PROJECT REPORT

TEAM ID	**PNT2022TMID33091**
PROJECT NAME	**ANAYTICS FOR HOSPITALS HEALTH - CAREDATA**

TEAM MEMBERS:

Team leader : SANJAY. V

Team member 1 : SIVASUBRAMANIYAN.A

Team member 2 : NAVEEN. A

Team member 3 : MOHAMED SALMAN MYDEEN. A

CHAPTER 1

INTRODUCTION

This project deals with the analytics for hospital's health care data using data analytics. Data analytics (DA) is the process of examining data sets in order to findtrends and draw conclusions about the information they contain. Increasingly, data analytics is done with the aid of specialized systems and software.Data analytics technologies and techniques are widely used in commercial industries to enable organizations to make more-informed business decisions.

1.1 Project Overview:

Health care management is the planning, administration, and management of all health care systems, hospitals, and other medical facilities. Health care management roles are crucial to the overall operations of the health care system.
Covid-19 recently, one of the most neglected areas to concentrate on has come under scrutiny due to the pandemic: healthcare management. While data science has many applications in healthcare administration,
If one wants to increase the effectiveness of healthcare management in a hospital, patient length of stay is one crucial indicator to track and forecast.

At the time of admission, this metric aids hospitals in identifying patients who are at high LOS-risk (patients who will stay longer). Once identified, patients at high risk for LOS can have their treatment plans improved to reduce LOS and reduce the risk of infection in staff or visitors. Additionally, prior awareness of LOS might help with planning logistics like room and bed allotment.

1.2 Purpose:

In healthcare, data analytics are crucial. According to the Harvard Business School, it aids healthcare organisations in the evaluation and training of practitioners, the identification of scan anomalies, and the forecasting of disease outbreaks. Additionally, data analytics can improve business intelligence and cut expenses for healthcare firms. Hospital data analytics can review patient records and any medication prescribed to identify improper dosages or prescriptions and notify doctors and patients, reducing human error and hospital costs. As a result, better insights are gained, and healthcare professionals are able to make wise decisions.

CHAPTER2

LITERARTURE SURVEY

The healthcare sector is widely considered as one of the most important industries in information technology (Wager 2005). More and more, information technology has been considered as a practice that facilitates healthcare performance through using data and information efficiently within the healthcare sectors. Therefore, Wager et al (2005) said that in order to understand the relation between information technologies and healthcare, we first need to understand what are the technologies used in healthcareThe healthcare sector is widely considered as one of the most important industries in information technology (Wager 2005). More and more, information technology has been considered as a practice that facilitates healthcare performance through using data and information efficiently within the healthcare sectors. Therefore, Wager et al (2005) said that in order to understand the relation between information technologies and healthcare, we first need to understand what are the technologies used in healthcareThe healthcare sector is widely considered as one of the most important industries in information technology (Wager 2005). More and more, information technology has been considered as a practice that facilitates healthcare performance through using data and information efficiently within the healthcare sectors. Therefore, Wager et al (2005) said that in order to understand the relation between information technologies and healthcare, we first need to understand what are the technologies used in healthcare The healthcare sector is widely considered as one of the most important industries in information technology. More and more, information technology has been considered as a practice that facilitates healthcare performance through using data and information efficiently within the healthcare sectors. Therefore, Wager et al(2005) said that in order to understand the relation between information technologies and healthcare, we first need to understand what are the technologies used in healthcareIn the mid-80,'s information technology changed the healthcare industry and brought many benefits when they used microcomputers, which were a small in shape, fast and very powerful for that time. Moreover, this allowed hospitals to develop clinical applications for various medical care settings. As a result, hospitals started to purchase and adopt information systems in the healthcare industries, and after that, challenges began to emerge when professionals tried to integrate data among these systems (Wager et al 2005).

The healthcare industry has generated large amount of data generated from record keeping, compliance and patient related data. In today's digital world, it is mandatory that these data should be digitized. To improve the quality of healthcare by minimizing the costs, it's necessary that large volume of data generated should be analysed effectively to answer new challenges. Similarly government also generates petabytes of data every day. It requires a technology that helps to perform a real time analysis on the enormous data set. This will help the government to provide value added services to the citizens. Big data analytics helps in discovering valuable decisions by understanding the data patterns and the relationship between them with the help of machine learning Algorithms (1).This paper provides an overview of big data analytics in healthcare and government systems. It describes about big data generated by these systems, data characteristics, security issues in handling big data and how big data analytics helps to gain a meaningful insight on these data set.

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TITLE :Historical Review of Health Policy Making

AUTHOR : Ravi Duggal

Health policy making and health planning in India is not a post-independence phenomenon. In fact, the most comprehensive health policy and plan document ever prepared in India was on the eve of Independence in 1946. This was the 'Health Survey and Development Committee Report' popularly referred to as the Bhore Committee. This Committee prepared a detailed plan of a National Health Service for the country, which would provide a universal coverage to the entire population free of charges through a comprehensive state run salaried health service.

Such a well-studied and minutely documented plan has not as yet been prepared in Independent India. Health services in India today in terms of accessibility are as inadequate and underdeveloped as they were during the time of the Bhore Committee. The analysis of the health situation by the Bhore Committee in the early forties would hold good if a similar enquiry were undertaken today, over half a century later. Instead of the National Health Service that the Bhore Committee had envisaged, which would be available to one and all irrespective of their ability to pay, further commodification of health care services took place strengthening the operation of market forces in this sector. The enclave pattern of development of the health sector continues even today - the poor, the villagers, women and other underprivileged sections of society, in other words the majority, still do not have access to affordable basic health care of any credible quality.

ventricular tachycardia(3.4%)which includes cardiogenic shock (1.4%)to hypotension (0.3%).

Disadvantages: To put more Extensive effort into building these predictive models.

2.1 EXISTINGPROBLEM

- The already existing model istrained with minimal parameters
- Low accuracy in prediction
- No feature extractiondone
- High complexity

2.2 REFERENCES

[1] Data analytics for the sustainable use of resources in hospitals: Predicting the length of stay for patients with chronic diseases

https://www.sciencedirect.com/science/article/pii/S0378720619301594

[2] Robust Length of Stay Prediction Model for Indoor Patients

https://www.researchgate.net/publication/355174497_Robust_Length_of_Stay_:_Prediction_Model_for_Indoor_Patients

[3] Predicting length of stay in hospitals intensive care unit using general admission features https://www.sciencedirect.com/science/article/pii/S2090447921001349

[4]] Using Data Analytics to Improve Hospital Quality Performance

htt ps:// jou rnals.lww.com/ jhmonline/ Fulltext/ 2020/08000/Using_Data Analytics_to Impr ove_Hospital_Qualtiy.9.aspx

[5] Big Data analytics on Diabetic Retinopathy Study (DRS) on real-time data set identifying survival time and length of stay

https://www.sciencedirect.com/science/article/pii/S1877050916304926

2.3 PROBLEMSTATEMENT AND DEFINITION

- The aim is to accurately predictthe Length of Stay for each patienton case by case basis so that the Hospitals can use this information for optimal resource allocation and better functioning.
- The length of stay is divided into 11 different classes ranging from 0-10 days to more than 100 days.

CHAPTER3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHYMAP CANVAS

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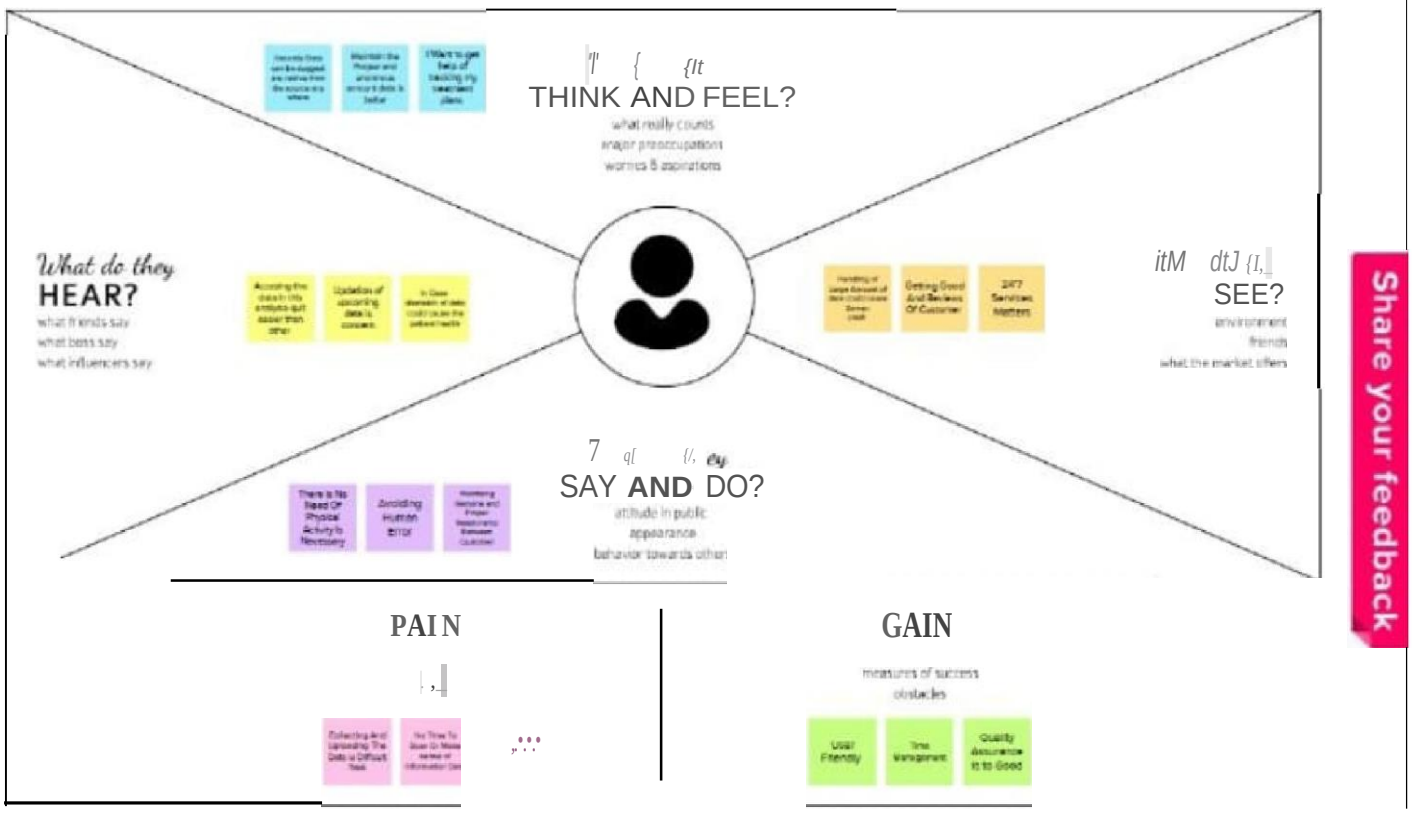


Share your feedback

3.2 IDEATION & BRAINSTORMING

3.3 PROPOSEDSOLUTION

Proposed Solution Template:

SNo:	Specification	Description
1.	Problem State1nent	Identify Patients who will stay longer at the time of admission to predict patient length of stay using the patients information details.
2.	Solution Description	Tracking the length of stay of patient in the hospital Health care Data using the data provided by the hospital .Create a dashboard using Cognos- Analytics to visualize the patient who stay longer at the time adtnission.
3.	Novelty	It predict the result with more accuracy and proper resources can be provided.
4.	Patient Satisfaction	Patient satisfaction is the strongest determinant of hospital functioning. Patient's happiness with the treatment and the services provided in the hospital that can be visualized by the dashboard of the patients data provided by the hospitals.
5.	Business Model	Health care revenue the set of all administrative and clinical functions that contribute to the capture, management, and collection of patient service revenue .The hospital staff can easily view the Patients trouble and they give the correct trea tment.
6.	Scalability of the Solution	• Ensuring patient data privacy. • Personalized patient details. • Hospital can view the length of stay of patients.

3.4 PROBLEM SOLUTION FIT

Project Title: Analytics For Hospital's Health-Care Data | Project Design Phase-I - Solution Fit Template | Team ID: PNT2022TMID33091

1. CUSTOMER SEGMENT(S)

- Patients
- Hospital Management

6. CUSTOMER CONSTRAINTS

Customers require more accurate and early predictions of Length of Stay (LOS).

