EARLY DETECTION OF CHRONIC KIDNEYDISEASE USING MACHINE LEARNING

TEAM ID:PNT2022TMID0462

A PROJECT REPORT

Submitted by

Chaganti Praneeth Kumar
Shiek Mohideen M
Vallarasu S
Vishwa B

in partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

INFORMATION TECHNOLOGY

SRI SAI RAM ENGINEERING COLLEGE

TABLE OF CONTENTS

a. INTRODUCTION

Project Overview

This article objects to predict Chronic Kidney Disease based on full features and important features of CKD dataset. Machine learning technique has become reliable for medical treatment. With the help of a machine learning classifier algorithms, the doctor can detect the disease on time. For this perspective, Chronic Kidney Disease prediction has been discussed in this article.. The important feature selection technique was also applied to the dataset. For each classifier, the results have been computed based on (i) full features, (ii) correlation-based feature selection, (iii) Wrapper method feature selection, (iv) Least absolute shrinkage and selection operator regression, (v) synthetic minority over-sampling technique with least absolute shrinkage and selection operator regression selected features, (vi) synthetic minority oversampling technique

with full features. Along with machine learning models one deep neural network has been applied on the same dataset and it has been noted that

deep neural network achieved the highest accuracy of 99.6%.

Purpose

This research article primarily aims to predict whether a person has Chronic Kidney Disease or not. In this perception, seven different machine learning classifiers were applied on the dataset. All the algorithms were running with both full features and selected features. SMOTE was used for over sampling and all the results were recorded. All the machine learning model results were also compared with one deep neural network algorithm. Deep learning neural

network was used with two hidden layers.

2.LITERATURE SURVEY

Existing Problem

SURVEY 1 : AUTHORS: Himanshu Kriplani, Bhumi Patel and Sudipta Roy

TITLE : Prediction of Chronic Kidney Diseases Using Deep Artificial NeuralNetwork Technique.

METHODS : This project presents a method to detect the chronic kidney disease and methodologies to diagnose chronic kidney disease is a challenging problem which can reduce the cost of treatment. We studied 224 records of chronic kidney disease available on the UCI machine learning repository named chronic kidney diseases dating back to 2015. Our proposed method is based on deep neural network which predicts the presence or absence of chronic kidney disease with an accuracy of 97%. Compared to other available algorithms, the model we built shows better results which is implemented using the cross-validation technique to keep the model safe

from over fitting. This automatic chronic kidney disease treatment helps reduce the kidney damage progression, but for this chronic kidney disease detection at initial stage is necessary.

SURVEY 2 :

AUTHORS : Hongquan Peng , Haibin Zhu , Chi WaAo Ieong , Tao Tao , TsungYang Tsai , Zhi Liu

TITLE : A two-stage neural network prediction of chronic kidney disease

METHODS : This paper presents a method to detect chronic kidney disease (CKD) plays a pivotal role in early diagnosis and treatment. Measured glomerular

filtration rate (mGFR) is considered the benchmark indicator in measuring the kidney function. However, due to the high resource cost of measuring mGFR, it is usually approximated by the estimated glomerular filtration rate, underscoring an

urgent need for more precise and stable approaches. With the introduction of novel machine learning methodologies, prediction performance is shown to be significantly improved across all available data, but the performance is still limited because of the lack of models in dealing with ultra-high dimensional datasets. This study aims to provide a two-stage neural network approach for prediction of GFR and to suggest some other useful biomarkers obtained from the blood metabolites in measuring GFR. It is a composite of feature shrinkage and neural network when the number of features is much larger than the number of training samples. The results show that the proposed method outperforms the existing ones, such as convolution neural network and direct deep neural network.

SURVEY 3 :

AUTHORS : Deepak K N , Adhwaidh P S , Akshay P D ,

Athira K S , Jisna Jayan**TITLE :** Chronic Kidney Disease Prediction system using Machine Learning **METHODS :** This paper reviews and analyzes the Chronic kidney disease (CKD) is a global health issue that causes a high rate of morbidity and mortality, as well as the onset of additional diseases. Because there are no clear symptoms in the early stages of CKD, people frequently miss it. Early identification of CKD allows patients to obtain timely treatment to slow the disease's progression. Due to their rapid and precise recognition capabilities, machine learning models can successfully assist doctors in achieving this goal. We propose a machine learning framework for diagnosing CKD in this paper. The CKD data set was taken from kaggle, which has a substantial number of missing values. We employ multiple machine learning methods such as DT, SVM, and DNN to analyze data from CKD patients with 21 characteristics and 400 records. The dataset is preprocessed by filling in

missing data and normalizing it. To increase accuracy and save training time, the most relevant features from the dataset are chosen. Image processing and letter recognition are used to automatically input the attributes.

References

1.Q.-L. Zhang and D. Rothenbacher, ‘ Prevalence of chronic kidney disease in population-based studies: Systematic review,’ BMC Public Health, vol. 8, no. 1, p. 117, Dec. 2008.

W. M. McClellan, D. G. Warnock, S. Judd, P. Muntner, R. Kewalramani, M.Cushman, L. A. McClure, B. B. Newsome, and G. Howard, ‘ Albuminuria and racial disparities in the risk for ESRD,’ J. Amer. Soc. Nephrol., vol. 22, no. 9, pp. 1721–1728, Aug. 2011.

1. M. K. Haroun, ‘ Risk factors for chronic kidney disease: A prospective study of 23,534 men and women in Washington County, Maryland,’ J. Amer. Soc. Nephrol., vol. 14, no. 11, pp.

2934–2941, Nov. 20.

2. W. D. Souza, L. C. D. Abreu, L. G. D. SilvaI, and I. M. P. Bezerra, ‘ Incidence of chronic kidney disease hospitalisations and mortality in Espírito Santo between 1996 to 2017,’ WisitCheungpasitporn, Univ. Mississippi Medical Center, Rochester, MN, USA, Tech. Rep., 2019, doi: 10.1371/journal.pone.0224889.

3. W. Mula-Abed, K. A. Rasadi, and D. Al-Riyami, ‘ Estimated glomerular filtration rate (eGFR): A serum creatinine-based test for the detection of chronic kidney disease and its impact on clinical practice,’ Oman Med. J., vol. 27, no. 4, pp. 339–340, 2012.

4. A. S. Levey, D. Cattran, A. Friedman, W. G. Miller, J. Sedor, K. Tuttle, B. Kasiske, and T. Hostetter, ‘ Proteinuria as a surrogate outcome in CKD: Report of a scientific workshop sponsored by the national kidney foundation and the US food

and drug administration,’ Amer. J. Kidney Diseases, vol. 54, no. 2, pp. 205–226, Aug. 2009.

Problem Statement Definition

To identify and manage patients who have early stages of chronic kidney disease may slow or prevent the progression to end stage kidney disease and reduce cardiovascular complications caused due to diabetes and high blood.

Who does the problem affect?

Chronic Kidney Disease is more common in people aged 65years or older (38%) than in people aged 45–64 years (12%) or 18–44 years (6%). CKD is slightly more common in women in (14%)than men (12%).

What are the boundaries of the problem?

A disease in GFR may also be a marker of kidney disease and precedes the onset of kidney failure . Below 60 ml/min/1.73 m , the prevalence of complications of CKD Increases , as does the risk of cardiovascular disease . Albuminuria (ACR ≥ 30 mg/g), Urine sediment abnormalities, Electrolyte and other abnormalities due to

tubular disorders, Abnormalities detected by histology, Structural abnormalities detected by imaging, History of kidney transplantation.

What is the issue?

Kidneys are damaged and can't filter blood the way they

should. The disease is called “chronic” because the damage to your kidneys happens slowly over a long period of time. Some of the common health problems caused by kidney disease include gout, anemia, bone disease, heart disease and fluid buildup.

Where is the issue occurring?

The kidneys grow larger and gradually lose the ability to function as they should. Chronic kidney disease occurs when a disease or condition impairs kidney function, causing kidney damage and high blood pressure.

Why is it important that we fix the problem?

