# Lung Cancer Prediction using Machine Learning

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**Abstract–Lung cancer (LC) is one of the most dangerous cancer diseases affecting the human health. Histopathological examination is the gold standard for qualitative and clinical staging of lung tumors. However, the process for doctors to examine thousands of histopathological values is very cumbersome, especially for doctors with less experience. Pathological diagnosis results are effectively helping doctors to select the most proper treatment mode, and thereby improve the patients survival rate. The present problem of incomplete experimental subjects in computer-aided diagnosis for cancer subtypes, this study includes rare lung adeno squamous carcinoma (ASC) samples for first time, and proposed the computer-aided diagnosis method in ASC histo-pathological values small cell lung carcinoma (SCLC) and lung squamous cell carcinoma (LUSC). Firstly, the multidimensional features of 121 LC histo-pathological values were extracted, and then the relevant features (Relief) algorithm was used for feature selection. The support vector machines (SVMs) classifier is being used for classifying LC subtypes, and area under the curve (AUC) and receiver operating characteristic (ROC) curve were used to make it more intuitive evaluate generalization ability of the classifier. Then, through a horizontal comparison with the mainstream classification models varieties, experiments showed that the classification effect which are being achieved by Relief-SVM model is the best. The LUSC-ASC classification accuracy was 73.91%, the LUSC-SCLC classification accuracy was 83.91% and the ASC-SCLC classification accuracy was 73.67%. Our experimental results verify the potential of the auxiliary diagnosis model constructed by machine learning (ML) in the diagnosis of LC.Random Forest Classifier, Logistic Regression algorithm is implemented to train the data and test the machine to get the accuracy**

**Keywords: Lung cancer (LC), Random Forest Classifier, Logistic Reggression algorithm and machine Learning algorithms.**

## I. INTRODUCTION

Lung Cancer becomes one of the most dangerous cancers threatening human health. Clinicians 3visual analysis of LC histopathological values is one of the most notable methods in evaluating LC subtypes.

However, it is challenging and complicated for pathologists to review thousands of histopathological values, and it is even more tough for doctors with less experience. So, to relieve the pressure for doctors and improve diagnosis accuracy and efficiency, it is must to study the computer-aided LC diagnosis model.

From the perspective of treatment and pathology, LC is divided into non-small cell lung carcinoma (NSCLC) as well as small cell lung carcinoma (SCLC), of which 80%-85% are VOLUME 9, 2021 This work is licensed under (CCA) Creative Commons Attribution 4.0 License. For more details, referhttps://creativecommons.org/licenses/by/4.0/ 53687 M. Li et al.: Research on Auxiliary Classification and Diagnosis of LC Subtypes NSCLC and the rest are SCLC.

The main NSCLC histological types are lung adenocarcinoma (ADC) and lung squamous cell carcinoma (LUSC). The other histological types of NSCLC are large-cell carcinoma and lung adenosquamous carcinoma (ASC).

In particular, ASC is a relatively rare subtype of NSCLC that accounts for 0.3–5% of all NSCLCs. Due to the various histopathological types of LC, the treatment methods adopted also are varying.

When lung tissue classification is determined, the appropriate treatment mode could be selected, like the reasonable surgery application, radiotherapy, chemotherapy, molecular targeted therapy and also immune therapy. Moreover, LC screening errors are avoided, clinicians' multifarious work pressure could be slowed, patients' survival time maximized and the patient's life quality will improve.

The LC imaging examination methods mainly include: (1) X-ray photography, which is the most basic lung imaging examination methods, and the photography resolution is low and blind spots are also found in examination. CT (Computed tomography), specifically, chest CT has advantage for detecting initially peripheral

LC and identify the lesion location. At present , it is the most commonly used imaging type of preoperative diagnosis and also LC staging. But, one of the drawbacks of using CT examinations is, for patients undergoing continuous examinations, it is must to consider the impact of radiation dose produced in the operation.

Magnetic resonance imaging (MRI) is having high sensitivity and specificity for bone metastases and vertebral, but it is not suitable for LC routine diagnosis Ultrasound is the non-invasive tool, which is superior usually to radiography in postoperative pulmonary complications (PPCs) examination.