5. AVAILABLE SOLUTIONS

There are few Length of Stay prediction model available which lacks in predicting some exceptional case where the length of stay may extend.

Explore

2. JOBS-TO-BE-DONE / PROBLEMS

Length of stay prediction may vary based on the patient's stage/severity of disease. Patient may get dissatisfied if there is no bed availability.

9. PROBLEM ROOT CAUSE

Unpredictable length of stay and improper medical records are the root cause of the problem.

7. BEHAVIOUR

Developing a model which predicts the length of stay of unexceptional cases with better accuracy.

Identify strong TR & EM

3. TRIGGERS

To accurately predict the length of stay.

4. EMOTIONS: BEFORE / AFTER

Before : Pateints often get frustrated and **depressed.**

After: They feel better and get new beginning.

10. SOLUTION

Our solution includes using algorithms like Fuzzy Logic, Tree Bagger, Random Forest, and Decision Trees to predict the length of stay more accurately. Gives frequent update about the bed availability.

8. CHANNELS of BEHAVIOUR

Users will check for bed availability.

Identify strong TR & EM

CHAPTER-4

REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement(Epic)	Sub Requirement (Story/ Sub-Task)
FR-1	**User Registration**	Utilizing a Form for Registration, Signing up with Gmail
FR-2	**User Confirmation**	Email confirmation required
FR-3	**Interoperability**	A dashboard makes it possible to quicklyand inter-operably transmit patient information with hospitals.
FR-4	**Accuracy**	Based on LOS (LenRth of Stay) the dashboard accurate y predicts thepatient's health risks.
FR-5	**Compliance**	The useof a dashboard for compliance by hospitals is quitedynamic and takesplacein real time.
FR-6	**Concise**	These dashboards are easy to understand, simpleto customize, and interactive.

Non-functional Requirements:

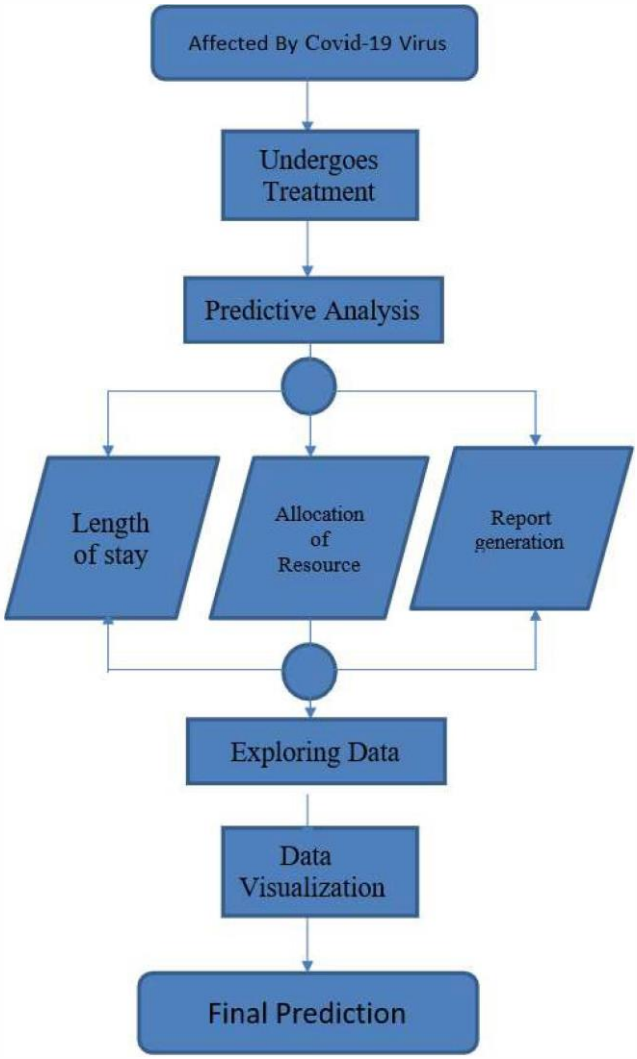
FR No.	Non-functional Requirement	Description
NFR-1	**Usability**	In order to provide a through visual representation of the patient's LOS, this dashboard makesuse of datavisualization techniques including charts and graphs.
NFR-2	**Security**	The Dashboard aids in indicating the level of threat that currently exists for the hospitals, aswell as past occurrences and incidents, authentication mistakes, scans, probes, and unwanted access.
NFR-3	**Reliability**	Users will find this dashboard to be consistent, dependabl t and helpful in using in an effective,erricient, and dependable manner.
NFR-4	**Performance**	This dashboard may scan backend users, andexamining how frequently they visit the dashboard might reveal relevant informationabout the jobs the data is beneficial for.
NFR-5	**Availability**	The dashboard is able to promptly satisfy userneeds and aids in giving the user's dataset the relevant information.
NFR-6	**Scalability**	A hosted feature layer, feature layer view, or hostedtile layer are the layersthat are used inthedashboard.

CHAPTERS

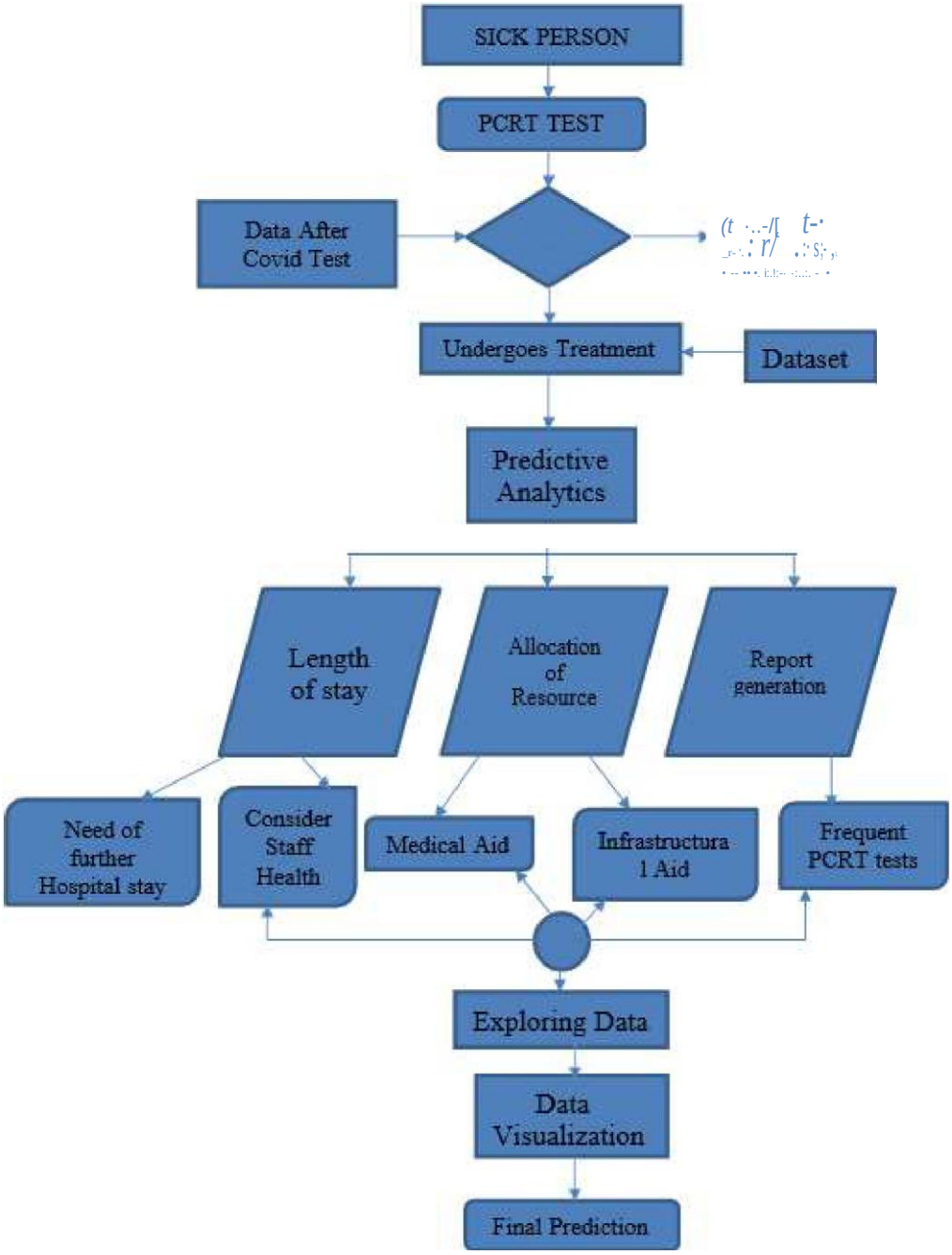
PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

LEVEL--0

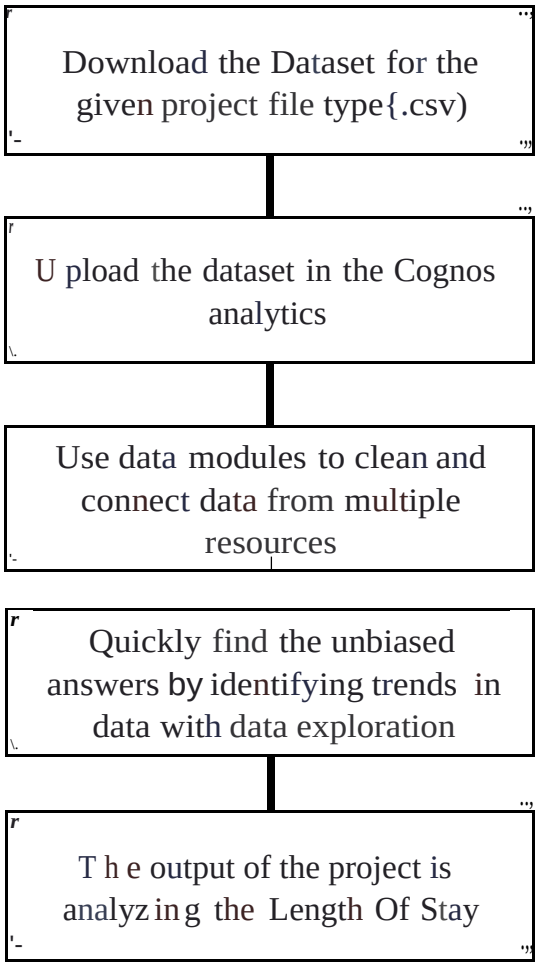


LEVEL-1


SICK PERSON
PCRT TEST
Data After Covid Test
Undergoes Treatment
Dataset
Predictive Analytics
Length of stay
Allocation of Resource
Report generation
Need of further Hospital stay
Consider Staff Health
Medical Aid
Infrastructura l Aid
Frequent PCRT tests
Exploring Data
Data Visualization
Final Prediction

5.2 SOLUTION AND TECHNICAL ARCHITECTURE:

Solution Architecture



5.3 USER STORIES:

User Type	Functional Requirements	User Story No.	User Task	Acceptance Criteria	Priority
Covid Patient	Undergoes Treatment	USN-1	Patients are required to get treatment if they have been tested as positive	Direct Hospitalization	High
	Report Generation	USN-2	Patients should collect their treatment report and get further doctor consult	They can get their reportfrom hospital	High
Hospital Management	Allocationof Resource	USN-3	Hospital Management should allocate the necessary resource for treating the Patients	Should be ready for all circumstance	High

	Length of Stay	**USN-4**	The Doctors should be aware of condition ofpatients to predict the Los	Exploring the data about thepatient health condition and predicting LoS	High
	Resource Availability	**USN-5**	The Hospital Staffshould be awareof available resources in hospital	Visualizing theaboutthe resource availability	High
	Staff Welfare	**USN-6**	The working staffshould be safe and conscious about the **COVID**	They can wear the PPE kit as instructed by Health experts	High