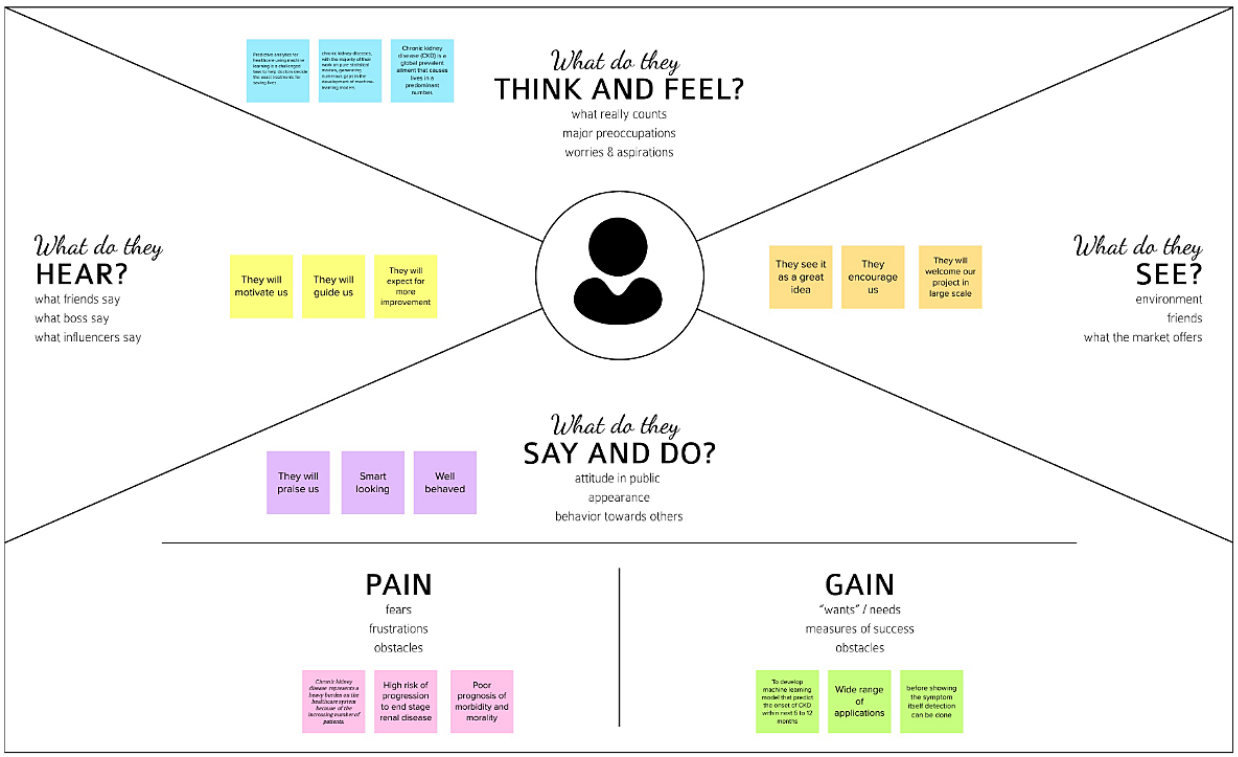
The older you get the more likely you are to have some degree of kidney disease.

This is important because CKD increases the risk of heart attack and stroke.

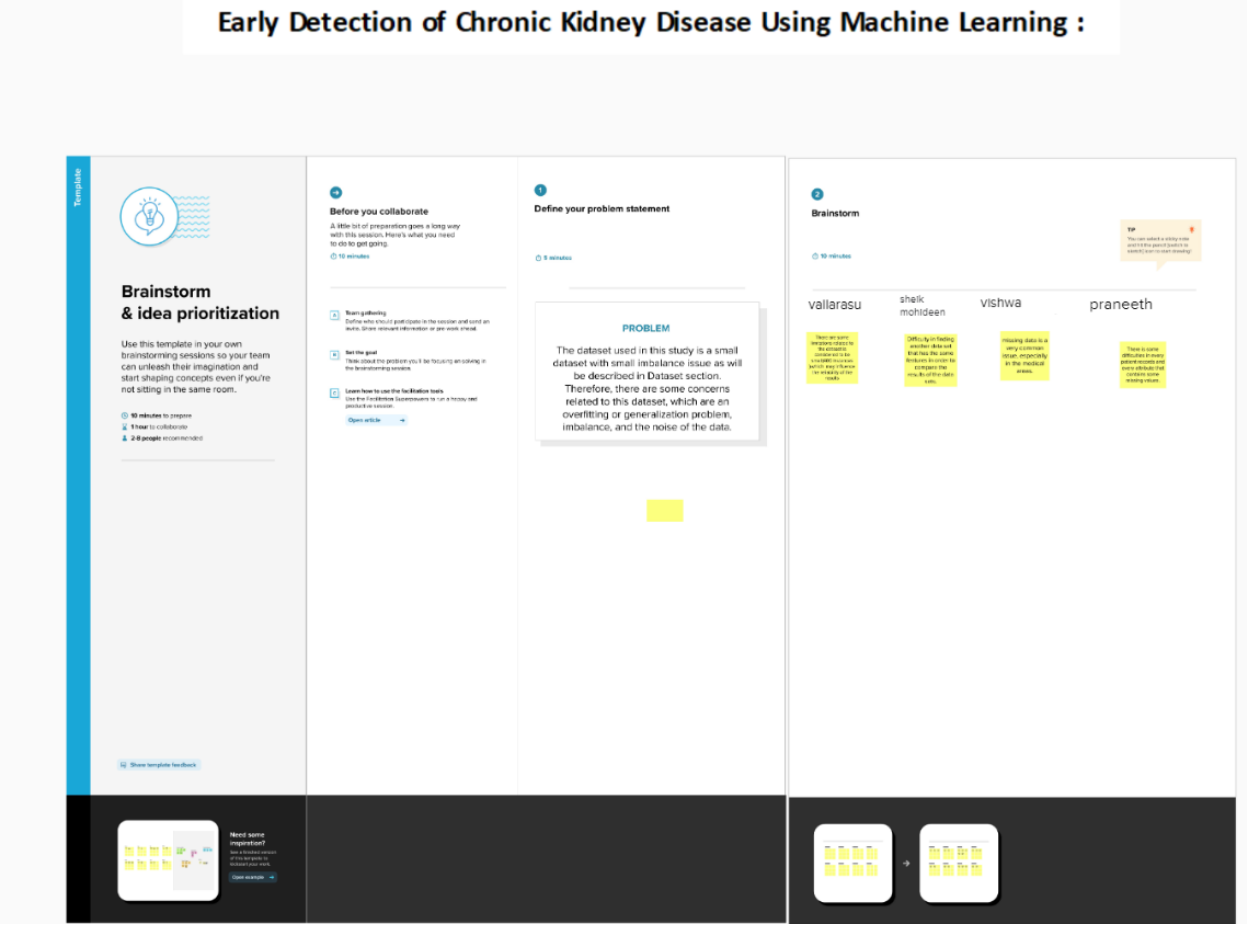
3.IDEATION & PROPOSED SOLUTION

Empathy Map Canvas

Early Detection of Chronic Kidney Disease using Machine Learning



Ideation and Brainstorming:



Proposed Solution

Problem Statement

Chronic Kidney Disease is a major concern for the global health care system. Chronic Kidney Disease is now wreaking havoc on society and is spreading at an alarming rate. Various efforts have been undertaken to advance early therapy to prevent the condition from progressing to CKD. Recent research suggest that someof the negative outcomes can be avoided with early identification and treatment.

Feasibility of idea

To predict the early onset of CKD, three Machine Learning techniques are used: ->Random Forest, Decision Tree, Support Vector Machines. Using these techniques, each algorithm’s effectiveness is evaluated and the prediction of howmany people have been affected by CKD is identified.

Novelty

The renal patient is recognized by undertaking two primary tests.

->A Blood Test to determine Glomerular FilterationRate(GFR).

->A Urine Test to determine Albumin.

Social Impact

As people don’t undergo the general test of their health, early detection of CKD is not identified. This creates a great social impact of not being aware of CKD. As a result of this many people are getting affected by CKD.

Business Model

The widespread use of Machine Learning of predicting the CKD in the Medical Industries promotes medical innovation, lowers medical expenses, and improves medical quality. In order to cure the CKD patients, the hospitals have been gainingbusiness profit in recovering the patients.

