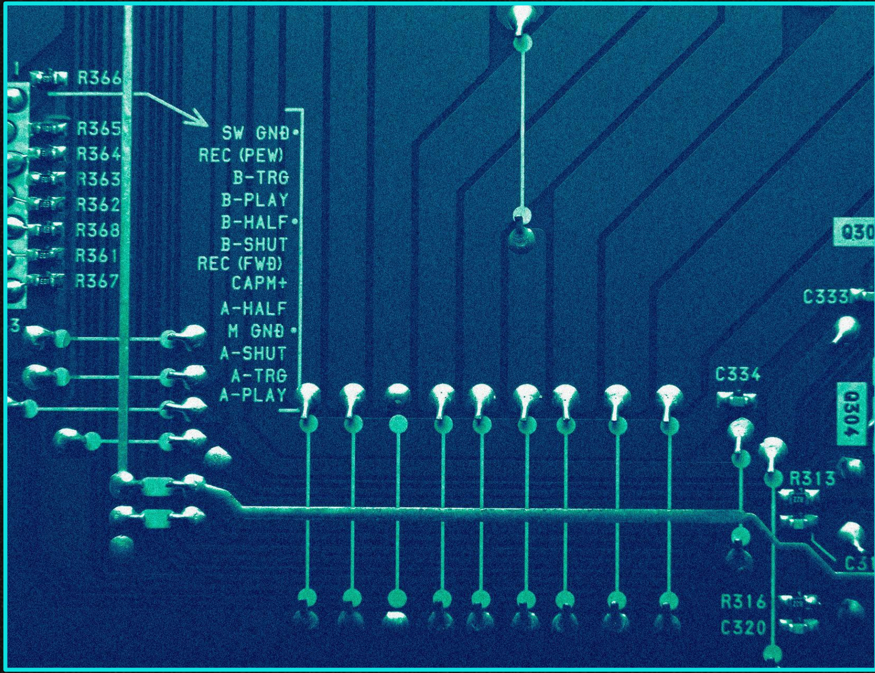
ILLINOIS DATA SCIENCE CLUB

Heart Disease Classification

DATA DIVE

By Team CWMDSJ



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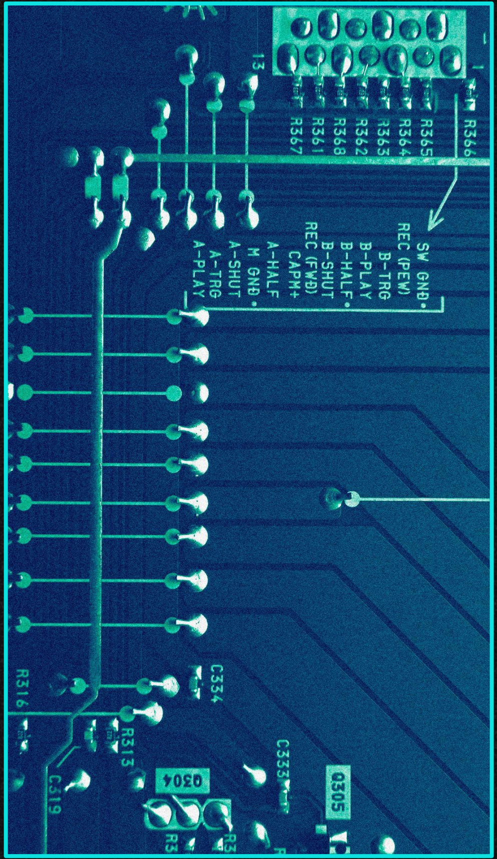