CHAPTER&

PROJECT PLANNING& SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Retrieve Data	USN-1	As a user, I should get clearer clinical context for AIDS patient's unique case	10	Medium	Sanjay. V Naveen. A
Sprint-1	Visualize the data	USN-2	As a user,I need nicely visualized dashboard of beds occupied and number of free beds in hospital.	20	High	Sanjay. V Naveen. A
Sprint-2	Track of patient visit of Hospital	USN-3	Tracking a patient Health care over years of visit and Screening of data they have in hospital.	10	Medium	Sanjay.V Naveen.A Sivasubramaniyan.A
Sprint-2	Dashboard	USN-4	As a user , I want the interactive dashboard to analyze the data. Have the data in terms of Graph.	20	High	Sanjay.V Naveen.A Sivasubramaniyan.A
Sprint-3	Detailed EHR's of patient	USN-5	Provided greater details in the EHR's of individual patient with clear idea of what to do.	10	Medium	Sanjay.V Naveen.A Mohamed SalmanMydeen.A
Sprint-3	Story Creation	USN-6	As a user , I need the story animation of the data set with insights	20	High	Sanjay.V Naveen.A Mohamed SalmanMydeen.A
Sprint-4	Predict LOS	USN-7	As a user, I want the flawless system to predict the length of stay of the patients	20	High	Sanjay. V Naveen. A

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint -4	Using ML algorithm for Prediction	USN-8	As a user,I need prior knowledge of LOS can aid in logistics such as room and bed allocation planning.	20	High	Sanjay. V Naveen .A

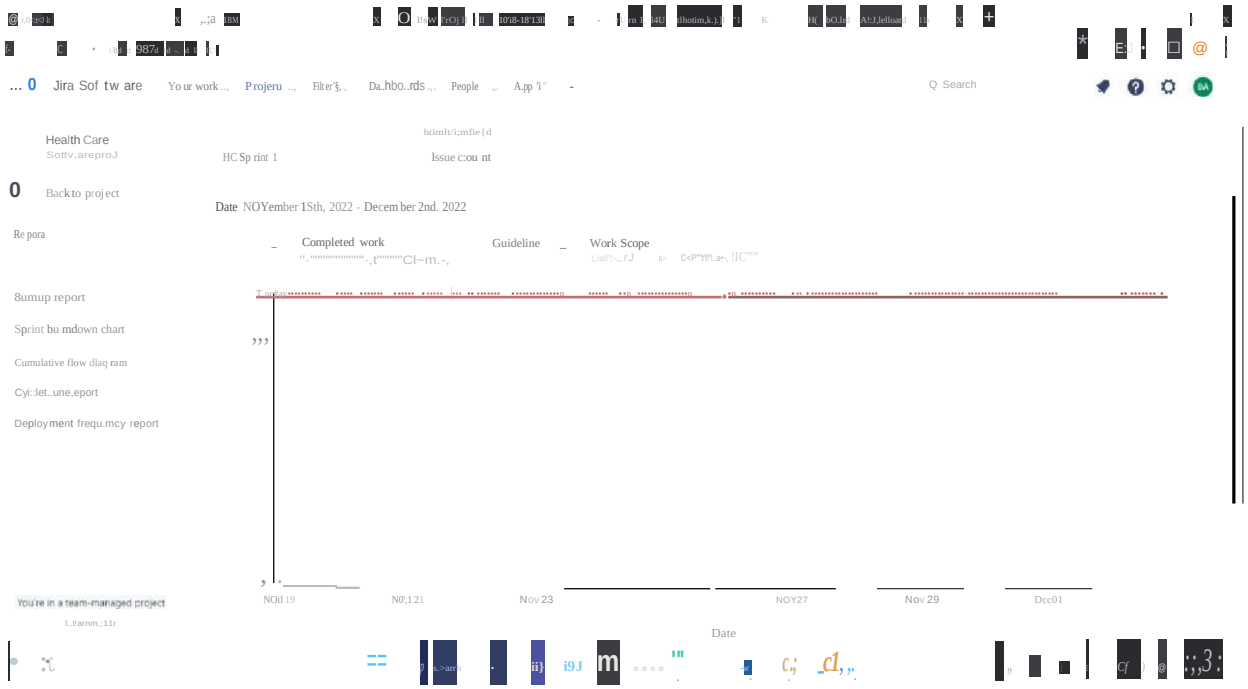
6.2 SPRINT DELIVERYSCHEDULE:

Project Tracker, Velocity & Burndown Chart: (4 Marks)

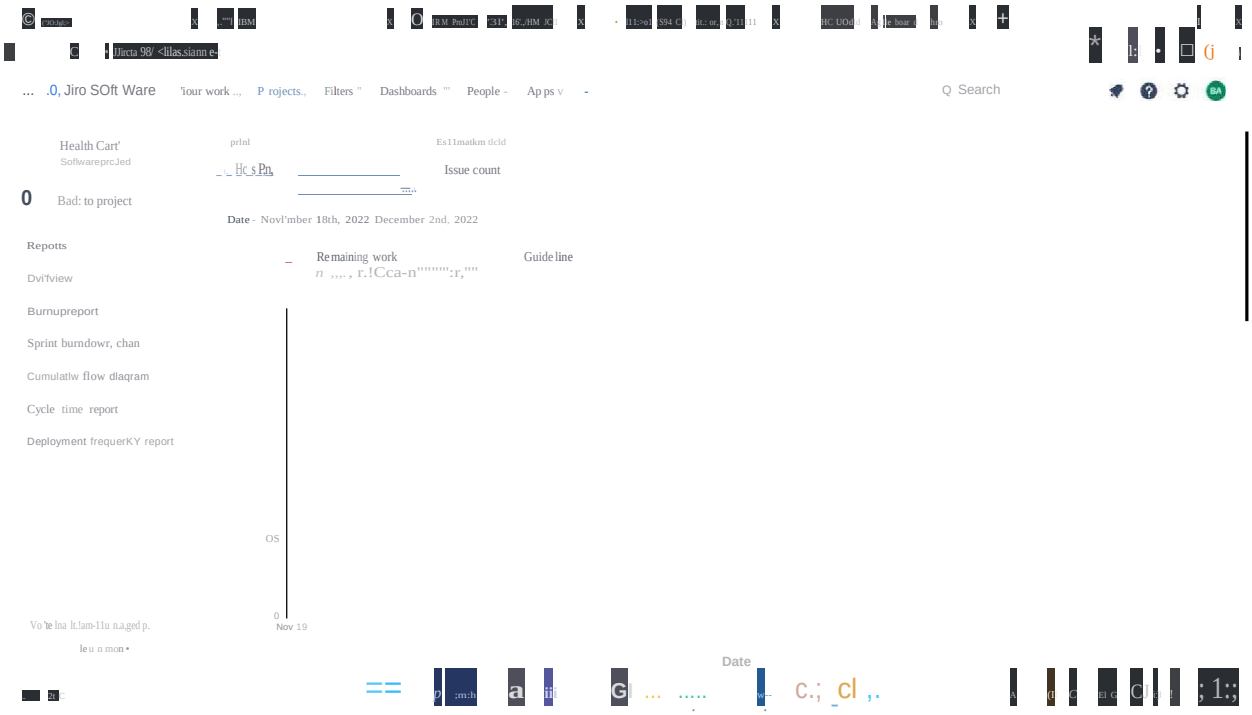
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint -1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint -2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint -3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint -4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 REPORTS FROM JIRA:

BURNUP CHART



BURNDOWN CHART

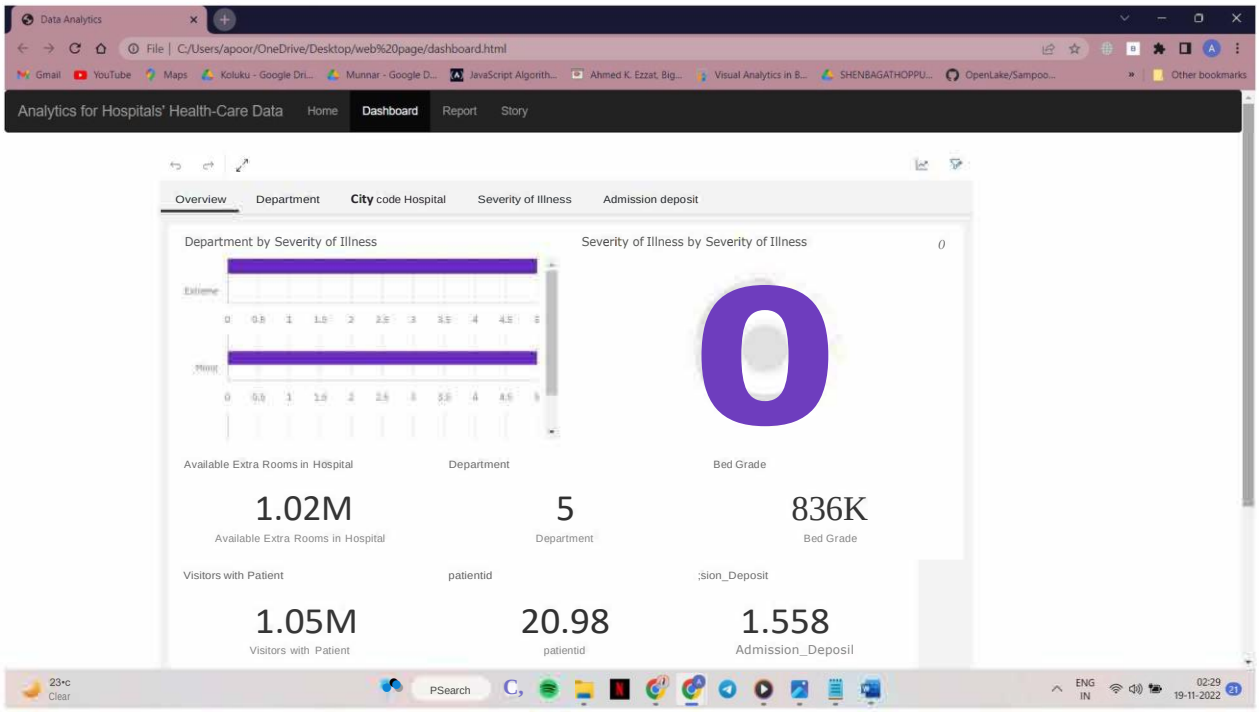


CHAPTER-7

CODING AND SOLUTIONING

7.1 FEATURE 1

STORYBOARD CREATION:



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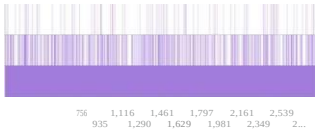
Department by patientid



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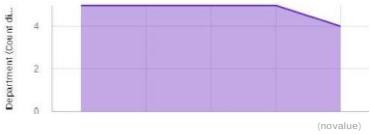

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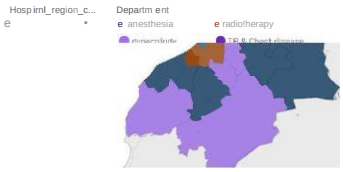

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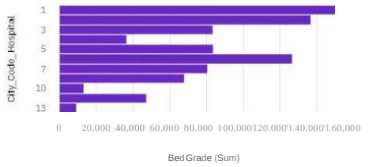

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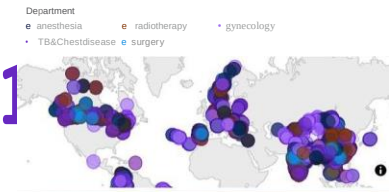

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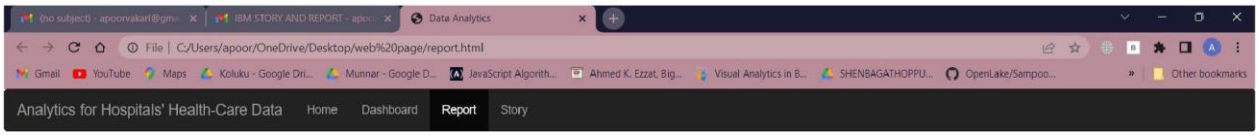
7.2 FEATURE 2-REPORT



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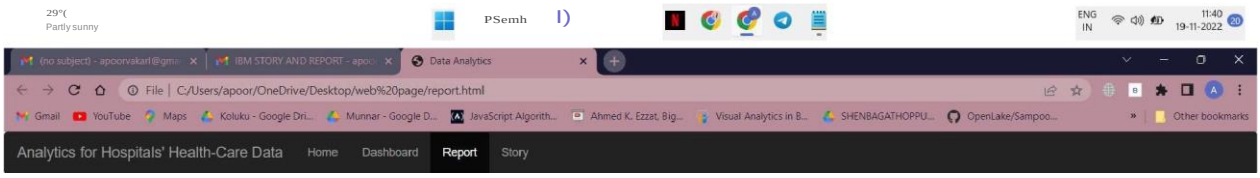

