# A MINI PROJECT

## ON

# WORK FORCE RETENTION SYSTEM

**Submitted to**

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

In partial fulfilment of the requirements for the award of the

## POST GRADUATION

**in**

## MASTER OF COMPUTER APPLICATIONS

Submitted By

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Under the guidance of

**Mrs. B. Rajitha**

Assistant Professor



## DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS

## VAAGDEVI ENGINEERING COLLEGE

Affiliated to JNTUH(Autonomous), HYDERABAD

BOLLIKUNTA, WARANGAL (T.S) —

506005

**DEPARTMENT OF**

**MASTER OF COMPUTER APPLICATIONS**

**VAAGDEVI  ENGINEERING  COLLEGE (Autonomous)(WARANGAL)**



# CERTIFICATE OF COMPLETION  PROJECT WORK   REVIEW-I

This is to certify that the PG Project Phase-1 entitled "WORK FORCE RETENTION SYSTEM"

Is being submitted by **KONAPARTHI GNANA JYOTHIKA(23UK1F0014)** in partial fulfilment of

the requirements for the award of Post Graduation of Master of Computer Applications to

Jawaharlal Nehru Technological University Hyderabad during the academic year 2023-2024.

**Project Guide**                                                          **HOD**

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(Assistant Professor)                                              (Professor)

**External**

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**KONAPARTHI GNANA JYOTHIKA**                                        **(23UK1F0014)**

# ABSTRACT

Massive investment in employee skills training has been adopted by lots of organizations in reaction to the rapid evolution of the global trends and technology adoption. Unfortunately,target employee retention after training unsatisfactorily gives a negative return on investment. Prediction of target candidate decision before training and understanding the features that affect the candidate decision can greatly contribute to candidate selection and decision feature optimization process for increased employee retention. The method proposed in this paper successfully models and analysis various machine learning classifiers for illustrating features that affect the target candidate decision and predict the probability of candidate retention before training.

# TABLE OF CONTENTS: -

# 1. INTRODUCTION

## 1.1 OVERVIEW

Strategic investments based on intelligent decisions are necessary for company development. Decision-making with the assistance of machine learning developed algorithms is increasingly determining our lives. There are numerous areas in which the artificial intelligence adoption impacts decision-making activities in a company or organization. HR management is one of those where the quality of employee skills greatly influences the growth the competitiveness of companies. Being adopted in marketing and sales, artificial intelligence is now applied in HR management employee decisions based on objective analysis of data in large amounts to advance the decision-making processes, achieve set corporate objectives and improve competitiveness.

Since skills, knowledge and employee loyalty are fundamental for business continuity and sustainability, artificial intelligence in the HR field can utilize employee data through models that allow predictions of employee decisions, hence minimizing risks and optimizing HR activities. Organizations invest much resources in employee recruitment and training based on their strategic needs. So, when an employee leaves the company, in loses valuable resources in terms of labor, time, money and effort that were invested in selecting and training the employee for their related tasks. Therefore, the organization must endlessly invest in selection, training, recruiting and developing new staff to fill important job positions which is a long and costly process. Companies are interested in retaining well-trained and highly motivated employees since they form the core of a productive company.

## 1.2 PURPOSE

The purpose of the Workforce Retention Prediction System is to leverage data-driven techniques to help organizations understand, predict, and improve employee retention. This system aims to identify key factors influencing employee turnover and provide actionable insights to HR departments, enabling them to develop targeted strategies for retaining top talent. By accurately forecasting the likelihood of employees leaving, organizations can proactively address retention issues, improve employee satisfaction, and maintain a stable and productive workforce.

1. **Predict Employee Turnover:**

   Utilize historical data and machine learning algorithms to predict which employees are at risk of leaving the organization.

2. **Identify Influencing Factors:**

   Analyze various parameters such as job satisfaction, performance metrics, workload, tenure, and demographic information to determine the primary drivers of employee turnover.

3. **Provide Actionable Insights:**

   Deliver insights and recommendations to HR managers, enabling them to implement effective retention strategies and improve overall employee engagement.

4. **Enhance Decision-Making:**

   Support HR decision-making processes with data-driven predictions and analyses, leading to more informed and strategic actions regarding workforce management.

5. **Improve Organizational Stability:**

   By reducing turnover rates, the system helps maintain continuity, preserve institutional knowledge, and minimize the costs and disruptions associated with high employee turnover.

# 2. LITERATURE SURVEY

## 2.1    EXISTING PROBLEM

Organizations across various sectors face significant challenges in managing employee turnover. High turnover rates can lead to increased costs, disrupted operations, and a negative impact on employee morale and organizational culture. Despite the availability of extensive employee data, many organizations struggle to effectively analyze and utilize this data to predict and prevent employee attrition. This project aims to address these challenges by developing a predictive system that leverages data-driven insights to improve workforce retention.

➢ Many organizations struggle to analyze and leverage the vast amounts of employee data at their disposal, failing to identify critical factors influencing turnover. This lack of actionable insights prevents HR departments from implementing effective, targeted retention strategies.

➢ Moreover, the diverse needs and expectations of the modern workforce add another layer of complexity, requiring personalized retention approaches that many organizations are ill-equipped to provide.

➢ In a competitive job market, the failure to meet employee expectations regarding career growth, job satisfaction, and work-life balance further exacerbates retention challenges, making it imperative to develop a robust, data-driven workforce retention prediction system.

## 2.2    PROPOSED SOLUTION

The proposed Workforce Retention Prediction System is designed to address the multifaceted challenges of employee turnover through a comprehensive, data-driven approach. By leveraging advanced analytics and machine learning techniques, the system aims to predict employee departures, identify key turnover factors, and provide actionable insights to enhance retention strategies.

- ➢ **Data Collection and Integration:**

- • **Sources of Data:** Gather data from various sources including employee performance metrics, engagement surveys, turnover rates, and demographic information.

- • **Unified Data Platform:** Integrate data into a centralized platform to facilitate comprehensive analysis and ensure data consistency.

- ➢ **Predictive Analytics:**

- • **Machine Learning Models:** Develop and implement machine learning models to predict the likelihood of employee turnover based on historical and current data. Models may include logistic regression, decision trees, random forests, and neural networks.

- • **Feature Engineering:** Identify and process relevant features (e.g., job satisfaction, last evaluation score, number of projects, average monthly hours, time spent at the company, work accidents, promotions, department, and salary) to enhance model accuracy.

- ➢ **Identification of Turnover Factors:**

- • **Data Analysis:** Utilize statistical techniques and data visualization tools to analyze the collected data and identify key factors influencing employee turnover.

- • **Insight Generation:** Generate insights on which factors (e.g., low job satisfaction, lack of career advancement opportunities, excessive workload) are most strongly associated with turnover risk.

# 3. SOCIAL OR BUSINESS IMPACT

Workforce Retention System can have a significant impact on both the social and business aspects of an organization. Here are some examples:

## Social Impact:

Improved employee job satisfaction and morale: By implementing retention strategies based on the insights provided by machine learning, employees may feel that the company cares about their well-being, leading to improved job satisfaction and morale. Enhanced work-life balance: Retention systems can help organizations identify employees who may be struggling with workload or work-life balance and take proactive steps to address these issues, leading to happier and more productive employees. Diversity and inclusion: Retention systems can help organizations identify any biases or barriers that may be impacting the retention of certain employee groups, leading to a more diverse and inclusive workforce.

## Business Impact:

Reduced employee turnover: By identifying key factors that contribute to employee turnover and developing targeted retention strategies, organizations can reduce their turnover rates, saving on recruitment and training costs.
Increased productivity: Happier, more engaged employees are typically more productive, which can have a positive impact on the organization's bottom line.
Improved financial performance: Lower turnover rates and increased productivity can lead to improved financial performance, which can benefit stakeholders such as investors and shareholders.
Overall, a Workforce Retention System can have a positive impact on both the social and business aspects of an organization by improving employee well-being, reducing costs, and increasing productivity and profitability. enhancing their reputation and potentially attracting more business.

