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# Lung Cancer Prediction Model Using Machine Learning

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**Abstract**
Lung cancer is one of the most widespread and life-threatening cancers across the world. A primary cause of this disease is cigarette smoking. It develops in the tissues of the lungs when cells begin to grow uncontrollably and abnormally. Lung cancer can originate in any part of the lungs and may impact the entire respiratory system. Therefore, early detection is crucial, and this can be achieved using various machine learning techniques. In this study, the K-Nearest Neighbors (KNN) algorithm is applied for lung cancer prediction. The model's performance is evaluated using accuracy scores and a confusion matrix to distinguish between correct and incorrect predictions. The process involves importing a relevant dataset and applying machine learning algorithms to analyze the data, ultimately determining whether individuals are likely to be affected by lung cancer.

**Keywords**: lung cancer, prediction, KNN, accuracy, performance

## I. INTRODUCTION

Lung cancer is one of the main cause of death and health issues in many countries with a 5-year survival rate of only 10-16%. Lung cancer is considered as the deadliest cancer in the world. This lung cancer would actually damage the cells of the respiratory system there by damaging the whole tissues which can leads to breathing problems and difficulty in intake of fresh air anymore and these cases might also lead to the death of a person.

It occurs when cells in the lung start to grow rapidly in an uncontrolled manner. Lung cancer can start anywhere in the lungs and affect any part of the respiratory system. So, this lung cancer needs to be detected at early stages and this can be predicted by using various machine learning algorithms. In this paper, it can be predicted by using some of the popular machine learning algorithms.

### 1.1 About the Project

The lung cancer prediction can be analysed using classification algorithm called KNN (K Nearest Neighbours). The key objective is the early diagnosis of lung cancer by examining the performance of this algorithm and predicting the stage of cancer for a patient. The implementation of the proposed approach on a lung cancer database reveals 95 % accuracy which gives accurate prediction results to the users.

### 1.2 Advantages of the System

1. The lung cancer detection using the machine learning algorithm can be used in early diagnosis of cancer in individuals. This can be very helpful for doctors, radiologists for giving a better result for the patients who consult them.

2. This technique can be used for curing the individuals and can also control the occurrence of lung cancer and can save millions of life. Machine learning algorithm can be used for more such improvements in health care and also other sectors.

## 2. MACHINE LEARNING ALGORITHM

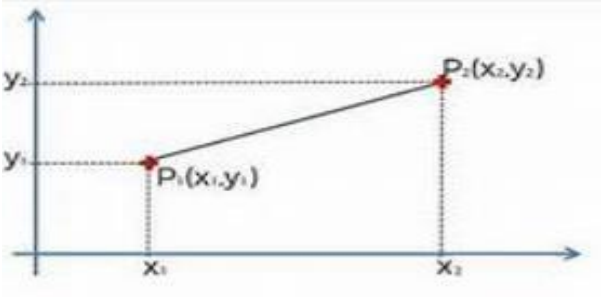
### K Nearest Neighbor Algorithm

The k-nearest neighbor algorithm, also known as KNN or k-NN, is a non-parametric, supervised learning classifier, which uses proximity to make classifications or predictions about the grouping of an individual data point. While it can be used for either regression or classification problems, it is typically used as a classification algorithm, working off the assumption that similar points can be found near one another.
For classification problems, a class label is assigned on the basis of a majority vote—i.e. the label that is most frequently represented around a given data point is used. While this is technically considered "plurality voting", the term, "majority vote" is more commonly used in literature. The distinction between these terminologies is that "majority voting"

technically requires a majority of greater than 50%, which primarily works when there are only two categories. When you have multiple classes—example four categories, you don't necessarily need 50% of the vote to make a conclusion about a class; you could assign a class label with a vote of greater than 25%.

### 2.1 Distance Metrics

**Euclidean distance (p=2):** This is the most commonly used distance measure, and it is limited to real-valued vectors. Using the below formula, it measures a straight line between the query point and the other point being measured.




