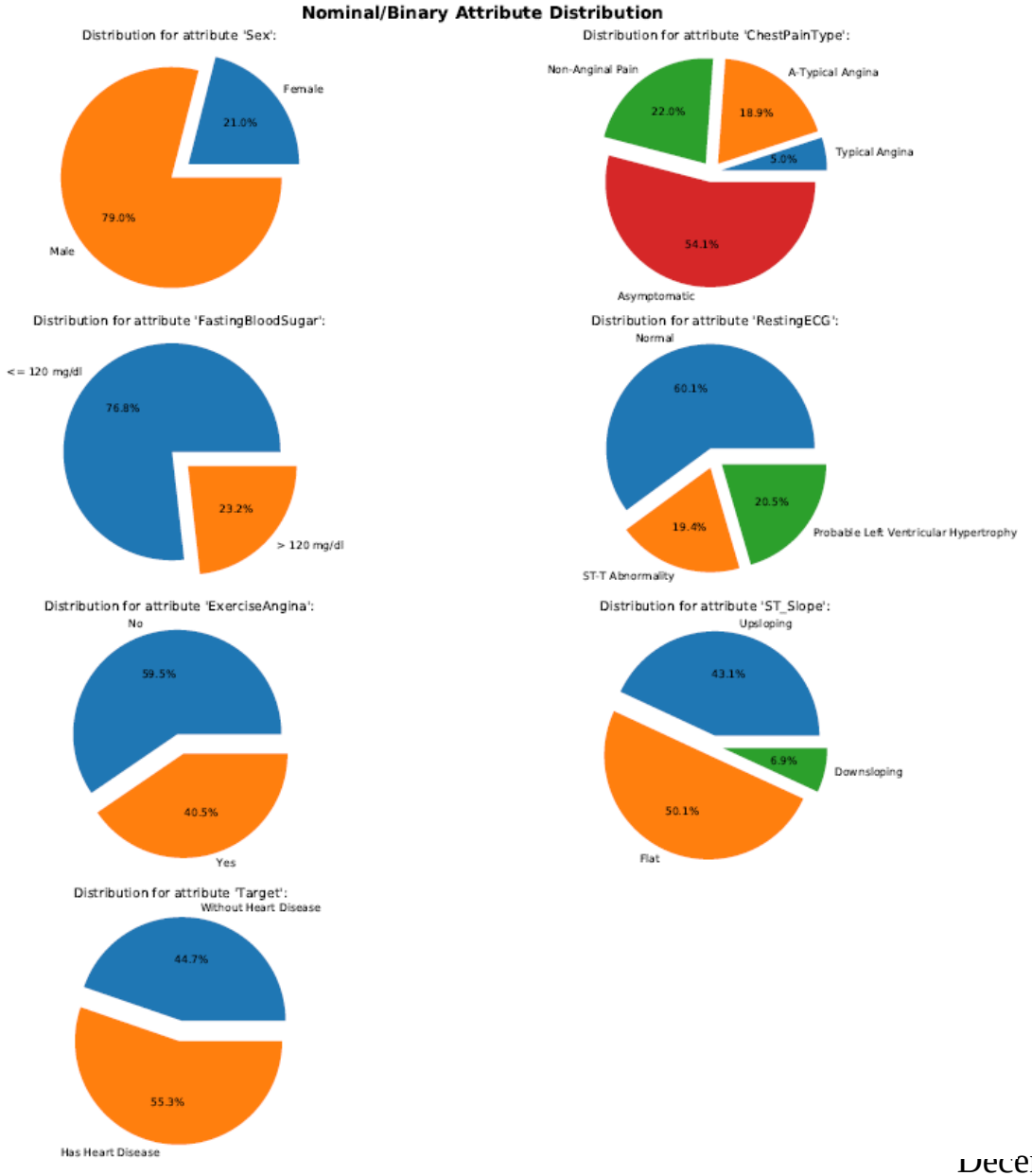
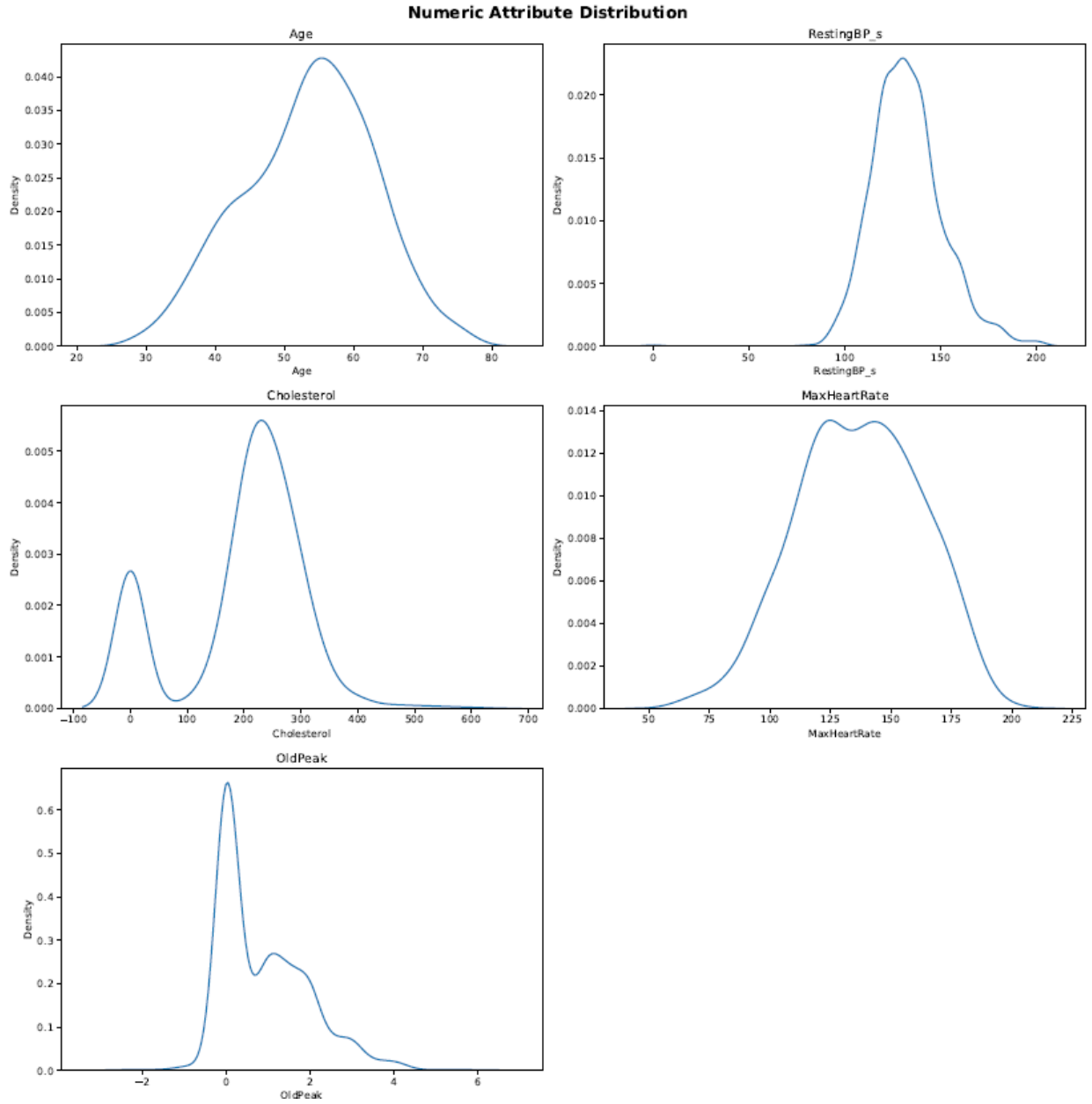