# 4. THEORITICAL ANALYSIS

## 4.1 Technical Architecture:
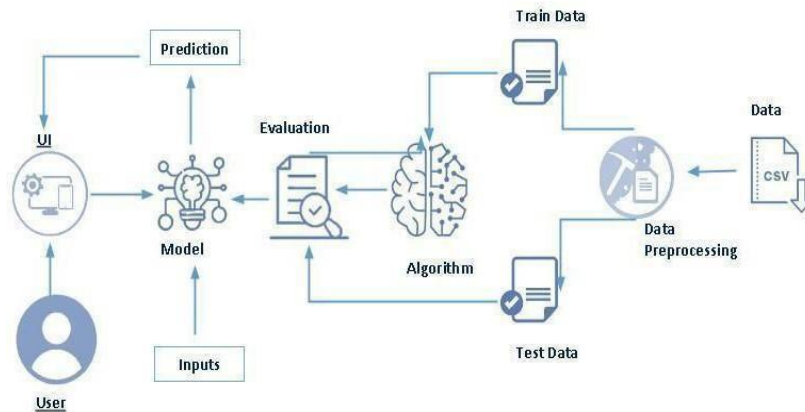


## 4.2 Project Flow:

- User interacts with the UI to enter the input.
- Entered input is analysed by the model which is integrated.
- Once model analyses the input the prediction is showcased on the UI

To accomplish this, we have to complete all the activities listed below,

- Data Collection & Preparation
  - Collect the dataset
  - Data Preparation
- Exploratory Data Analysis
  - Descriptive statistical
  - Visual Analysis
- Model Building

- Training the model in multiple Define Problem / Problem Understanding
  - Specify the business problem
  - Business requirements
  - Literature Survey
  - Social or Business Impact.
  - algorithms
  - Testing the model
- Performance Testing & Hyperparameter Tuning
  - Testing model with multiple evaluation metrics
  - Comparing model accuracy before & after applying hyperparameter tuning
- Model Deployment
  - Save the best model
  - Integrate with Web Framework
- Project Demonstration & Documentation
  - Record explanation Video for project end to end solution
  - Project Documentation-Step by step project development procedure

# 5. RESULT

## HOME PAGE



**WORKFORCE.** HOME PREDICTION ABOUT

**WorkForce Retention System**

KNOW MORE..



### About

Work Force Retention System provides companies with insights into the underlying causes of employee turnover and offers personalized recommendations on how to address them. This allows companies to take proactive measures to improve employee satisfaction and retention, reducing the costs and disruptions associated with high employee turnover.

# PREDICTIONS

**Prediction (i)**



From above picture we need to give the values of Satisfaction level, last evaluation, Number of Projects , Average Monthly Hours , Time Spend Company, Work Accident, Left, Promotion Last 5 Years, Salary    By giving these values that can predict which employees are at risk of leaving an organization and develop targeted retention strategies to improve employee retention rates.

**WORKFORCE.** HOME PREDICTION

Predict the Likelihood
of an Employee Leaving
The Company:0

GO BACK

This is the Output Predicted  Employees working In an Organization.

**(Prediction ii)**

This is the other set of sample input by giving the values of  Satisfaction level, last evaluation, Number of Projects , Average Monthly Hours , Time Spend Company, Work Accident, Left, Promotion Last 5 Years, Salary.

WORKFORCE. HOME PREDICTION

Predict the Likelihood
of an Employee Leaving
The Company:1

GO BACK

This is the Output Predicted  Employees Working In  an Organization.

# 6. ADVANTAGES AND DISADVANTAGES

## Advantages of Workforce Retention System

1. **Cost Reduction:**
   o **Lower Turnover Costs:** Reducing employee turnover can save significant costs associated with hiring and training new employees.
   o **Increased Productivity:** Retaining experienced employees helps maintain productivity levels and reduces the downtime associated with onboarding new hires.

2. **Enhanced Employee Morale:**
   o **Improved Job Satisfaction:** By identifying and addressing factors contributing to employee dissatisfaction, companies can enhance overall job satisfaction and morale.
   o **Better Work Environment:** Proactive retention strategies create a more stable and positive work environment.

3. **Improved Decision-Making:**
   o **Data-Driven Insights:** Utilizing data analytics to predict employee turnover provides actionable insights for management to make informed decisions.
   o **Strategic Planning:** Helps in strategic workforce planning, ensuring that critical roles are always filled with qualified personnel.

4. **Competitive Advantage:**
   o **Talent Retention:** Retaining top talent gives companies a competitive edge in the market.
   o **Reputation:** Companies known for high employee retention rates often have better reputations, attracting more skilled candidates.

5. **Enhanced Employee Engagement:**
   o **Personalized Interventions:** Enables personalized interventions to address individual employee concerns, increasing engagement and loyalty.
   o **Career Development:** Helps identify opportunities for employee development and career progression, which can increase retention.

# Disadvantages of Workforce Retention System

1. **Implementation Costs:**
   o **Initial Investment:** Setting up a retention system involves costs related to software, data collection, and analysis.
   o **Resource Allocation:** Requires dedicated resources, such as HR personnel and data scientists, which can be costly for smaller organizations.

2. **Data Quality and Privacy Concerns:**
   o **Data Accuracy:** The effectiveness of the system depends on the accuracy and completeness of the data collected.
   o **Privacy Issues:** Collecting and analyzing employee data raises privacy concerns and requires careful handling to ensure compliance with regulations.

3. **Resistance to Change:**
   o **Employee Resistance:** Employees may resist the monitoring and analysis of their performance and engagement, perceiving it as intrusive.
   o **Management Resistance:** Some managers might be reluctant to adopt new systems and processes, especially if they are accustomed to traditional methods.

4. **Complexity:**
   o **Model Complexity:** Building and maintaining predictive models can be complex and require specialized skills.
   o **Interpretation of Results:** Interpreting the results and translating them into actionable strategies can be challenging.

5. **Potential Biases:**
   o **Algorithmic Bias:** Predictive models may inherit biases present in historical data, leading to unfair treatment of certain employee groups.
   o **Over-Reliance on Technology:** Over-reliance on predictive analytics may result in overlooking human aspects and nuances that are not captured by the data.

6. **Unintended Consequences:**
   o **Demotivation:** Employees identified as high-risk for leaving might feel demotivated or singled out if interventions are not handled sensitively.
   o **Short-Term Focus:** Focusing too much on retention metrics may lead to short-term solutions rather than addressing underlying organizational issues.

# 7. CONCLUSION

**Conclusion on Workforce Retention System:**

A workforce retention system helps companies understand why employees leave and take steps to keep them. By analyzing data like job satisfaction, performance, and work hours, organizations can identify who might leave and address their concerns before it happens.

This system can save money by reducing hiring costs, improve employee morale, and maintain a competitive edge by keeping valuable staff. While setting up such a system can be expensive and complex, the benefits outweigh the challenges.

Overall, a workforce retention system is a valuable tool for any organization. It helps create a better work environment, make informed decisions, and ensure employees are happy and productive. Investing in such a system is essential for long-term success.

# 8. FUTURE SCOPE

- **<u>Advanced Predictive Analytics:</u>**

  - **AI and Machine Learning:** Enhanced predictive models using artificial intelligence and machine learning algorithms can provide even more accurate predictions about which employees are at risk of leaving.

  - **Real-time Analytics:** Implementing real-time analytics to continuously monitor employee engagement and satisfaction, allowing for immediate interventions.

- **<u>Integration with HR Technologies:</u>**

  - **Unified HR Platforms:** Integration with comprehensive HR platforms like HRIS (Human Resource Information Systems) and ERM (Employee Relationship Management) systems for seamless data collection, analysis, and action.

  - **Wearable Technology:** Using wearable technology to monitor employee health and stress levels, providing insights into potential burnout and disengagement.

- **<u>Personalization and Employee Experience:</u>**

  - **Personalized Interventions:** Developing personalized retention strategies based on individual employee profiles, preferences, and career goals.

  - **Enhanced Employee Experience:** Focusing on holistic employee experience, including work-life balance, mental health support, and career development opportunities.