$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

### 2.2 Advantages and Disadvantages

Just like any machine learning algorithm, k-NN has its strengths and weaknesses. Depending on the project and application, it may or may not be the right choice.

**Advantages**
- **Easy to implement**: Given the algorithm's simplicity and accuracy, it is one of the first classifiers that a new data scientist will learn.
- **Adapts easily**: As new training samples are added, the algorithm adjusts to account for any new data since all training data is stored into memory.
- **Few hyperparameters**: KNN only requires a k value and a distance metric, which is low when compared to other machine learning algorithms.

**Disadvantages**
- **Curse of dimensionality**: The KNN algorithm tends to fall victim to the curse of dimensionality, which means that it doesn't perform well with high-dimensional data inputs. This is sometimes also referred to as the peaking phenomenon, where after the algorithm attains the optimal number of features, additional features increase the amount of classification errors, especially when the sample size is smaller.

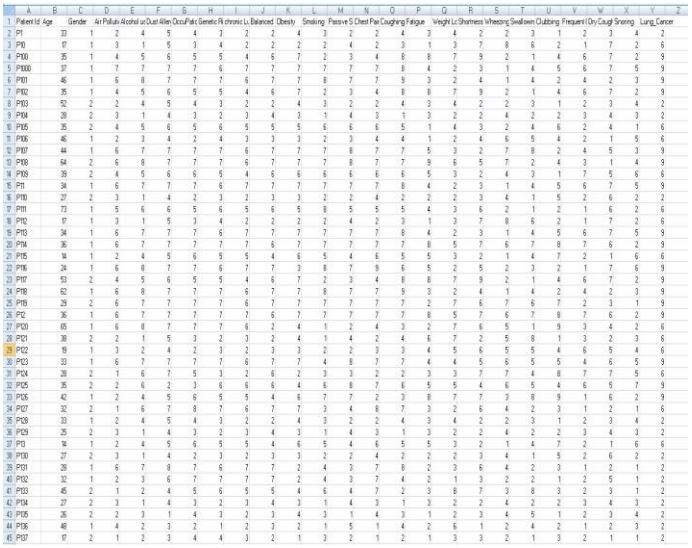
- **Prone to overfitting**: Due to the "curse of dimensionality", KNN is also more prone to overfitting. While feature selection and dimensionality reduction techniques are leveraged to prevent this from occurring, the value of k can also impact the model's behavior. Lower values of k can overfit the data, whereas higher values of k tend to "smooth out" the prediction values since it is averaging the values over a greater area, or neighborhood. However, if the value of k is too high, then it can underfit the data.

## 3. DATASET AND ATTRIBUTES

The below is the sample image of the dataset that is imported from Kaggle to predict the lung cancer of few individuals by using KNN. This dataset includes attributes such as Age, Gender, Air Pollution, Dust Allergy, Shortness of breath, Obesity, Alcohol Consumption, Wheezing, Swallowing Difficulty, Dry Cough, Lung Cancer.

These attributes are numerical attributes which can be easily used for prediction than categorical ones. The last Attribute

if this dataset is Lung Cancer which predicts the lung cancer result with three numerical values 2, 6, 9.



| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Patient Id | Age | Gender | Air Pollution | Alcohol use | Dust Allergy | Occupational Hazards | Genetic Risk | Chronic Lung Disease | Balanced Diet | Obesity | Smoking | Passive Smoker | Chest Pain | Coughing of Blood | Fatigue | Weight Loss | Shortness of Breath | Wheezing | Swallowing Difficulty | Clubbing of Finger Nails | Frequent Cold | Dry Cough | Snoring | Lung_Cancer | |
| 2 | P1 | 33 | 1 | 2 | 4 | 5 | 4 | 3 | 2 | 2 | 4 | 3 | 2 | 2 | 4 | 3 | 4 | 2 | 2 | 3 | 1 | 2 | 3 | 4 | 2 | |
| 3 | P10 | 17 | 1 | 3 | 1 | 5 | 3 | 4 | 2 | 2 | 2 | 2 | 4 | 2 | 3 | 1 | 3 | 7 | 8 | 6 | 2 | 1 | 7 | 2 | 6 | |
| 4 | P100 | 35 | 1 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 7 | 2 | 3 | 4 | 8 | 8 | 7 | 9 | 2 | 1 | 4 | 6 | 7 | 2 | 9 | |
| 5 | P1000 | 37 | 1 | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 4 | 2 | 3 | 1 | 4 | 5 | 6 | 7 | 5 | 9 | |
| 6 | P101 | 46 | 1 | 6 | 8 | 7 | 7 | 7 | 6 | 7 | 7 | 8 | 7 | 7 | 9 | 3 | 2 | 4 | 1 | 4 | 2 | 4 | 2 | 3 | 9 | |
| 7 | P102 | 35 | 1 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 7 | 2 | 3 | 4 | 8 | 8 | 7 | 9 | 2 | 1 | 4 | 6 | 7 | 2 | 9 | |
| 8 | P103 | 52 | 2 | 2 | 4 | 5 | 4 | 3 | 2 | 2 | 4 | 3 | 2 | 2 | 4 | 3 | 4 | 2 | 2 | 3 | 1 | 2 | 3 | 4 | 2 | |
| 9 | P104 | 28 | 2 | 3 | 1 | 4 | 3 | 2 | 3 | 4 | 3 | 1 | 4 | 3 | 1 | 3 | 2 | 2 | 4 | 2 | 2 | 3 | 4 | 3 | 2 | |
| 10 | P105 | 35 | 2 | 4 | 5 | 6 | 5 | 6 | 5 | 5 | 5 | 6 | 6 | 6 | 5 | 1 | 4 | 3 | 2 | 4 | 6 | 2 | 4 | 1 | 6 | |
| 11 | P106 | 46 | 1 | 2 | 3 | 4 | 2 | 4 | 3 | 3 | 3 | 2 | 3 | 4 | 4 | 1 | 2 | 4 | 6 | 5 | 4 | 2 | 1 | 5 | 6 | |
| 12 | P107 | 44 | 1 | 6 | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 8 | 7 | 7 | 5 | 3 | 2 | 7 | 8 | 2 | 4 | 5 | 3 | 9 | |
| 13 | P108 | 64 | 2 | 6 | 8 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 8 | 7 | 7 | 9 | 6 | 5 | 7 | 2 | 4 | 3 | 1 | 4 | 9 | |
| 14 | P109 | 39 | 2 | 4 | 5 | 6 | 6 | 5 | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 3 | 2 | 4 | 3 | 1 | 7 | 5 | 6 | 6 | |
| 15 | P11 | 34 | 1 | 6 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 4 | 2 | 3 | 1 | 4 | 5 | 6 | 7 | 5 | 9 | |
| 16 | P110 | 27 | 2 | 3 | 1 | 4 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 4 | 2 | 2 | 2 | 3 | 4 | 1 | 5 | 2 | 6 | 2 | 2 | |
| 17 | P111 | 73 | 1 | 5 | 6 | 6 | 5 | 6 | 5 | 6 | 5 | 8 | 5 | 5 | 5 | 4 | 3 | 6 | 2 | 1 | 2 | 1 | 6 | 2 | 6 | |
| 18 | P112 | 17 | 1 | 3 | 1 | 5 | 3 | 4 | 2 | 2 | 2 | 2 | 4 | 2 | 3 | 1 | 3 | 7 | 8 | 6 | 2 | 1 | 7 | 2 | 6 | |
| 19 | P113 | 34 | 1 | 6 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 4 | 2 | 3 | 1 | 4 | 5 | 6 | 7 | 5 | 9 | |
| 20 | P114 | 36 | 1 | 6 | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 5 | 7 | 6 | 7 | 8 | 7 | 6 | 2 | 9 | |
| 21 | P115 | 16 | 1 | 2 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 5 | 4 | 6 | 5 | 5 | 3 | 2 | 1 | 4 | 7 | 2 | 1 | 6 | 6 | |
