PROJECT 4
Stroke Prediction

Bec B & Bec N

INTRODUCTION

1 PROJECT OVERVIEW

2 IMPLEMENTATION

3 OUTCOME

29 August 2023

AGENDA

- Project overview
- Data techniques
- Project implementation
- Outcome
- Visualisation

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1 PROJECT OVERVIEW

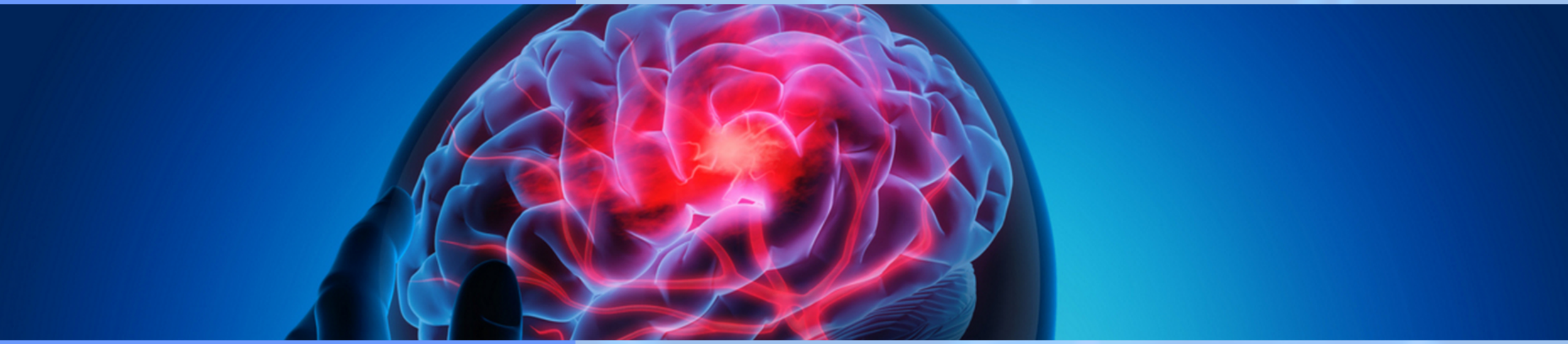
DEFINITIONS

PROJECT OBJECTIVE

DATA SOURCE

What is a stroke?

- Insufficient blood to areas of the brain by:
  - Blood vessel being blocked; or
  - Blood vessel ruptures and bleeds.
- Brain cells die due to lack of oxygen.
- Globally 1 in 4 adults over the age of 25 will have a stroke in their lifetime*



*Obtained from world-stroke.org

Project Objective

Understanding risk factors are important in the prevention of strokes, their identification early on is crucial for preventing strokes.

The objective of this project is to use a machine learning algorithm to develop an early detection model for strokes, using a stroke prediction dataset

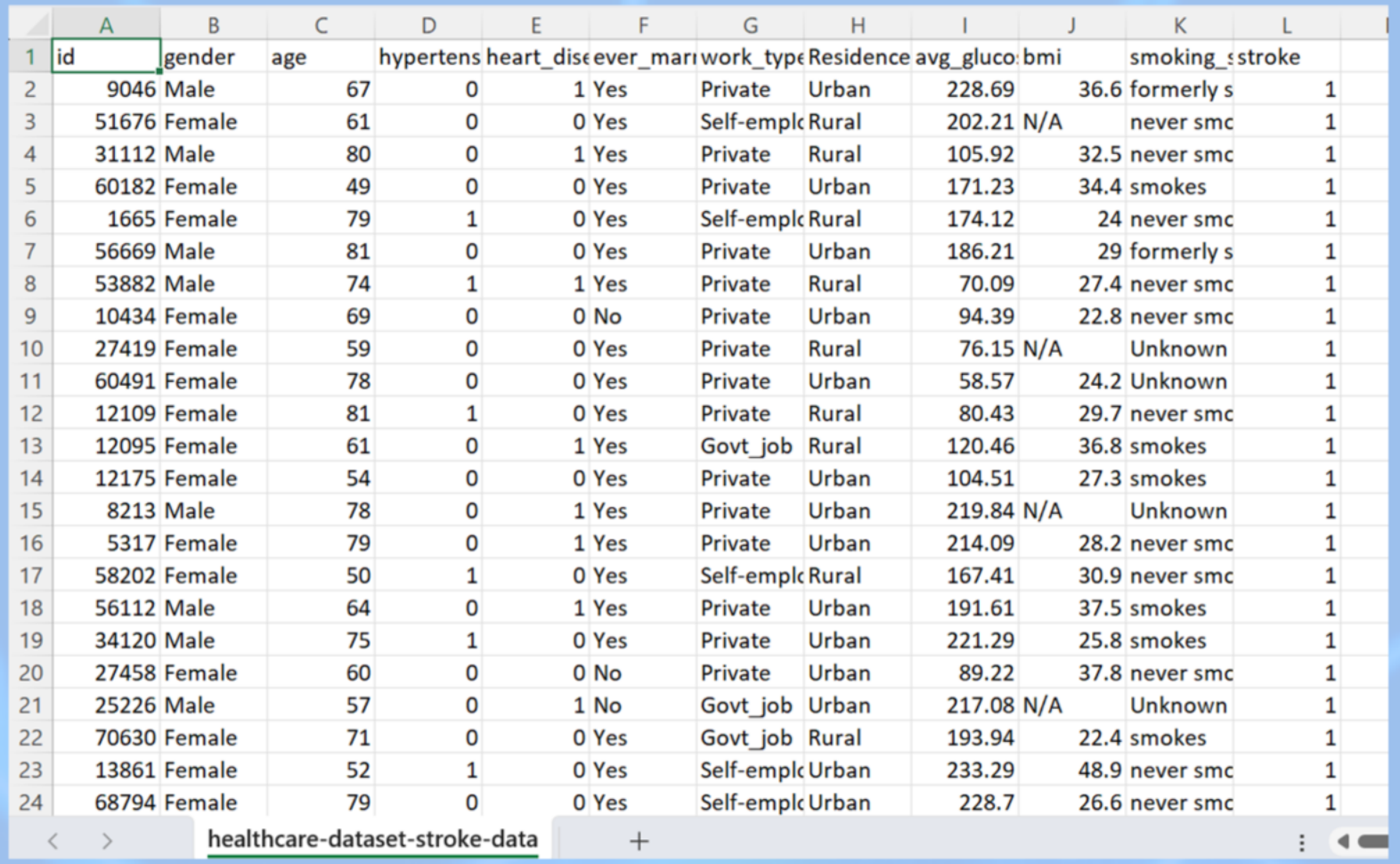
DATA SOURCE

The stroke prediction dataset was obtained from Kaggle.