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4o

# 10 .APPENDIX

## Model building :

1)Dataset

 2)Google colab and VS code Application Building

      1. HTML file (Index file, Predict file )

      2. CSS file

      3. Models in pickle format SOURCE CODE:

## INDEX.HTML

```
<!doctype html>
<!--
        Solution by GetTemplates.co
        URL: https://gettemplates.co
-->
<html lang="en">
<head>
  <!-- Required meta tags -->
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">

  <!-- awesone fonts css-->
  <link href="../static/css/font-awesome.css" rel="stylesheet" type="text/css">
  <!-- owl carousel css-->
  <link rel="stylesheet" href="../static/owl-carousel/assets/owl.carousel.min.css" type="text/css">
  <!-- Bootstrap CSS -->
  <link rel="stylesheet" href="../static/css/bootstrap.min.css">
  <!-- custom CSS -->
  <link rel="stylesheet" href="../static/css/style.css">
  <title>Workforce.</title>
  <style>
  </style>
</head>
<body>
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  <div class="container"><a class="navbar-brand">WorkForce.</a>
    <button class="navbar-toggler" data-target="#my-nav" onclick="myFunction(this)" data-
toggle="collapse"><span
        class="bar1"></span> <span class="bar2"></span> <span class="bar3"></span></button>
    <div id="my-nav" class="collapse navbar-collapse">
      <ul class="navbar-nav mr-auto">
        <li class="nav-item"><a class="nav-link" href="/index">Home</a></li>
```

```html
<li class="nav-item"><a class="nav-link" href="/predict">Prediction</a></li>
<li class="nav-item"><a class="nav-link" href="#about">About</a></li>

</ul>

</div>
</div>
</nav>
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   <div class="container">
     <div class="row">
       <div class="col-md-6">
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         <p></p>
         <a href="#">Know more.. <i class="fa fa-angle-right" aria-hidden="true"></i></a></div>
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alt=""></div>
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     </div>
   </div>
</div>
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Z"></path>
                </clipPath>
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    </div>
</div>
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    <p>Work Force Retention System provides companies with <br> insights into the underlying causes
of employee turnover and offers personalized recommendations on how to address them. This allows
companies to take proactive measures to improve employee satisfaction and retention, reducing the costs
and disruptions associated with high employee turnover.
    </p>
    </div>
    </div>
</div>
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            <div class="col-lg-4">
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                    We Offer For You </h2>
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cursus
                    impediet augue egestas id. Suspendisse dolor lectus, pellentesque quis tincidunt ac, dictum id
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```