| 22 | P116 | 24 | 1 | 6 | 8 | 7 | 7 | 6 | 7 | 7 | 3 | 8 | 7 | 9 | 6 | 5 | 2 | 5 | 2 | 3 | 2 | 1 | 7 | 6 | 9 | |
| 23 | P117 | 53 | 2 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 7 | 2 | 3 | 4 | 8 | 8 | 7 | 9 | 2 | 1 | 4 | 6 | 7 | 2 | 9 | |
| 24 | P118 | 62 | 1 | 6 | 8 | 7 | 7 | 7 | 6 | 7 | 7 | 8 | 7 | 7 | 9 | 3 | 2 | 4 | 1 | 4 | 2 | 4 | 2 | 3 | 9 | |
| 25 | P119 | 29 | 2 | 6 | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 2 | 7 | 6 | 7 | 6 | 7 | 2 | 3 | 1 | 9 | |
| 26 | P12 | 36 | 1 | 6 | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 8 | 5 | 7 | 6 | 7 | 8 | 7 | 6 | 2 | 9 | | |
| 27 | P120 | 65 | 1 | 6 | 8 | 7 | 7 | 7 | 6 | 2 | 4 | 1 | 2 | 4 | 3 | 2 | 7 | 6 | 5 | 1 | 9 | 3 | 4 | 2 | 6 | |
| 28 | P121 | 38 | 2 | 2 | 1 | 5 | 3 | 2 | 3 | 2 | 4 | 1 | 4 | 2 | 4 | 6 | 7 | 2 | 5 | 8 | 1 | 3 | 2 | 3 | 6 | |
| 29 | P122 | 19 | 1 | 3 | 2 | 4 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 5 | 4 | 6 | |
| 30 | P123 | 33 | 1 | 6 | 7 | 7 | 7 | 7 | 6 | 7 | 7 | 4 | 8 | 7 | 7 | 4 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 5 | 9 | |
| 31 | P124 | 28 | 2 | 1 | 6 | 7 | 5 | 3 | 2 | 6 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 7 | 7 | 4 | 8 | 7 | 7 | 5 | 6 | |
| 32 | P125 | 35 | 2 | 2 | 6 | 2 | 3 | 6 | 6 | 4 | 4 | 6 | 8 | 7 | 6 | 5 | 5 | 4 | 6 | 5 | 4 | 6 | 5 | 7 | 9 | |
| 33 | P126 | 42 | 1 | 2 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 7 | 7 | 2 | 3 | 8 | 7 | 7 | 3 | 8 | 9 | 1 | 6 | 2 | 9 | |
| 34 | P127 | 32 | 2 | 1 | 6 | 7 | 8 | 7 | 6 | 7 | 7 | 3 | 4 | 8 | 7 | 3 | 2 | 6 | 4 | 2 | 3 | 1 | 2 | 1 | 6 | |
| 35 | P128 | 33 | 1 | 2 | 4 | 5 | 4 | 3 | 2 | 2 | 4 | 3 | 2 | 2 | 4 | 3 | 4 | 2 | 2 | 3 | 1 | 2 | 3 | 4 | 2 | |
| 36 | P129 | 25 | 2 | 3 | 1 | 4 | 3 | 2 | 3 | 4 | 3 | 1 | 4 | 3 | 1 | 3 | 2 | 2 | 4 | 2 | 2 | 3 | 4 | 3 | 2 | |
| 37 | P13 | 16 | 1 | 2 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 5 | 4 | 6 | 5 | 5 | 3 | 2 | 1 | 4 | 7 | 2 | 1 | 6 | 6 | |
| 38 | P130 | 27 | 2 | 3 | 1 | 4 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 4 | 2 | 2 | 3 | 4 | 1 | 5 | 2 | 6 | 2 | 2 | |
| 39 | P131 | 28 | 1 | 6 | 7 | 8 | 7 | 6 | 7 | 7 | 2 | 4 | 3 | 7 | 8 | 2 | 3 | 6 | 4 | 2 | 3 | 1 | 2 | 1 | 2 | |
| 40 | P132 | 32 | 1 | 2 | 3 | 6 | 7 | 7 | 7 | 7 | 2 | 4 | 3 | 7 | 4 | 2 | 1 | 3 | 2 | 2 | 1 | 2 | 5 | 1 | 2 | |
| 41 | P133 | 45 | 2 | 1 | 2 | 4 | 5 | 6 | 5 | 5 | 4 | 6 | 4 | 7 | 2 | 3 | 8 | 7 | 3 | 8 | 3 | 2 | 3 | 1 | 2 | |
| 42 | P134 | 27 | 2 | 3 | 1 | 4 | 3 | 2 | 3 | 4 | 3 | 1 | 4 | 3 | 1 | 3 | 2 | 2 | 4 | 2 | 2 | 3 | 4 | 3 | 2 | |
| 43 | P135 | 26 | 2 | 2 | 3 | 1 | 4 | 3 | 2 | 3 | 4 | 3 | 1 | 4 | 3 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 2 | |
| 44 | P136 | 48 | 1 | 4 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 5 | 1 | 4 | 2 | 6 | 1 | 2 | 4 | 2 | 1 | 2 | 3 | 2 | |
| 45 | P137 | 17 | 2 | 1 | 2 | 3 | 4 | 4 | 3 | 2 | 1 | 3 | 2 | 1 | 2 | 1 | 3 | 3 | 2 | 1 | 3 | 2 | 1 | 1 | 2 | |