The data contains information on:

- Gender
- Age
- Hypertension
- Heart disease
- Marriage status
- Work type
- Residence type
- Glucose levels
- BMI
- Smoking status
- Stroke status

The Kaggle dataset was obtained from patient records



	A	B	C	D	E	F	G	H	I	J	K	L
1	id	gender	age	hypertens	heart_dise	ever_mari	work_type	Residence	avg_gluco	bmi	smoking_s	stroke
2	9046	Male	67	0	1	Yes	Private	Urban	228.69	36.6	formerly s	1
3	51676	Female	61	0	0	Yes	Self-emplc	Rural	202.21	N/A	never smc	1
4	31112	Male	80	0	1	Yes	Private	Rural	105.92	32.5	never smc	1
5	60182	Female	49	0	0	Yes	Private	Urban	171.23	34.4	smokes	1
6	1665	Female	79	1	0	Yes	Self-emplc	Rural	174.12	24	never smc	1
7	56669	Male	81	0	0	Yes	Private	Urban	186.21	29	formerly s	1
8	53882	Male	74	1	1	Yes	Private	Rural	70.09	27.4	never smc	1
9	10434	Female	69	0	0	No	Private	Urban	94.39	22.8	never smc	1
10	27419	Female	59	0	0	Yes	Private	Rural	76.15	N/A	Unknown	1
11	60491	Female	78	0	0	Yes	Private	Urban	58.57	24.2	Unknown	1
12	12109	Female	81	1	0	Yes	Private	Rural	80.43	29.7	never smc	1
13	12095	Female	61	0	1	Yes	Govt_job	Rural	120.46	36.8	smokes	1
14	12175	Female	54	0	0	Yes	Private	Urban	104.51	27.3	smokes	1
15	8213	Male	78	0	1	Yes	Private	Urban	219.84	N/A	Unknown	1
16	5317	Female	79	0	1	Yes	Private	Urban	214.09	28.2	never smc	1
17	58202	Female	50	1	0	Yes	Self-emplc	Rural	167.41	30.9	never smc	1
18	56112	Male	64	0	1	Yes	Private	Urban	191.61	37.5	smokes	1
19	34120	Male	75	1	0	Yes	Private	Urban	221.29	25.8	smokes	1
20	27458	Female	60	0	0	No	Private	Urban	89.22	37.8	never smc	1
21	25226	Male	57	0	1	No	Govt_job	Urban	217.08	N/A	Unknown	1
22	70630	Female	71	0	0	Yes	Govt_job	Rural	193.94	22.4	smokes	1
23	13861	Female	52	1	0	Yes	Self-emplc	Urban	233.29	48.9	never smc	1
24	68794	Female	79	0	0	Yes	Self-emplc	Urban	228.7	26.6	never smc	1

healthcare-dataset-stroke-data

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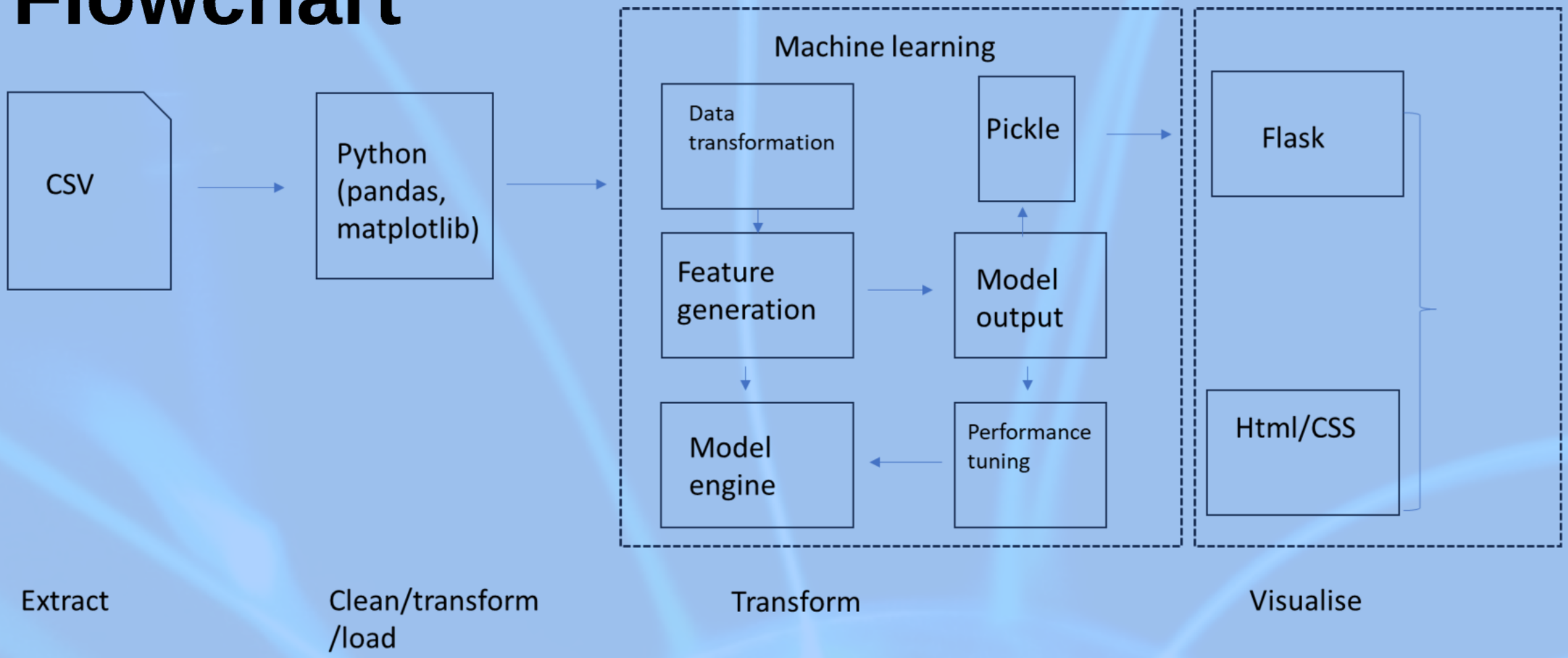
2 IMPLEMENTATION

APPROACH

- Identify data sources and import dependencies
- Perform Exploratory Data Analysis (**EDA**), determine feature set and transform the stroke data
- Compile, train and evaluate the model
- Compare models for optimization of accuracy metric
- Store the transformed dataset into pickle
- Create Flask App, import data in via pickle and connect routes to model
- Create interactive web app using pickle, html and css

Flowchart


CSV
Python (pandas, matplotlib)
Machine learning
Data transformation
Pickle
Feature generation
Model output
Model engine
Performance tuning
Flask
Html/CSS
Extract
Clean/transform /load
Transform
Visualise

DATA EXPLORATION AND CLEANING

- Investigate NaN cells
- Remove unnecessary columns ("ID")
- Dropping duplicates
- Remove 'Other' gender

DATA CLEANING

In [44]:
```
stroke_df.isnull().sum()
```

Out[44]:
```
id                   0
gender               0
age                  0
hypertension         0
heart_disease        0
ever_married         0
work_type            0
Residence_type       0
avg_glucose_level    0
bmi                201
smoking_status       0
stroke               0
dtype: int64
```

In [45]:
```
#remove unnecessary columns
stroke_df.drop(['id'],axis=1,inplace = True)
```

In [46]:
```
#remove duplicates values
stroke_df.drop_duplicates(inplace=True)
```

In [47]:
```
#null data handled
stroke_df.isnull().sum()
```

Out[47]:
```
gender               0
age                  0
hypertension         0
heart_disease        0
ever_married         0
work_type            0
Residence_type       0
avg_glucose_level    0
bmi                201
smoking_status       0
stroke               0
dtype: int64
```