```
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Z"/>
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```

```
          </div>
          <div class="col-3">
            <div class="card">
              <div class="card-body">
                <h5 class="card-title">200</h5>
                <p class="card-text">Business Growth</p>
              </div>
            </div>
          </div>
          <div class="col-3">
            <div class="card">
              <div class="card-body">
                <h5 class="card-title">530</h5>
                <p class="card-text">Completed Projects</p>
              </div>
            </div>
          </div>
          <div class="col-3">
            <div class="card">
              <div class="card-body">
                <h5 class="card-title">941</h5>
                <p class="card-text">Happy Clients</p>
              </div>
            </div>
          </div>
        </div>
      </div>
</div>
<div class="container-fluid gtco-testimonials">
  <div class="container">
    <h2>What our customers say about us.</h2>
    <div class="owl-carousel owl-carousel1 owl-theme">
      <div>
        <div class="card text-center"><img class="card-img-top" src="../static/images/customer1.jpg"
alt="">
          <div class="card-body">
            <h5>Lisa Gally <br/>
              <span> Project Manager </span></h5>
            <p class="card-text">" Nam libero tempore, cum soluta nobis est eligendi optio cumque nihil
              impedit quo minus id quod maxime placeat " </p>
          </div>
        </div>
      </div>
      <div>
        <div class="card text-center"><img class="card-img-top" src="../static/images/customer2.jpg"
alt="">
```

```html
            <div class="card-body">
              <h5>Missy Limana<br/>
                <span> Project Manager </span></h5>
              <p class="card-text">" Nam libero tempore, cum soluta nobis est eligendi optio cumque nihil
                impedit quo minus id quod maxime placeat " </p>
            </div>
          </div>
        </div>
        <div>
          <div class="card text-center"><img class="card-img-top" src="../static/images/customer3.jpg"
alt="">
            <div class="card-body">
              <h5>Aana Brown<br/>
                <span> Project Manager </span></h5>
              <p class="card-text">" Nam libero tempore, cum soluta nobis est eligendi optio cumque nihil
                impedit quo minus id quod maxime placeat " </p>
            </div>
          </div>
        </div>
        <div>
          <div class="card text-center"><img class="card-img-top" src="../static/images/customer3.jpg"
alt="">
            <div class="card-body">
              <h5>Aana Brown<br/>
                <span> Project Manager </span></h5>
              <p class="card-text">" Nam libero tempore, cum soluta nobis est eligendi optio cumque nihil
                impedit quo minus id quod maxime placeat " </p>
            </div>
          </div>
        </div>
      </div>
    </div>
</div>
<div class="container-fluid gtco-features-list">
  <div class="container">
    <div class="row">
      <div class="media col-md-6 col-lg-4">
        <div class="oval mr-4"><img class="align-self-start" src="../static/images/quality-results.png"
alt=""></div>
        <div class="media-body">
          <h5 class="mb-0">Quality Results</h5>
          Aliquam a nisl pulvinar, hendrerit arcu sed, dapibus velit. Duis ac quam id sapien vestibulum
          fermentum ac eu eros. Aliquam erat volutpat.
        </div>
      </div>
      <div class="media col-md-6 col-lg-4">
```

```
        <div class="oval mr-4"><img class="align-self-start" src="../static/images/analytics.png"
alt=""></div>
        <div class="media-body">
          <h5 class="mb-0">Analytics</h5>
          Aliquam a nisl pulvinar, hendrerit arcu sed, dapibus velit. Duis ac quam id sapien vestibulum
          fermentum ac eu eros. Aliquam erat volutpat.
        </div>
      </div>
      <div class="media col-md-6 col-lg-4">
        <div class="oval mr-4"><img class="align-self-start" src="../static/images/affordable-pricing.png"
alt=""></div>
        <div class="media-body">
          <h5 class="mb-0">Affordable Pricing</h5>
          Aliquam a nisl pulvinar, hendrerit arcu sed, dapibus velit. Duis ac quam id sapien vestibulum
          fermentum ac eu eros. Aliquam erat volutpat.
        </div>
      </div>
      <div class="media col-md-6 col-lg-4">
        <div class="oval mr-4"><img class="align-self-start" src="../static/images/easy-to-use.png"
alt=""></div>
        <div class="media-body">
          <h5 class="mb-0">Easy To Use</h5>
          Aliquam a nisl pulvinar, hendrerit arcu sed, dapibus velit. Duis ac quam id sapien vestibulum
          fermentum ac eu eros. Aliquam erat volutpat.
        </div>
      </div>
      <div class="media col-md-6 col-lg-4">
        <div class="oval mr-4"><img class="align-self-start" src="../static/images/free-support.png"
alt=""></div>
        <div class="media-body">
          <h5 class="mb-0">Free Support</h5>
          Aliquam a nisl pulvinar, hendrerit arcu sed, dapibus velit. Duis ac quam id sapien vestibulum
          fermentum ac eu eros. Aliquam erat volutpat.
        </div>
      </div>
      <div class="media col-md-6 col-lg-4">
        <div class="oval mr-4"><img class="align-self-start" src="../static/images/effectively-increase.png"
alt=""></div>
        <div class="media-body">
          <h5 class="mb-0">Effectively Increase</h5>
          Aliquam a nisl pulvinar, hendrerit arcu sed, dapibus velit. Duis ac quam id sapien vestibulum
          fermentum ac eu eros. Aliquam erat volutpat.
        </div>
      </div>
    </div>
  </div>
```

```html
</div>
<div class="container-fluid gtco-logo-area">
  <div class="container">

    <h1>Welcome to Employee Turnover Prediction</h1>
    <p>Predict the likelihood of an employee leaving the company.</p>
    <a href="{{ url_for('predict') }}" class="btn btn-primary">Get Started</a>
  </div>

    <div class="row">
      <div class="col"><img src="../static/images/logo1.png" class="img-fluid" alt=""></div>
      <div class="col"><img src="../static/images/logo2.png" class="img-fluid" alt=""></div>
      <div class="col"><img src="../static/images/logo3.png" class="img-fluid" alt=""></div>
      <div class="col"><img src="../static/images/logo4.png" class="img-fluid" alt=""></div>
      <div class="col"><img src="../static/images/logo5.png" class="img-fluid" alt=""></div>
    </div>
  </div>
</div>
<div class="container-fluid gtco-news" id="news">
  <div class="container">
    <h2>Latest News & Articles</h2>
    <div class="owl-carousel owl-carousel2 owl-theme">
      <div>
        <div class="card text-center"><img class="card-img-top" src="../static/images/news1.jpg" alt="">
          <div class="card-body text-left pr-0 pl-0">
            <h5>Aenean ultrices lorem quis blandit
              tempor urabitur accumsan. </h5>
            <p class="card-text">Donec non sem mi. In hac habitasse platea dictumst. Nullam a feugiat
augue,
              et porta metus. Nulla mollis lobortis leet. Maecenas tincidunt, arcu sed ornare purus risus
              . . . </p>
            <a href="#">READ MORE <i class="fa fa-angle-right" aria-hidden="true"></i></a></div>
        </div>
      </div>
      <div>
        <div class="card text-center"><img class="card-img-top" src="../static/images/news2.jpg" alt="">
          <div class="card-body text-left pr-0 pl-0">
            <h5> Nam vel nisi eget odio pulvinar
              iaculis. Fusce aliquet. </h5>
            <p class="card-text">Donec non sem mi. In hac habitasse platea dictumst. Nullam a feugiat
augue,
              et porta metus. Nulla mollis lobortis leet. Maecenas tincidunt, arcu sed ornare purus risus
              . . . </p>
            <a href="#">READ MORE <i class="fa fa-angle-right" aria-hidden="true"></i></a></div>
        </div>
      </div>
```

```html
<div>
    <div class="card text-center"><img class="card-img-top" src="../static/images/news3.jpg" alt="">
        <div class="card-body text-left pr-0 pl-0">
            <h5>Morbi faucibus odio sollicitudin
                risus scelerisque dignissim. </h5>
            <p class="card-text">Donec non sem mi. In hac habitasse platea dictumst. Nullam a feugiat augue,
                et porta metus. Nulla mollis lobortis leet. Maecenas tincidunt, arcu sed ornare purus risus
                . . . </p>
            <a href="#">READ MORE <i class="fa fa-angle-right" aria-hidden="true"></i></a></div>
    </div>
</div>
<div>
    <div class="card text-center"><img class="card-img-top" src="../static/images/news1.jpg" alt="">
        <div class="card-body text-left pr-0 pl-0">
            <h5>Aenean ultrices lorem quis blandit
                tempor urabitur accumsan. </h5>
            <p class="card-text">Donec non sem mi. In hac habitasse platea dictumst. Nullam a feugiat augue,
                et porta metus. Nulla mollis lobortis leet. Maecenas tincidunt, arcu sed ornare purus risus
                . . . </p>
            <a href="#">READ MORE <i class="fa fa-angle-right" aria-hidden="true"></i></a></div>
    </div>
</div>
<div>
    <div class="card text-center"><img class="card-img-top" src="../static/images/news2.jpg" alt="">
        <div class="card-body text-left pr-0 pl-0">
            <h5> Nam vel nisi eget odio pulvinar
                iaculis. Fusce aliquet. </h5>
            <p class="card-text">Donec non sem mi. In hac habitasse platea dictumst. Nullam a feugiat augue,
                et porta metus. Nulla mollis lobortis leet. Maecenas tincidunt, arcu sed ornare purus risus
                . . . </p>
            <a href="#">READ MORE <i class="fa fa-angle-right" aria-hidden="true"></i></a></div>
    </div>
</div>
<div>
    <div class="card text-center"><img class="card-img-top" src="../static/images/news3.jpg" alt="">
        <div class="card-body text-left pr-0 pl-0">
            <h5>Morbi faucibus odio sollicitudin
                risus scelerisque dignissim. </h5>
            <p class="card-text">Donec non sem mi. In hac habitasse platea dictumst. Nullam a feugiat augue,
                et porta metus. Nulla mollis lobortis leet. Maecenas tincidunt, arcu sed ornare purus risus
                . . . </p>
            <a href="#">READ MORE <i class="fa fa-angle-right" aria-hidden="true"></i></a></div>
```

```html
                    </div>
                </div>
            </div>
        </div>
</div>
<footer class="container-fluid" id="gtco-footer">
    <div class="container">
        <div class="row">
            <div class="col-lg-6" id="contact">
                <h4> Contact Us </h4>
                <input type="text" class="form-control" placeholder="Full Name">
                <input type="email" class="form-control" placeholder="Email Address">
                <textarea class="form-control" placeholder="Message"></textarea>
                <a href="#" class="submit-button">READ MORE <i class="fa fa-angle-right" aria-
hidden="true"></i></a>
            </div>
            <div class="col-lg-6">
                <div class="row">
                    <div class="col-6">
                        <h4>Company</h4>
                        <ul class="nav flex-column company-nav">
                            <li class="nav-item"><a class="nav-link" href="#">Home</a></li>
                            <li class="nav-item"><a class="nav-link" href="#">Services</a></li>
                            <li class="nav-item"><a class="nav-link" href="#">About</a></li>
                            <li class="nav-item"><a class="nav-link" href="#">News</a></li>
                            <li class="nav-item"><a class="nav-link" href="#">FAQ's</a></li>
                            <li class="nav-item"><a class="nav-link" href="#">Contact</a></li>
                        </ul>
                        <h4 class="mt-5">Fllow Us</h4>
                        <ul class="nav follow-us-nav">
                            <li class="nav-item"><a class="nav-link pl-0" href="#"><i class="fa fa-facebook"
                                                    aria-hidden="true"></i></a></li>
                            <li class="nav-item"><a class="nav-link" href="#"><i class="fa fa-twitter"
                                                    aria-hidden="true"></i></a></li>
                            <li class="nav-item"><a class="nav-link" href="#"><i class="fa fa-google"
                                                    aria-hidden="true"></i></a></li>
                            <li class="nav-item"><a class="nav-link" href="#"><i class="fa fa-linkedin"
                                                    aria-hidden="true"></i></a></li>
                        </ul>
                    </div>
                    <div class="col-6">
                        <h4>Services</h4>
                        <ul class="nav flex-column services-nav">
                            <li class="nav-item"><a class="nav-link" href="#">Web Design</a></li>
                            <li class="nav-item"><a class="nav-link" href="#">Graphics Design</a></li>
                            <li class="nav-item"><a class="nav-link" href="#">App Design</a></li>
```

```html
                        <li class="nav-item"><a class="nav-link" href="#">SEO</a></li>
                        <li class="nav-item"><a class="nav-link" href="#">Marketing</a></li>
                        <li class="nav-item"><a class="nav-link" href="#">Analytic</a></li>
                    </ul>
                </div>
                <div class="col-12">
                    <p>&copy; 2019. All Rights Reserved. Design by <a href="https://gettemplates.co"
    target="_blank">GetTemplates</a>.</p>
                </div>
            </div>
        </div>
      </div>
    </footer>-->


    <!-- Optional JavaScript -->
    <!-- jQuery first, then Popper.js, then Bootstrap JS -->
    <script src="../static/js/jquery-3.3.1.slim.min.js"></script>
    <script src="../static/js/popper.min.js"></script>
    <script src="../static/js/bootstrap.min.js"></script>
    <!-- owl carousel js-->
    <script src="../static/owl-carousel/owl.carousel.min.js"></script>
    <script src="../static/js/main.js"></script>
    </body>
    </html>
```