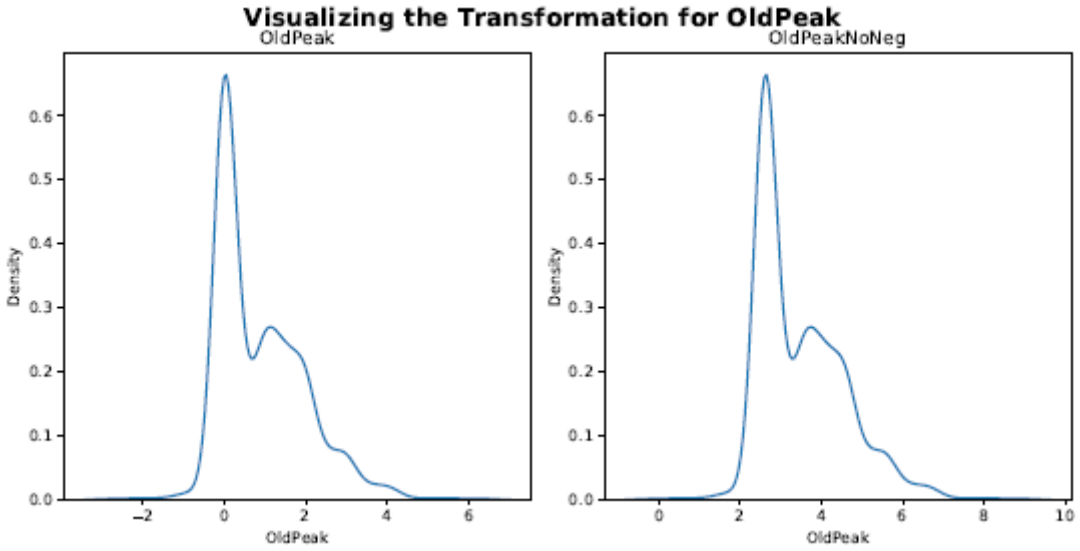