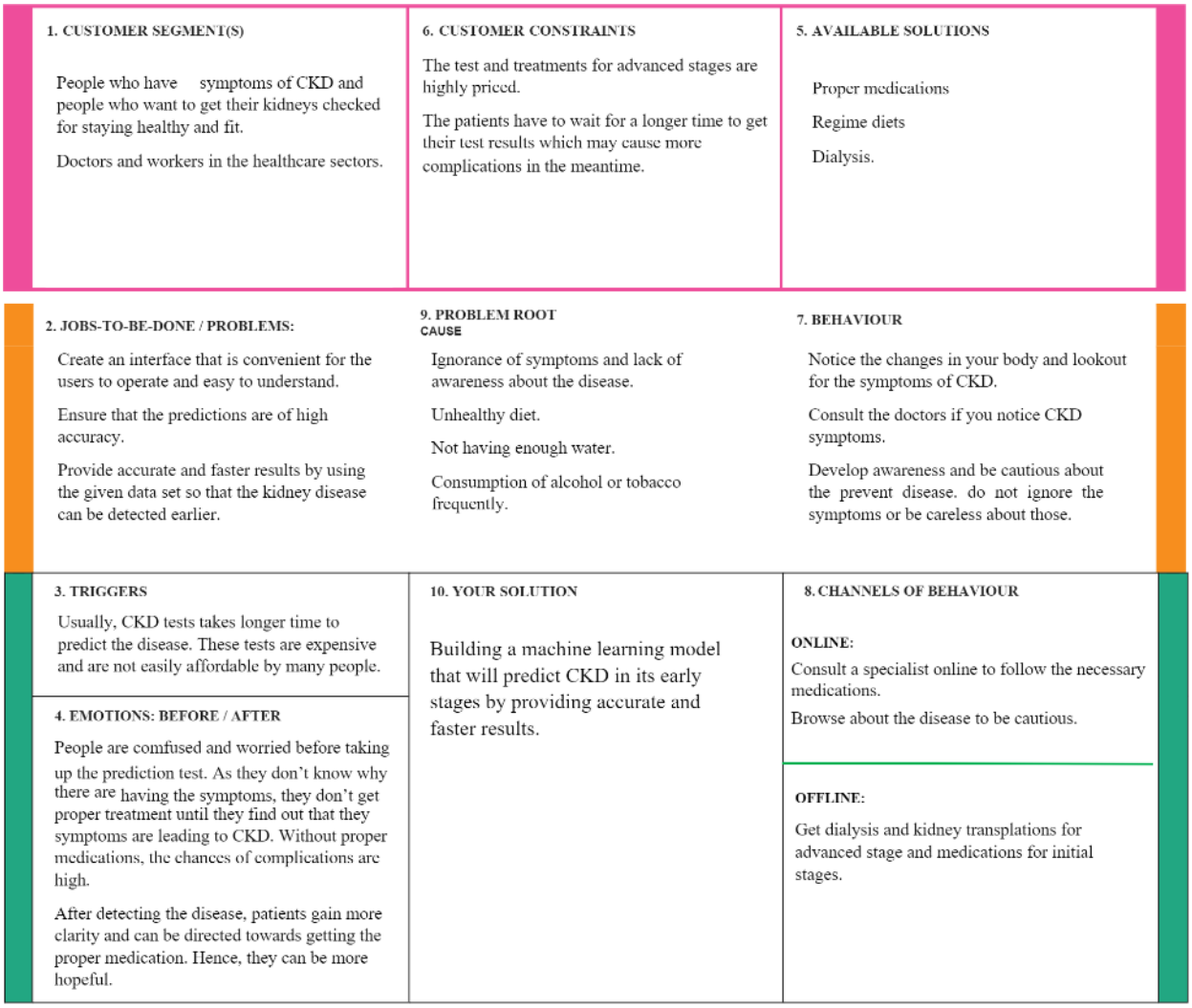
Scalability of solution

This Chronic Kidney Disease have been spreading widely now a days.

Early prediction of CKD using Machine Learning that is more efficient

to analyze thedisease so that it can be cured on time.

Problem Solution Fit



4.REQUIREMENTS ANALYSIS

Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR 1	User Page	Users can go to home pag
FR 2	Details	Users can know more details about theCKD.
FR 3	User Requirements	Store past records Generate report for presence of CKD Diagnostic remedies forsymptoms
FR 4	User Entry	Input form for pre-diagnostic test results
FR 5	Business Requirements	Quick diagnosis for CKD
FR 6	User Feedback	Allows users to submit feedback

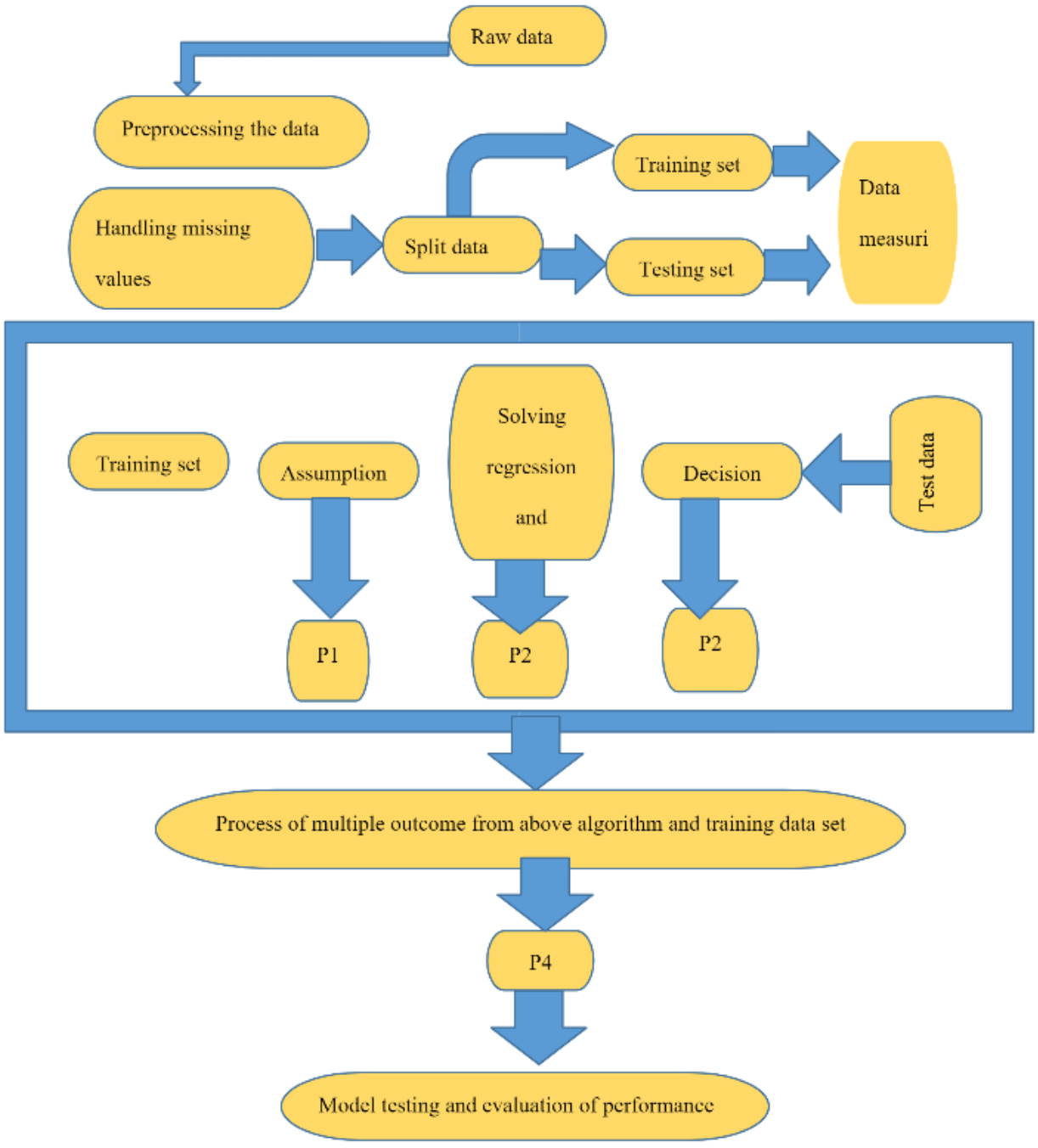
Non- Functional Requirements

FR NO.	**Non-Functional Requirement**	**Description**
NFR - 1	Usability	Simple user-friendly interface for communication
NFR - 2	Security	Safeguard the details shared by users and maintain confidentiality
NFR - 3	Reliability	Diagnosis based on probability predicted by MLmodel must be reliable
NFR - 4	Performance	Reduction in overall time taken for diagnosis