## PREDICT.HTML

```html
<head>

    <!-- Required meta tags -->

    <meta charset="utf-8">

    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">

    <!-- awesone fonts css-->

    <link href="../static/css/font-awesome.css" rel="stylesheet" type="text/css">

    <!-- owl carousel css-->

    <link rel="stylesheet" href="../static/owl-carousel/assets/owl.carousel.min.css" type="text/css">

    <!-- Bootstrap CSS -->

    <link rel="stylesheet" href="../static/css/bootstrap.min.css">
```

```html
    <!-- custom CSS -->

    <link rel="stylesheet" href="../static/css/style.css">

    <title>Workforce.</title>
  </head>
  <body>
    <nav class="navbar navbar-expand-lg navbar-light bg-light bg-transparent" id="gtco-main-nav">
      <div class="container"><a class="navbar-brand">WorkForce.</a>
        <button class="navbar-toggler" data-target="#my-nav" onclick="myFunction(this)" data-toggle="collapse"><span
            class="bar1"></span> <span class="bar2"></span> <span class="bar3"></span></button>
        <div id="my-nav" class="collapse navbar-collapse">
          <ul class="navbar-nav mr-auto">
            <li class="nav-item"><a class="nav-link" href="/index">Home</a></li>
            <li class="nav-item"><a class="nav-link" href="/predict">Prediction</a></li>
          </ul>
        </div>
      </div>
    </nav>
    <div class="container-fluid gtco-banner-area">
      <div class="container">
        <div class="row">
          <div class="col-md-6">
            <section>
              <div class="container">
                <div class="row">
                  <center>
                    <div class="  col-lg-7 px-5 pt-5">
                      <div class="divider"></div>
                        <form action="/results" method="POST">
                          <!-- satisfaction_level -->
```

```html
<div class="row mb-4">
    <div class="col">
        <div class="form-outline">
            <p>Satisfaction level <input type="text" placeholder=" Sector score" class="form-control" name='satisfaction_level'></p>
        </div>
    </div>
    <div class="col">
        <div class="form-outline">
            <!-- last_evaluation -->
            <p>last evaluation<input type="text" placeholder="summary report A in Rs (in crore)" class="form-control" name='last_evaluation'></p>
        </div>
    </div>
</div>
<div class="row mb-4">
    <div class="col">
        <div class="form-outline">
            <!-- number_project -->
            <p>number project<input type="text" placeholder="Risk of report A" class="form-control" name='number_project'></p>
        </div>
    </div>
    <div class="col">
        <div class="form-outline">
            <!-- average_monthly_hours -->
            <p>average monthly hours<input type="text" placeholder="summary report B in Rs (in crore)" class="form-control" name='average_monthly_hours'></p>
        </div>
    </div>
</div>
```

```html
          </div>
          <div class="row mb-4">
            <div class="col">
              <div class="form-outline">
              <!-- time_spend_company -->
              <p>time spend company<input type="text" placeholder="Risk of report B" class="form-control" name='time_spend_company'></p>
              </div>
            </div>
            <div class="col">
              <div class="form-outline">
              <!-- Work_accident -->
              <p>Work accident<input type="text" placeholder="Total" class="form-control" name='Work_accident'></p>
              </div>
            </div>
          </div>
          <div class="row mb-4">
            <div class="col">
              <div class="form-outline">
              <!-- left -->
              <p>left<input type="text" placeholder="Risk of report A" class="form-control" name='left'></p>
              </div>
            </div>
            <div class="col">
              <div class="form-outline">
              <!-- promotion_last_5years -->
              <p>promotion last 5years<input type="text" placeholder="Risk of report A" class="form-control" name='promotion_last_5years'></p>
              </div>
```

```html
                </div>

              </div>


              <div class="col">

                <div class="form-outline">

                <!-- salary-->

                <p>salary<input type="text" placeholder="Risk of report A" class="form-control"
name='salary'></p>

                </div>

              </div>

            <!-- Submit button -->

            <button  type="submit" class="btn btn-primary" value="pred" <a
href="/result">Predict</a></button>

            </form>

          </div>

        </center>

      </div>

    </div>

  </section>

</div>

<div class="col-md-6">

    <div class="card"><img class="card-img-top img-fluid" src="../static/images/banner-img.png"
alt=""></div>

  </div>

 </div>

</div>

</div>

<!-- Optional JavaScript -->

<!-- jQuery first, then Popper.js, then Bootstrap JS -->

<script src="../static/js/jquery-3.3.1.slim.min.js"></script>

<script src="../static/js/popper.min.js"></script>
```

```
<script src="../static/js/bootstrap.min.js"></script>

<!-- owl carousel js-->

<script src="../static/owl-carousel/owl.carousel.min.js"></script>

<script src="../static/js/main.js"></script>

</body>

</html>
```

## RESULTS.HTML

```
<!doctype html>

<html>

  <head>

    <!-- Required meta tags -->

    <meta charset="utf-8">

    <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">

    <!-- awesone fonts css-->

    <link href="../static/css/font-awesome.css" rel="stylesheet" type="text/css">

    <!-- owl carousel css-->

    <link rel="stylesheet" href="../static/owl-carousel/assets/owl.carousel.min.css" type="text/css">

    <!-- Bootstrap CSS -->

    <link rel="stylesheet" href="../static/css/bootstrap.min.css">

    <!-- custom CSS -->

    <link rel="stylesheet" href="../static/css/style.css">

    <title>Workforce.</title>

  </head>

  <body>
```

```html
<nav class="navbar navbar-expand-lg navbar-light bg-light bg-transparent" id="gtco-main-nav">

    <div class="container"><a class="navbar-brand">WorkForce.</a>

        <button class="navbar-toggler" data-target="#my-nav" onclick="myFunction(this)" data-toggle="collapse"><span

            class="bar1"></span> <span class="bar2"></span> <span class="bar3"></span></button>

        <div id="my-nav" class="collapse navbar-collapse">

            <ul class="navbar-nav mr-auto">

                <li class="nav-item"><a class="nav-link" href="/index">Home</a></li>

                <li class="nav-item"><a class="nav-link" href="/predict">Prediction</a></li>

            </ul>

        </div>

    </div>

</nav>

<div class="container-fluid gtco-banner-area">

    <div class="container">

        <div class="row">

            <div class="col-md-6">

                <h1>{{predict}}</h1>

                <a href="{{ url_for('index') }}" class="btn btn-primary">Go Back</a>

            </div>

            <div class="col-md-6">

                <div class="card"><img class="card-img-top img-fluid" src="../static/images/banner-img.png" alt=""></div>

            </div>

        </div>

    </div>

</div>

<!-- Optional JavaScript -->

<!-- jQuery first, then Popper.js, then Bootstrap JS -->

<script src="../static/js/jquery-3.3.1.slim.min.js"></script>

<script src="../static/js/popper.min.js"></script>
```

```html
<script src="../static/js/bootstrap.min.js"></script>

<!-- owl carousel js-->

<script src="../static/owl-carousel/owl.carousel.min.js"></script>

<script src="../static/js/main.js"></script>

</body>
</html>
```

## APP.PY

```python
from flask import Flask, request, render_template

import pickle

import os

app = Flask(__name__)

# Path to the directory where your script is located

encoders_path = os.path.dirname(os.path.abspath(__file__))

# Load the model

model = pickle.load(open(os.path.join(encoders_path, 'lgr.pkl'), 'rb'))

@app.route('/')

@app.route('/index')

def index():

    return render_template('index.html')

@app.route('/predict', methods=['GET', 'POST'])

def predict():

    return render_template("predict.html")

@app.route('/results', methods=['POST'])

def results():

    if request.method=="POST":

        satisfaction_level=request.form['satisfaction_level']

        last_evaluation=request.form['last_evaluation']
```

```python
        number_project=request.form['number_project']

        average_monthly_hours=request.form['average_monthly_hours']

        time_spend_company=request.form['time_spend_company']

        work_accident=request.form['Work_accident']

        left=request.form['left']

        promotion_last_5years=request.form['promotion_last_5years']

        salary=request.form['salary']

        pred = [[float(satisfaction_level), float(last_evaluation), float(number_project),

            float(average_monthly_hours), float(time_spend_company), float(work_accident),

            float(left), float(promotion_last_5years), float(salary)]]

        print(pred)

        output=model.predict(pred)

        print(output)

    return render_template("results.html",predict="Predict the Likelihood of an Employee Leaving The Company:"
+str(output[0]))


if __name__ == '__main__':

    app.run(debug=True)
```