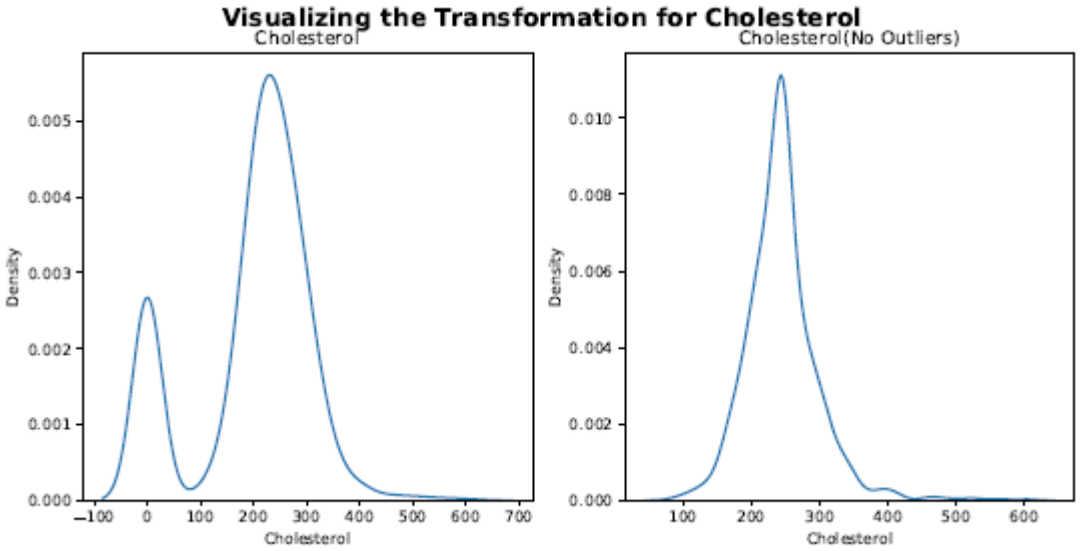
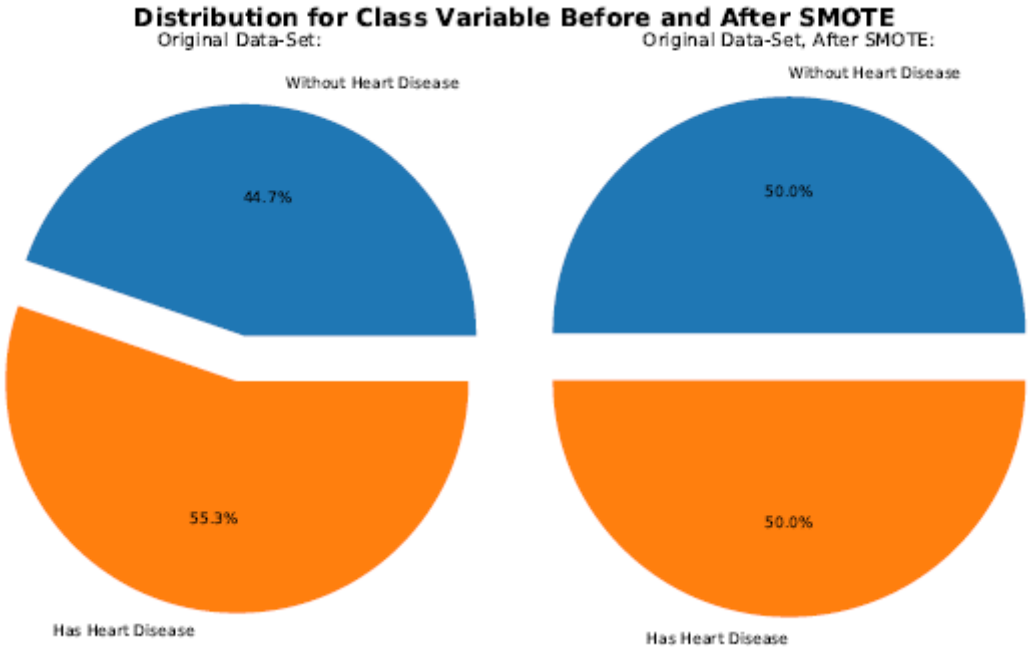