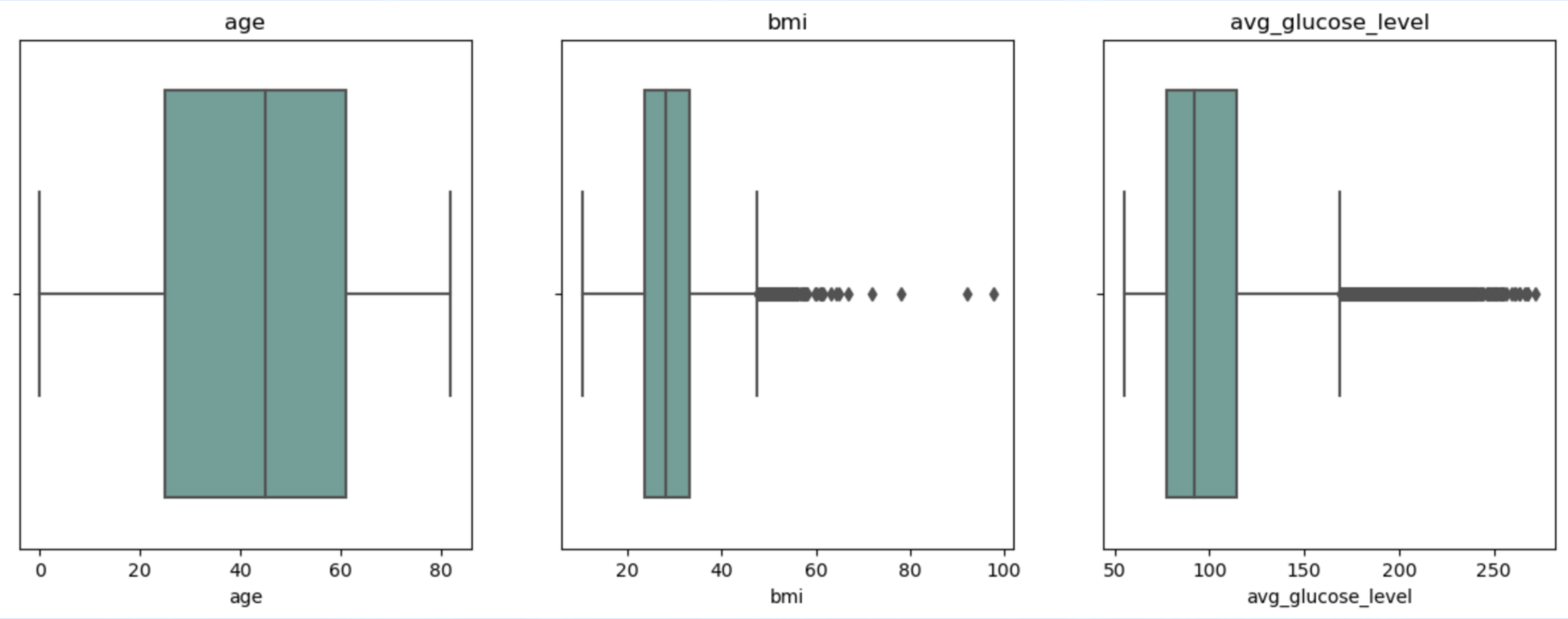
```
# Replace NaN values in the "bmi" column with the average BMI of the corresponding age
def replace_bmi(row):
    if pd.isna(row['bmi']):
        return avg_bmi_by_age[row['age']]
    else:
        return row['bmi']

stroke_df['bmi'] = stroke_df.apply(replace_bmi, axis=1)
```

```
# Check the info of the dataframe (if the NaN values in the 'bmi' column are replaced)
stroke_df.info()
```

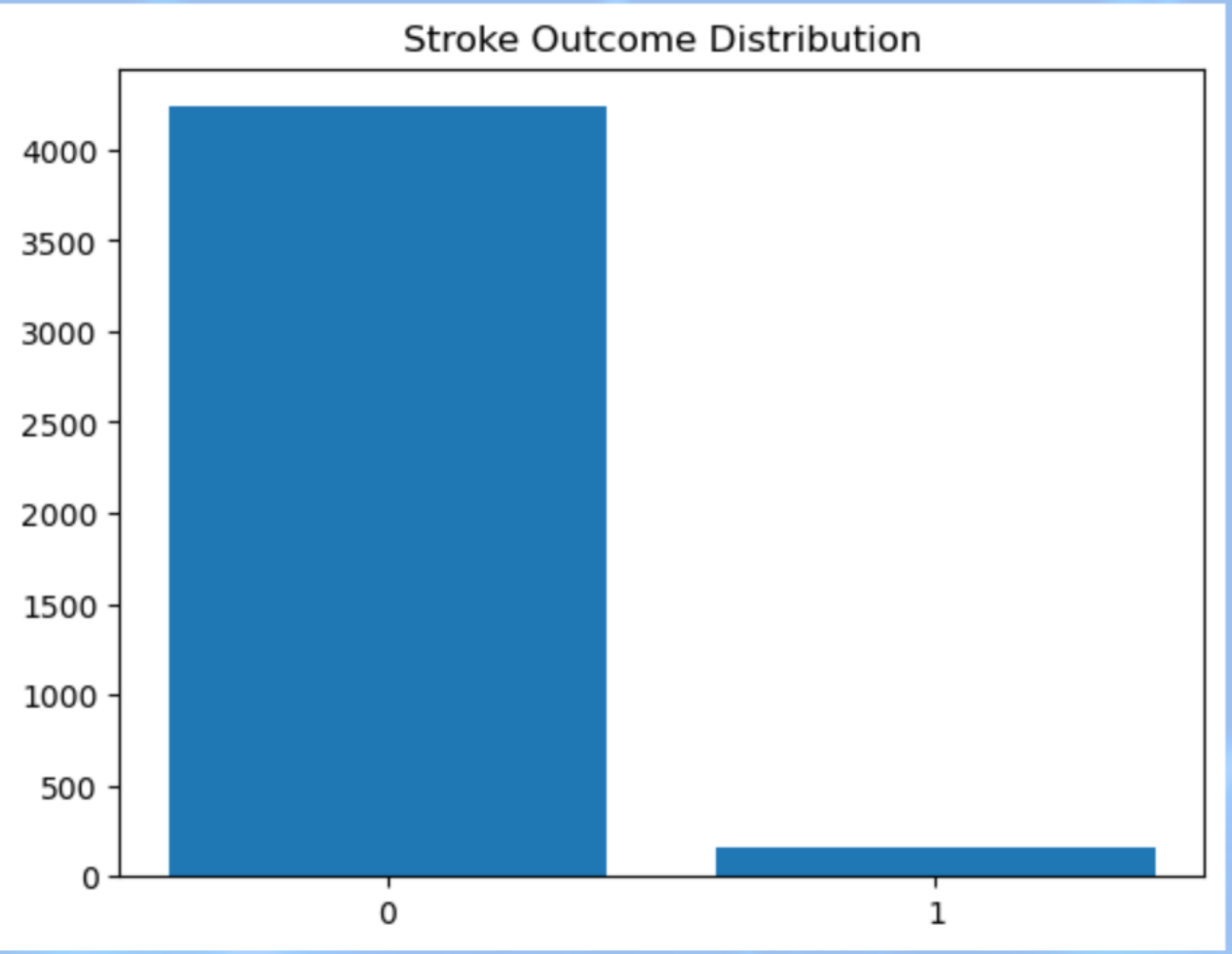
```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4401 entries, 2 to 5109
Data columns (total 11 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   gender             4401 non-null   object
 1   age                4401 non-null   float64
 2   hypertension       4401 non-null   int64
 3   heart_disease      4401 non-null   int64
 4   ever_married       4401 non-null   object
 5   work_type          4401 non-null   object
 6   Residence_type     4401 non-null   object
 7   avg_glucose_level  4401 non-null   float64
 8   bmi                4401 non-null   float64
 9   smoking_status     4401 non-null   object
 10  stroke             4401 non-null   int64
dtypes: float64(3), int64(3), object(5)
memory usage: 541.6+ KB
```