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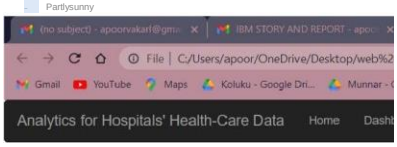
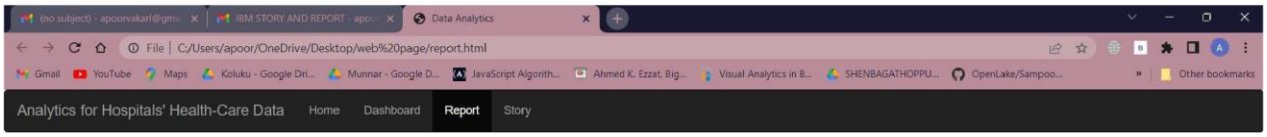
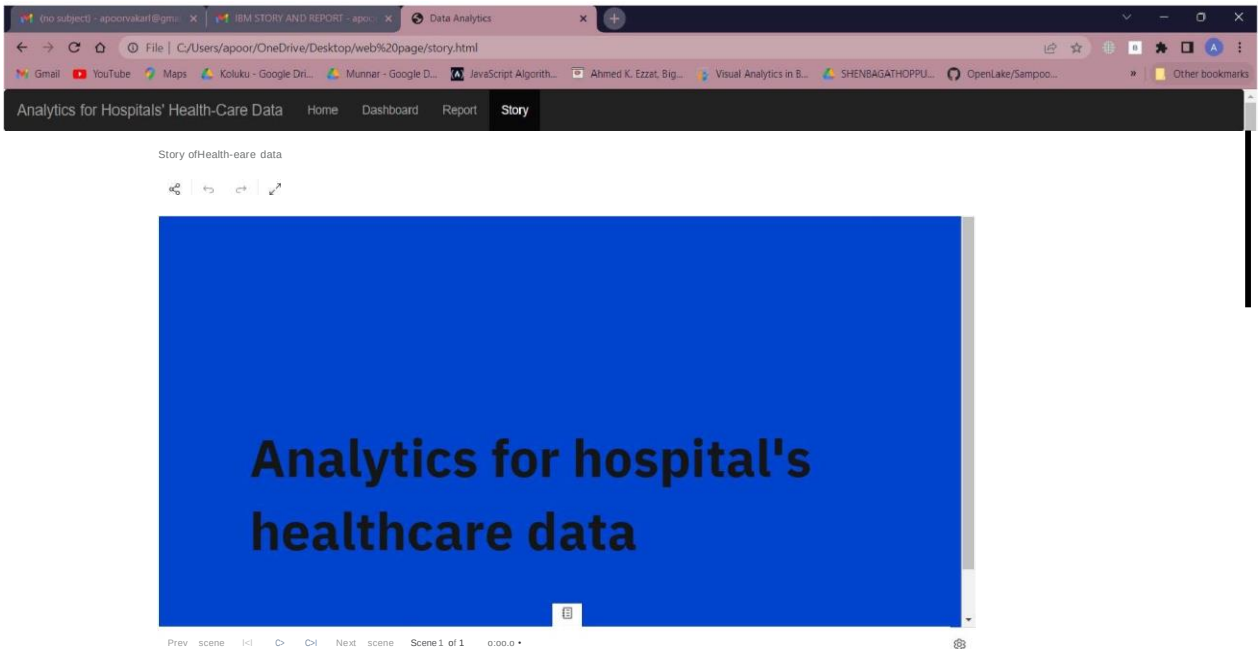
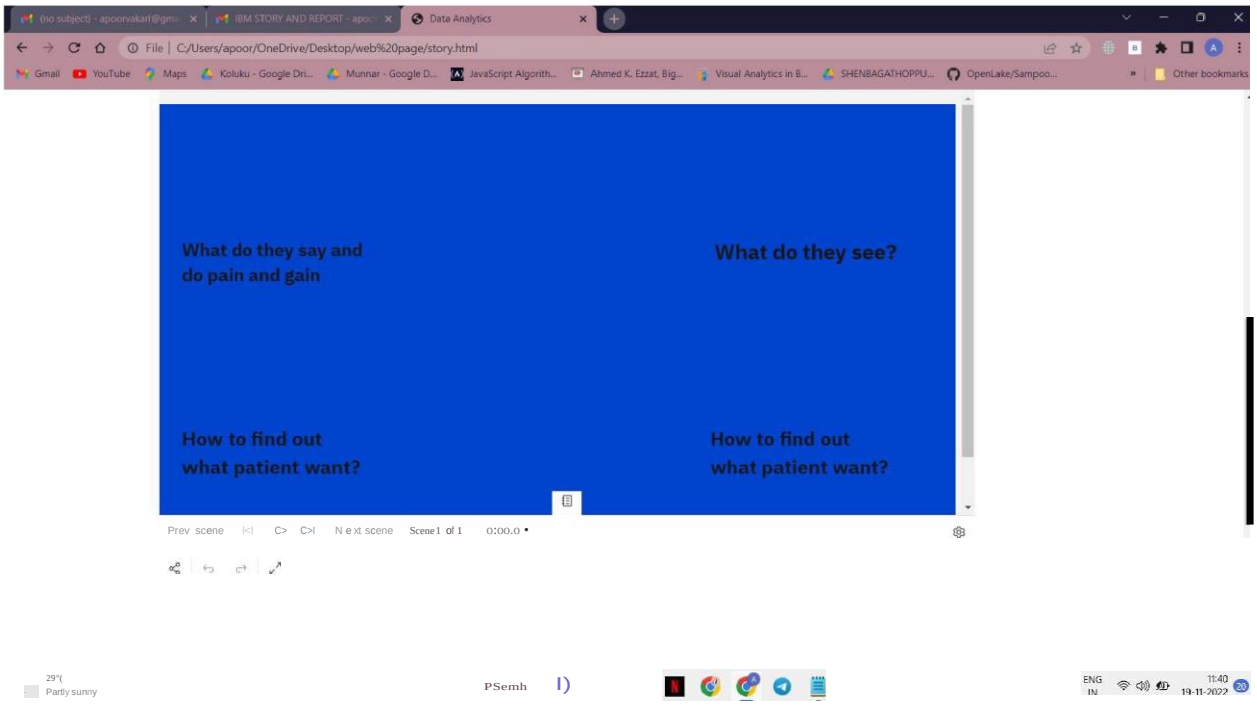
Department by Type of Admission





7.3 FEATURE -STORY

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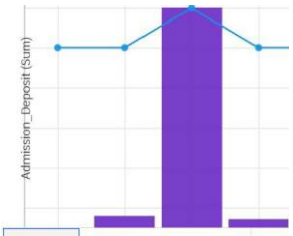
• Admission_Deposit(SUm) e ward _Type[Coumdi stinct)



Ward Type (Co

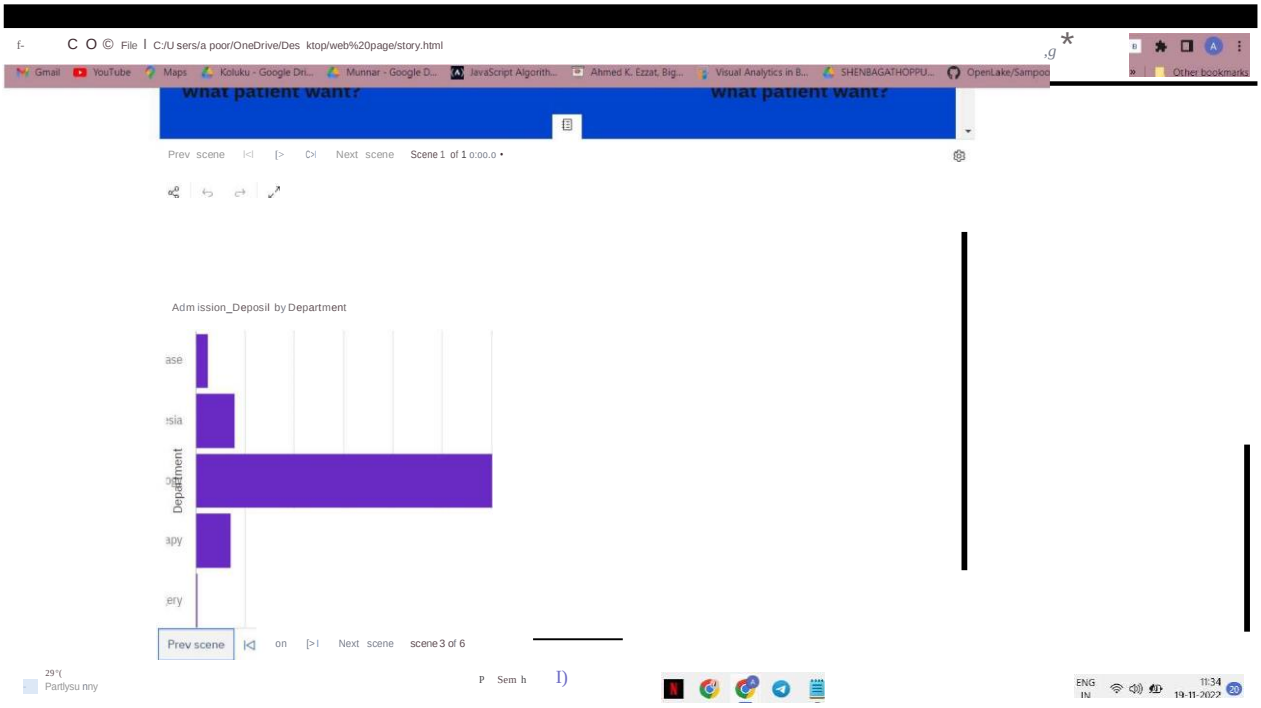
{j]

Prev scene on Next scene scene 4 of 6

29°(Partly sunny

PSemh I)

ENG IN 11:34 19-11-2022


what patient want?
what patient want?
Prev scene
Next scene
Scene 1 of 1
Admission_Deposit by Department
Department
Prev scene
on
Next scene
scene 3 of 6

CHAPTERS

TESTING

Bl.TESTING

- verify user is able to see home page
- verify user is able to see dashboard page
- verify user is able to naivigate to story page
- verify filters are working

8.2 USER ACCEPTANCE TESTING

1.Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issuesof the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2.Defect Analysis

This report showsthe 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	8	5	0	3	16
Duplicate	1	0	4	0	7
External	0	3	5	1	5
Fixed	13	4	3	18	32
Not Reproduced	0	1	0	1	2
Skipped	1	2	0	0	1
Won't Fix	0	5	2	1	8
Totals	23	14	13	26	75

3. Test Case Analysis

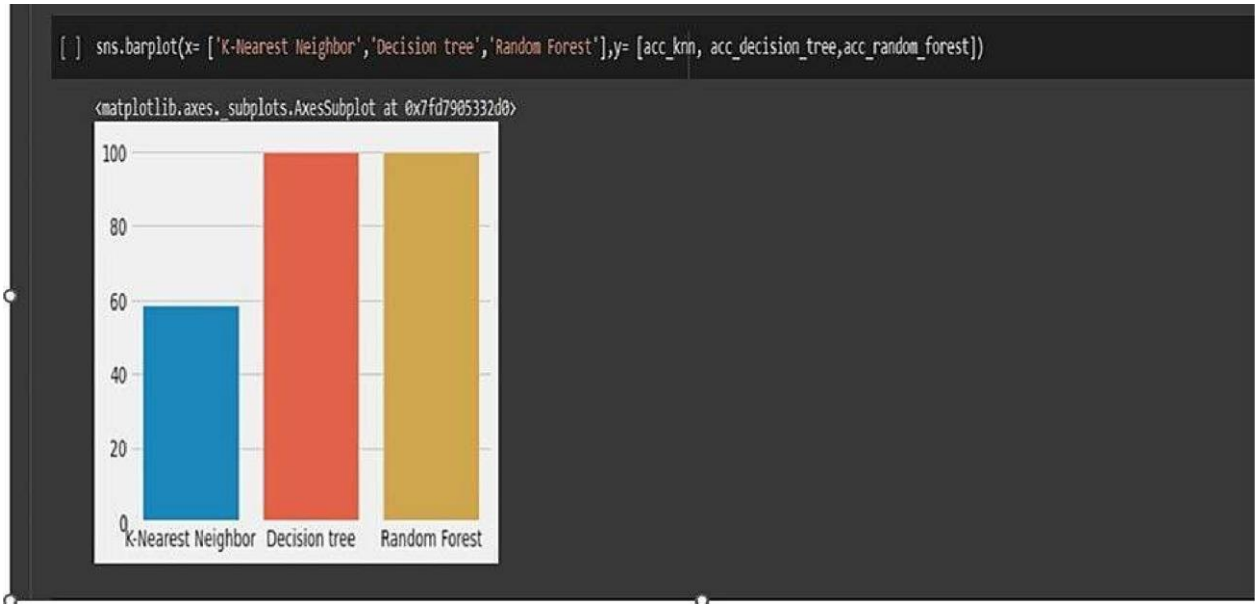
This report shows the number of test cases that have passed, failed,and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	6	0	0	6
Client Application	51	0	0	51
Security	1	0	0	1
Outsource Shipping	3	0	0	3
Exception Reporting	6	0	0	6
Final Report Output	2	0	0	2
Version Control	1	0	0	1