**Figure 1:** Representation of Dataset

### 3.1 Libraries

Python's standard library is very extensive. The library contains built-in modules (written in C) that provide access to system functionality such as file I/O that would otherwise be inaccessible to Python programmers, as well as modules written in Python that provide standardized solutions for many problems that occur in everyday programming. The Python installers for the Windows platform usually include the entire standard library and often also include many additional components. For Unix-like operating systems Python is normally provided as a collection of packages, so it may be necessary to use the packaging tools provided with the operating system to obtain some or all of the optional components. Some of the libraries used are:

1. **Pandas:** Pandas are an important library for data scientists. It is an open-source machine learning library that provides flexible high-level data structures and a variety of analysis tools. It eases data analysis, data manipulation, and cleaning of data. Pandas support operations like Sorting, Re-indexing, Iteration, Concatenation, Conversion of data, Visualizations, Aggregations, etc.

2. **Numpy:** The name "Numpy" stands for "Numerical Python". It is the commonly used library. It is a popular machine learning library that supports large matrices and multi-dimensional data. It consists of in-built mathematical functions for easy computations. Even libraries like TensorFlow use Numpy internally to perform several operations on tensors. Array Interface is one of the key features of this library.

3. **Scikit-learn:** It is a famous Python library to work with complex data. Scikit-learn is an open-source library that supports machine learning. It supports variously supervised and unsupervised algorithms like linear regression, classification, clustering, etc. This library works in association with Numpy and SciPy.

4. **Matplotlib:** This library is responsible for plotting numerical data. And that's why it is used in data analysis. It is also an open-source library and plots high-defined figures like pie charts, histograms, scatterplots, graphs, etc.

### 3.2 Figures

Here, representation of architecture of KNN algorithm and use case diagram of its working in the project is shown