Nominal/Binary Attribute Distribution
Distribution for attribute 'Sex':
Female
21.0%
79.0%
Male
Distribution for attribute 'ChestPainType':
Non-Anginal Pain
22.0%
A-Typical Angina
18.9%
5.0%
Typical Angina
54.1%
Asymptomatic
Distribution for attribute 'FastingBloodSugar':
<= 120 mg/dl
76.8%
23.2%
> 120 mg/dl
Distribution for attribute 'RestingECG':
Normal
60.1%
20.5%
Probable Left Ventricular Hypertrophy
19.4%
ST-T Abnormality
Distribution for attribute 'ExerciseAngina':
No
59.5%
40.5%
Yes
Distribution for attribute 'ST_Slope':
Upsloping
43.1%
6.9%
Downsloping
50.1%
Flat
Distribution for attribute 'Target':
Without Heart Disease
44.7%
55.3%
Has Heart Disease


Numeric Attribute Distribution
Age
Density
Age
RestingBP_s
Density
RestingBP_s
Cholesterol
Density
Cholesterol
MaxHeartRate
Density
MaxHeartRate
OldPeak
Density
OldPeak


Visualizing the Transformation for OldPeak
OldPeak
OldPeakNoNeg
Density
OldPeak


Visualizing the Transformation for Cholesterol
Cholesterol
Cholesterol(No Outliers)
Density
Cholesterol