CHAPTER 9

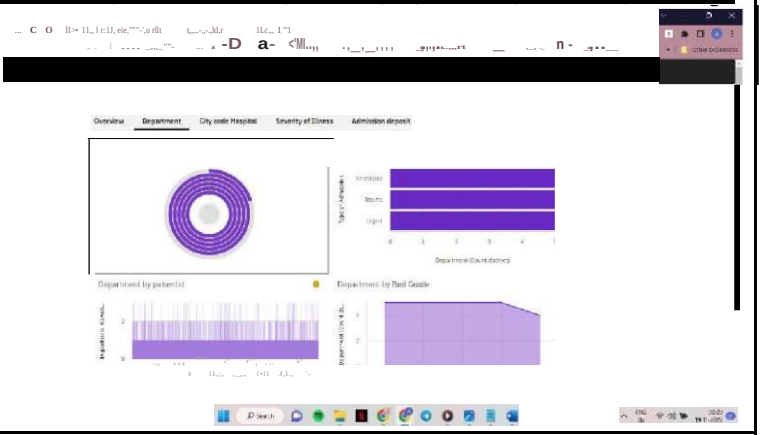
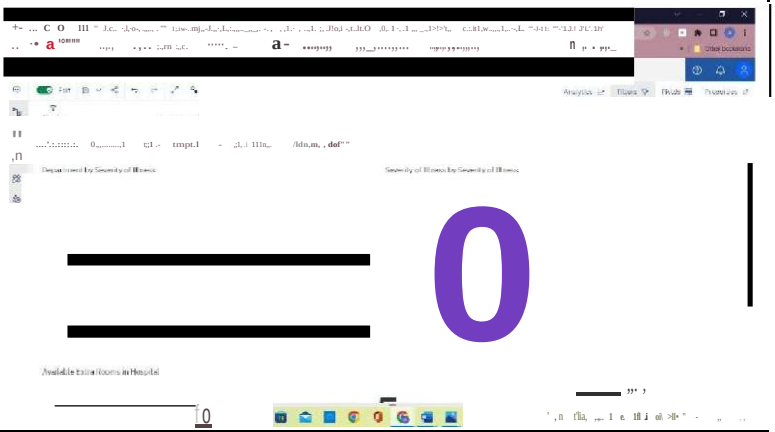
RESULTS

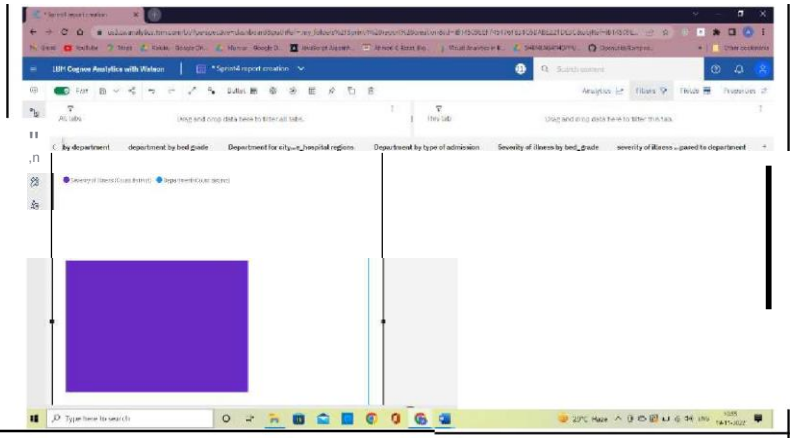
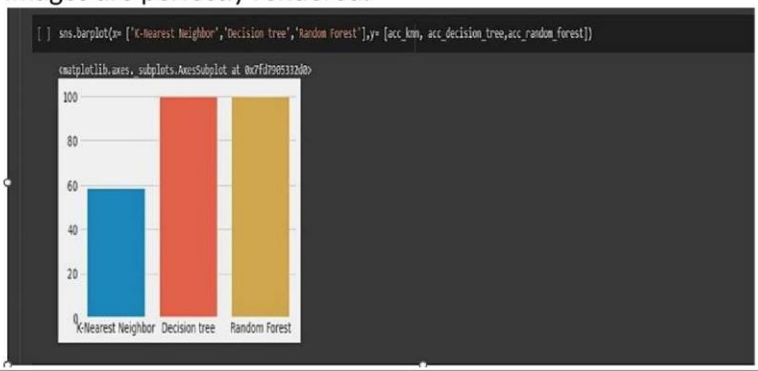
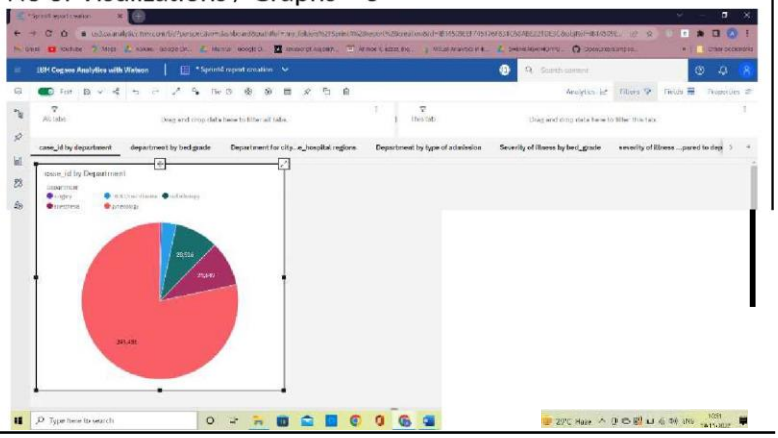
9.1 PERFORMANCE METRICS



Model Performance Testing:

Project team shall till the following information in model performance testing template.

S.No.	Parameter	Screenshot / Values
1.	Dashboard design	Number of Visulizations / Graphs - 24 No of tabs-  8
2.	Data Responsiveness	Data along with their respective graph will dynamically change 
3.	Amount Data to Rendered (DB2 Metrics)	Number of rows read-318438 Number of rows loaded-318438 Number of rows rejected-a 

4.	Utilization of Data Filters	We created filters for Dashboards 
5.	Effective User Story	No of Scene Added -6 Animations are perfectly displayed Images are perfectly rendered. 
6.	Descriptive Reports	No of Visulizations / Graphs – 6 

CHAPTER 10

ADVANTAGE AND DISADVANTAGES

ADVANTAGES:

- Cost-effective use of technology
- Improved project management
- Sustaining the improvements in the result
- Boosting hospital capacity
- Enhance the qualityand efficiency of healthcare
- benefit areas like emergency preparation, charting, administration,compliance, and financial management.
- Analysing clinical data to improvemedical research

- Using patient data to improve health outcomes
- Gaining operational insights from healthcareprovider data

- Improved staffing throughhealth business management analytics
- Early detection of disease.
- Prevention of unnecessary doctor's visits.

- Discovery of new drugs.
- More accurate calculation of health insurancerates.

- More effective sharing of patient data

DISADVANTAGES:

REPLACING MEDICAL PERSONNEL:

Application of technology in every sphere of human life is improving the way things are done. These technologies are are also posing some threat to world of works. Robotics are replacing human labour.

DATA SAFETY:

Data security is another challenge in applying big data in healthcare. Big data storage is usually targets of hackers. This endangers the safety of medical data.

Healthcare organisations are very much concerned about the safety of patients' sensitivepersonal data. For this, all healthcare applications must meet the requirement for data security and be HIPAA compliant before they can be deployed for healthcare services.

PRIVACY:

One of the major drawbacks in the application of big data in healthcare industry is the issue of lack of privacy. Application of big data technologies involves monitoring of patient's data, tracking of medical inventoryand assets, organizing collected data, and visualization of data on the dashboard and the reports. So visualization of sensitive medical data especially that of the patients creates negative impression of big data as it violets privacy

MAN POWER:

Applying big data solutions in healthcare requires special skills, and such kills are scarce. Handling of big data requires the combination of medical, technological and statistical knowledge.

CHAPTER 11

CONCLUSION

The impact of data analytics in healthcare has already made a substantial difference in the ability of healthcare providers to offer patients high-quality care in an efficient, cost-effective manner. However, the role of data analytics in improving patientoutcomes and healthcare processes continues to grow and expand as more types of data become available and new tools are developed that make the results of the analytics clear and easy for healthcare professionals to access.Realizing the potential of data analytics to transform the healthcare industry begins by understanding how the technology can be applied to address healthcare providers' challenges, including staff recruitment and

utilization, operational efficiencies, and enhanced patientexperiences. Patient-centered healthcare depends on knowing what patients want and need. Data analytics holds the key to unlockingthis vital information.

CHAPTER 12

FUTURE SCOPE

Artificial Intelligence (AI) will play a significant role in data analytics in healthcare for the next decade. For example, the field of AI-enabled clinical decision support is just emerging. This type of support can compare patients who fit similar profileswithin a system,then it can alert doctorsto trends in data that may havebeen overlooked. The use of big data in healthcare will include testing for drug interactions that small studies are unlikely to catch and prevent patients from takingharmful drug combinations.

Decisions made by physicians, like what test or treatments to give a particular patient, makeup 80-90% of all healthcare spending, so using artificial intelligence to make more educated decisions will bring down healthcare costs. It's crucial to have informed leaders at the vanguard of these innovations in healthcare.

CHAPTER 13

APPENDIX

SOURCE CODE

HOME PAGE_;_

Index.html

```
<!DOCT
YPE
html>
        <html lang="en">
        <head>
          <title>Data Analytics</title>
          <meta charset="utf-8">
          <meta name="viewport" content="width=device-width, initial-
        scale=l">
          <link rel="stylesheet"
        href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.
        min.css">
          <script
        src="https://ajax.googleapis.coma/jax/libs/jquery/3.6.0/jquery.min.js">
        </script>
          <script
        src="https:// maxcdn.bootstrapcdn.com/ bootstrap/3.4.1/js/bootstrap.mi
        n.js"></script>
        </head>
        <body>
```

```
<nav class="navbar navbar-inverse">
  <div class="container-fluid">
    <div class="navbar-header">
      <a class="navbar-brand" href="about.html">Analytics for
Hospitals' Health-Care Data</a>
    </div>
    <ul class="nav navbar-nav">
      <li class="active"><a href="#">Home</a></li>

      <li><a href="dashboard.html">Dashboard</a></li>
      <li><a href="report.html">Report</a></li>
      <li><a href="story.html">Story</a></li>
    </ul>
  </div>
</nav>

<div class="jumbotron">
 <center>  <h4><i><b>Team ID: PNT2022TMID18479
</b></i></h4></center>

</div>
<table class="table table-bordered">

    <tbody>
      <tr>
        <td>Team Leader</td>
        <td>Apoorva GK</td>
```

```
    </tr>
    <tr>
      <td>Team member</td>
      <td>Bharathi Leela A</td>

    </tr>
    <tr>
      <td>Team member</td>
      <td>Bhoomika A</td>

    </tr>
      <tr>
      <td>Team member</td>
      <td>Deepa Rani S</td>

  </tr>

    </tbody>
  </table>
</body>
</html>
```

About Page ;

about.html

```
<!DOCTY
PE html>
        <html lang="en">
        <head>
          <title>Data Analytics</title>
```

```
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">
  <script src="https:/ /ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>
  <script src="https:/ /maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>
</head>
<body>

<nav class="navbar navbar-inverse">
  <div class="container-fluid">
    <div class="navbar-header">
      <a class="navbar-brand" href="#">Analytics for Hospitals' Health-Care Data</a>
    </div>
    <ul class="nav navbar-nav">
      <li class="active"><a href="index.html">Home</a></li>
      <li><a href="dashboard.html">Dashboard</a></li>
      <li><a href="report.html">Report</a></li>
      <li><a href="story.html">Story</a></li>
    </ul>
  </div>
</nav>
```

Analytics For Hospitals' Health-Care Data

Recent Covid-19 Pandemic has raised alarms over one of the most overlooked areas to focus: HealthcareManagement.
While healthcare management has various use cases for using data science, patient length of stay is one critical parameter to observe and predict if one wants to improve the efficiency of the healthcare management in a hospital.
This parameter helps hospitals to identify patients of high LOS-risk (patients who will stay longer) at the time of admission. Once identified, patients with high LOS risk can have their treatment plan optimized to minimize LOS and lower the chance of staff/visitor infection. Also, prior knowledge of LOS can aid in logistics such as room and bed allocation planning.
Suppose you have been hired as Data Scientist of Health Man a not for profit organization dedicated to manage the functioning of Hospitals in a professional and optimal manner.