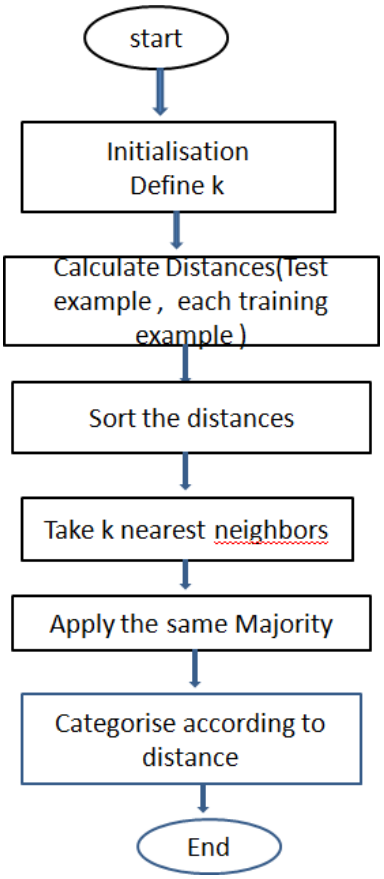



**Figure1.** Architecture of working of KNN algorithm with dataset imported.

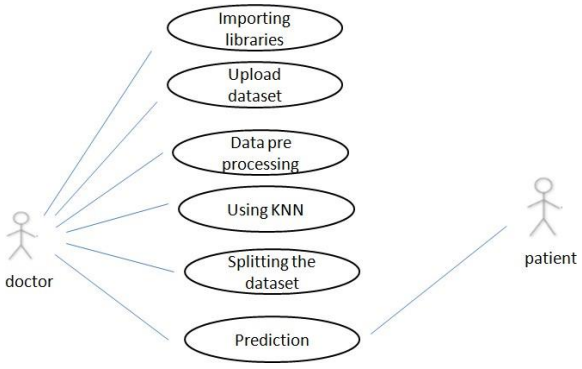



**Figure2 :** Use Case Diagram representing the working of the project.

Below represents some of the plots that have been used for better visualization of the predictions results of the dataset.