# 11. CODE SNIPPETS

## MODEL BUILDING

Import the necessary libraries as shown in the image.

```
Importing Libraries

import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from imblearn.over_sampling import SMOTE
from imblearn import under_sampling
```

```
[ ] import plotly.express as px
```

```
[ ] import warnings
    warnings.filterwarnings('ignore')
```

```
[ ] pip install flask
```

```
Requirement already satisfied: flask in /usr/local/lib/python3.10/dist-packages (2.2.5)
Requirement already satisfied: Werkzeug>=2.2.2 in /usr/local/lib/python3.10/dist-packages (from flask) (3.0.3)
Requirement already satisfied: Jinja2>=3.0 in /usr/local/lib/python3.10/dist-packages (from flask) (3.1.4)
Requirement already satisfied: itsdangerous>=2.0 in /usr/local/lib/python3.10/dist-packages (from flask) (2.2.0)
Requirement already satisfied: click>=8.0 in /usr/local/lib/python3.10/dist-packages (from flask) (8.1.7)
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from Jinja2>=3.0->flask) (2.1.5)
```

```
[ ] df=pd.read_csv('/content/HR_comma_sep.csv')
```

```
df
```

| | satisfaction_level | last_evaluation | number_project | average_montly_hours | time_spend_company | Work_accident | left | promotion_last_5years | sales | salary |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.38 | 0.53 | 2 | 157 | 3 | 0 | 1 | 0 | sales | low |
| 1 | 0.80 | 0.86 | 5 | 262 | 6 | 0 | 1 | 0 | sales | medium |
| 2 | 0.11 | 0.88 | 7 | 272 | 4 | 0 | 1 | 0 | sales | medium |
| 3 | 0.72 | 0.87 | 5 | 223 | 5 | 0 | 1 | 0 | sales | low |
| 4 | 0.37 | 0.52 | 2 | 159 | 3 | 0 | 1 | 0 | sales | low |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 14994 | 0.40 | 0.57 | 2 | 151 | 3 | 0 | 1 | 0 | support | low |
| 14995 | 0.37 | 0.48 | 2 | 160 | 3 | 0 | 1 | 0 | support | low |
| 14996 | 0.37 | 0.53 | 2 | 143 | 3 | 0 | 1 | 0 | support | low |
| 14997 | 0.11 | 0.96 | 6 | 280 | 4 | 0 | 1 | 0 | support | low |
| 14998 | 0.37 | 0.52 | 2 | 158 | 3 | 0 | 1 | 0 | support | low |

14999 rows × 10 columns

Let's find the shape of our dataset first. To find the shape of our data, the df.shape method is used.

```
df.shape

(14999, 10)
```

To find the data type, df.info() function is used.

```
df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14999 entries, 0 to 14998
Data columns (total 10 columns):
 #   Column                 Non-Null Count  Dtype
---  ------                 --------------  -----
 0   satisfaction_level     14999 non-null  float64
 1   last_evaluation        14999 non-null  float64
 2   number_project         14999 non-null  int64
 3   average_montly_hours   14999 non-null  int64
 4   time_spend_company     14999 non-null  int64
 5   Work_accident          14999 non-null  int64
 6   left                   14999 non-null  int64
 7   promotion_last_5years  14999 non-null  int64
 8   sales                  14999 non-null  object
 9   salary                 14999 non-null  object
dtypes: float64(2), int64(6), object(2)
memory usage: 1.1+ MB
```

For checking the null values, df.isnull() function is used. To sum those null values we use .sum() function. From the below image we found that there are no null values present in our dataset. So we can skip handling the missing values step.

```
df.isnull().sum()

satisfaction_level       0
last_evaluation          0
number_project           0
average_montly_hours     0
time_spend_company       0
Work_accident            0
left                     0
promotion_last_5years    0
sales                    0
salary                   0
dtype: int64
```

For checking the Categorical data, you can use value_counts() function. As per the given data, there is no categorical data present

```
Converting categorical data into numerical data

df['salary'] = df['salary'].map({"low":0,"medium":1,"high":2})

df['salary'].unique()
array([0, 1, 2])

df['salary'].value_counts()
salary
0    7316
1    6446
2    1237
Name: count, dtype: int64

df['sales']=df['sales'].map({"sales":0,"accounting":1,"hr":2,"technical":3,"support":4,"management":5,"IT":6,
                "product_mng":7,"marketing":8,"RandD":9})

df['sales'].unique()
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```
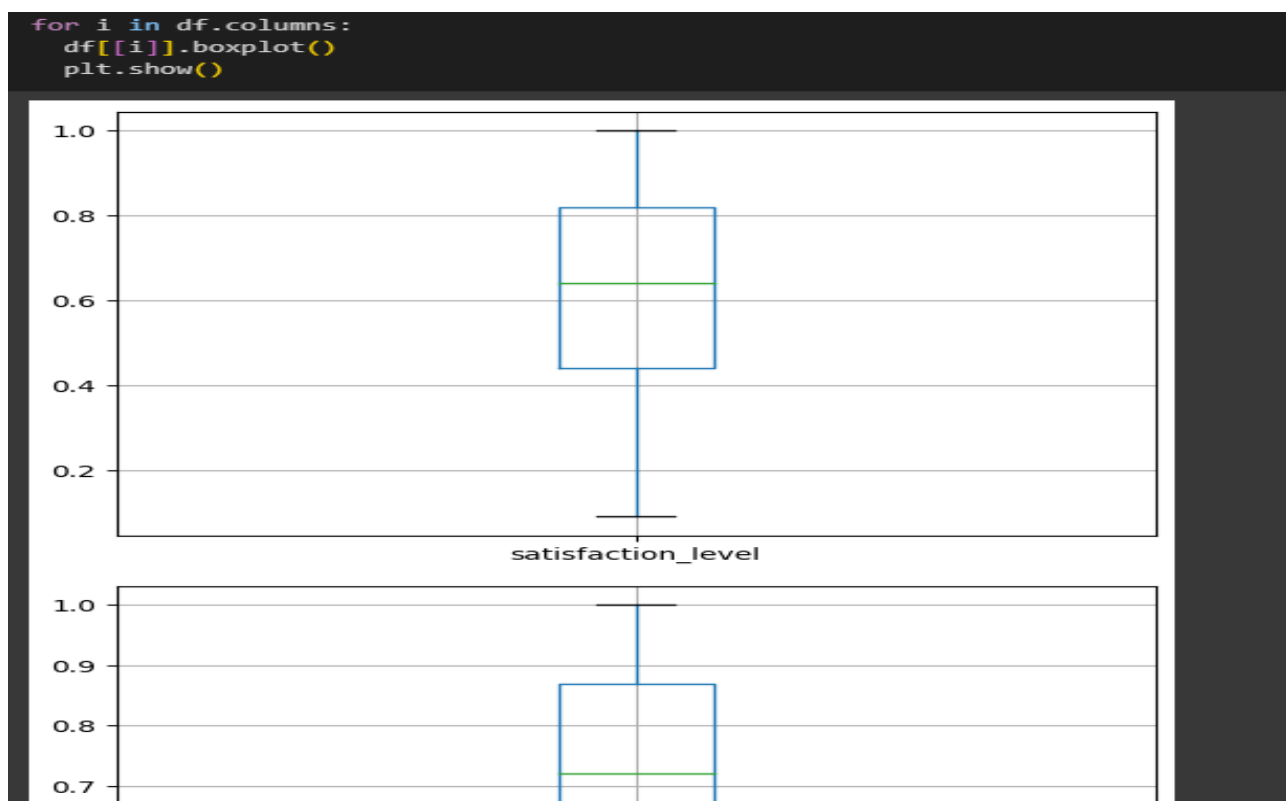
With the help of boxplot, outliers are visualized. And here we are going to find upper bound and lower bound with some mathematical formula.

From the below diagram, we could visualize the outliers. Boxplot from seaborn library is used