Goal:

The goal is to accurately predict the Length of Stay for each patient on case by case basis so that the Hospitals can use this information for optimal resource allocation and better functioning. The length of stay is divided into 11 different classes ranging from 0-10 days to more than

100 days.

Technical Architecture:

<img src= "Technical_architecture.png">

</body>
</html>

DASHBOARD PAGE_:_

```
< !Doctype html>
<html lang="en">
<head>
<title>Data Analytics</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=l">
  <link  rel="stylesheet"  href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/boot
  <script src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>
  <script src="https://maxcdn.bootstrapcdncom/bootstrap/3.4.1/js/bootstrap.min.js"><f s
```

```
</head>
<body>

<nav class="navbar navbar-inverse ">
  <div class="container-fluid">
    <div class="navbar-header">
      <a class="navbar-brand" href="#">Analytics for Hospitals' Health-Care Data</a>
    </div>
    <ul class="nav navbar-nav">
      <li><a href="index.html">Home</a></li>
      <li class="active"><a href="#">Dashboard</a></li>
      <li><a href="report.html">Report</a></li>
      <li><a href="story.html">Story</a ></li>
    </ul>
  </div>
</nav>

<div class="container">
        <iframe
src="https://us3.ca.analytics.ibm.com/bi/?perspective=dashboard&amp;pathRef=.my_fol
dded&amp;action=view&amp;mode=dashboard&amp;subView=model000001848bea4a5e
allowfullscreen=""></iframe>
</div>

</body>
</html>
```

REPORT PAGE :

```
<!DOCTYPE html>
<html lang="en">
<head>
 <title>Data Analytics</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=l">
  <link rel="stylesheet" href="htt ps:// maxcdn.bootstrapcdn.com/ bootstrap/ 3.4.1/css/boot
  <script src= "https:// ajax .googleapis.com/ajax/libs/jquery/ 3.6.0/jquery.min.js"> </script>
  <script src="https://maxcdn.bootstrapcdn .com/bootstrap/3.4.1/js/bootstrap.min.js"><f s
</head>
<body>

<nav class="navbar navbar-inverse ">
  <div class="container-fluid">
    <div class= "navbar-header">
      <a class="navbar-brand" href="#">Analytics for Hospitals' Health-Care Data</a>
    </div>
    <ul class="nav navbar-nav">
      <li><a href="index.html">Home</a></li>
      <li><a  href="dashboard.html">Dashboard </a></li>
      <Ii class="active"><a href="#">Report</a></li>
      <li><a href="story.html">Story</a ></Ii>

    </ul>
  </div>
</nav>
```

```
<div class="container">

<iframe
src="https://us3.ca.analytics.ibm.com/bi/?perspective=dashboard&amp;pathRef=.my_fold
embedded&amp;action=view&amp;mode=dashboard&amp;subView=model000001848e4(

</br>

</div>

</body>
</html>
```

STORY_:_

```
<!DOCTYPE html>
<html lang="en">
<head>
 <title>Data Analytics</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrc
  <script src= "https:// ajax .googleapis.com/ajax/ libs/ jquery/ 3.6.0/jquery.min.js"> </script>
  <script src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></scriJ
</head>
<body>

<nav class="navbar navbar-inverse ">
```

```
  <div class="container-fluid">
    <div class="navbar-header">
      <a class="navbar-brand" href="#">Analytics for Hospitals' Health-Care Data</a>
    </div>
    <ul class="nav navbar-nav">
      <li><a href="index.html">Home</a></li>
      <li><a href="dashboard.html">Dashboard</a></li>
      <li><a href="report.html">Report</a></li>
      <li class="active"><a href="#">Story</a></li>

    </ul>
  </div>
</nav>

<div class="container">
<p>Story of Health-care data</p>
<iframe
src="https://us3.ca.analytics.ibm.com/bi/?perspective=story&amp;pathRef=.my_folders%2F
mbedded&amp;action=view&amp;sceneId=model00000l848e2967c2_00000002&amp;scene
allowfullscreen=""></iframe>
</br>
</div>
<div class="container">

<iframe
src="https://us3.ca.analytics.ibm.com/bi/?perspective=story&amp;pathRef=.my_folders%2F
embedded&amp;action=view&amp;sceneId=model00000l848e2f216f_00000000&amp;scem
allowfullscreen=""></iframe>
</br>
```

<iframe
src="https://us3.ca.analytics.ibm.com/bi/?perspective=story&pathRef=.my_folders%2F
embedded&action=view&sceneId=model00000l848e33666e_00000002&scen
allowfullscreen=""></iframe>
</br>

</body>
</html>

Importing required Packages

In [72]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
sns.set_style("darkgrid")
plt.style.use("dark_background")
```

Importing the dataset

In [73]:
```
train = pd.read_csv('/content/input/training_data.csv')
test = pd.read_csv('/content/input/testing_data.csv')
Paramters_Description = pd.read_csv('/content/input/parameter_description.csv')
sample = pd.read_csv('/content/input/testing_target.csv')
```

Viewing dataset

In [74]:
```
train.head(5)
```

Out[74]:

	case_id	Hospital_code	Hospital_type_code	City_Code_Hospital	Hospital_region_code	Available_Extra_Rooms_in_Hospital	Department	Ward_Type	Ward_Facility_Code	Bed_Grade
0	1	8	c	3	Z	3	radiotherapy	R	F	2.(
1	2	2	c	5	Z	2	radiotherapy	S	F	2.(
2	3	10	e	1	X	2	anesthesia	S	E	2.(
3	4	26	b	2	Y	2	radiotherapy	R	D	2.(
4	5	26	b	2	Y	2	radiotherapy	S	D	2.(

Analysis of dataset

Distrib tion of vo ues.

rl ospita l_cod e

```
train.Hospital_code.value_counts()
```

```
26      lSl2S
2J      l95!J5
1<)     1682.5
5       1484 7
2B      l3 J4 l
IJI,    1.2:59'1
u       l 24 S-d
27      l.312
 <)      8828
!}       3SSS
12       8312
32        1 55
25       75:19
10       7:2.57
IS       6%5
l l       6226
2.4      5863
17       4JI9
J        ,mis
1        411 -
n        3974
l        394!0
30       37e7
S        36Eld
31       3651
22       2140
S        2679
18       21!'4
15       2119
          !)37
2.0       9135
7         i;s.i
l a  ""  Hospi t al._cc de, dtype;  int 6'1
```

```
plt:,fi sur e (fi  c:si ze  {10, 7 ))
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```
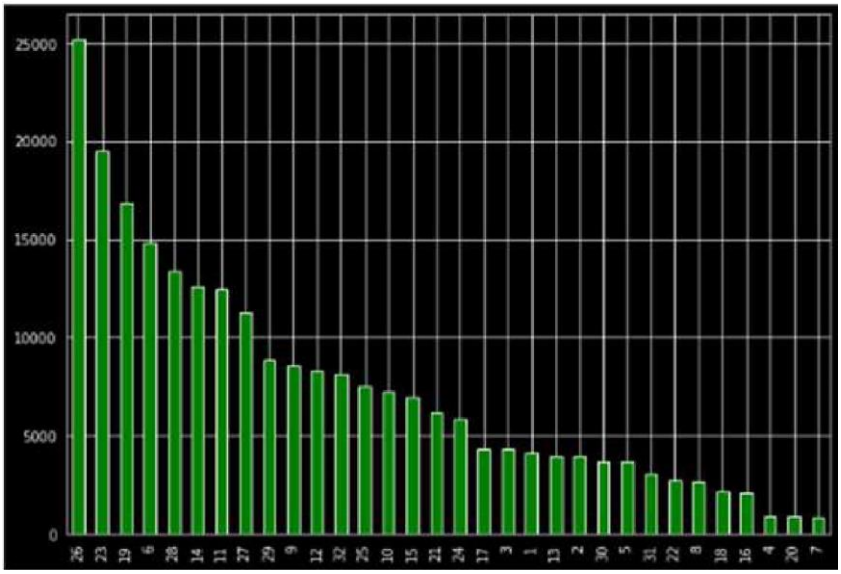
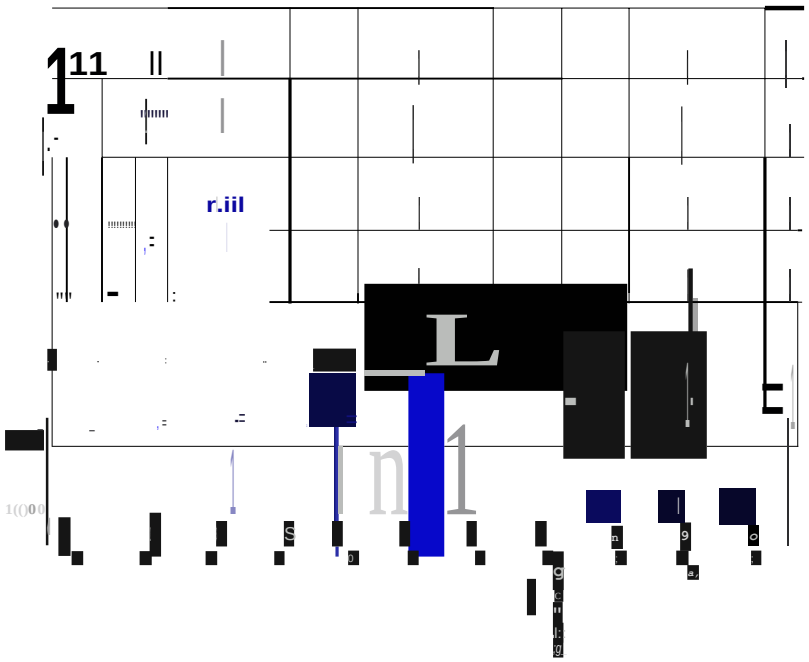



say

```
rain.s ay. lue_coun s()
```

```
2 :30                    97
l  •.                    S  9
ll-4!1                   ll  al
 1-be                    I14SII
 -1.0                    1586b
11-SO                    1166
II•IIiI                  8ei6l
   ,._, thall  00 Days   ',019
111-90                   Jlil :
 ·1 011                  2.179
111-70
     : Stay, dtype: ini:64
```