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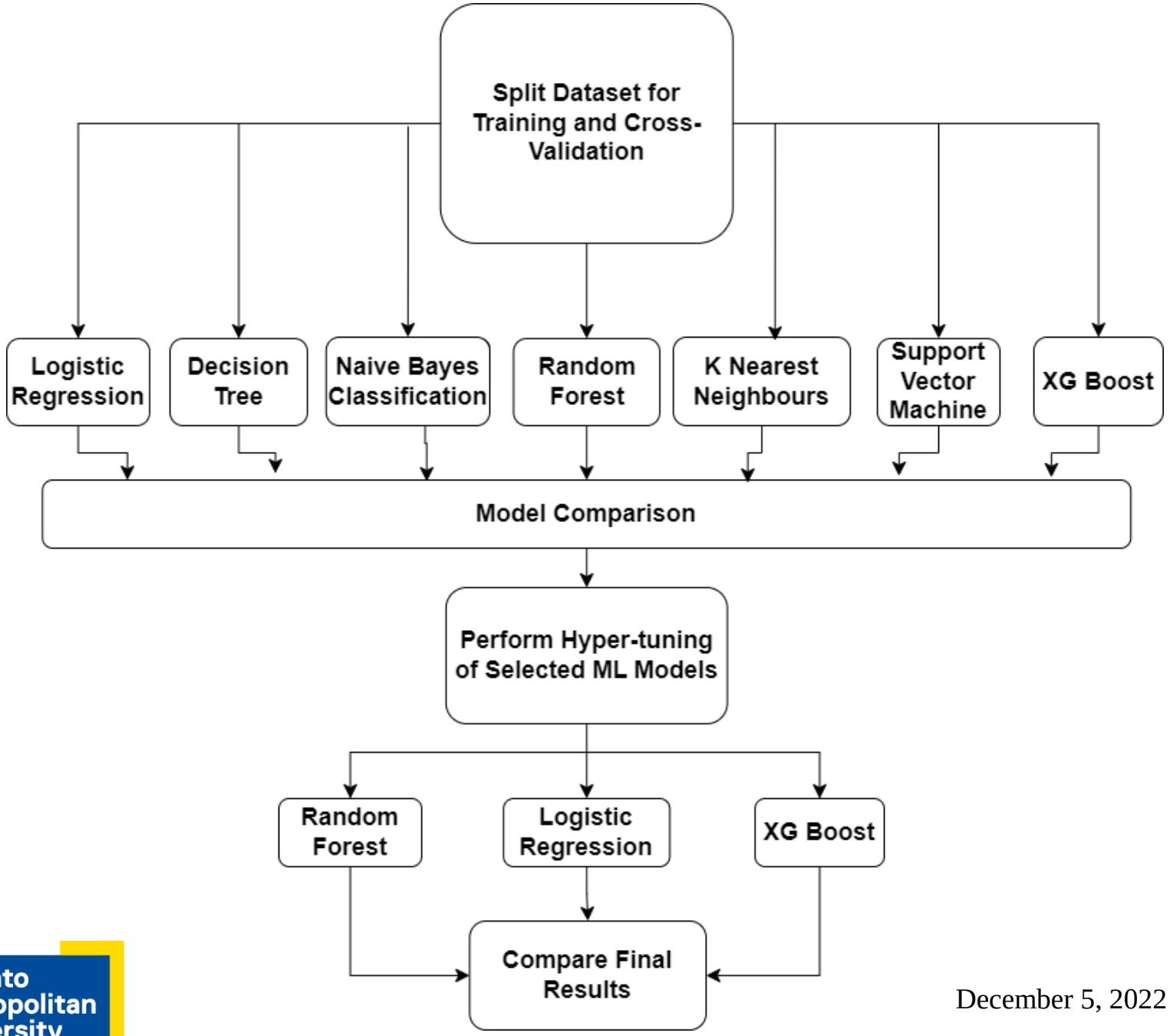