```
for i in df.columns:
    df[[i]].boxplot()
    plt.show()
```

```
def iqr(df):
    iqr=df.quantile(0.75)-df.quantile(0.25)
    upper_range=df.quantile(0.75) + (1.5*iqr)
    lower_range=df.quantile(0.25) - (1.5*iqr)
    return upper_range,lower_range
```

```
upper,lower=iqr(df)
```

```
upper,lower
```

```
(satisfaction_level        1.390
 last_evaluation           1.335
 number_project            8.000
 average_montly_hours    378.500
 time_spend_company        5.500
 Work_accident             0.000
 left                      0.000
 promotion_last_5years     0.000
 sales                    15.000
 salary                    2.500
 dtype: float64,
 satisfaction_level       -0.130
 last_evaluation           0.095
 number_project            0.000
 average_montly_hours     22.500
 time_spend_company        1.500
 Work_accident             0.000
 left                      0.000
 promotion_last_5years     0.000
 sales                    -9.000
 salary                   -1.500
 dtype: float64)
```

```
r=['satisfaction_level','last_evaluation','number_project','number_project',
   'time_spend_company','Work_accident','left','promotion_last_5years','sales','salary']



fig,ax=plt.subplots(4,2,figsize=(25,15))
for i,subplot in zip(r,ax.flatten()):
    sns.boxplot(df[i],ax=subplot,color='g')
```
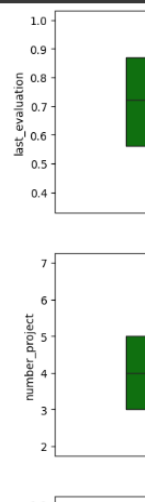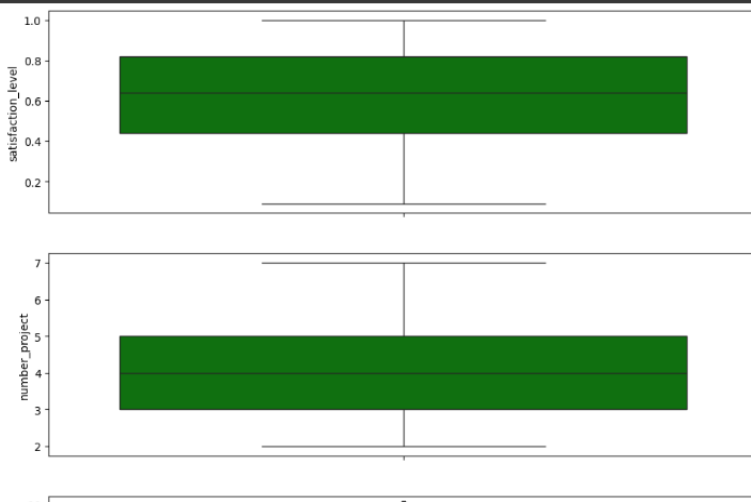
Descriptive analysis is to study the basic features of data with the statistical process. Here pandas has a worthy function called describe. With this describe function we can understand the unique, top and frequent values of categorical features. And we can findmean, std, min, max and percentile values of continuous features.

```
df.describe()
```

| | satisfaction_level | last_evaluation | number_project | average_montly_hours | time_spend_company | Work_accident | left | promotion_last_5years | sales | salary |
|---|---|---|---|---|---|---|---|---|---|---|
| count | 14999.000000 | 14999.000000 | 14999.000000 | 14999.000000 | 14999.000000 | 14999.000000 | 14999.000000 | 14999.000000 | 14999.000000 | 14999.000000 |
| mean | 0.612834 | 0.716102 | 3.803054 | 201.050337 | 3.498233 | 0.144610 | 0.238083 | 0.021268 | 3.339823 | 0.594706 |
| std | 0.248631 | 0.171169 | 1.232592 | 49.943099 | 1.460136 | 0.351719 | 0.425924 | 0.144281 | 2.820837 | 0.637183 |
| min | 0.090000 | 0.360000 | 2.000000 | 96.000000 | 2.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 25% | 0.440000 | 0.560000 | 3.000000 | 156.000000 | 3.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 50% | 0.640000 | 0.720000 | 4.000000 | 200.000000 | 3.000000 | 0.000000 | 0.000000 | 0.000000 | 3.000000 | 1.000000 |
| 75% | 0.820000 | 0.870000 | 5.000000 | 245.000000 | 4.000000 | 0.000000 | 0.000000 | 0.000000 | 6.000000 | 1.000000 |
| max | 1.000000 | 1.000000 | 7.000000 | 310.000000 | 10.000000 | 1.000000 | 1.000000 | 1.000000 | 9.000000 | 2.000000 |

Here we have displayed two different graphs such as distplot and countplot.

Seaborn package provides a wonderful function distplot. With the help of distplot, we can find the distribution of the feature. To make multiple graphs in a single plot, we use subplot.
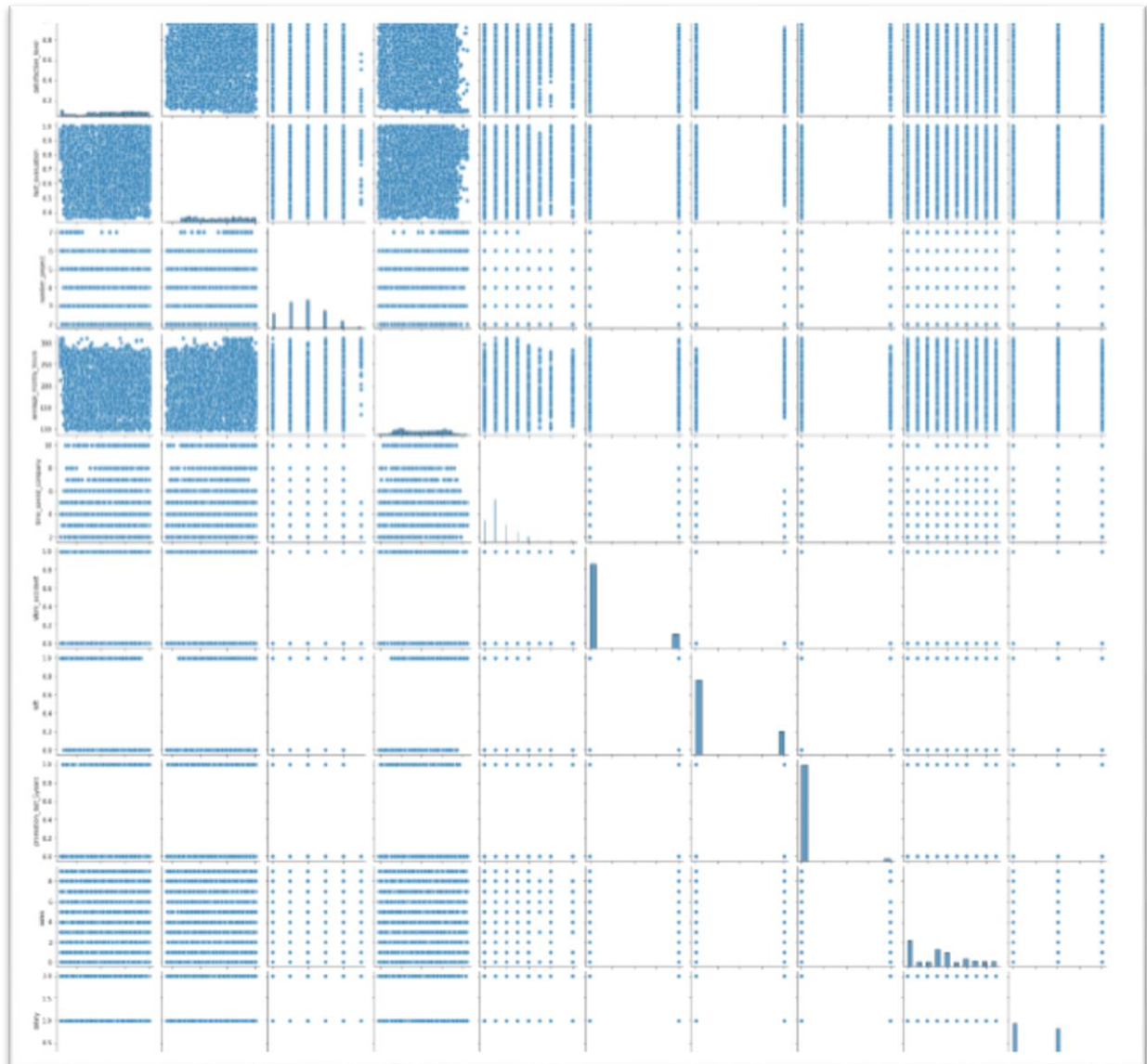
```python
import matplotlib.pyplot as plt