It is developed as a valuable method. Although the imaging examination methods mentioned above play the important role in LC detection, each examination results are only used as the reference for diagnosis, staging, efficacy monitoring and also LC prognosis evaluation, but histopathological examination is the standard for clinical staging and tumour qualitative.

Still, due to complex texture features of histopathological values, there is no computer-aided diagnosis method for a) ASC, b) LUSC and c) SCLC based on histopathological values. To resolve this, this study includes ASC sample data for first time and then introduces the computer-aided model in LC subtypes automatic classification based on LC histopathological values.

First, 7 texture analysis methods are being used for extracting 265-dimensional features in LC histopathological values, and then the relevant features (Relief) algorithm is used in feature selection.

1)Project Challenges

This section explains the challenges that were overcome to finish this project. Each of the challenges are introduced briefly and detailed in the later sections of report. This section is useful for those who need to do a deep learning project with the large image datasets.

2) Large 3D Dataset Management and Preprocessing

Working with dataset is the most difficult challenge that has been to be overcome for the project. The dataset is very large (around seventy Gigabytes) and makes managing and analysing dataset and training the model is very computationally heavy. A potential solution to this is to transfer the computation workload to the cloud service like AWS, Google Cloud or Floydhub which results in the more efficient work flow for project. A single CT scan is also three Dimensional which is complex to work during feature selection and the data preparation.

3) Neural Network Architecture

Design Choices in Neural networks are architectures that are designed in of itself and there are so many types of architectures out there that still exist to solve various problems. A key challenge for authors is to use the architecture that is able to detect malignant tumour patterns in the dataset.

To resolve this, the author has to undertake necessary study to implement proper model design prior for training. There are some other neural network architectures convolutional networks, multi-layer perceptrons and sequence models.

Project Challenge This section discusses the challenges that are overcome to finish the study.

4) Doctor's Challenges during Diagnosis

The author met Dr. Seamus Linnane who is the respiratory physician in Beaumont Hospital. Dr.Linanne shared the valuable insight into the present diagnosing way lung cancer. Dr. Linanne is part of the multidisciplinary radiologists team, surgeons, oncologist and other respiratory physicians and Beaumont Hospital consultants to diagnose the lung cancer. This multidisciplinary team uses a huge variety of data, X-rays, CT ScansPet Scans and Biopsies in assessing; if a patient is having lung cancer. These tests help the members to fully diagnose the patient and this approach will use all of them to get data. According to Dr.Linanne, In 2016, 133 patients were diagnosed for lung cancer at Beaumont Rapid Access Clinic where 216 patients were diagnosed in total across the entire hospital services.

This means that, approximately one-third of the referrals in the clinic are having lung cancer in Beaumont Hospital. Medical professionals apply TNM classification for help characterising lung cancer from basic - advanced forms of malignant tumours. IA being the earliest cancer stages which is likely that it is accidentally found out, and the more difficult it is to perform the biopsy and ultimately the better prognosis (likelihood to get well). But, IV is an advanced cancer stage which means that it is easy in diagnosing, which includes biopsy, and highly likely to cause symptoms and prognosis worse.

5) Kaggle 3D Unlabeled Dataset:

Data Science Bowl 2017 This dataset was part of the Kaggle competition Data Science Bowl 2017 [4]. The topic of the competition was about lung cancer detection. The dataset was provided by the National Lung Cancer Screening Trial, The Cancer Imaging Archive, Diagnostic Image Analysis Group (Radboud University), Lahey Hospital and Medical Center and Copenhagen University Hospital. The dataset contains full CT scan values of a patients lungs.

The dimension is (512,512, 200) which refers (Height, Width and number of Values). See Figure 2.4a. For this project the dataset has been used to segment different parts of the CT scans as part of feature engineering and visualizations. This dataset was what the author originally wanted to work with as the data was labeled as desired and useful for the project. However the largest challenge that hindered the author from continuing using this data is the size of the entire dataset. The entire dataset is about 100GB zipped which could not fit on the authors laptop. Preprocessing the total dataset is computationally heavy too.

## II. RELATED WORKS

Jena, Sanjukta Rani et al. “Texture Analysis Based Feature Extraction and Classification of Lung Cancer.” *2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT)* (2019): 1-5.