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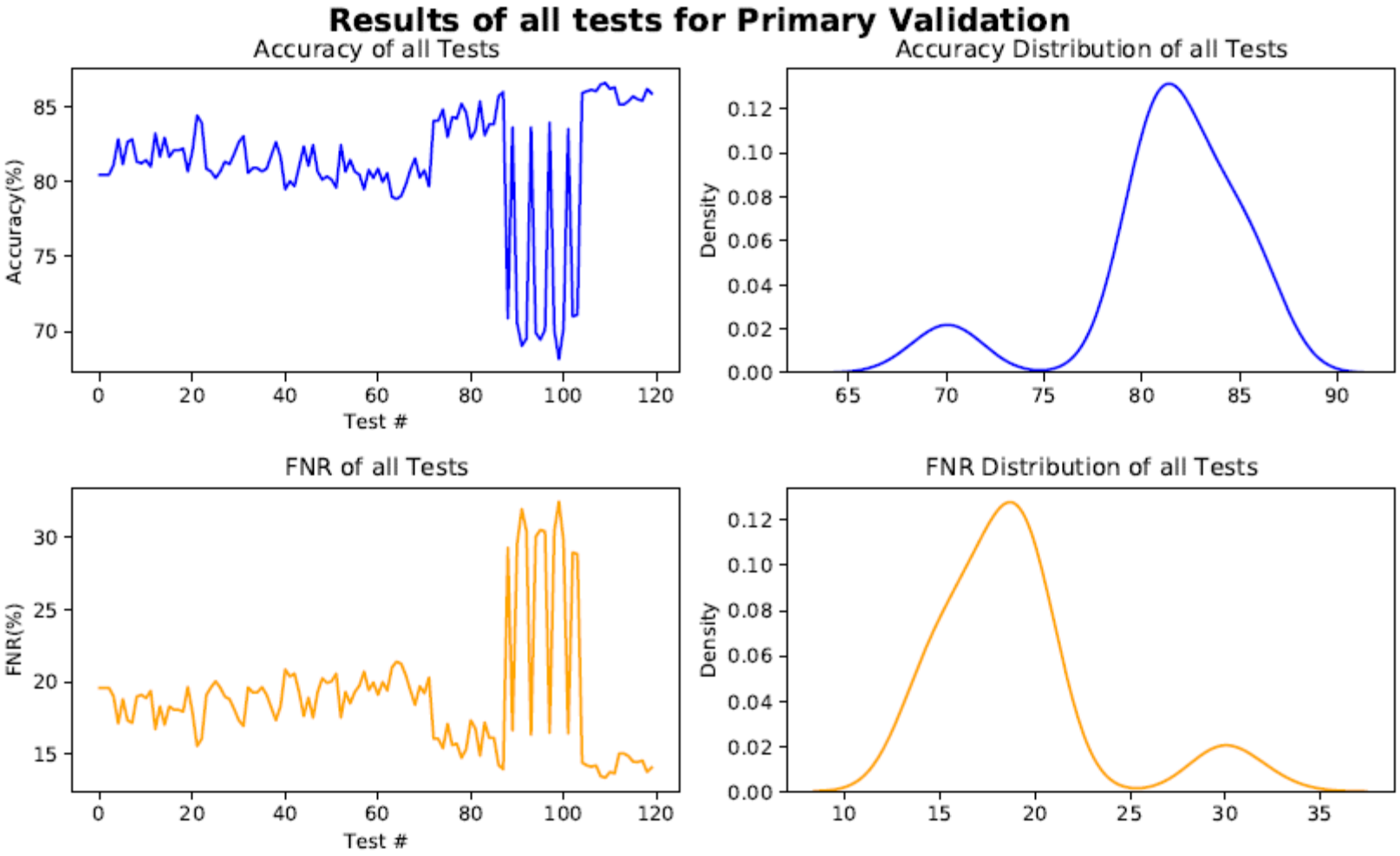

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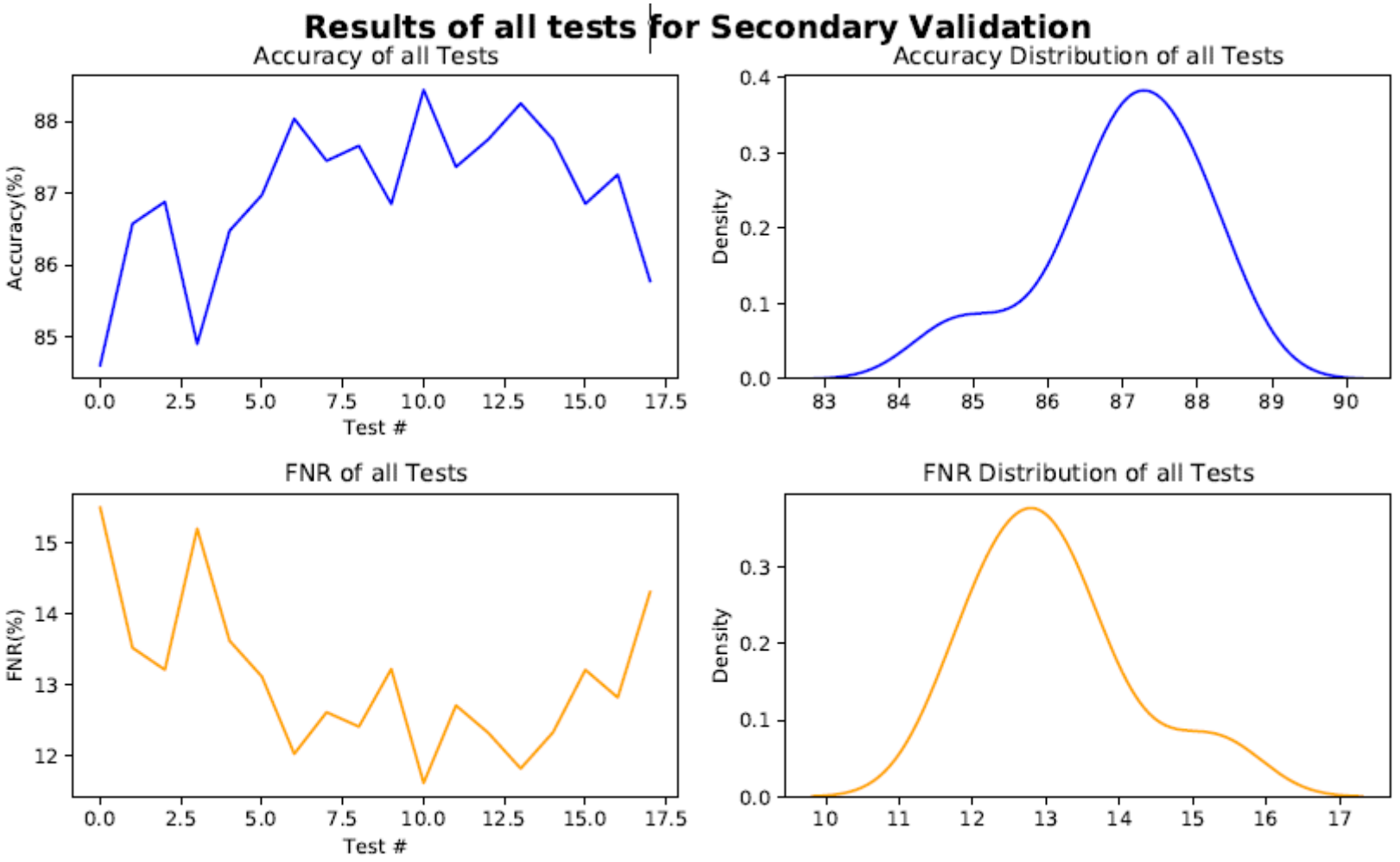
Results of Initial Tests sorted by Accuracy (Top 10)