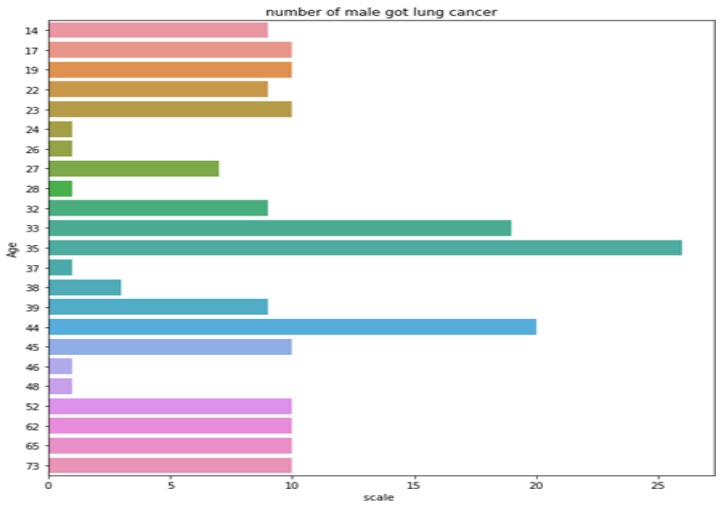



**Figure 4 :** Representation using Count plot

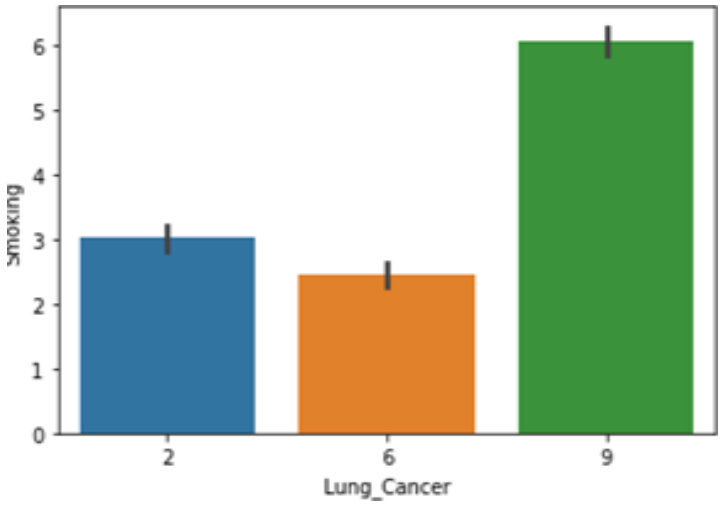



**Figure 5:** Representation using Bar Plot

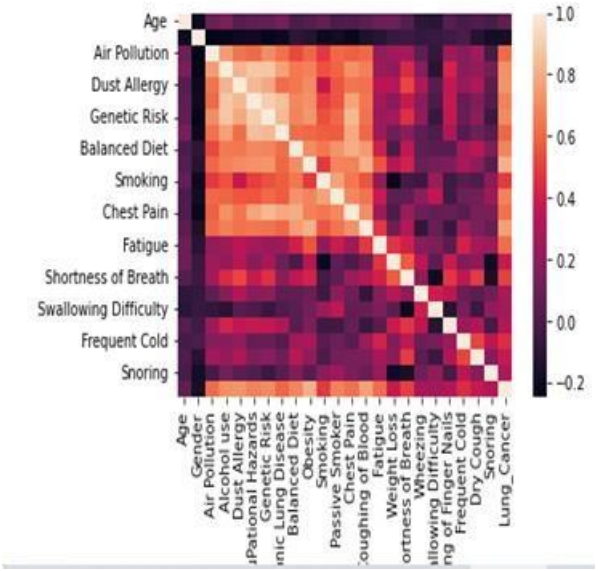


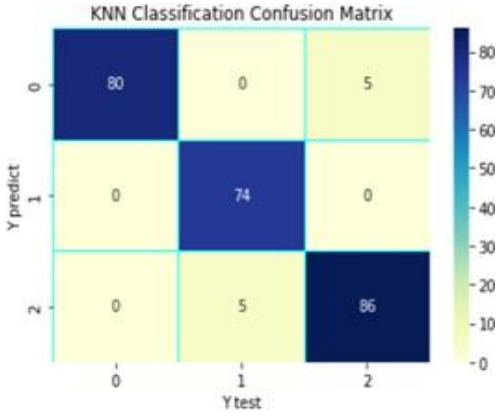

**Figure 6:** Representation using Heat Map

# 4 RESULTS

## 4.1 Confusion Matrix

A confusion matrix **is** a tabular summary of the number of correct and incorrect predictions made by a classifier. It is used to measure the performance of a classification model. It can be used to evaluate the performance of a classification model through the calculation of performance metrics like accuracy, precision, recall, and F1-score.

The confusion matrix obtained for this system based on the dataset imported is shown below:




## 4.1 Classification Report

A classification report is a performance evaluation metric in machine learning. It is used to show the precision, recall, F1 Score, and support of your trained classification model. If you have never used it before to evaluate the performance of your model then this article is for you. In this article, I will take you through an introduction to the classification report in machine learning and its implementation using Python.

CLASSIFICATION REPORT

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 2 | 1.00 | 0.94 | 0.97 | 85 |
| 6 | 0.94 | 1.00 | 0.97 | 74 |
| 9 | 0.95 | 0.95 | 0.95 | 91 |
| accuracy | | | 0.96 | 250 |
| macro avg | 0.96 | 0.96 | 0.96 | 250 |
| weighted avg | 0.96 | 0.96 | 0.96 | 250 |

# 5 CONCLUSION

Lung cancer prediction using machine learning process helps us to predict the lung cancer of the patient and there are many algorithms to predict this. Some of the algorithms are SVM, Linear Regression, Logistic Regression and KNN. But even though we have many algorithms correct prediction is necessary to detect the lung cancer of the patient so that necessary precautions can be taken by the individual and incorrect prediction might leads to harmful consequences for the individual.

So, in order to predict correctly the particular algorithm needs to be accurate and hence can have a better performance on predicting the result. KNN is one of the algorithms with good accuracy of 96% and can be a good algorithm that would

be able to predict lung cancer more effectively than other algorithms. This can be better shown by importing the dataset and calculating its accuracy score and even plots are drawn for better visualization of the data.

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