Lung cancer is the most life-threatening dangerous diseases treatment must be the primary goal throughout the research. The early cancer recognition can be helpful in solving disease entirely. There are various techniques found in the literature to detect the lung cancer. Various investigators were contributed their facts in cancer prediction. These papers pact about prevailing lung cancer detection methods that was obtainable in the study literature.

Various methodologies were originated in methodologies of cancer detection to progress the efficiency of detection. Diverse applications such as SVM (support vector machines), NN (neural networks), image processing techniques are extensively applied in to detect cancer which is elaborated in this study.

The primary pre-processing goal is to enhance the image quality so that it could be used to eliminate or minimize irrelevant parts. To enhance the image’s quality, pre-processing stage is still critical. Filters eliminate noise and other segments with more recurrence and datasets preparing for further processing. Lung cancer processing methods are depicted in here.

Alam, Janee et al. “Multi-Stage Lung Cancer Detection and Prediction Using Multi-class SVM Classifie.” *2018 International Conference on Computer, Communication, Chemical, Material and Electronic Engineering (IC4ME2)* (2018): 1-4.

The authors applied an image processing technique in MATLAB for creating an effective lung cancer prediction nand detection algorithm. Lung cancer are detected using the multi-stage classification. Using this algorithm, lung cancer predictions are made. The algorithm then found the likelihood of lung cancer if input image is not containing any cells affected by the cancer. The algorithm checks the respective cancer stage, like the initial, middle, and then final stage, if the cancer-affected cell is identified. Various methods are used to improve and segment values prior to classification stages. Image improvement techniques contain contrast enhancement, color-space transformation and image scaling.

For segmentation, threshold and marker-controlled watershed based segmentation were utilized. The new system's overall flowchart is found here. The authors made graylevel co-occurrence framework from image and from this it is computed surface measures from GLCM. The element were taken for extraction are a) mean, b) standard deviation, c) entropy, d) RMS, e) fluctuation, smoothness, f) kurtosis, g) IDM, h) differentiate, i) relationship, j) vitality and k) homogeneity.

### 3.3 Lung Cancer Disease Diagnosis Using Machine Learning Approach

Author: S. U. Bohra Swati Mukherjee

From the beginning to the present, the most intriguing area of medical research has been the investigation and study of lung diseases. A diagnosis system like this can only help reduce the risk of human life-threatening conditions by detecting malignant growths earlier. Eventually, a few structures are proposed, but a great number of them are still just ideas. In the following philosophy, the performance of a neural network model is examined to address the common problem in therapeutic imaging applications of recognizing cancerous cells in image data.

A lung cancer identification framework based on AI and deep neural systems is developed in an effort to complete this task. The method relies on supervised learning, which has improved precision, particularly through the use of the deep learning mechanism. A strategy for classifying lung tumors is the CNN classification. Image acquisition, pre-preparation, enhancement, segmentation, feature extraction, and neural framework identification are among the various methods included in the framework. To put it succinctly, the machine learning approach has the potential to provide a once-in-a-lifetime opportunity to enhance low-cost decision support for lung cancer treatment.

Saric, Matko et al. "CNN-based Method for Lung Cancer Detection in Whole Slide Histopathology Images." *2019 4th International Conference on Smart and Sustainable Technologies (SpliTech)* (2019): 1-4.

The regions would assist the pathologist and significantly speed up the entire procedure. A completely automated method for detecting lung cancer in whole slide values of lung tissue samples is presented in this paper. Using a convolutional neural network (CNN), classification is carried out at the image patch level.

The performance of two CNN architectures—VGG and ResNet—is trained and compared. The obtained results indicate that a CNN-based approach may assist pathologists in diagnosing lung cancer.

Index Terms: digital pathology, lung cancer, and covolutional neural networks I. Introduction Lung cancer is the most common cancer-related death cause. Patients with this disease have a poor prognosis, with a 5-year survival rate of less than 20%.

Due to a diagnosis made at an advanced stage of the disease, the majority of patients have a poor prognosis. Early-stage patients have a significantly higher 5-year survival rate of over 70%. In [2], it is demonstrated that screening with low dose computed tomography (LDCT) reduces high-risk population mortality by 20%. The significance of early detection and diagnosis, which has a significant impact on the outcome of treatment, is emphasized in these findings.