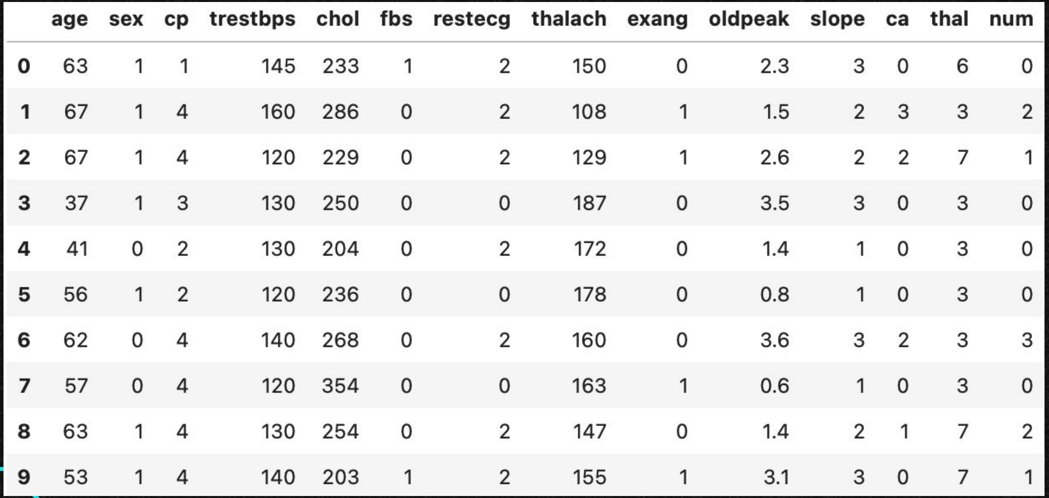
Problem Identification

- Why heart disease ?
    - The leading cause of death for both men and women in U.S.
    - Is heart disease preventable?

- To solve the questions? We should know:
    - What features are correlated with heart disease ?
    - How to classify the features that are correlated with heart disease?

Collecting Data

- Dataset from UC Irvine
  - Cleveland Database
- 14 Columns (more detail on next slide)
  - 13 possible explanatory variables
  - 1 response variable (num)



	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	num
0	63	1	1	145	233	1	2	150	0	2.3	3	0	6	0
1	67	1	4	160	286	0	2	108	1	1.5	2	3	3	2
2	67	1	4	120	229	0	2	129	1	2.6	2	2	7	1
3	37	1	3	130	250	0	0	187	0	3.5	3	0	3	0
4	41	0	2	130	204	0	2	172	0	1.4	1	0	3	0
5	56	1	2	120	236	0	0	178	0	0.8	1	0	3	0
6	62	0	4	140	268	0	2	160	0	3.6	3	2	3	3
7	57	0	4	120	354	0	0	163	1	0.6	1	0	3	0
8	63	1	4	130	254	0	2	147	0	1.4	2	1	7	2
9	53	1	4	140	203	1	2	155	1	3.1	3	0	7	1

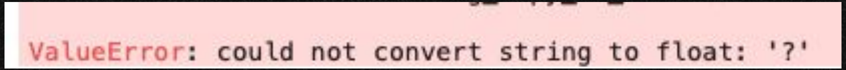
Column Descriptions

- Age - age in years
- Sex - (1 = male; 0 = female)
- CP - chest pain type
- Trestbps - resting blood pressure (in mm Hg on admission to the hospital)
- Chol - serum cholesterol in mg/dl
- FBS - (fasting blood sugar > 120 mg/dl) (1 = true; 0 = false)
- Restecg - resting electrocardiographic results
- Thalach - maximum heart rate achieved
- Exang - exercise induced angina (1 = yes; 0 = no)
- Oldpeak - ST depression induced by exercise relative to rest
- Slope - the slope of the peak exercise ST segment
- Ca - number of major vessels (0-3) colored by fluoroscopy
- Thal - 1 = normal; 2 = fixed defect; 3 = reversible defect
- Num - artery diameter (0-4)

Data Cleaning

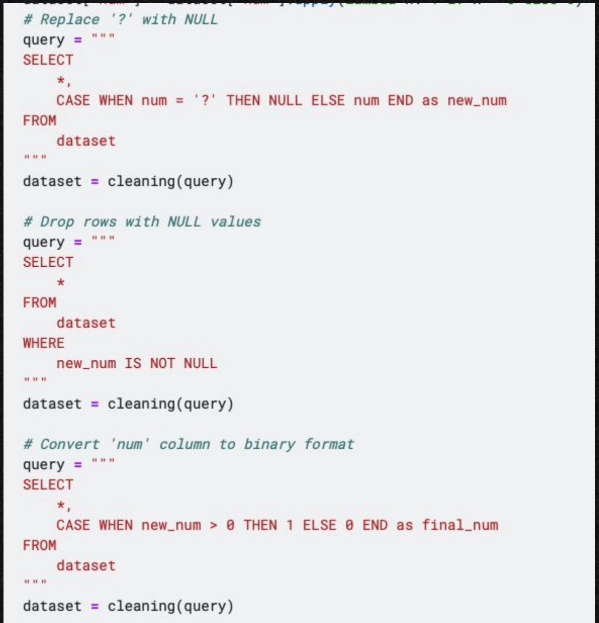
Our data was uncleaned

- Our data type was in the wrong format for the model
- We needed to get rid of categories showing little correlation
- We wanted a clear target - yes or no (1 or 0)



```
ValueError: could not convert string to float: '?'
```