NFR - 5	Availability	Available at any time to users from various places
NFR - 6	Scalability	Needs to support numerous users at once

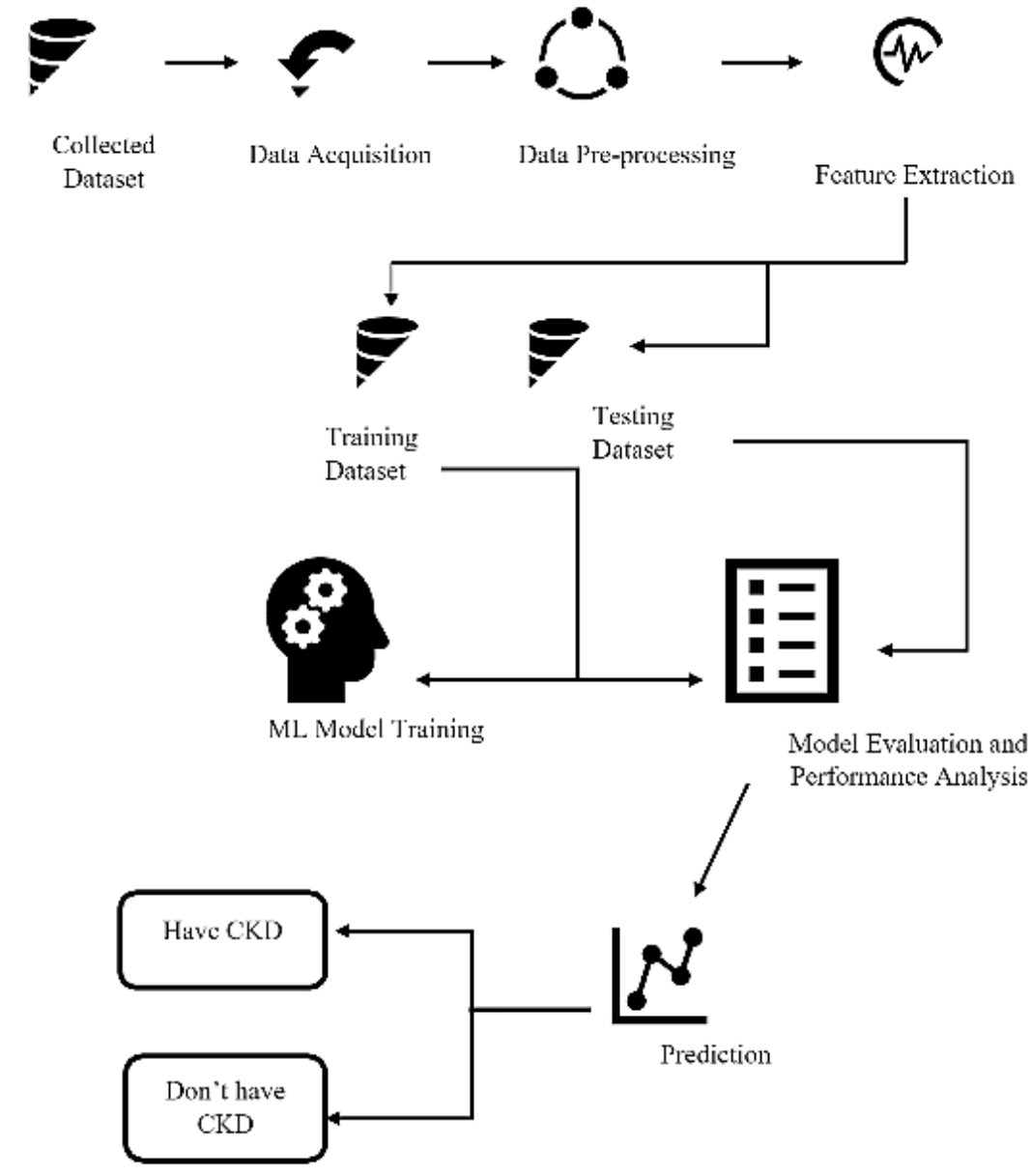
5.PROJECT DESIGN

Data Flow Diagrams


Raw data
Preprocessing the data
Handling missing values
Split data
Training set
Testing set
Data measuri
Training set
Assumption
Solving regression and
Decision
Test data
P1
P2
P2
Process of multiple outcome from above algorithm and training data set
P4
Model testing and evaluation of performance

Solution & Technical Architecture:-

Technical Architecture:



User Stories

Create Home page

As a user, I can collect the database of patients.

Preprocessing

As a user, I can preprocess the data from the database.

Testing

As a user, I can make the patients undergo two kinds of test (urine and blood test)

Analysis

As a user, I can analyse the test results

Prediction

As a user, I can predict CKD with the test results

Recovering Process

As a user, I can make the affected patients to take treatment

Awareness

As a user, I can advise the patients to maintain a healthy diet plan.

6.PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Collection of Dataset	USN-1	Collect dataset and clean the dataset	5	High	Praneeth kumar Vallarasu
Sprint-1		USN-2	Create, test and save the model	5	High	Vishwa Sheik mohideen
Sprint-2	Home page	USN-3	The user can enter into the home page	6	High	Praneeth kumar Vallarasu
Sprint-2		USN-4	User can use the prediction button to enter into the prediction page	4	Medium	Vishwa Sheik mohideen
Sprint-3	Prediction page	USN-5	The user will be presented with the prediction page where he can enter the values of report	3	Medium	Praneeth kumar Vallarasu
Sprint-3		USN-6	User should enter the blood glucose parameters	7	High	Vishwa Sheik mohideen
Sprint-4	Result	USN-7	The user will get the output	4	Medium	Praneeth kumar Vallarasu
Sprint-4		USN-8	Deploy into IBM CLOUD	6	High	Vishwa Sheik mohideen

Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned EndDate)	Sprint Release Date(Actual)
Sprint-1	20	6Days	24Oct2022	29Oct2022	20	29Oct2022
Sprint-2	20	6Days	31Oct2022	05Nov2022		
Sprint-3	20	6Days	07Nov2022	12Nov2022		
Sprint-4	20	6Days	14Nov2022	19Nov2022		

7.CODING AND SOLUTIONING

Feature 1:

In our website, we have additionally created some more pages:

Home Page.html

```
<html lang="en">
  <head>
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>chronic</title>
    <link rel="stylesheet" href="/static/style.css" />
  </head>
  <body bgcolor="black">


    <div class="d1" align="right">
      <a href="/"> HOME </a>

      <a href="/index">PREDICTION</a>

    </div>

    <div class="glow" align="center">
      <h2>CHRONIC KIDNEY DISEASE PREDICTION</h2>
    </div>
  </body>
</html>
```