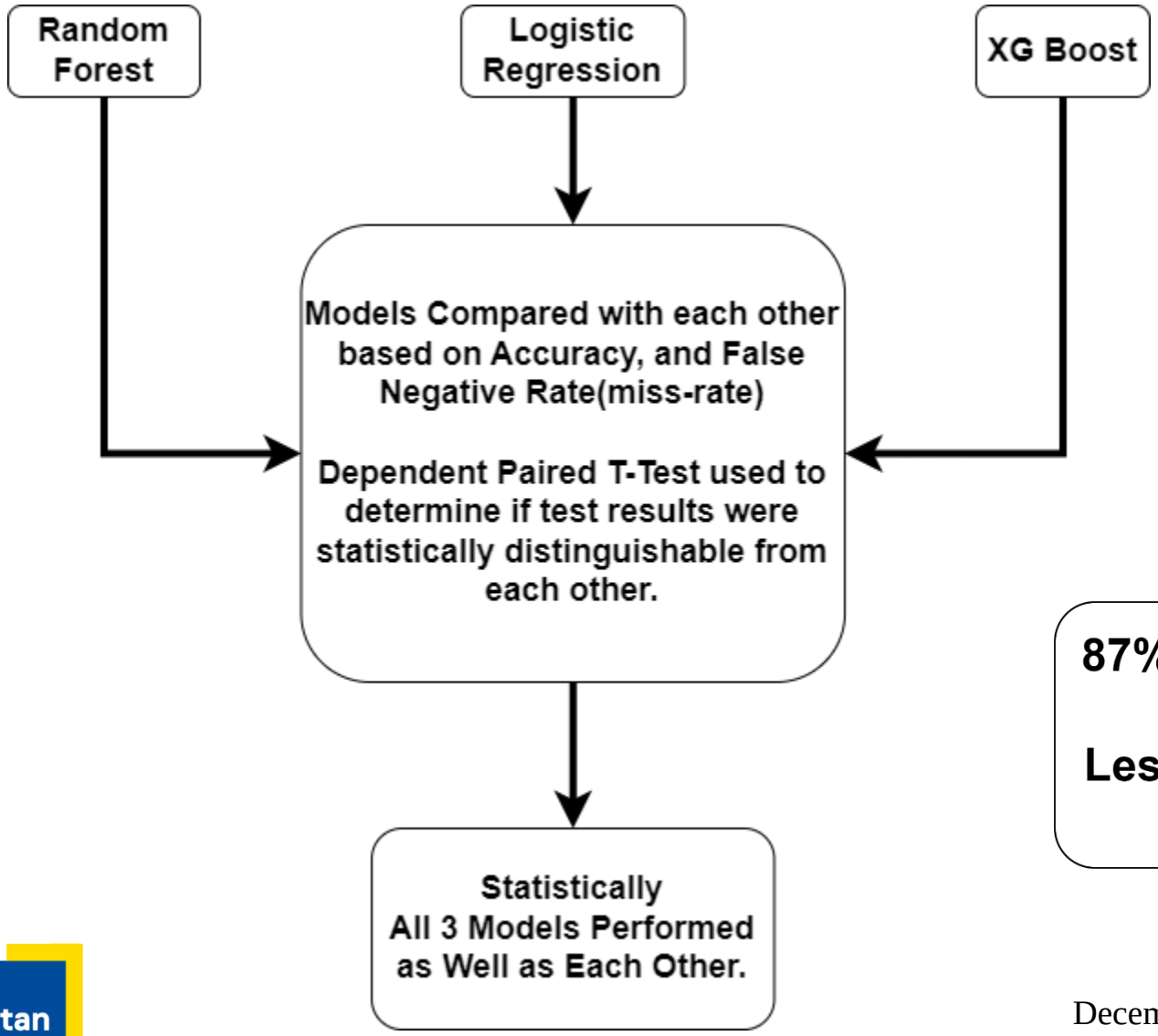
ML Model	Data-Set	Accuracy	FNR
Random Forest(RF)	Normalized, After SMOTE	86.58%	13.37%
Random Forest(RF)	Original, After SMOTE	86.48%	13.46%
Random Forest(RF)	Outliers Addressed, After ONEHOT, After SMOTE	86.29%	13.66%
Random Forest(RF)	Original, After ONEHOT, After SMOTE	86.19%	13.76%
XG Boost(XGB)	Original, After ONEHOT, After SMOTE	86.18%	13.76%
Random Forest(RF)	Original, After ONEHOT	86.13%	14.12%
Random Forest(RF)	Outliers Addressed	86.02%	14.21%
Random Forest(RF)	Normalized	86.02%	14.22%
Logistic Regression(LR)	Outliers Addressed, After ONEHOT, After SMOTE	85.99%	13.95%
Random Forest(RF)	Original	85.91%	14.41%