Fixed Using SQLDF



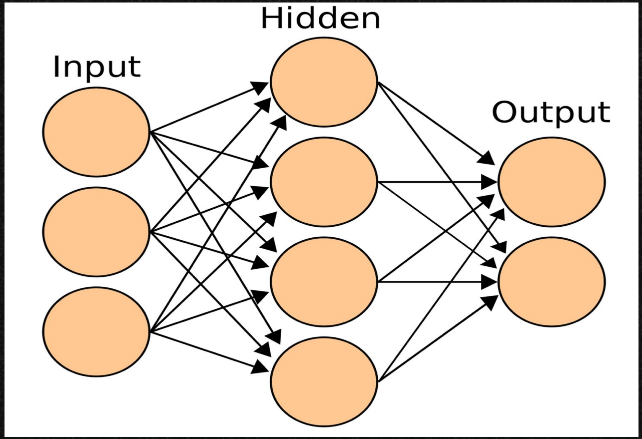
```
# Replace '?' with NULL
query = """
SELECT
    *,
    CASE WHEN num = '?' THEN NULL ELSE num END as new_num
FROM
    dataset
"""
dataset = cleaning(query)

# Drop rows with NULL values
query = """
SELECT
    *
FROM
    dataset
WHERE
    new_num IS NOT NULL
"""
dataset = cleaning(query)

# Convert 'num' column to binary format
query = """
SELECT
    *,
    CASE WHEN new_num > 0 THEN 1 ELSE 0 END as final_num
FROM
    dataset
"""
dataset = cleaning(query)
```

Machine Learning Model

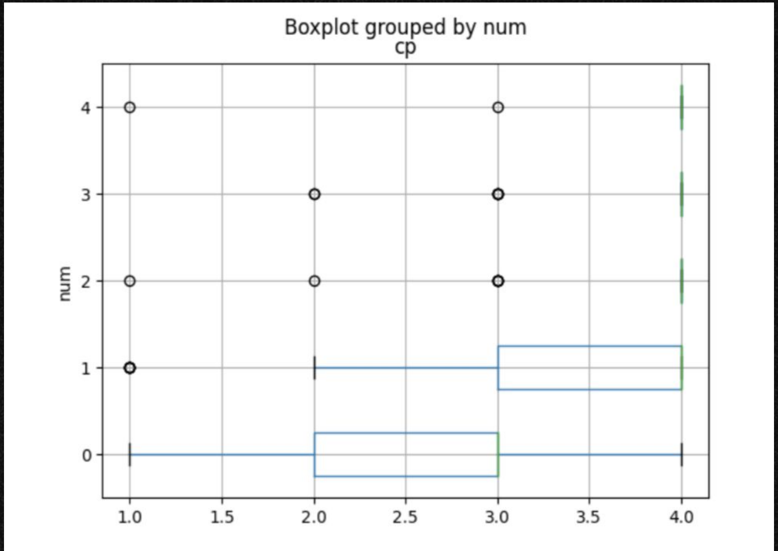
- The MLP we use has two hidden layers, with 32 neurons in the first layer and 16 neurons in the second layer.
- The activation function for the neurons is ReLU (Rectified Linear Unit), and the optimizer used for training the network is Adam.
- The model determines the weights of each layer based on previous iterations of epoch training.