Removing Outliers



Outliers were removed from the dataset. BMI and average glucose level fields contained numerous outliers therefore were removed from the dataset, particularly as BMI >60 is very rare

Data distribution, stroke vs. no stroke



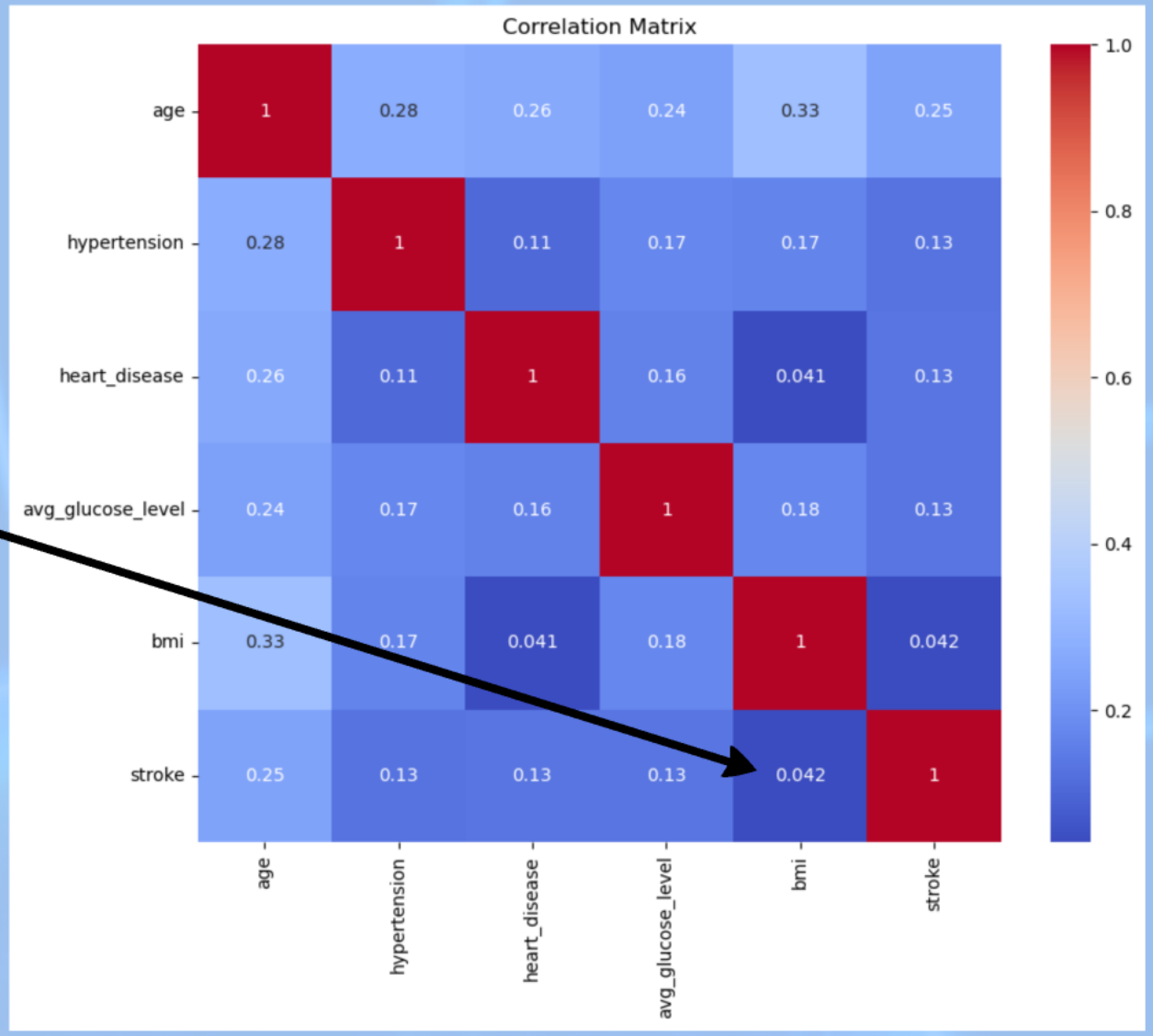
Data entries before sanitisation:
0 (non stroke): 4861
1 (stroke): 249