sns.countplot(df['left'])
```
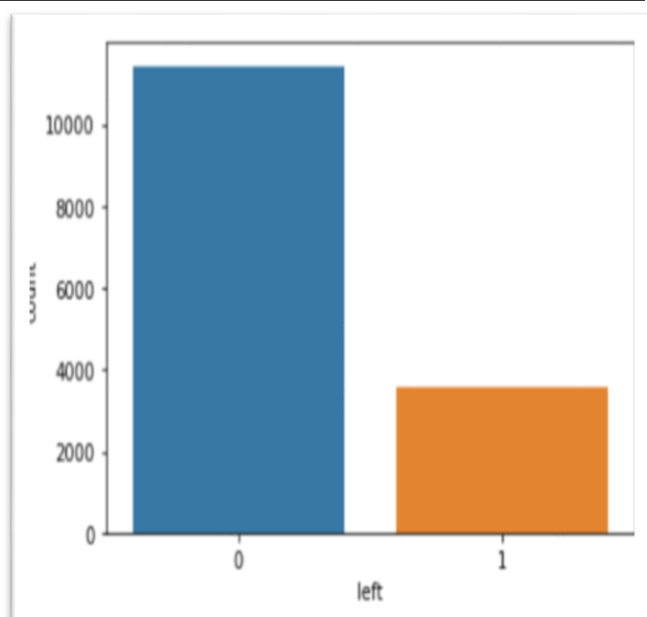
we have used pairplot from seaborn package.

From the below image, we came to a conclusion that risk is predicted.

## **PAIRPLOT**

```
sns.pairplot(df)
```

# Seperating data for training and testing

```python
from sklearn.model_selection import train_test_split
```

```python
x=df.drop(['left'],axis=1)
y=df['left']
```

```python
x_train,x_test,y_train,y_test=train_test_split(x,y,random_state=42,test_size=0.2,shuffle=True)
```

## scaling the values

```python
from sklearn.preprocessing import StandardScaler
```

```python
from sklearn.preprocessing import StandardScaler
scaler=StandardScaler()
x_scaled=scaler.fit_transform(x)
```

```python
#x_train,x_test,y_train,y_test=train_test_split(x_scaled,y,random_state=42,test_size=0.2,shuffle=True)
```

```python
x_train,x_test,y_train,y_test=train_test_split(x,y,random_state=42,test_size=0.2,shuffle=True)
```

## Model Building with Logistic Regression

```python
from sklearn.linear_model import LogisticRegression
```

```python
lgr=LogisticRegression()
```

```python
lgr
```

```
▼ LogisticRegression
LogisticRegression()
```

```python
lgr.fit(x_train,y_train)
```

```
▼ LogisticRegression
LogisticRegression()
```

```python
from sklearn.metrics import accuracy_score
```

```python
from sklearn.metrics import confusion_matrix
```

```python
from sklearn.metrics import classification_report
```

```python
y_train_pred = lgr.predict(x_train)
y_test_pred = lgr.predict(x_test)
```

```python
# Confusion Matrix For Training Data with Training Data
```

```python
confusion_matrix(y_train,y_train_pred)
```

```
array([[8607,  527],
       [2120,  745]])
```

```python
# Accuracy For Training Data With Logistic Regression
```

```python
accuracy_score(y_train,y_train_pred)*100
```

```
77.93982831902659
```

Double-click (or enter) to edit

```python
# Classifiaction Report For Training Data Logistic Regression
```

```python
print(classification_report(y_train,y_train_pred))
```

```
              precision    recall  f1-score   support

           0       0.80      0.94      0.87      9134
           1       0.59      0.26      0.36      2865

    accuracy                           0.78     11999
   macro avg       0.69      0.60      0.61     11999
weighted avg       0.75      0.78      0.75     11999
```

```
smote=SMOTE(random_state=42)
x_train,y_train=smote.fit_resample(x_train,y_train)
```

```
y_train.value_counts()
```

```
left
0    9134
1    9134
Name: count, dtype: int64
```

```
confusion_matrix(y_test,y_test_pred)
```

```
array([[2140,  154],
       [ 548,  158]])
```

```
accuracy_score(y_test,y_test_pred)*100
```

```
76.6
```

```
print(classification_report(y_test,y_test_pred))
```

```
              precision    recall  f1-score   support

           0       0.80      0.93      0.86      2294
           1       0.51      0.22      0.31       706

    accuracy                           0.77      3000
   macro avg       0.65      0.58      0.58      3000
weighted avg       0.73      0.77      0.73      3000
```

## hyperparametric tuning for logistic regression

```
import warnings
warnings.filterwarnings('ignore')
```

```
from sklearn.model_selection import GridSearchCV
```

```
from sklearn.model_selection import cross_val_score
```

```
logi_final=LogisticRegression()
```

```
parameters={'penalty' : ['l1', 'l2', 'elasticnet', 'none'],
        'tol' : [1e-1 , 1e-2 , 1e-3 , 1e-4],
        'class_weight' : ['balanced',None],
        'max_iter' : [50,100,130,150,200],
        'solver' : ['newton-cg', 'lbfgs', 'liblinear', 'sag', 'saga'],
        'multi_class' : ['auto', 'ovr', 'multinomial'],
        'verbose' : [0,1],
        'n_jobs' : [1,-1]}
```

```
gs=GridSearchCV(estimator=logi_final,
                param_grid=parameters,
                scoring='accuracy',
                cv=10,
                n_jobs=-1)
```

## testing logistic regression

```
lgr.predict([[0.80,0.86,5,262,6,0,0,0,1]])
```

```
lgr.predict([[0.72,0.87,5,223,5,0,0,0,0]])
```

```
lgr.predict([[0.38,0.53,2,157,3,0,0,0,0]])
```

```
lgr.predict([[0.11,0.88,7,272,4,0,0,0,1]])
```

```
lgr.predict([[0.40,0.57,2,151,3,0,0,4,0]])
```

## Giving Data Points Randomly for checking Model

```
lgr.predict([[0.23,0.28,3,121,2,0,0,2,0]])
```

#Model Building With Random Forest Classifier

```
from sklearn.ensemble import RandomForestClassifier
```

```
ran = RandomForestClassifier(criterion = 'entropy', random_state = 0)
```

```
ran
```

```
ran.fit(x_train,y_train)
```

```
y_train_pred = ran.predict(x_train)
```

```
y_test_pred = ran.predict(x_test)
```

```
confusion_matrix(y_train , y_train_pred)
```

```
accuracy_score(y_train,y_train_pred)*100
```

```
print(classification_report(y_train,y_train_pred))
```

```python
#Confusion Matrix For Training Data With Random Forest Classifier
```

```python
confusion_matrix(y_test, y_test_pred)
```

```python
#Accuracy For Training Data With Random Forest Classifier
```

```python
accuracy_score(y_test,y_test_pred)*100
```

```python
#Classifiacation Report For Training Data With Random Forest Classifier
```

```python
print(classification_report(y_test,y_test_pred))
```

# Saving The Model

```python
df.head()
```

```python
import os
```

```python
os.chdir("D:\MiniProjects24\Work_Force_Retention_System_Jyo")
```

```python
import pickle
pickle.dump(ran,open('lgr.pkl','wb'))
```

```python
os.getcwd()
```