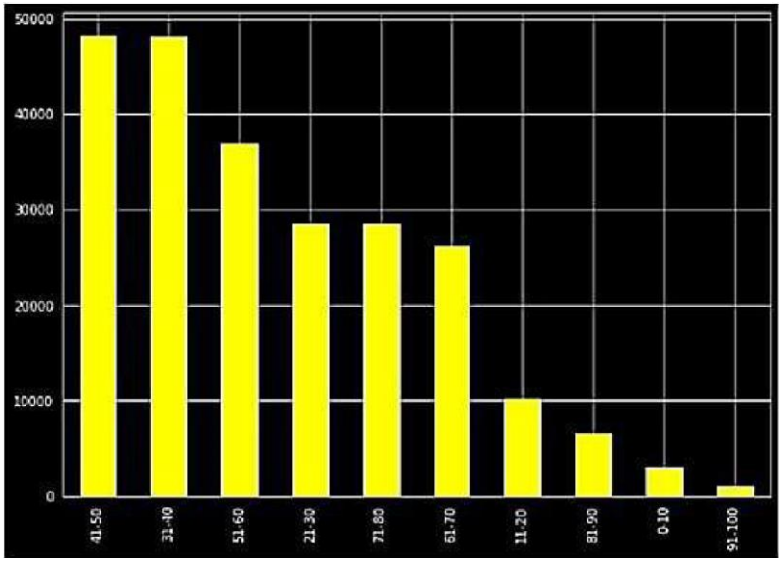
Age

t rai n. Age . valu e_co unt s ()

41 - 50	4 272
3! -dll	<18 ! 06
Sl • <>il	] 6 % 9
2.1 - 3\l	2855S
?i -88	ZS5 52
6 ! - ? ll	26! 39
n-20	I9141

!!l - 98 557!1
fl, I ll 303B
1 • 10 0 **9E.e**
rii!..;nr!Q: Ag;2, dsyp : **in-::64**

ITAge disrrillurioo
plt .f ig1J ie(fi i;sh e {l ll, 7**))**
tr ain . Agc ,val ue_, 11 un tcs () , 11lGt (ki mJ a"bar", c11l 0r = [' Ve . l o,i'])



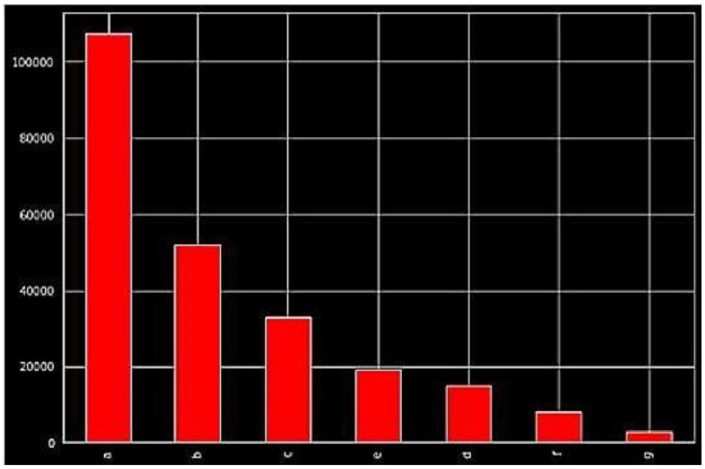
Hospital_:type_code

```
train.Hospital_type_code.value_counts()
```

a 107545
b SrniS

29-95
e 19105
d USH
166
S :!7118
rJa.rr.e: Hcis.pi t i=1! _.:yp ,e_code, dtype : intE4

:1Hosp{rot_type:_ ode d'tser-ibUTiiien
```
pln . fi s uca ( fi ssi za• tIO, 7))
t rai.n. Hosp i t ail _ l:Jpe_ c:ode. v lue _counn () . plot (kind=· D;:u" c:o l o!" = {·Fled · 1)
```



Hospital_region_code

```
train.Hospital_region_code.value_counts()
```

X 99S6S
Y 'J:Z21 4
2 aSS21
_r air.e: Hos pi t al _reg_c ri c:o de _J tvpe : i nt iS-.1

r.J-kJs pi t a l _re gi on_codc di..st"riti;utign
```
plt .f i sure(f iss i ze -= ( 18, ?))
t r ai n. HDs pi ta! _ r egi on_code. oal ue _cou nt s () . p! ot( k! n:d "bar'", color: {"Vi ol et ' ] )
```

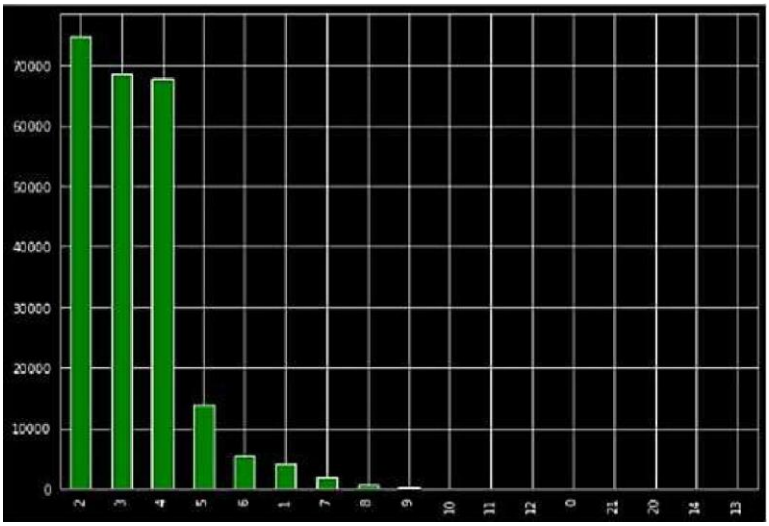
Availal11e_Ext ra_Rooms_i n_Hospita l

```
train.Available_Extra_Rooms_in_Hospital.value_counts()
```

74877
6 8517
;;n ;;
1.387
6 5344
I 4288
7 1876
8 622
9 1<14
18 46

```
11          13
12          11
0           11
Il           2
J,0          l
14           l
B
1-b!..o!:  ,wa-il  a bl  _  ir.ra _Ro co,  _i n_ftospi t,'1 ,  d.ype:  int
```

```
R'4vaitabte_Ert-,.,_IlQOmS_ tn_HDJ;pita( dhcri.bv,(o,n
plt .f :lgur i!( fi g<i ze  o{lll , 7>)
t ra,i n. Avai!  abl e_b   t r a_Roort<_i n_Ho, p.it  • l . Val u_e_:count s ()  .p l o t ( ki ml<" bar ",  color      [·sr en'  ))
```



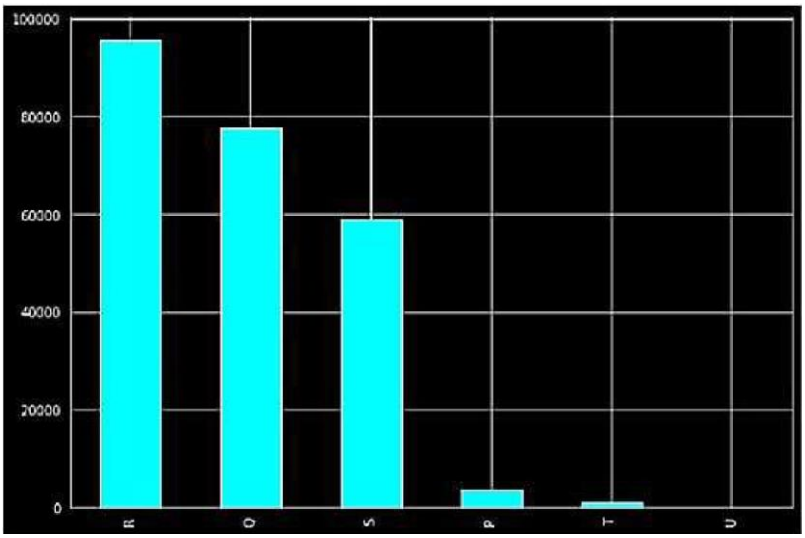
Department

```
trai n. Depa tment ,v al ue_c   oont s ( )
```

gyoeco! ogy

```
R        788
Q       77797
S      s9a2.2
P        3, 9!
i        l Il i>Z
U
Nauc: Nard_Ty e,,  dt •pe:  i nt &<!
```

```
1/l,brd _ rype di..st ei buti an
pl-r .fi i;ure  ( fi gsi e=( 1e,7))
t r  i ,.h•ard _1 Yl'e .,va1oe_co u nt s () . pl ot (ki n<-l      ba.-",  col or     [ 'cya n·  J)
```



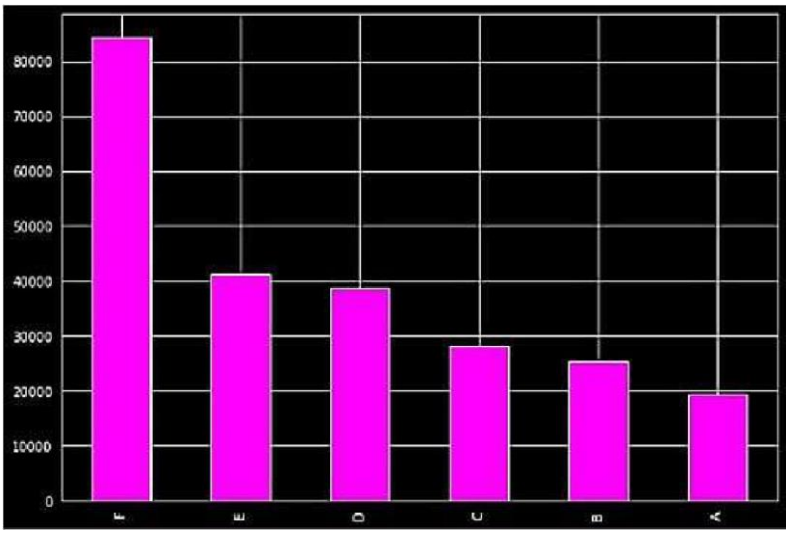
Ward_Facility_Code

rain . Ward _Faci li t)·_Co e,value _co unts O

F 84438
E 41246

V 3B B4
C 2807
S z5<1•J
I< 194.l 1
N o;,: W l"d_f ;, ci.li cy_C◇◁e drype: i 64

,n,tr,,J_Fad Li ty _Cade distriburfon
ph. fisure (fi i;;;fr e- (10, 7))
train.Ward_Fad !i:t y_C◇de . val Ye _« ,em s O. plo t (kind-"bar", col or = f 'magenta·])



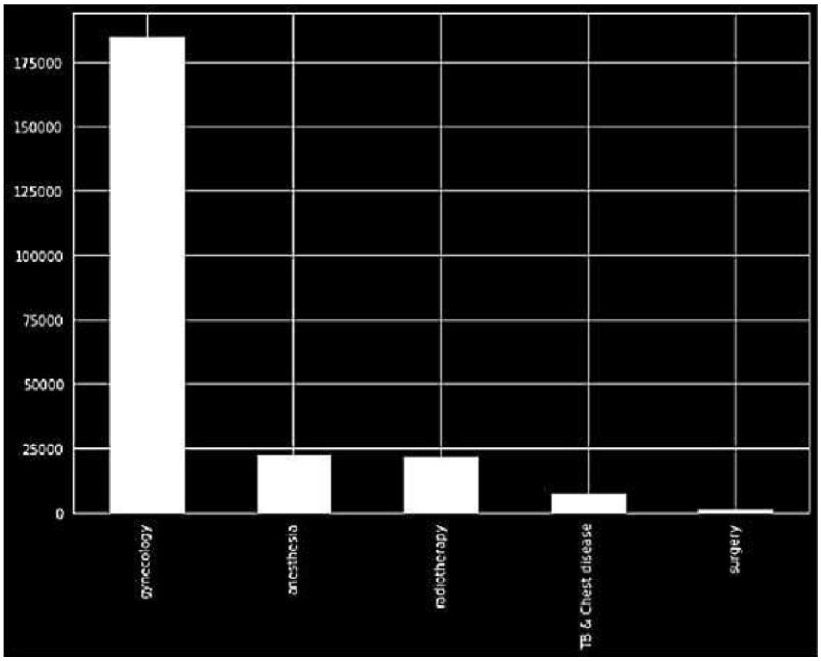
Visitors_wilh_Patient

```
train.Visitors_with_Patient.value_counts()
```

2.tl 1033 7
4.1¼ S l0.Sl:I
,J () d33f,fl
6.G 14211
S.!l G99l

anesthesia 22.557
,.adi o t h r py 21 72 5
TB & c1>es .:: di$ease 70H
suq:ery VMI
l.l:.cre : Oepartmeo;;, dt ype : i nt 64

```
 Depcrt e r distMbu-ci n
plt.fii:uc@{ f i s:si z@=(10,7))
train.Oep arm ent .\la l1 1e _ CQ1mt s ( ) . p! ot (k .fo d="b ar·   -cr    ['white'])
```