Data entries after sanitisation:
0 (non stroke): 4235
1 (stroke): 165

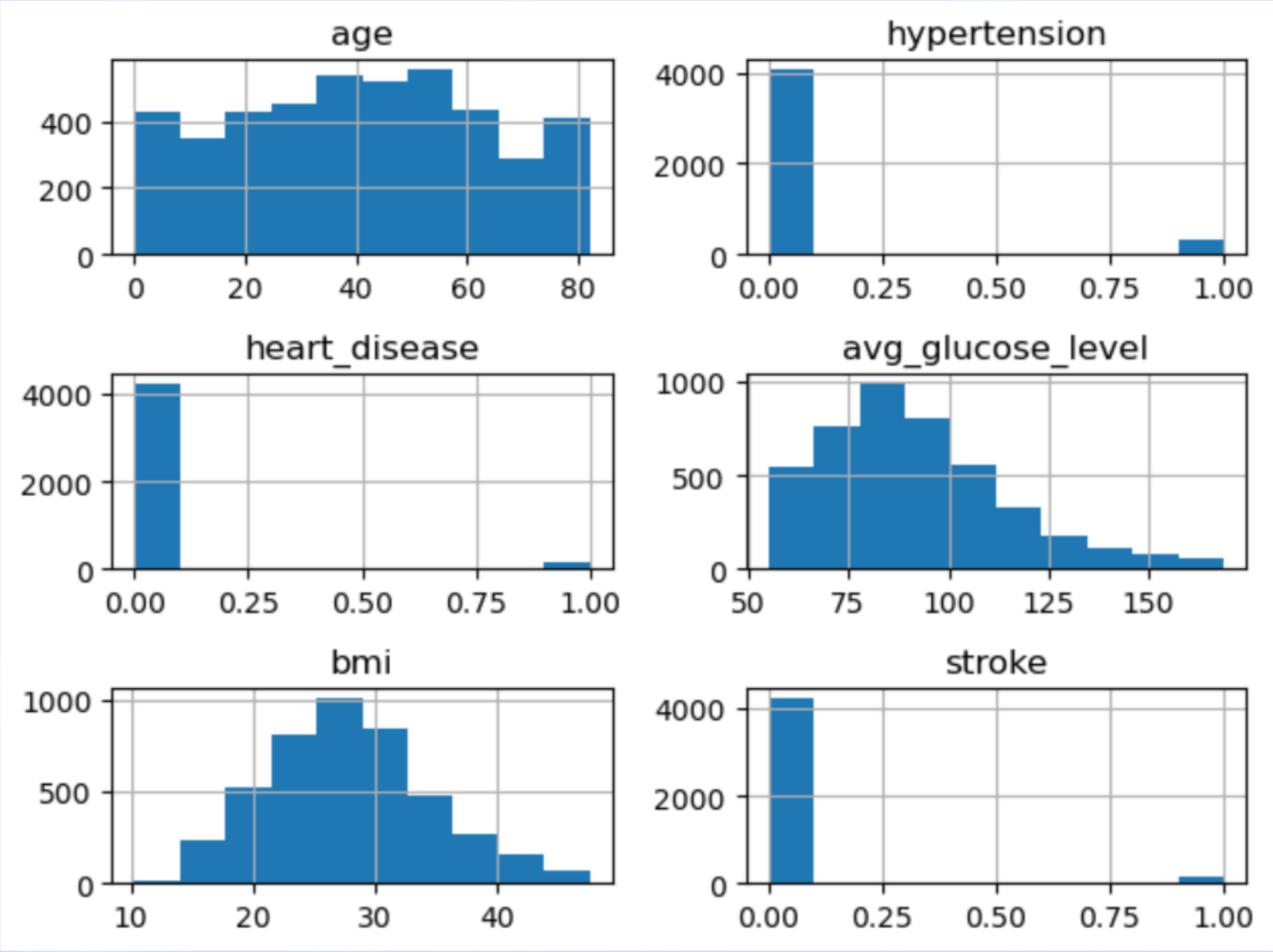
Correlation Matrix

Most of the features are not highly correlated with any other features

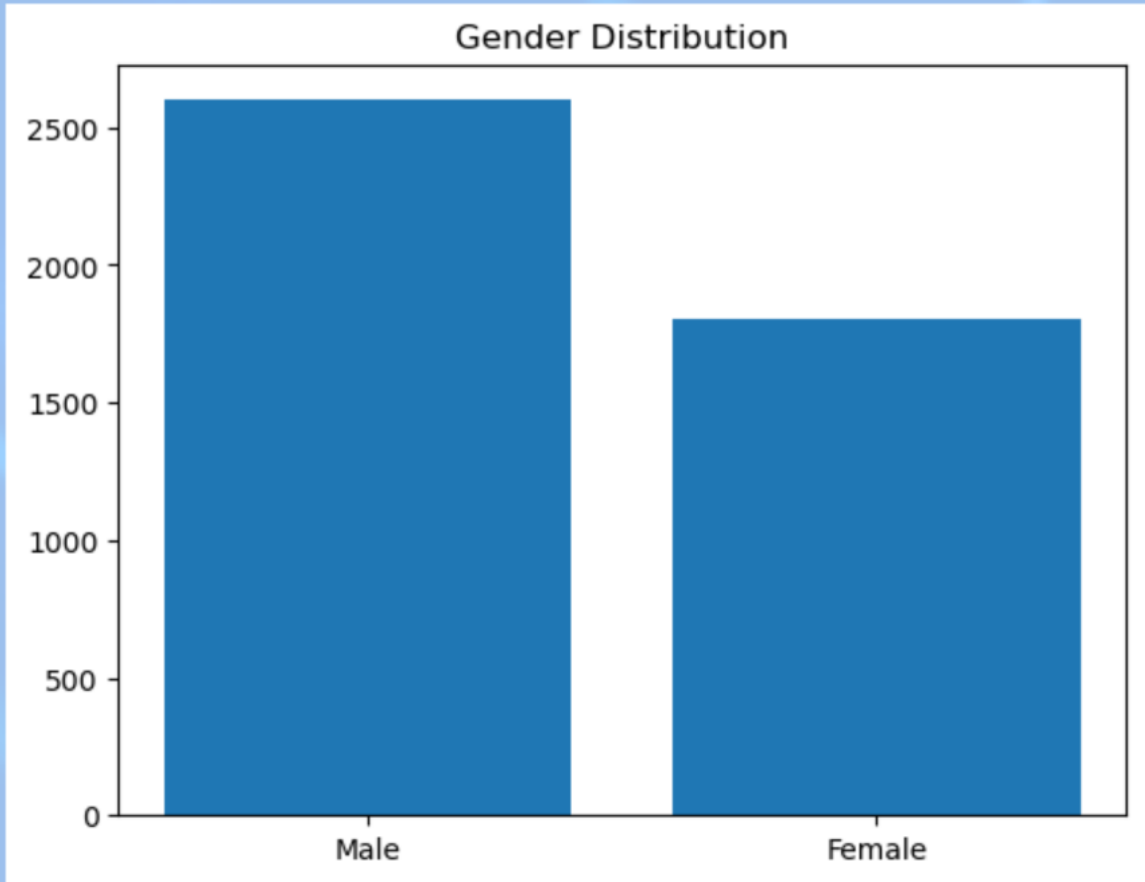
BMI has a weakly positive correlation with stroke