Index.html

```
<html lang="en">
  <head>
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>pridiction</title>
    <link rel="stylesheet" href="style.css" />
    <link rel="stylesheet" href="/static/indexStyle.css" />
    <script>
      function check() {
```

```
      document.getElementById("prediction").innerHTML = "";
    }
  </script>
</head>
<body>

  <div class="d1" align="right">
    <a href="/"> HOME </a>

    <a href="index.html">PREDICTION</a>

  </div>

  <h2>Enter the mentioned values</h2>

  <form class="container" action="/predict" method="post">
    <div class="tab" align="center">
      <table>
        <tr></tr>
        <tr></tr>
        <tr></tr>
        <tr></tr>
        <tr></tr>
        <tr>
          <td>
            <label for="age">Age : </label>
          </td>
          <td>
            <input id="age" type="number" name="age" required />
          </td>
        </tr>
        <tr></tr>
        <tr></tr>
        <tr></tr>
        <tr></tr>
        <tr>
          <td>
```

```
    <label for="blood_Urea">Blood Urea : </label>
  </td>
  <td>
    <input id="blood_Urea" type="number" name="blood_Urea" required />
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label for="BGR">Blood Glucose Random : </label>
  </td>
  <td>
    <input id="BGR" type="number" name="BGR" required />
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Are you Affected by Coronary Artery Disease : </label>
  </td>
  <td>
    <select name="CRD" id="CRD">
      <option for="CRD" value="1">YES</option>
      <option for="CRD" value="0">NO</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
```

```
<tr>
  <td>
    <label>Do you have Anemia : </label>
  </td>
  <td>
    <select name="anemia" id="anemia">
      <option for="anemia" value="1">YES</option>
      <option for="anemia" value="0">NO</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Pus cell : </label>
  </td>
  <td>
    <select name="pus_cell" id="pus_cell">
      <option for="pus_cell" value="1">NORMAL</option>
      <option for="pus_cell" value="0">ABNORMAL</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Red Blood Cell : </label>
  </td>
  <td>
    <select name="RBC" id="RBC">
      <option for="RBC" value="1">NORMAL</option>
```

```
      <option for="RBC" value="0">ABNORMAL</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Diabetesmellitus : </label>
  </td>
  <td>
    <select name="Diabete" id="Diabete">
      <option for="Diabete" value="1">YES</option>
      <option for="Diabete" value="0">NO</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Pedal Edema : </label>
  </td>
  <td>
    <select name="P_edema" id="P_edema">
      <option for="P_edema" value="1">YES</option>
      <option for="P_edema" value="0">NO</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
```

```
          <tr></tr>
          <tr>
            <td>
              <input type="submit" value="submit" />
            </td>
            <td>
              <input type="reset" value="clear" onclick="check()" />
            </td>
          </tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
        </table>
      </div>
    </form>

    <div align="center" class="hidden">
      <h2 id="prediction">{{pred}}</h2>
    </div>
  </body>
</html>
```

Indexstyle.css

```
* {
  margin: 0px;
  padding: 0px;
}
body {
  background-image: linear-gradient(
      rgba(206, 61, 174, 0.527),
      rgba(202, 78, 78, 0.5),
      rgba(67, 153, 173, 0.8)
    ),
    url("index_image.jpg");
```

```
  background-repeat: no-repeat;
  background-attachment: fixed;
  background-size: cover;
  font-display: #1dbfca;
  user-select: none;
}
h2 {
  font-family: "Damion", cursive;
  font-weight: 400;
  color: black;
  font-size: 35px;
  text-align: center;
  position: flex;
}
.container {
  text-align: center;
  position: flex;
}
input {
  padding: 5px;
  background-color: transparent;
  border-color: rgb(11, 116, 116);
  font-size: 20px;
  color: white;
  display: flex;
  outline: none;
  border: 1px solid black;
  border-radius: 10px;
  text-align: center;
}

label {
  font-family: "Damion", cursive;
  font-weight: 200;
  color: black;

  font-size: 25px;
```

```
  text-align: left;
}

@media screen {
  label,
  .d1 {
    position: flex;
  }
}
.tab {
  border-radius: 50px 0px 50px 0px;
  align-items: center;
  margin-left: 15%;
  padding: 10px;
  margin-right: 15%;
  background: linear-gradient(
    rgb(168, 69, 131),
    rgb(58, 58, 193),
    rgb(43, 150, 164)
  );
}
input[type="submit"],
input[type="reset"] {
  margin-top: 20px;
  padding: 10px;
  outline: none;
  border-radius: 10px;
  font-size: 14px;
  text-transform: uppercase;
}

input[type="submit"]:hover,
input[type="reset"]:hover {
  background-color: white;
  transition: 0.8s ease-in-out;
  color: black;
}
```

Style.css

```
    * {
    margin: 0;
    padding: 0;
}
.glow {
    font-family: cursive;
    text-align: center;
    position: absolute;
    top: 50%;
    left: 50%;
    transform: translate(-50%, -50%);

    color: rgb(218, 218, 233);
    animation: glow 1s ease-in-out infinite alternate;
}
@keyframes glow {
    from {
        text-shadow: 0 0 10px rgb(20, 19, 19), 0 0 20px rgb(15, 2, 2),
        0 0 30px #090111, 0 0 40px #f3d9e6,
        0 0 50px #e60073, 0 0 60px #e60073,
        ;
    }
    to {
        text-shadow: 0 0 20px rgb(163, 85, 85),0 0 30px #92667c,
        0 0 40px #ff4da6;
    }
}
.glow h2 {
    font-size: 7vmin;
}
a {
    font-size: 3vmin;
    color: whitesmoke;
    text-decoration: dashed;
    font-family: 'Lato',sans-serif;
```

```
    padding: 2px 5px;


}
a:hover {

    color: #090111;
    text-shadow:  0 0 20px rgb(240, 233, 233),0 0 30px #f7f1f4,
    0 0 90px #ff4da6;

}
```

8.TESTING

Test Cases:

Test Case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps to execute	Expected Result	Actual Result	Status
Home_TC_01	UI	Home Page	When user clicks on my website,	HTML , CSS and Flask for integration	1.Create HTML files 2. Run	Result was not as expected	Actual result was	Pass

			the user can see the home page I've created and it is verified successfully.		using python		good	
Prediction_TC_002	UI	Prediction Page	Verify the input values valid or not	Flask Server, Python, anaconda prompt	1.Create HTML files 2. Run using Flask	Working as expected	Satisfied as expected	Pass
Result_TC_003	UI	Result Page	Verify whether the user is able to predict	HTML,CSS, Visual Code	1.Create HTML files 2. Run using Flask			Pass

User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [Early Detection of Chronic Kidney Disease] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	3	1	1	1	6
Duplicate	4	0	2	0	6
External	2	2	0	1	5
Fixed	1	1	1	1	4
Not Reproduced	0	0	0	0	0
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	10	4	4	3	21

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Home Screen	1	0	0	1
User Input	3	0	0	3
Chronic Kidney Disease testing	2	0	0	2
No Chronic Kidney Disease testing	2	0	0	2
Version Control	2	0	0	2

9.RESULTS:

Performance metrics

Category (# of Measures)	Subcategories	Measure Validity Rating ■ High ■ Medium ■ Low
CKD Prevention (7)	Hypertension, Diabetes	2 5 0
Slowing CKD Progression (2)	Hypertension/CKD	2 0
CKD Management (2)	Advance Care Planning, Lipid Testing	1 10
Advanced CKD/Kidney Replacement (1)	Dialysis Access	10
Dialysis Management (28)	Dialysis Access, Adequacy, Anemia, ESRD-related Complications, Transplant Referral, Advance Care Planning, Care Coordination	17 7 4
Broad Measures (18)	Preventive Care, Medication Reconciliation and Safety, Advance Care Planning, Falls, Complications/Misc.	6 8 4
PROMs (2)	PROMs	0 2 0

10.ADVANTAGES AND DISADVANTANGES

Advantages:

a. Resulted in good accuracy.

b. Customers can easily predict CKD.

c. This machine learning model helps us in analysing the CKD.

Disadvantages:

a. At some point algorithm may fail.

b. Correct prediction may not be done.

11.CONCLUSION

This work examines the ability to detect CKD using machine learning algorithmswhile considering the least number of tests or features. We approach this aim by applying machine learning classifier logistic regression on a big dataset of around 4000 records. We found that haemoglobin, albumin, and specific gravity have the most impact to predict the CKD.

We conclude that by using Machine Learning algorithm , we can predict whether a person is suffering from CKD or not. This effective supervised learning algorithm helps us to analyze the datasets and helps us conclude about the disease. Thus, this project helps customers to easily predict the CKD by giving their data

12.FUTURE SCOPE

This work will be considered as basement for the healthcare system for CKD

patients. Also extension to this work is that implementation of deep learning sincedeep learning provides high-quality performance than machine learning algorithm.In order to help in reducing the prevalence of CKD, we plan to predict if a person with CKD risk factors such as diabetes, hypertension, and family history of kidney failure will have CKD in the future or not by using appropriate dataset.

