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| **IN3062: Introduction to Artificial Intelligence Coursework**  **Stroke Prediction** |
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Contents

[What is your dataset, problem domain? 3](#_Toc87350793)

[Define questions and analysis tasks 3](#_Toc87350794)

[Initial investigation of the dataset and the characteristics 4](#_Toc87350795)

[of the data 4](#_Toc87350796)

[Plan as to how you might transform the data to make it useable 4](#_Toc87350797)

[Is your model classification or regression? 5](#_Toc87350798)

[Did you have any missing, corrupt, or misleading data? 5](#_Toc87350799)

[If so, how did you cope it? 5](#_Toc87350800)

[Have you omitted some data? If so, why? 5](#_Toc87350801)

[Did you apply techniques to understand your dataset? 5](#_Toc87350802)

[What models did you use? 5](#_Toc87350803)

[How did you encode the input variables? 5](#_Toc87350804)

[What are the criteria for selecting model performance evaluation tools? 5](#_Toc87350805)

[What were your outputs? 5](#_Toc87350806)

[Did you have any problems or difficulties working with the dataset? 5](#_Toc87350807)

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# What is your dataset, problem domain?

The dataset used for this project will be the dataset from the website known as Kaggle (<https://www.kaggle.com/datasets>). The specific dataset used from Kaggle is the stroke dataset (<https://www.kaggle.com/fedesoriano/stroke-prediction-dataset>). The dataset provides information regarding different types of factors that can influence the cause of stroke. It is a large dataset that initially contains 12 attributes and approximately 5000 observations. This means that there is a lot of data to work with.

The problem domain the project is focusing on is predicting stroke based on the different attributes that the dataset presents and the valuable data included. There are some columns and rows that are required to be removed and edited to increase the accuracy of the prediction through means such as removing unnecessary data and replacing null with data acquired from the median amount. This will further increase the accuracy of the prediction regarding the problem domain.

# Define questions and analysis tasks

The domain is focused on predicting stroke based on various factors such as age, gender, diseases and if the person is a smoker or not. These factors can cause stroke. The reason for choosing stroke as the problem domain out of the similar issues is because stroke is one of the highest leading causes of death in the world. By undergoing stroke prediction, doctors can find out the chances of someone getting a stroke in the earlier stages. This will provide them with a foundation to apply more advanced checks on the patients to rapidly help them with recovery.

The analytical questions that are being asked regarding the stroke prediction are:

* What factors can increase the likeliness of stroke?
* What is the cause of stroke in individuals?
* Can chances of stroke be identified at an earlier stage?
* What can people do to reduce the chances of stroke?
* How does smoking affect the chances of a stroke?

The objectives are as followed:

* To create clear visualisations for the user to clearly understand the dataset
* For the machine to predict, as accurately as possible, whether a person is at risk of a stroke given variables such as smoking, age, BMI etc.
* To use the correct and most accurate machine learning model to train the stroke dataset i.e., Linear Regression, Random Forest Regression, Clustering or Classification.

The expected outputs are:

* From the dataset, we have 95% of the patients within it are unhealthy and are at risk of a stroke. In a perfect scenario, we would expect the AI to successfully predict to a degree of accuracy as close to 95% as possible
* The real accuracy of our machine learning will be illustrated through a graph that would show actual vs predicted data
* (Expected table)

Initial investigation of the dataset and the characteristics of the data

The dataset used includes 12 columns of data in which after discussing, we decided that most data was useful but some were not required for the prediction as it would not affect the accuracy and precision of the prediction if it were not included. For example, the column which had data on if the person was married or not, was not required as stroke is based on many individual factors and not an external factor such as being married. Similarly, the work type of the patient was not required as the data was general and not specific enough to affect the prediction. By being self-employed or working in a private field was not useful as there were no specific jobs. However, the other data were key information regarding predicting strokes such as smoking status, BMI, age, gender, and glucose levels. The characteristics of the data in the dataset are that it consists of numerical figures as well as descriptions. For example, the BMI and if a person is a smoker or not.

# Plan as to how you might transform the data to make it useable

Some data were either null or missing. To make these useful for the prediction of stroke these data will be transformed. In some cases, some figures were missing from the body mass index which we decided to use the median as it provides better precision and accuracy rather than using the mean. This will allow the end prediction to be more accurate. The data from the columns which are not required will be removed from the dataset as it can have negative affluence on the prediction. The data such as the id from the dataset will be removed as it is not useful as we are only focusing on the factors which affect stroke.

# Is your model classification or regression?

The model we use is classification because we want to predict a discrete outcome-based of multiple variables through unsupervised learning. We also split the dataset into training and test samples **THROUGH K-FOLD OR TRAIN** as well as improve the model as we go when we test the outcomes.

We cannot use regression as a machine learning model such as linear regression because linear regression focuses on one variable whereas ours uses multiple independent variables to predict an outcome. Regression provides outputs that are continuous which our model does not. Also, linear regression is supervised learning, and we are trying to implement unsupervised learning.

# Did you have any missing, corrupt, or misleading data? If so, how did you cope with it?

Within the BMI column, there were several records or ‘N/A’ values for the BMI. It is always better to have more data to train the AI and because we had already removed the unknown smoking status. We believed it would have been better to replace unknown values with the median.

# Have you omitted some data? If so, why?

We have omitted data such as ID, Work Type and Residence Type as we believe that these are factors that do not affect the risk of strokes. Whilst cleaning the data we had noticed there were values such as the Smoking Status being ‘Unknown’ and Gender being ‘Other’. We removed that as this does play a very large factor in stroke and it being an unknown would cause inaccuracy whilst training.