Histopathological examination of tissues obtained through bronchoscopy is a standard procedure that is required for early diagnosis following the acquisition of tumor-suspected CT values. Pathologists perform biopsy tissue assessment, which is a time-consuming and error-prone task with a diagnostic accuracy of less than 80% [3].

It is essential for treatment selection to correctly classify the patient into the major histological subtypes of squamos carcinoma, adenocarcinoma, small cell carcinoma, and undifferentiated carcinoma. Since digital pathology scanners now produce high-resolution whole-slide values (WSIs) (up to 160 nm per pixel), it is now possible to use computer vision to automatically detect cancer in WSIs.

Convolutional neural networks (CNNs) are the method of choice right now because of their improved accuracy in a variety of computer vision tasks, including medical imaging [4].

A method for automatically detecting cancer cells in lung tissue WSIs is presented in this paper. In order to lessen the amount of computation required, the first step is to extract the tissue-rich WSI region, or ROI. CNN-based classification of image patches into tumor and normal classes follows next.

In the context of the most recent Automatic Cancer Detection and Classification in Whole-slide Lung Histopathology (ACDC@LUNGHP), this task was proposed, and the preliminary findings are outlined in [5].

Other than this, there are no other papers that deal with CNN-based evaluation of lung cancer values. The structure of the paper is as follows: The method is described in Section 3, which follows a brief overview of the related work in Section 2. Section 4 presents the results, and Section 5 provides a conclusion.

3.5Deep Learning Methods for Lung Cancer Segmentation in Whole-slide Histopathology Values - the ACDC@LungHP Challenge

Author: Lihong Liu, Yang Xiao, Byungjae Lee, Yilong Li

A pathologist's evaluation of biopsy tissue is the gold standard for diagnosing lung cancer. The diagnostic accuracy, on the other hand, is less than 80% [4]. Squamous carcinoma, adenocarcinoma, small cell carcinoma, and undifferentiated carcinoma are the most common histological subtypes of malignant lung disease. In order to make the best treatment decisions, it is essential to correctly evaluate these subtypes on biopsy.

However, there aren't enough qualified pathologists to meet the huge clinical needs, especially in countries like China, where there are a lot of lung cancer patients. Lung cancer screening with low-dose Computed Tomography was recently implemented in the United States thanks to the National Lung Screening Trial (NLST), the largest randomized control trial.

Additionally, the Dutch-Belgian lung cancer screening trial (NELSON), the second-largest randomized control trial, demonstrates the advantages of screening for lung cancer. Whole-slide histopathology values, biopsies, and resected tumors are likely to result from the implementation of lung cancer screening in the United States and Europe.

At the same time, there is a severe shortage of pathologists and a heavy workload. By automatically evaluating lung biopsies, an artificial intelligence (AI) system may effectively resolve the aforementioned issues.

## III. PROPOSED METHODOLOGY

At present, there have been a number of lung cancer risk models developed and validated that one may consider to be a form of CADx tool (6-9).

Typically using logistic regression, the tools aim to give an overall risk of the patient having cancer based on patient meta-data such as sex, age and smoking history along with nodule characteristics such as nodule size, morphology and then growth, if a previous CT was available.

DISADVANTAGES

- Lung cancer diagnosed patient may suffer through Cough,
- Chest pain
- Shortness of breath
- Wheezing, Hemoptys.

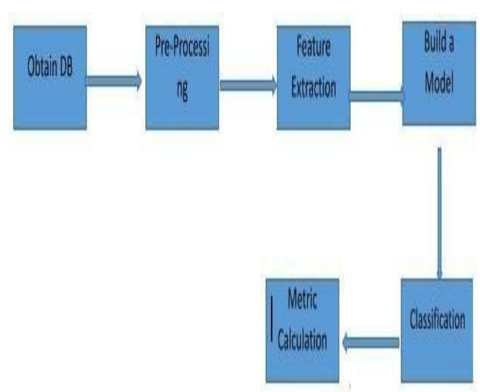



Figure 1: Existing System

The process can be automated and the machine learning algorithms are applied for better performance of the model. The mortality rate can be analyzed properly and better prediction can be done. Proposed work and the first the data pre-processing and data cleaning is done. By this process the data is filtered and now the data is inserted into algorithm.