APPENDIX

Source code:

HTML CODING:

Home.html

```
<html lang="en">
  <head>
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>chronic</title>
    <link rel="stylesheet" href="/static/style.css" />
  </head>
  <body bgcolor="black">


    <div class="d1" align="right">
      <a href="/"> HOME </a>

      <a href="/index">PREDICTION</a>

    </div>
```

```
    <div class="glow" align="center">
      <h2>CHRONIC KIDNEY DISEASE PREDICTION</h2>
    </div>
  </body>
</html>
```

Index.html

```
<html lang="en">
  <head>
    <meta name="viewport" content="width=device-width, initial-scale=1.0" />
    <title>pridiction</title>
    <link rel="stylesheet" href="style.css" />
    <link rel="stylesheet" href="/static/indexStyle.css" />
    <script>
      function check() {
        document.getElementById("prediction").innerHTML = "";
      }
    </script>
  </head>
  <body>

    <div class="d1" align="right">
      <a href="/"> HOME </a>

      <a href="index.html">PREDICTION</a>

    </div>

    <h2>Enter the mentioned values</h2>

    <form class="container" action="/predict" method="post">
      <div class="tab" align="center">
        <table>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
```

```
<tr>
  <td>
    <label for="age">Age : </label>
  </td>
  <td>
    <input id="age" type="number" name="age" required />
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label for="blood_Urea">Blood Urea : </label>
  </td>
  <td>
    <input id="blood_Urea" type="number" name="blood_Urea" required />
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label for="BGR">Blood Glucose Random : </label>
  </td>
  <td>
    <input id="BGR" type="number" name="BGR" required />
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
```

```
  <td>
    <label>Are you Affected by Coronary Artery Disease : </label>
  </td>
  <td>
    <select name="CRD" id="CRD">
      <option for="CRD" value="1">YES</option>
      <option for="CRD" value="0">NO</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Do you have Anemia : </label>
  </td>
  <td>
    <select name="anemia" id="anemia">
      <option for="anemia" value="1">YES</option>
      <option for="anemia" value="0">NO</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Pus cell : </label>
  </td>
  <td>
    <select name="pus_cell" id="pus_cell">
      <option for="pus_cell" value="1">NORMAL</option>
      <option for="pus_cell" value="0">ABNORMAL</option>
```

```
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Red Blood Cell : </label>
  </td>
  <td>
    <select name="RBC" id="RBC">
      <option for="RBC" value="1">NORMAL</option>
      <option for="RBC" value="0">ABNORMAL</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr>
  <td>
    <label>Diabetesmellitus : </label>
  </td>
  <td>
    <select name="Diabete" id="Diabete">
      <option for="Diabete" value="1">YES</option>
      <option for="Diabete" value="0">NO</option>
    </select>
  </td>
</tr>
<tr></tr>
<tr></tr>
<tr></tr>
<tr></tr>
```

```
          <tr>
            <td>
              <label>Pedal Edema : </label>
            </td>
            <td>
              <select name="P_edema" id="P_edema">
                <option for="P_edema" value="1">YES</option>
                <option for="P_edema" value="0">NO</option>
              </select>
            </td>
          </tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr>
            <td>
              <input type="submit" value="submit" />
            </td>
            <td>
              <input type="reset" value="clear" onclick="check()" />
            </td>
          </tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
          <tr></tr>
        </table>
      </div>
    </form>

    <div align="center" class="hidden">
      <h2 id="prediction">{{pred}}</h2>
    </div>
  </body>
</html>
```

CSS CODING:

Indexstyle.css

```
* {
  margin: 0px;
  padding: 0px;
}
body {
  background-image: linear-gradient(
      rgba(206, 61, 174, 0.527),
      rgba(202, 78, 78, 0.5),
      rgba(67, 153, 173, 0.8)
    ),
    url("index_image.jpg");
  background-repeat: no-repeat;
  background-attachment: fixed;
  background-size: cover;
  font-display: #1dbfca;
  user-select: none;
}
h2 {
  font-family: "Damion", cursive;
  font-weight: 400;
  color: black;
  font-size: 35px;
  text-align: center;
  position: flex;
}
.container {
  text-align: center;
  position: flex;
}
input {
  padding: 5px;
  background-color: transparent;
```

```
  border-color: rgb(11, 116, 116);
  font-size: 20px;
  color: white;
  display: flex;
  outline: none;
  border: 1px solid black;
  border-radius: 10px;
  text-align: center;
}

label {
  font-family: "Damion", cursive;
  font-weight: 200;
  color: black;

  font-size: 25px;
  text-align: left;
}

@media screen {
  label,
  .d1 {
    position: flex;
  }
}
.tab {
  border-radius: 50px 0px 50px 0px;
  align-items: center;
  margin-left: 15%;
  padding: 10px;
  margin-right: 15%;
  background: linear-gradient(
    rgb(168, 69, 131),
    rgb(58, 58, 193),
    rgb(43, 150, 164)
  );
}
```

```
input[type="submit"],
input[type="reset"] {
  margin-top: 20px;
  padding: 10px;
  outline: none;
  border-radius: 10px;
  font-size: 14px;
  text-transform: uppercase;
}

input[type="submit"]:hover,
input[type="reset"]:hover {
  background-color: white;
  transition: 0.8s ease-in-out;
  color: black;
}
```

Style.css

```
* {
    margin: 0;
    padding: 0;
}
.glow {
    font-family: cursive;
    text-align: center;
    position: absolute;
    top: 50%;
    left: 50%;
    transform: translate(-50%, -50%);

    color: rgb(218, 218, 233);
```

```
    animation: glow 1s ease-in-out infinite alternate;
}
@keyframes glow {
    from {
        text-shadow: 0 0 10px rgb(20, 19, 19), 0 0 20px rgb(15, 2, 2),
        0 0 30px #090111, 0 0 40px #f3d9e6,
        0 0 50px #e60073, 0 0 60px #e60073,
        ;
    }
    to {
        text-shadow: 0 0 20px rgb(163, 85, 85),0 0 30px #92667c,
        0 0 40px #ff4da6;
    }
}
.glow h2 {
    font-size: 7vmin;
}
a {
    font-size: 3vmin;
    color: whitesmoke;
    text-decoration: dashed;
    font-family: 'Lato',sans-serif;
    padding: 2px 5px;


}
a:hover {

    color: #090111;
    text-shadow:  0 0 20px rgb(240, 233, 233),0 0 30px #f7f1f4,
    0 0 90px #ff4da6;

}
```

Flask Integrate With Scoring End Pints:

```
* {
    margin: 0;
    padding: 0;
}
.glow {
    font-family: cursive;
    text-align: center;
    position: absolute;
    top: 50%;
    left: 50%;
    transform: translate(-50%, -50%);

    color: rgb(218, 218, 233);
    animation: glow 1s ease-in-out infinite alternate;
}
@keyframes glow {
    from {
        text-shadow: 0 0 10px rgb(20, 19, 19), 0 0 20px rgb(15, 2, 2),
        0 0 30px #090111, 0 0 40px #f3d9e6,
        0 0 50px #e60073, 0 0 60px #e60073,
        ;
    }
    to {
        text-shadow: 0 0 20px rgb(163, 85, 85),0 0 30px #92667c,
        0 0 40px #ff4da6;
    }
}
.glow h2 {
    font-size: 7vmin;
}
a {
    font-size: 3vmin;
    color: whitesmoke;
    text-decoration: dashed;
    font-family: 'Lato',sans-serif;
    padding: 2px 5px;
```