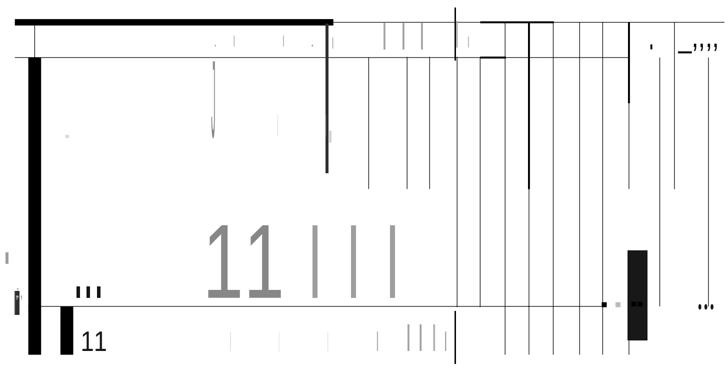
Wilrd_Type

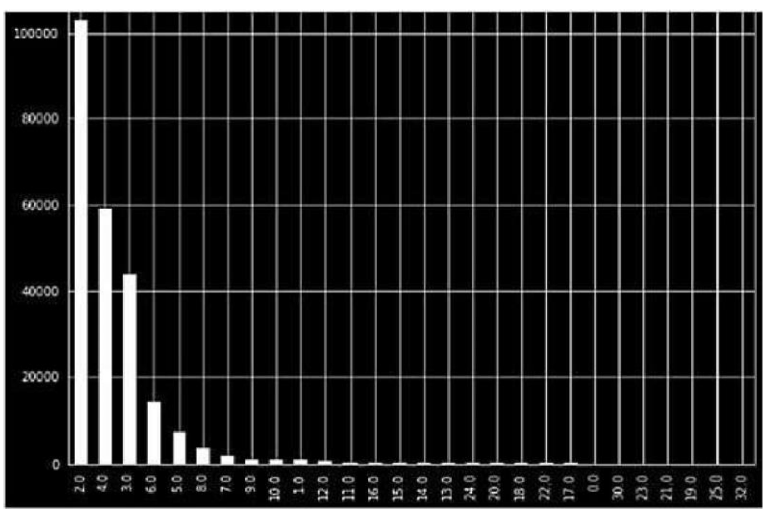
```
train.Ward_Type.value_counts()
```

M.8	3"62
7.9	188M
9.0	rn 2
HI.El	8.$2
I. {I	81l
ll .8	7S7
11.. e	2. 2
1▷. e	2.ze-
1s . 0	l M,
14 .0	138
B.0	84
2A .0	63
0.0	•6
18.0	35
l .6	16
17.0	1S
9.0	ll
Je.e	9
H ,0	8
21. 0	
1\\.0	6
11.O	6
32.0	I

IIan:e,: v :.d t:Or-!:_ fÌri. t.h_Pn :i rl't , dtype: in t64

```
#VisiC'<>rs_.-tt:h_PatLet>t dfatriburion
i,. t ,·Hi;ur-e(f ig• iz e• (18, 7))
·t r-au, . vi s it:or s_><i t h_pat ie nt , val ue_ co unt sO . pl ot (k d-•bar·, color • ľ""hite 'J)
```





Severity of Illness

```
ra in . Se v,d ty _of _ lness .va l ue_caimts (}
```

li'c!idtH"t'f 't,e	l34H4
•linor	55665
Ex etr-e	47l19
iJ1	1

Name: Severity_of_Illness, dtype: int64

```
IISeve.ri.cy_of_l ll r,es.s di.st:ri:bution
pl• .fi gur • ( fi g<i :l:i! e( l B,.7 ))
ain .S v• r i.y _of'_I ll n2, ,-.. val u2_ coun t,: () . plo t (:ki n<l•" b• r· , color • [ ' r od' l)
```

```
x_:t"'c1iin = ·.:r a in . dro p( ( · cas iE!-_ i .-d ,   ·s1:.ay'" J,.. a:i.::i.s l)
Y_tt'"ain = -.:r a i n [ .. S c1iy' J
X_.:e- t:   = -.:e 5t dr op( ""c a.!i.@_ i :d'",. a.:,,:j_s. 1 ) . cc .py ( )
```

```
X_ tr a.i n .;Sha p,e
```

(237309, 12)

```
Y_train.shape
```

(237309,)

```
X_-::es t . :shape
```

(137057, 12)

```
x_te-st . co l umns
```

```
Ind ([ "!f-losp i ta ! _code,·   "H os pi t al _-zy_c;_cod;" , ·  Cit y_(o <le _flos pi al, ·
      • Availab..-e_Ex r a_ RO-OD'.:S_ i n_ Hos pi 'ta l ·.,  ·oe p-.a rta.en't ' ., 'Wa rd _l ype "
      "W-.af'd_Fa  ci l i 't y_ Cod  "   ' l y p,e_ o-f_ltd ,1:1i ssi on · • •  St!\/'er"i.: •-of _I I I ness· .,.
      "Vi  i ;:ors _i:-ii tl_   f':!i!!ti i:!!nt: ",.  'Ag •,  'Adrn.i5 :5.:_o,n _D!!!po si ;: "  ,.
     a.:yp•• · obj e c · )
```

```
0        0.0
I        <. O
2        3 . 0
3        4 . 0
         <.0

2n,a•    s.a
2 ?3 S    .<l
237J05   2 . 0
n n a,   1.0
23?30:!::i McIM
r c1   S i:.;y "  L j,!r:i.gt b : 2. ?3 C9'., d :i,•p!:!: -fI ci.c1.:b a.
```

```
X_t:r a-i.n. f i ! l oa (O ., i npl ac ie• ff ue )
V_rt  a,i n . f i ! l na (a .,inplace•True)
X_t es t:.-fi ! ! na (a ., i npl a c.e-=Tr ue )
```

K-Nearest Neighbor Algorithm

```
knn .: K:Ne   hbcr s Cl ass i f i.-er { n_ne:i s l"lbor s  • l )
knn . -fi.t (X _ tr ;ai n ., Y_ t r ai o )
V_pre-d • knn p.re:C,i ct ( .X_ :t-es t: }
acc _k nn :::;_ r o -.io d( k;nn . s c:o.re ( X_ t r-a.i n., 'Y_ t:r a i l"l) • 100., 2)
.acc_l<nn
```

Descision Tree Algorithm

```
dcc:i s-i o n_tT e :e •  De_ci s i on rr ceC!  ass i f i er ( )
d c:i s i on _'t r ee ..:Fi t ( X._'tr  a b, ., V_ "d""ai n )
v_predl = deci s i o n_-i:,..,ee . p r-edi ct;( X_t e s't )
acc_de-cision_t:ree :::;  l"OrJ nd(d ec i s i-011_ :tre e . :s.c:ore ( X_t:r a i i:1.,  v_-c;r.ain) + 10£11., 2)
acc_deicisior'l_Lt"E:a
```

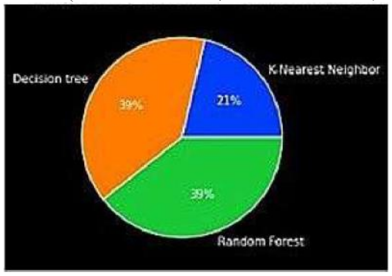
Random Forest Algorithm

```
r;aimJo _f or es t: _. Fta:n do i:if o :re :s.t C! a.ss i f .i er ( n_es t i mat ors • 1 00 )
r a ndo m:i_-fc r-es i:. f i t:( X:_'t ra fJ1l., v_t l"'ai n )
v_pr-e,dl  l"' an.d c:m_ ore s:i:.. p r""edic;: . (X_t e s t )
r"i:!l do rr:._ f C1t"lE!-s;: . :5:c o:re( .X_t' r .c1i.n _ Y_:r ai ni)
i  r-a ndom_for e, r   N>und( aod'cm_fo r s • . •  or e ( X_  ra i n, Y_-::r-ain) • rnfl, 2)
   _r-c1ndo m_Tcir e s.t
```

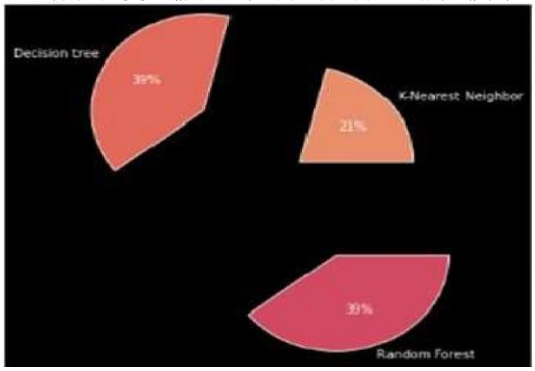
Prediction accuracy comparison

```
al ie·t.tie_ c::ol or ns . c:o l or_p al e t t:e ( "br i Q'.ht "}
.irta:. Lacc...kfl n) acc-_ de c:i si on..t r-e , acc....r-and) 1|_i a-res t l
keys =[ · t.:- f.eares T Neig hbo r', "Decision tree·, 'Ran do for-es:t " ]

irgietting the atgorith.':I with highesr g urac;y
rna;oi;_ ac:cur-ac;•-rnax( dat ,a )
1 x•[ e, a,a1
j, e;
fur i in data:
   if(i =•"-' x_accura c );
      i ndox{ j J 1
      j a j +l
   else:
      ndox{ j )• . e1
      j e j +l

plt . pi-e ( dat .a , l abe! s-::ke y s.., col ors=pal e:t te_c ol or , auto pct :;:: ¼.e -P" ' )
```

```
([.

l,
[Texr(0 .65 802l6425ll272, e. 6822773025085H, · K• ! /aar osr nai g boe· ),
Te xt ( -0 .927749 }0 83715313, 0 . 5 3990::l.4l 9J27B ., 'Oc ,c:isio n tree"),
T• xt (0 . l 6ll 682l 3278)7l l l , - l . 0 90:l03 607 l:18l , ' R a n Q For> est ')],
[Te er ( 0.47M 0l 289508 ae93, e . 37n: s1; s.ios 10l.2 s, ·n 1:· ),
Te x t ( -0 . 50-:,04 5-Q0i 567926 I , e . 32236 3-l 2 6 S08:?Sa , '39 · ) _.
i e xt ( 0.196996470070 2!7 , -0 . 565HS37o3026l52, · 39:,;· )] )
```




```
pal e-t t c _co !.or :. sns . col o r-_p al e t t e (' fl .arc ' )
plt, pi e (tlata, l Gt: b mk e:y , ,c,ol or npah :t t li:_ ( 0lor, xplc Oe • i lm:h:x, aut0'pc-t • . 8-fX ' )


ell f ( p[8J =• ) :
   prirtt{"lhe pre-dined LOS cf patiert is Sl-%")
el if (p[ OJ••9):
   pri nt (" The predicted LOS of patient is 91-108")
eli f ( pl 8J•• l8 );
   pr i nt ( '" The pre-dined lO of. pait:ie nt is 1-bl""il- t han 12-e O;Jjys.-}


d at a• np. ar ra y (( [29,0,.i,2,2, 3,5, I,2,4,7 AB18J])
p r.d r.idM_fo re:st . Jl!'l!di ct { da.::a )
pr>n<(p)


pr@di ct i an( p)

The pri>dicted LOS of patient i.> l -60
```




```
output['Stay'] = output['Stay'].replace(stay_labels.values(), stay_labels.keys())
```

```
c _td  S,.,.
0  31 i9  )-10
2  311!-!.i1  21-,0
3  311!-!.i2  ,- .Z
●  3- z.:.;,.;  3',t.,.,:O

137052  .lSS.:.91  0-10
137053  .:tSS-!CR  0- 10
137054  .l$ 5-'9  Z'.:;,0
13 70 5 5  5 5.1\i.!  2"1-:;.(l
137056  ..15;.J. ;  -60
```

```
p
```

```
p M n --r:( "Tr-.  p...-.C:Sitll!!,c:11 La?, of pat:i ll!-fl  i!i  0 1 0 "')
```

GitHub Links:

GitHub link: https://github.com/IBM-EPBL/IBM-Project-38824-1660385799.git