After that the 4 algorithms are to be compared to analyze the accuracy of Lung cancer to find the accuracy percentage. Dataset is the records collection. The histopathological valus are faced with a large number of rich geometric structures and complex textures caused by the diversity of structural morphology.

HISTOPATHOLOGICAL IMAGE PREPROCESSING

Histopathological examination is the gold standard for qualitative and clinical tumor staging standard for qualitative and clinical tumor staging. Histopathological values have been widely used by doctors for diagnosis and treatment, and are an important basis for predicting patient survival. The histopathological values of LUSC, ASC and SCLC. According to reports, the following problems exist in histopathological values:

• The histopathological values are faced with a large number of rich geometric structures and complex textures caused by the diversity of structural morphology.

• The histopathological values are easily affected by color differentiation and noise due to external reasons such as illumination condition.

• Due to the difference in microscope magnification, equipment parameters and other factors in histopathological values, the image size and resolution are not the same.

• Texture features such as local micro vessels in histopathological values are the key to disease diagnosis, and the extraction of features is of great significance to assist in the diagnosis and classification of LC.

For all these reasons, the histopathological values presented to us are often not perfect. Gaussian filter becomes the efficient low-pass filter, shows good filtering performance in spatial domain as well as frequency domain, and is widely applied in image processing for noise reduction. Generally, the pixel value of each point is replaced by the weighted mean of its neighbourhood, so Gaussian filtering is the process of weighted averaging of the whole image.

The histopathological values processed by Gaussian filtering tend to be smoother and contain less noise, which is ready for our subsequent studies. According to the Ciompi et al. description, the existence of differences such as color destandardization in histopathological values will limit the interpretation of histopathological values by inexperienced pathologists, and the color differences will affect the performance of the automatic diagnosis model.

To avoid the problem of information loss due to excessive brightness of histopathological values, we adopt the adaptive histogram equalization algorithm (AHE) to normalize the colour of histopathological values in this study. In this mode, the image is divided into several 8×8 pieces, and then the histograms of multiple local regions of the image segmentation are calculated.

At this point, the brightness is redistributed in the 8 × 8 area to change the image contrast. Therefore, this algorithm is more beneficial for improving the local contrast of the image and obtain more image details. According to the investigation, the improvement in model classification performance by the colour normalization method is limited. The image after the above image pre-processing operation . the details before and after the pre-processing operation of the ASC histopathological image.

HANDCRAFTED TEXTURE EXTRACTION METHODS: We extracted 265-dimensional features using seven handcrafted texture extraction algorithms, including the Hu invariant moments, GLGCM, wavelet transform, GLCM, LBP, GLDS and Markov random field, as shown in Table.