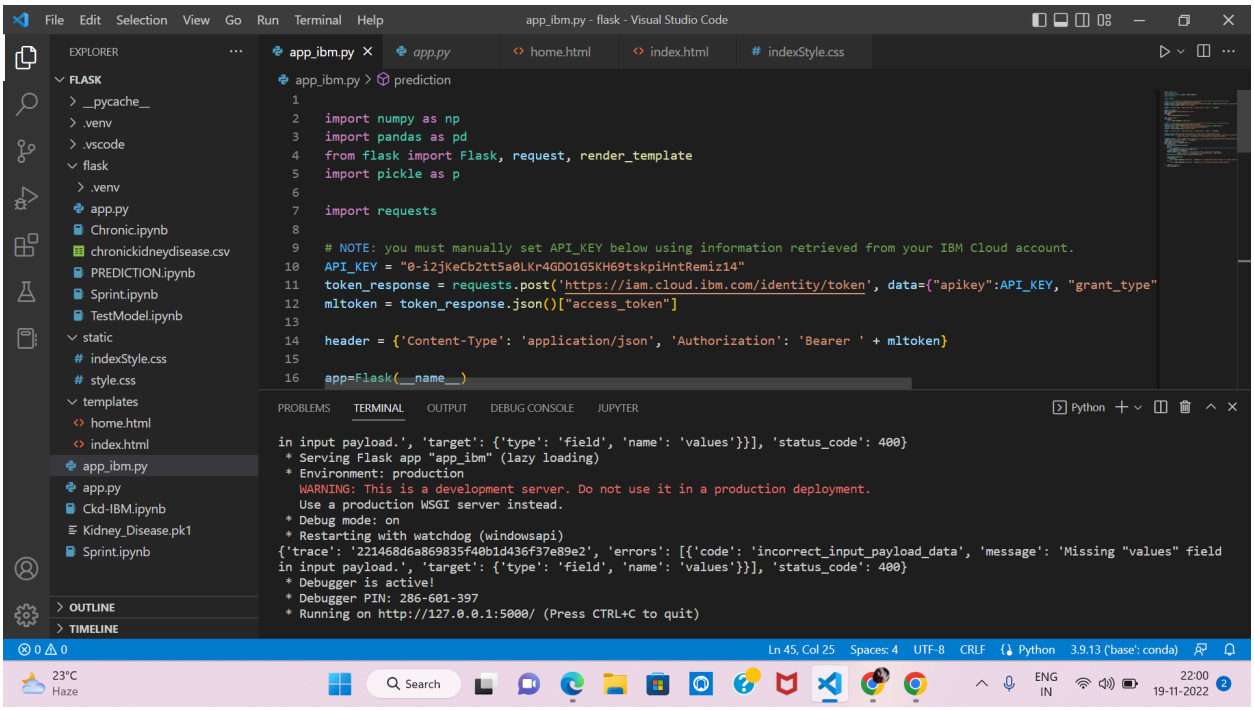
```
}
a:hover {

    color: #090111;
    text-shadow:  0 0 20px rgb(240, 233, 233),0 0 30px #f7f1f4,
    0 0 90px #ff4da6;

}
```

NOTEBOOK .ipynb

Import **Dataframe:**



Import Libraries:

In [131]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import preprocessing
import scipy.stats as stats
from sklearn.model_selection import train_test_split
from collections import Counter
from sklearn.metrics import accuracy_score,confusion_matrix,classification_report
from sklearn import metrics
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
import joblib
```

Load The Dataset:

LOAD DATASET

In [15]:
```
df=pd.read_csv("chronickidneydisease.csv")
pd.set_option("display.max_column",None)
df
```

In [38]:
```
df.shape
```

Out[38]: (400, 27)

In [39]:
```
df.info
```

In [42]:
```
df.sod.unique()
```

Out[42]:
```
array([139. , 136. , 140. , 111. , 142. , 104. , 147. , 131. , 114. ,
       124. , 138. , 135. , 130. , 141. , 145. ,   4.5, 128. , 129. ,
       144. , 132. , 133. , 150. , 134. , 125. , 137. , 163. , 143. ,
       127. , 146. , 126. , 122. , 115. , 113. , 120. ])
```

In [43]:
```
df.pcc.value_counts()
```

Out[43]:
```
notpresent    354
present        42
Name: pcc, dtype: int64
```

In [18]:
```
print(numerical_feature)
```

```
['id', 'age', 'bp', 'sg', 'al', 'su', 'bgr', 'bu', 'sc', 'sod', 'pot', 'hemo']
```

In [104]:
```
df.isnull().any()
```

Out[104]:
```
id                False
```

Visualization:

VISUALIZATION

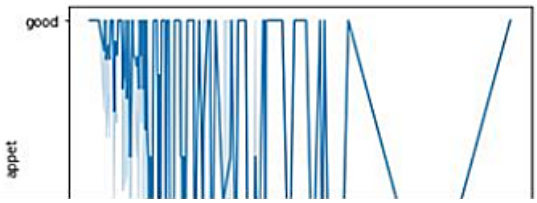
In [44]:
```
sns.displot(df.age)
```

Out[44]:
```
<seaborn.axisgrid.FacetGrid at 0x28be2b13d30>
```

In [45]:
```
sns.lineplot(df.bu,df.appet)
```

```
C:\Users\ELCOT\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the followi
ng variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `da
ta`, and passing other arguments without an explicit keyword will result in an error or misinterpreta
tion.
  warnings.warn(
```

Out[45]:
```
<AxesSubplot:xlabel='bu', ylabel='appet'>
```



In [48]:
```
sns.scatterplot(df.sg,df.bp)
```

```
C:\Users\ELCOT\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the followi
ng variables as keyword args: x, y. From version 0.12, the only valid positional argument will be `da
ta`, and passing other arguments without an explicit keyword will result in an error or misinterpreta
tion.
  warnings.warn(
```

Out[48]:
```
<AxesSubplot:xlabel='sg', ylabel='bp'>
```

In [55]:
```
df.hist(figsize=(8,8))
```

Out[55]:
```
array([[<AxesSubplot:title={'center':'id'}>,
        <AxesSubplot:title={'center':'age'}>
```

Outlier Detection:

OUTLIER DETECTION ¶

In [57]:
```
sns.boxplot(df.pot)
```

```
C:\Users\ELCOT\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the followi
ng variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data
`, and passing other arguments without an explicit keyword will result in an error or misinterpretati
on.
  warnings.warn(
```

Out[57]:
```
<AxesSubplot:xlabel='pot'>
```

Outlier Using IQR:

OUTLIER REMOVAL USING IQR

```
In [58]: q1=df.hemo.quantile(0.25)  #(Q1)
         q3=df.hemo.quantile(0.75)  #(Q3)

In [65]: IQR=q3-q1

In [66]: upper_limit= q3 + 1.5*IQR

In [68]: uppper_limit= q3 + 1.5*IQR
         lower_limit=q1 - 1.5*IQR

In [69]: sns.boxplot(df.bu)
```

Outlier removal with percentile:

OUTLIER REMOVAL WITH PERCENTILE

```
In [71]: p99=df.hemo.quantile(0.99)
         p99
```

Z-Score:

Z-SCORE

```
In [73]: from scipy import stats

In [76]: hemo_zscore=stats.zscore(df.hemo)

In [77]: hemo_zscore
```

Encoding Techniques:

ENCODING TECHNIQUES

1. One hot encoding

```
In [78]: from sklearn.preprocessing import LabelEncoder

In [79]: le=LabelEncoder()

In [80]: df.age=le.fit_transform(df.age)
         df.bp=le.fit_transform(df.bp)
```

2. One hot encoding

```
In [83]: df_main=pd.get_dummies(df,columns=['hemo'])
         df_main.head()
```

X and Y Split:

X and Y Split

In [116]:
```
# dependent variable

y=df_main['pcc']
y
```

In [92]:
```
# independent variable

x=df_main.drop(columns=['pcc'],axis=1)
x.head()
```

Linear Regression:

LINEAR REGRESSION

1.Simple Linear Regression

In [120]:
```
sns.displot(df.wc)
```

```
C:\Users\ELCOT\anaconda3\lib\site-packages\seaborn\axisgrid.py:88: UserWarning: Glyph 9 (       ) missing from current font.
  self._figure.tight_layout(*args, **kwargs)
```

In [141]:
```
x=df.drop(columns=['hemo'],axis=1)
x
```

Multi Linear Regression:

2. Multi Linear Regression

In [126]:
```
from sklearn.linear_model import LinearRegression
```

In [151]:
```
from sklearn.preprocessing import LabelEncoder
le=LabelEncoder()
```

In [153]:
```
df.State=le.fit_transform(df.hemo)
df
```

```
In [155]: df.corr().age.sort_values(ascending=False)
```

X ana Y split

```
In [157]: X=df.drop(columns=['age'],axis=1)
          X.head()  # independent variables

In [158]: y= df.age
          y.head()
```

Polynomial Regression:

Polynomial Regression

```
In [163]: x=df.iloc[:,1:2]
          x

In [166]: from sklearn.linear_model import LinearRegression
          lr=LinearRegression()

In [167]: lr.fit(xp,y)
```


Convert Normal Feature to Polynomial feature

```
In [164]: from sklearn.preprocessing import PolynomialFeatures
          pr=PolynomialFeatures(degree=4)