# Did you apply techniques to understand your dataset?

The first step we took to understanding our dataset was using a confusion matrix to visualise how smoking and gender impacts the likelihood of having a stroke. This matrix allowed us to easily picture the dataset and better understand that both smoking and gender influenced the probability of stroke according to our data. Using this matrix we were able to find out that the highest percentage of people with a stroke in our dataset were females that had never smoked at 45% along with males that had quit smoking at 33%.

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Figure 1 – Confusion matrix

Along with the matrix, we also loaded the data in a data structure using pandas DataFrame. With this table, we were able to analyse the data by splitting the data into mean, minimum, maximum etc. The table shows the mean age of people in the data is 48, yet has a wide range of age from 10 to 82 years old. We discovered that for the mean from the data, it can be assumed that most people have not smoked since the smoking status is around -0.02.

# 

Figure 2 – Data as a table (features matrix)

# What models did you use?

Since we’re predicting whether someone is more likely to get a stroke using our dataset, we, therefore, have a classification problem. To handle this problem we will use several models including decision tree, random forest, convolutional neural network and logistic regression.

The first step we took before applying any of these techniques was cleaning our dataset. With the current dataset we had, there were a few columns in the table that would not affect the prediction and were unnecessary for us to use, hence we removed the id and work-type and residence type columns. Therefore while inspecting our dataset, we also noticed a few BMI records contained N/A instead of a useable figure, therefore we disregarded those rows from the dataset. Moreover, to clean up the data, we changed any text to figures, for example, for the gender, changing male to 0 and female to 1. The smoking status column also contained 3 categories “formerly smoked”, “never smoked” and “smokes”, which we translated to the numbers -1,0,1, as well as removing rows that contained “Unknown” under smoking status.

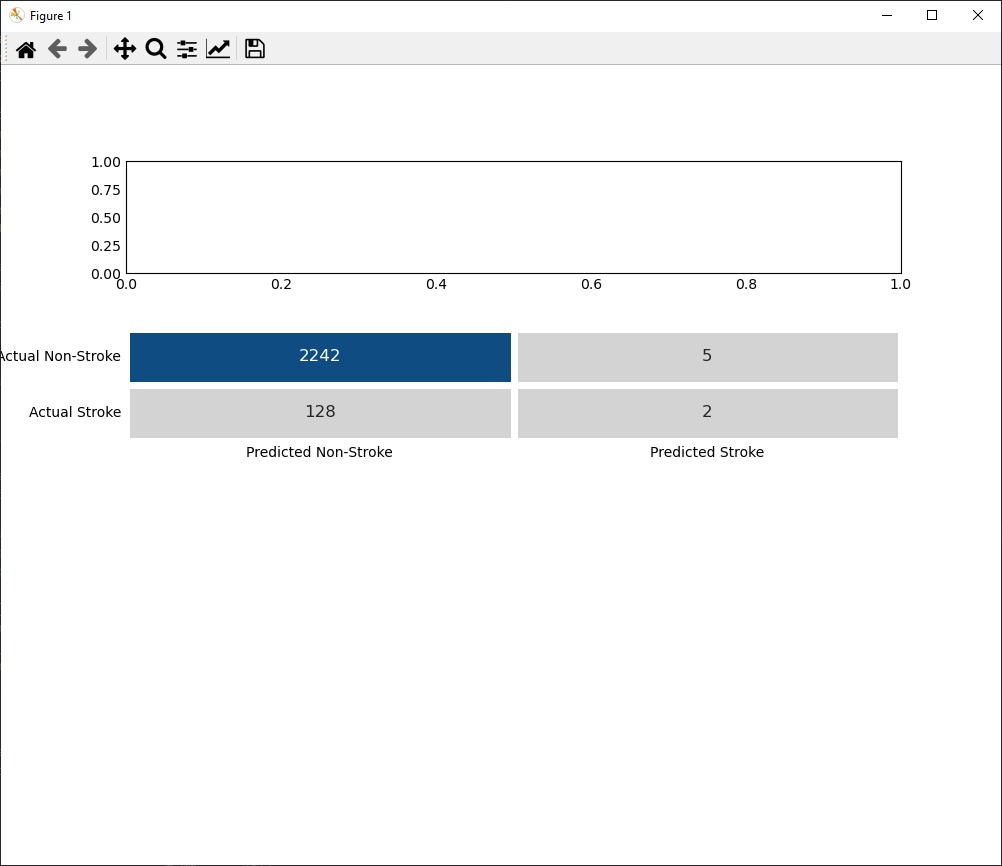
K-fold

-To split and train our data, we decided to use kfolds.

-Our data was undersampled so we used smote to level it out.

Decision Tree

A decision tree creates questions and then continuously splits/classifies the data until it divides all the data from each class e.g. true and false statements. It starts at the first node, the root node, and adds on a node for each time a question is asked, where it creates subnodes at decision nodes and eventually stop at a leaf node.



# How did you encode the input variables?

# What are the criteria for selecting model performance evaluation tools?

# What were your outputs?

# Did you have any problems or difficulties working with the dataset?

Problems with the dataset included missing BMI, unknown smoking status and unknown/other gender. For BMI we solved this problem by replacing the unknown values with the median. As for the gender and smoking status, any rows with unknown factors, we had completely removed from the dataset.