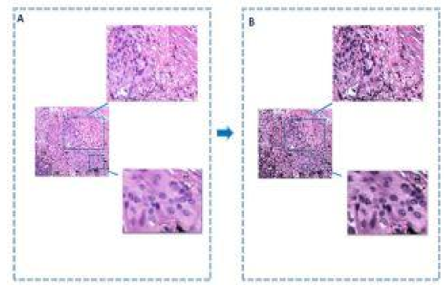



Figure 2: Markov Random Field

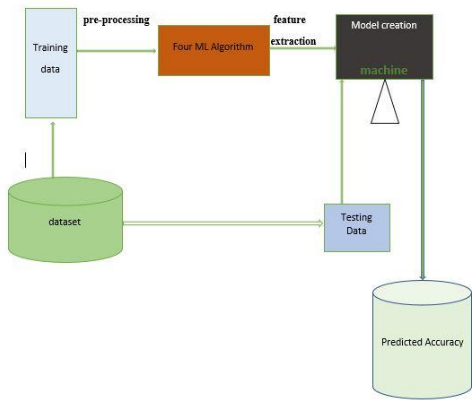



Figure 3: Proposed System

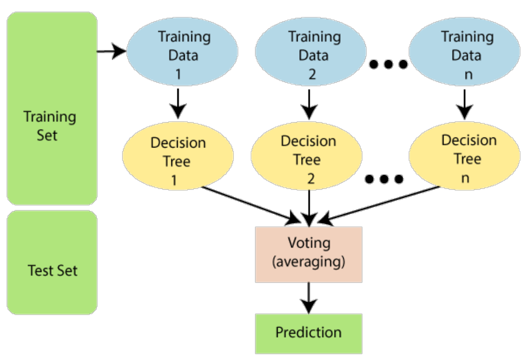



Figure 4: Random Forest Algorithm

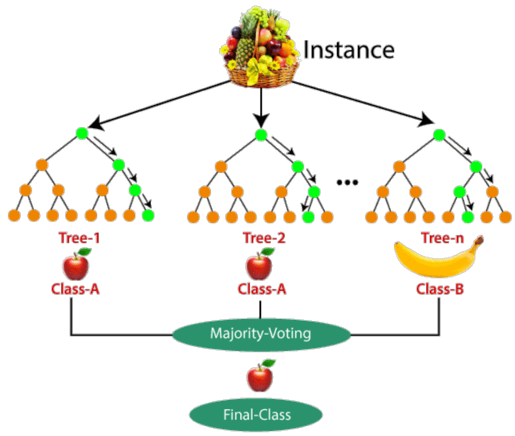



Figure 5: Applications Of Random Forest

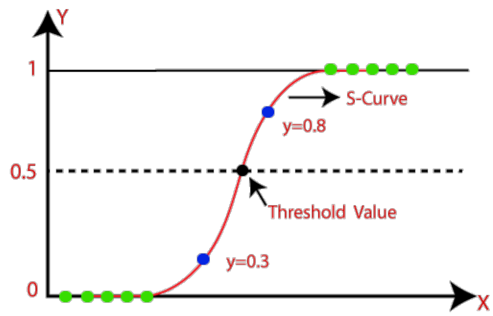
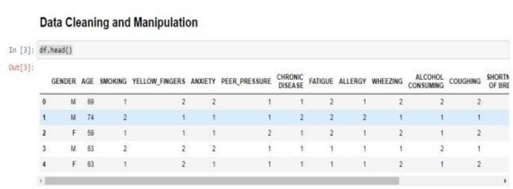



Figure 6: Logistic Function [Sigmoid Function]



Data Cleaning and Manipulation

In [3]: df.head()

Out[3]:

| | GENDER | AGE | SMOKING | YELLOW_FINGERS | ANXIETY | PEER_PRESSURE | CHRONIC DISEASE | FATIGUE | ALLERGY | WHEEZING | ALCOHOL CONSUMING | COUGHING | SHORTN OF BRE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | M | 69 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | |
| 1 | M | 74 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | |
| 2 | F | 59 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | |
| 3 | M | 63 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | |
| 4 | F | 63 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | |

Figure 7: Data Cleaning


Figure 8: Anxiety in People with Cancer

## IV. EXPERIMENTAL RESULTS

- This study was the first to include relatively rare ASCs in lung histopathological values and applies them to the automatic classification of LC subtypes.

- This paper was the first to apply the Relief-SVM algorithm to the classification of LC histopathological values, which demonstrates the tremendous potential of ML algorithms to be used in the diagnosis of LC subtypes.

## V. CONCLUSION AND FUTURE ENHANCEMENT

Currently, ML Algorithms play a significant role in early LC prediction, and with the help of these techniques available data can be used to make predictions or decisions. Study work provided a proposed system followed by MLa in predicting early LC which provides the researcher with better knowledge in ML Technique for early prediction of LC. Moreover, to make ML approaches easier in the field of LC, different types of the dataset used, various data preprocessing methods implemented, essential features that are been selected and extracted are been explained in detail. Also, the numerous ML performance is evaluated. The parameters used in constructing an efficient and accurate ML model for early prediction of Lung cancer is a piece of additional information. This study will help the researchers to identify ML techniques that produces more accuracy and efficiency.

To construct an efficient and accurate ML model for early LC, the model can be developed with the following parameters Data should be collected from large and highly qualified authorized canter's. "e.g." www.cancerimagingarchive.net Data collected should be pre-processed by a powerful technique such that no important data is lost. Highly correlated Features with the output should be identified for best results. Using the Hybrid ML model, early prediction of LC can produce accurate results. Several ML tools and platforms are made available for research teams to yield good results. There are some other data analytical tools there that provide useful information in future data analysis.

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