In [165]: xp=pr.fit_transform(x)
          xp

In [168]: # checking the prediction on a random value

          id=lr.predict(pr.fit_transform([[6]]))
          id
```

Logistic Regression:

LOGISTIC REGRESSION

In [170]:
```
from sklearn.preprocessing import LabelEncoder

le=LabelEncoder()

df.age=le.fit_transform(df.age)

df.head()
```

In [171]:
```
df.id.value_counts()
```

In [237]:
```
sns.displot(df.age)
```

Model Building:

In [243]:
```
from sklearn.preprocessing import MinMaxScaler
scale = MinMaxScaler()
```

Model Building

In [242]:
```
## Logistic Regression

from sklearn.linear_model import LogisticRegression
```

In [244]:
```
model = LogisticRegression()
```

In [245]:
```
model.fit(x_train,y_train)
```

Evaluating Model:

Evaluating the Model

In [182]:
```
# accuracy score

from sklearn.metrics import accuracy_score,classification_report,confusion_matrix,roc_auc_score,roc_curve
```

In [247]:
```
accuracy_score(y_test,pred_test) # test accuracy
```

Out[247]:
```
0.8686868686868061
```

In [248]:
```
# Confusion matrix

pd.crosstab(y_test,pred_test)
```

```
In [249]: # Classification report

          print(classification_report(y_test,pred_test))
```

```
In [186]: # Precision

          #  TP/(TP+FP)

          24/30
```

```
In [187]: # Recall

          # TP /(TP+FN)

          24/32
```

```
In [188]: # F1 score

          # 2*precision*Recall / (precision+Recall)

          2*0.8*0.75/(0.8+0.75)
```

```
In [229]: # performs the split

          from sklearn.model_selection import train_test_split
          x_train, x_test, y_train, y_test = train_test_split(x,y)
```

```
In [223]: # Display the shape

          print(x_train.shape)
          print(x_test.shape)
          print(y_train.shape)
          print(y_test.shape)

          (297, 1)
          (99, 1)
          (297,)
          (99,)
```

```
In [231]: x_train.shape
Out[231]: (297, 1)
```

```
In [232]: x_test.shape
Out[232]: (99, 1)
```

```
In [252]: # ROC - AUC Score

          probability = model.predict_proba(x_test)[:,1]
          probability
```


Evaluation Metrics for Regression:

1.Evaluation metrics for Regression problem

```
In [267]: # R-Square
          # testing accuracy for both model

          print(metrics.r2_score(y_test,pred1))
          print(metrics.r2_score(y_test,pred2))
```

```
0.9999999998368482
0.9999856081783125
```

```
In [268]: profit=pd.DataFrame({'Actual':y_test,'ridge_pred':pred1,'lasso_pred':pred2})
          profit.head(10)
```

```
In [269]: ## MSE(Mean square error)

          print(metrics.mean_squared_error(y_test,pred1))
          print(metrics.mean_squared_error(y_test,pred2))
```

```
3.7522833790478166e-08
0.0033099339693025715
```

Decision Tree Classifier:

DECISION TREE CLASSIFIER

```
In [270]: # X and y split

          X=df.iloc[:,:-1]
          X.head()
```

1. Model Building

```
In [277]: from sklearn.tree import DecisionTreeClassifier

          model = DecisionTreeClassifier(max_depth=4,splitter='best',criterion='entropy')
```

```
In [278]: model.fit(x_train,y_train)
```

```
Out[278]: DecisionTreeClassifier(criterion='entropy', max_depth=4)
```

```
In [279]: y_predict= model.predict(x_test)
          y_predict
```

IBM CODING:

```
import numpy as np
import pandas as pd
from flask import Flask, request, render_template
import pickle as p
```

```
import requests

# NOTE: you must manually set API_KEY below using information
retrieved from your IBM Cloud account.
API_KEY = "0-i2jKeCb2tt5a0LKr4GDO1G5KH69tskpiHntRemiz14"
token_response =
requests.post('https://iam.cloud.ibm.com/identity/token',
data={"apikey":API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-
type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer
' + mltoken}

app=Flask(__name__)
model=p.load(open('Kidney_Disease.pk1','rb'))
@app.route('/')
def HOME():
    return render_template('home.html')

@app.route('/index')
def index():
    return render_template('index.html')

# NOTE: you must manually set API_KEY below using information
retrieved from your IBM Cloud account.
API_KEY = "JhrY6sRjbDvE3BjbiXEiTHfBCleWtA4aHZQ_7iIDL0qe"
token_response =
requests.post('https://iam.cloud.ibm.com/identity/token',
data={"apikey":
 API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer
' + mltoken}

# NOTE: manually define and pass the array(s) of values to be scored in
the next line
payload_scoring = {"input_data": [{"field":[['age','blood_urea','blood
glucose random','coronary_artery_disease',
```

```
'anemia','pus_cell','red_blood_cell','diabetesmellitus','pedal_edema']
]}]}

response_scoring = requests.post('https://us-
south.ml.cloud.ibm.com/ml/v4/deployments/5fe68712-4338-4ea2-a6c3-
13c0c4e0c562/predictions?version=2022-11-19', json=payload_scoring,
 headers={'Authorization': 'Bearer ' + mltoken})
print(response_scoring.json())
@app.route('/predict',methods=['POST'])
def prediction():
    form_value=request.form.values()
    data=[]
    for x in form_value:
        data.append(pd.to_numeric(x).astype(float))
    features_value=[np.array(data)]
    features_name=['age','blood_urea','blood glucose
random','coronary_artery_disease',

'anemia','pus_cell','red_blood_cell','diabetesmellitus','pedal_edema']
    df=pd.DataFrame(features_value, columns=features_name)

    output=model.predict(df)
    if(output==0):
        return render_template('index.html' , pred='Oops!! You have
Kidney Chronic Disease. So, please concern a Doctor')
    else:
        return render_template('index.html' , pred='you are not
affected by Chronic kidney Disease')

if __name__=='__main__':
    app.run(debug=True)
```

IBMDEPLOYMENT:

Building a Machine Learning model

```
In [34]: from sklearn.linear_model import LogisticRegression
         lgr=LogisticRegression()
         lgr.fit(x_train,y_train)
```

```
C:\Users\DX\anaconda3\lib\site-packages\sklearn\utils\validation.py:993: DataConversionWarning: A column-vector y was passed wh
en a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

```
Out[34]: LogisticRegression()
```


Building a Machine Learning model

```
In [34]: from sklearn.linear_model import LogisticRegression
         lgr=LogisticRegression()
         lgr.fit(x_train,y_train)
```

```
C:\Users\DX\anaconda3\lib\site-packages\sklearn\utils\validation.py:993: DataConversionWarning: A column-vector y was passed wh
en a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

```
Out[34]: LogisticRegression()
```


Predicting our output with the model which we build

```
In [35]: y_pred=lgr.predict(x_test)
```

```
In [37]: y_pred1=lgr.predict([[129,99,1,0,0,1,0,1]])
         print(y_pred)
         c(y_pred)
```

```
[0 0 0 0 1 0 0 0 1 0 0 0 1 1 0 0 0 1 1 0 1 1 0 1 0 1 0 0 1 0 0 1 0 0 0 0 1
 0 0 1 0 1 0 0 0 1 0 1 1 1 0 0 0 1 0 1 0 1 1 1 0 1 1 0 0 0 0 1 0 1 1 0 0 1
 0 1 0 1 1 0]
```

```
Out[37]: Counter({0: 47, 1: 33})
```

```
In [39]: accuracy_score(y_test,y_pred)
```

```
Out[39]: 0.9125
```


Confusion Matrix of our model

```
In [40]: conf_mat=confusion_matrix(y_test,y_pred)
         conf_mat
```

```
Out[40]: array([[47,  7],
                [ 0, 26]], dtype=int64)
```

IBM Deployment

```
In [2]: !pip install -U ibm-watson-machine-learning
```

```
Requirement already satisfied: ibm-watson-machine-learning in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.257)
Requirement already satisfied: importlib-metadata in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-ma
chine-learning) (4.8.2)
```

GitHub and Project Demo Link

GitHub Link: https://github.com/IBM-EPBL/IBM-Project-14189-1659544470

Demo Link :

https://drive.google.com/file/d/1UL1q7R4kwt2JojlMSYkG_ICaz1DDBscg/view?usp=drivesdk