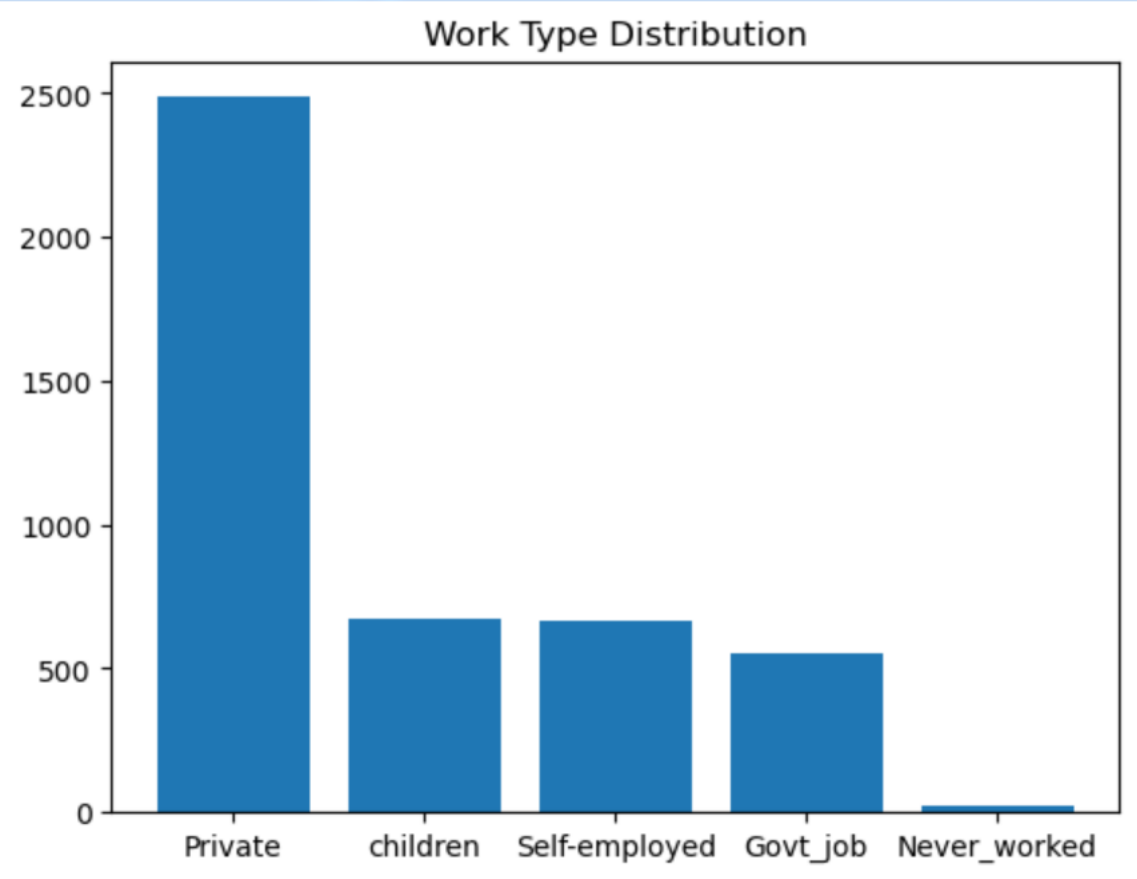


Data Distribution

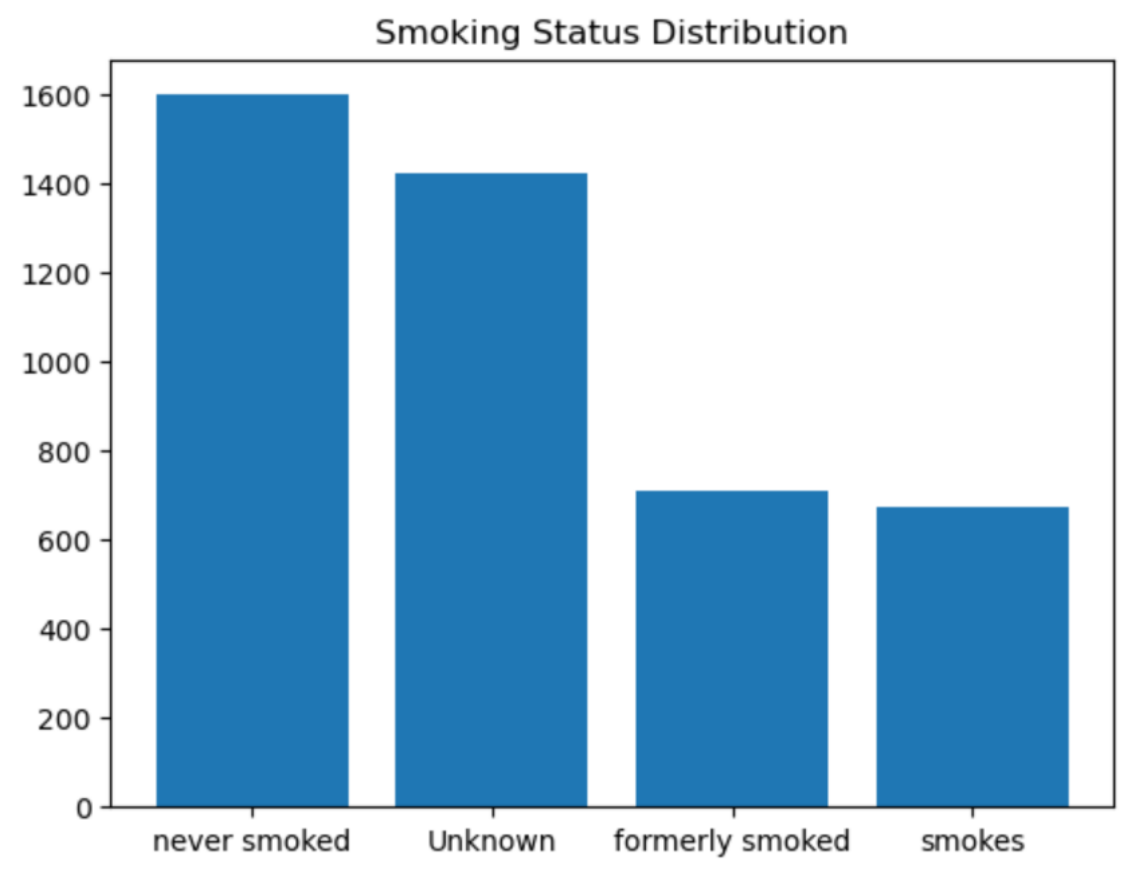


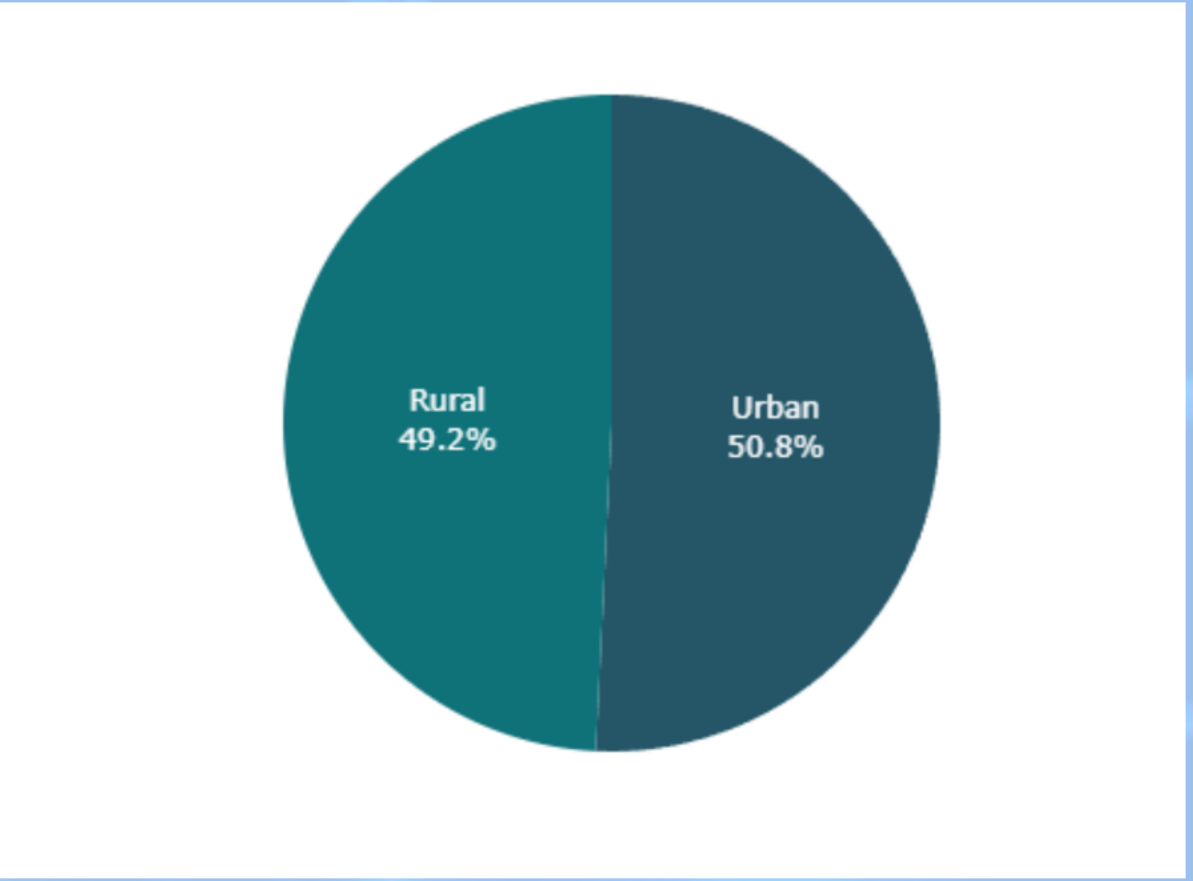
Data Distribution



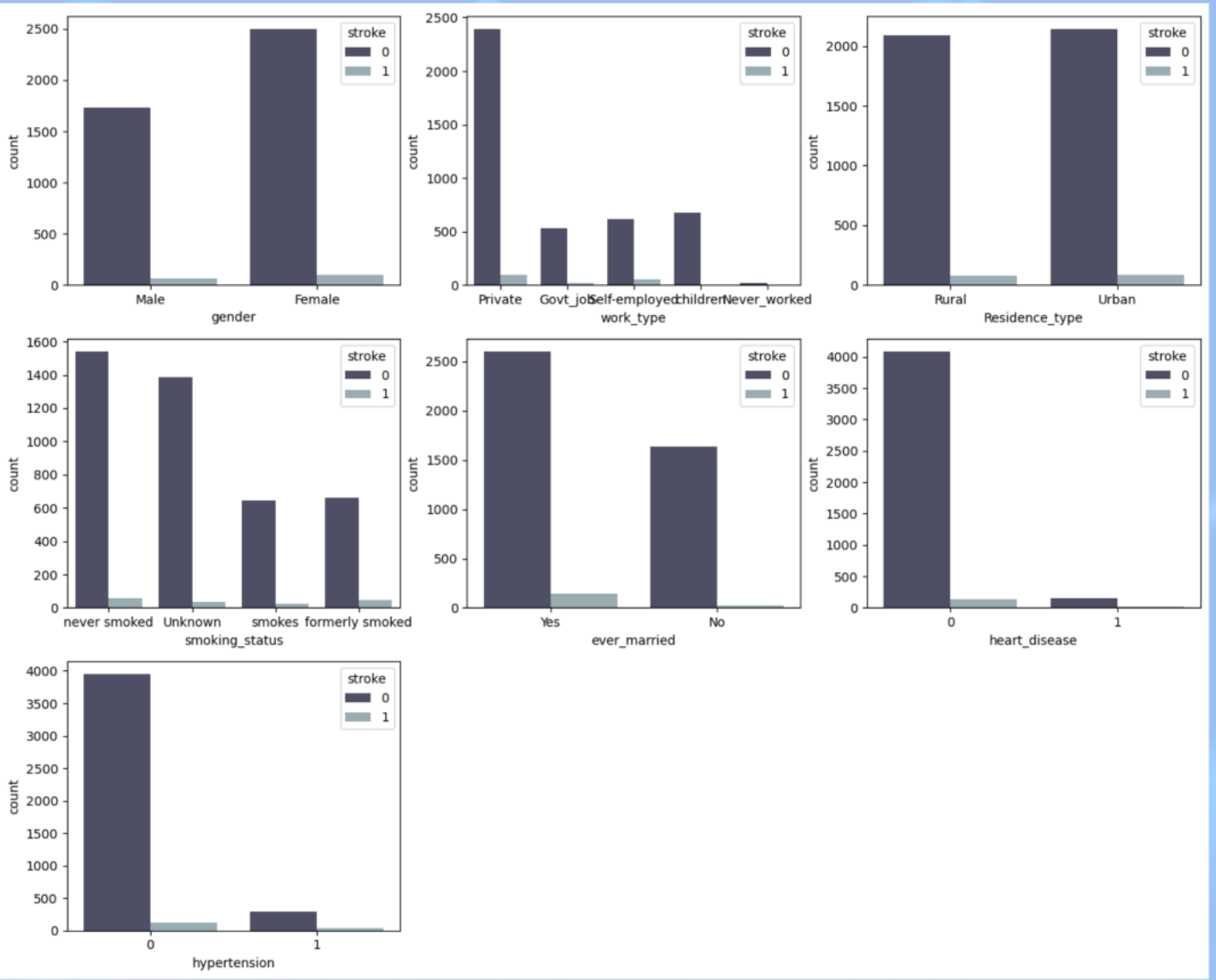


Data Distribution





Data Distribution



DATA TECHNIQUES

The following techniques were used:

- Python Packages including scikit-learn, matplotlib, Pandas, seaborn
- pickle
- Flask
- HTML
- CSS

MODEL SELECTION

- Random Forest model with Synthetic Minority Oversampling Technique (**SMOTE**)
- Random Forest and binning
- Random Forest
- Decision Tree
- Logistic Regression

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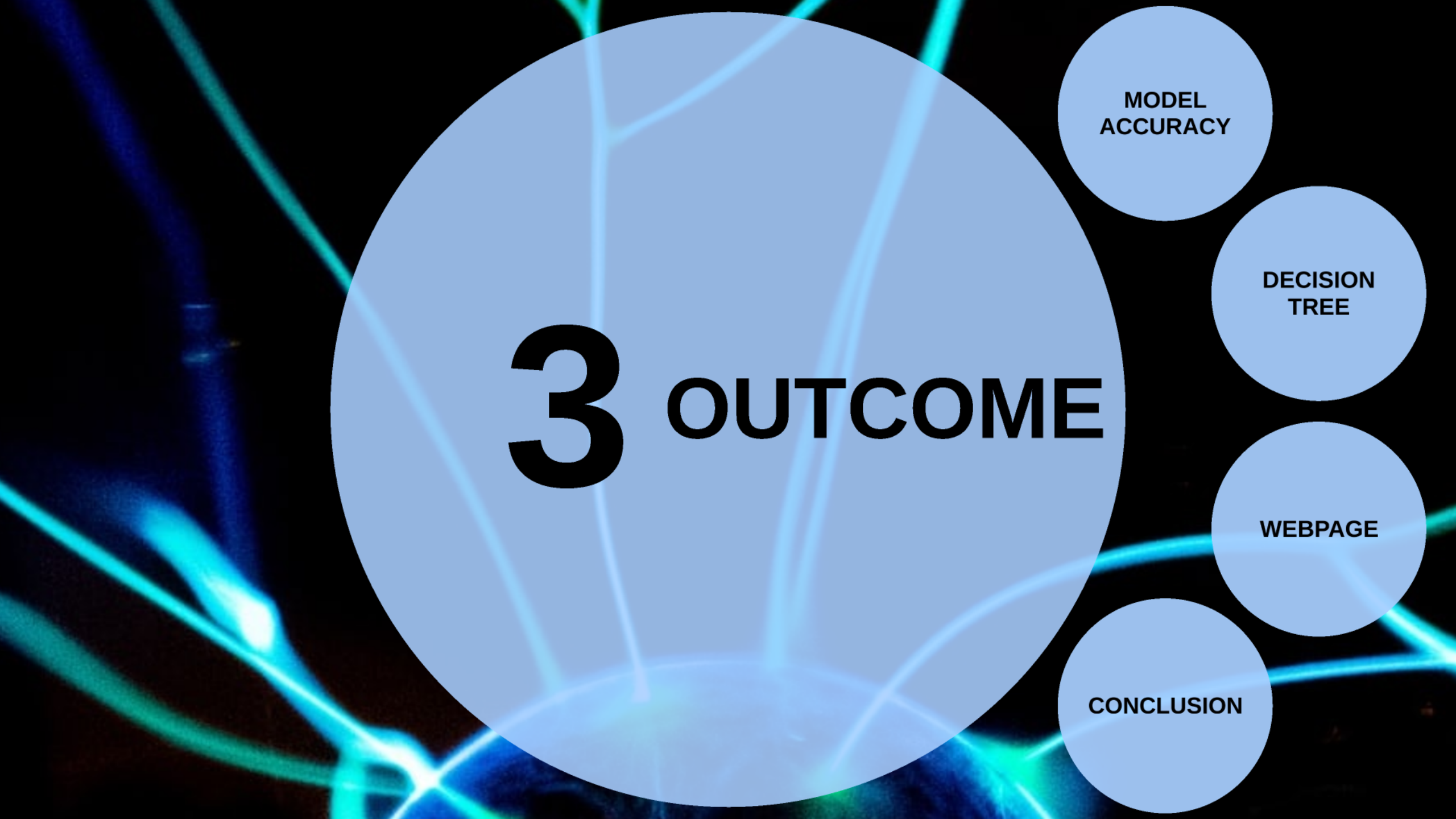