Results of all tests for Secondary Validation
Accuracy of all Tests
Accuracy(%)
Test #
Accuracy Distribution of all Tests
Density
FNR of all Tests
FNR(%)
Test #
FNR Distribution of all Tests
Density

Results of Secondary Validation sorted by Accuracy (Top 10)

Random Forest(RF)	Original, After ONEHOT, After SMOTE	89.03%	11.02%
Random Forest(RF) - Tuned	Original, After ONEHOT, After SMOTE	88.34%	11.72%
XG Boost(XGB)	Original, After ONEHOT, After SMOTE	88.24%	11.83%
Random Forest(RF)	Original, After SMOTE	88.03%	12.03%
XG Boost(XGB)	Original, After SMOTE	87.85%	12.22%
Random Forest(RF) - Tuned	Outliers Addressed, After ONEHOT, After SMOTE	87.56%	12.52%
XG Boost(XGB) - Tuned	Original, After ONEHOT, After SMOTE	87.55%	12.52%
Random Forest(RF)	Outliers Addressed, After ONEHOT, After SMOTE	87.26%	12.81%
XG Boost(XGB)	Outliers Addressed, After ONEHOT, After SMOTE	87.16%	12.92%
Logistic Regression(LR) - Tuned	Outliers Addressed, After ONEHOT, After SMOTE	87.07%	12.98%

The Best Model?



87%+ Accuracy & Less Than 12 % FNR

Deployment Considerations:

Cloud vs On-Premise?

Data Safety and Privacy Concerns?

Is 87% Accuracy Good Enough for a Medical based tool?

Next-Steps:

Obtain more Data?

Obtain higher quality Data?

More advanced ML Algorithms? Deep learning? Neural Networks?

Turning a trained Model into a usable tool?

Questions?

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