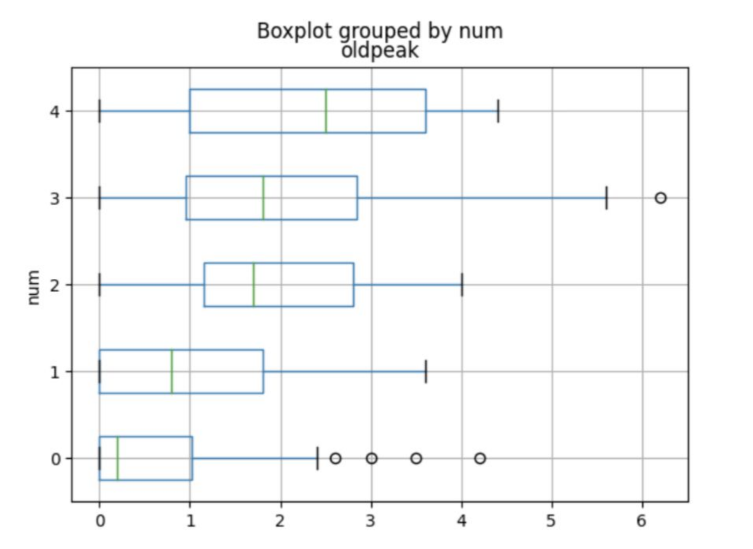


Exploratory Data Analysis

Question: Which categories show the highest correlation with the classification.

Approach: Visualize each category via a box plot.

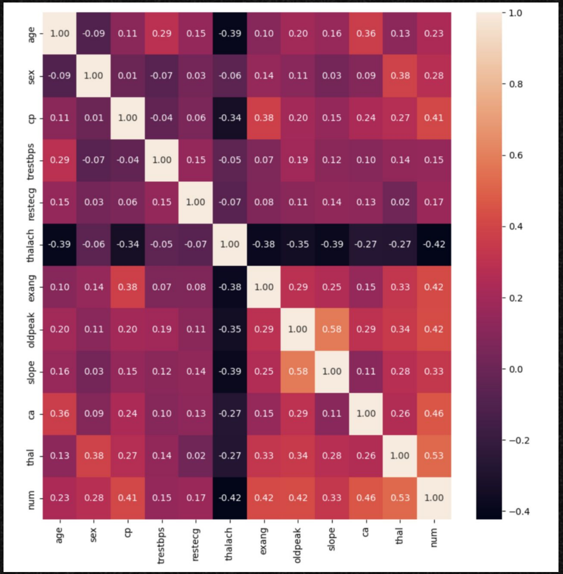




**num on the y axis is the target variable, showing severity of heart disease (0 being none, 4 being fatal)

Feature Analysis & Statistical Analysis

- Another tool we used to determine correlation between target and features was a correlation matrix
- Using this we could tell columns that are strongly correlated based on the heat map
- By removing features with little correlation, we were able to increase our accuracy by ~10%



	age	sex	cp	trestbps	restecg	thalach	exang	oldpeak	slope	ca	thal	num
age	1.00	-0.09	0.11	0.29	0.15	-0.39	0.10	0.20	0.16	0.36	0.13	0.23
sex	-0.09	1.00	0.01	-0.07	0.03	-0.06	0.14	0.11	0.03	0.09	0.38	0.28
cp	0.11	0.01	1.00	-0.04	0.06	-0.34	0.38	0.20	0.15	0.24	0.27	0.41
trestbps	0.29	-0.07	-0.04	1.00	0.15	-0.05	0.07	0.19	0.12	0.10	0.14	0.15
restecg	0.15	0.03	0.06	0.15	1.00	-0.07	0.08	0.11	0.14	0.13	0.02	0.17
thalach	-0.39	-0.06	-0.34	-0.05	-0.07	1.00	-0.38	-0.35	-0.39	-0.27	-0.27	-0.42
exang	0.10	0.14	0.38	0.07	0.08	-0.38	1.00	0.29	0.25	0.15	0.33	0.42
oldpeak	0.20	0.11	0.20	0.19	0.11	-0.35	0.29	1.00	0.58	0.29	0.34	0.42
slope	0.16	0.03	0.15	0.12	0.14	-0.39	0.25	0.58	1.00	0.11	0.28	0.33
ca	0.36	0.09	0.24	0.10	0.13	-0.27	0.15	0.29	0.11	1.00	0.26	0.46
thal	0.13	0.38	0.27	0.14	0.02	-0.27	0.33	0.34	0.28	0.26	1.00	0.53
num	0.23	0.28	0.41	0.15	0.17	-0.42	0.42	0.42	0.33	0.46	0.53	1.00

Project Takeaway

- Utilized Python libraries such as Pandas, NumPy, Matplotlib, and Seaborn for data preprocessing, cleaning, and visualization in a heart disease classification project built off a Kaggle available dataset
- Conducted data manipulation with SQLDF, handling missing values and transforming categorical variables into binary
- Leveraged Scikit-learn to implement a Neural Network model, achieving a 95% accuracy rate in heart disease prediction