3 OUTCOME
MODEL ACCURACY
DECISION TREE
WEBPAGE
CONCLUSION

MODEL ACCURACY

Model 1: SMOTE and Random Forest Classifier

	TRAINING		TESTING	
	Predicted 0	Predicted 1	Predicted 0	Predicted 1
Actual 0	3,385	-	848	2
Actual 1	-	3,391	27	817

Accuracy 98.2%

Classification Report

	Precision	Recall	F1-Score	Support
0	0.97	1.00	0.98	850
1	1.00	0.97	0.98	844
Accuracy			0.98	1,694
Macro avg	0.98	0.98	0.98	1,694
Weighted avg	0.98	0.98	0.98	1,694

Model 2: Random Forecast Classifier with binning

	TRAINING		TESTING	
	Predicted 0	Predicted 1	Predicted 0	Predicted 1
Actual 0	3,385	-	844	6
Actual 1	-	3,391	-	844

Accuracy 99.6%

Classification Report

	Precision	Recall	F1-Score	Support
0	1.00	0.99	1.00	850
1	0.99	1.00	1.00	844
Accuracy			1.00	1,694
Macro avg	1.00	1.00	1.00	1,694
Weighted avg	1.00	1.00	1.00	1,694

Model 3: Random Forecast Classifier

	TRAINING		TESTING	
	Predicted 0	Predicted 1	Predicted 0	Predicted 1
Actual 0	3,385	-	843	7
Actual 1	-	3,391	-	844

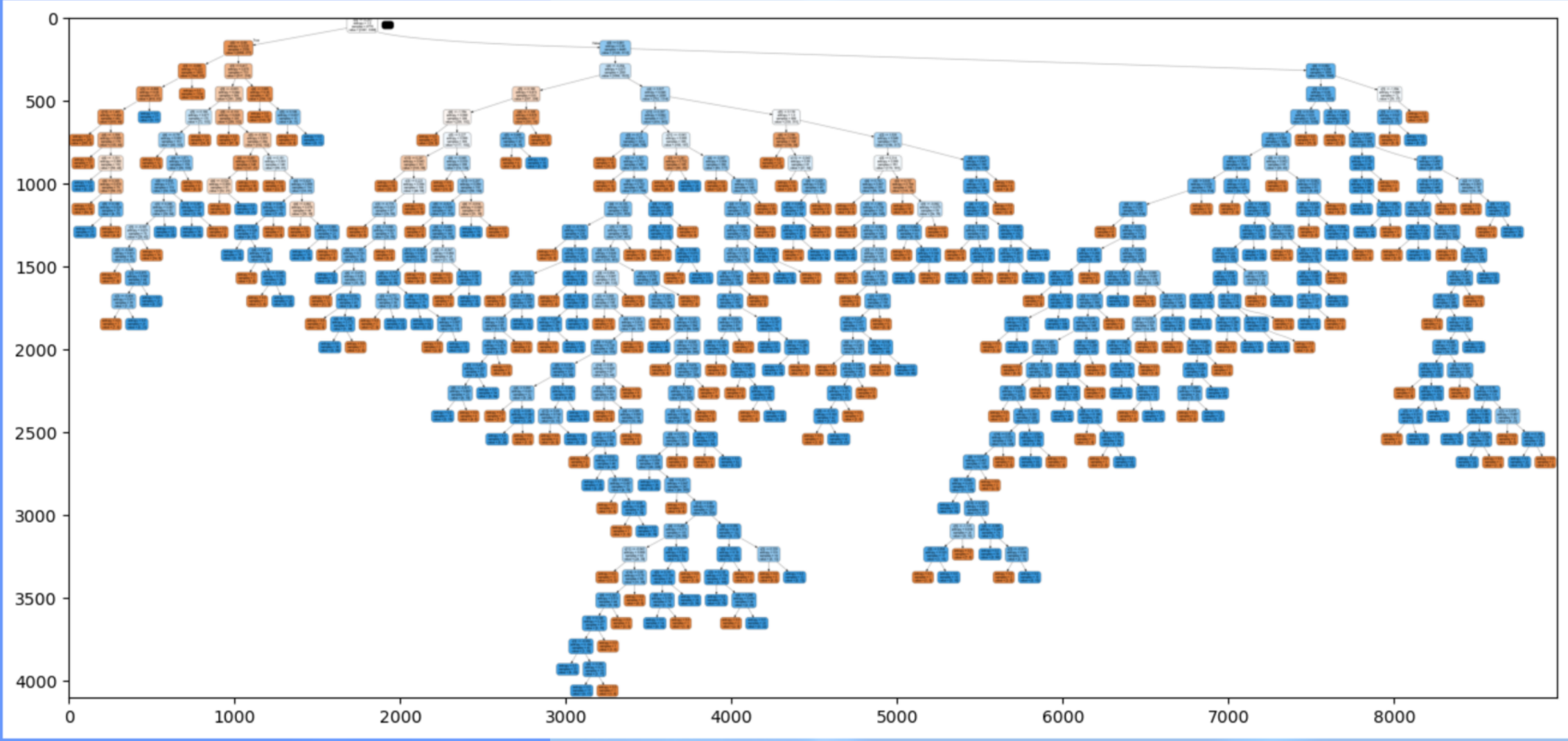
Accuracy 99.6%

Classification Report

	Precision	Recall	F1-Score	Support
0	1.00	0.99	1.00	850
1	0.99	1.00	1.00	844
Accuracy			1.00	1,694
Macro avg	1.00	1.00	1.00	1,694
Weighted avg	1.00	1.00	1.00	1,694

DECISION TREE

F1 Score: 66%



WEBPAGE


STROKE PREDICTION
Gender:
Male
Age:
e.g 1-10(
Hypertension:
Yes
Heart Diseases:
Yes
Marital Status:
Yes
Work-Type:
Private
Residency Type:
Urban Area
Glucose Levels:
e.g 20-300
BMI:
e.g 18-45
Smoking Status:
Unknown
SUBMIT

THANKS FOR LISTENING

Happy graduation :) Thanks James and Shriya!

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