

Project Report - Phase 4: Application Development and Deployment

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4.1. Web Application Development

A web application was developed using the **Flask** framework in Python to provide a userfriendly interface for the machine learning model. The application consists of a single-page interface with a form where users can input the various attributes of an employee.

- **Frontend:** The user interface was built with HTML and styled using **Tailwind CSS** to create a modern and responsive design.
- **Backend:** The Flask backend handles the form submission, preprocesses the user's input to match the format expected by the model, and then uses the loaded .pkl model to make a prediction.

4.2. Application Logic and Flow

1. The user navigates to the application's URL.
2. They fill out the web form with the required employee data.
3. Upon clicking "Predict Productivity," the data is sent to the Flask server.
4. The server's Python code applies the same **Label Encoding** transformations to the categorical data as was done during model training.
5. The processed data is then passed to the XGBoost model for prediction.
6. The model returns a productivity score, which is then categorized as "High," "Medium," or "Low" and displayed back to the user on the web page.

4.3. Deployment to Render

The final application was deployed to the **Render** cloud platform to make it publicly accessible. The deployment process involved:

1. Pushing all project files (app.py, best_model.pkl, requirements.txt) to a GitHub repository.
2. Creating a new Web Service on Render and linking it to the GitHub repository.
3. Configuring the build command (pip install -r requirements.txt) and the start command (gunicorn app:app).

The use of a requirements.txt file ensures that all necessary Python libraries are installed in the deployment environment, and Gunicorn is used as a production-ready web server.

4.4. Conclusion and Future Work

This project successfully demonstrates the end-to-end process of building and deploying a machine learning application. The final deployed web service provides a valuable and accessible tool for predicting employee productivity.

Future enhancements could include:

- **Hyperparameter Tuning:** To further improve the model's accuracy.
- **Data Visualization:** Adding charts and graphs to the web interface to provide more insights.
- **Batch Predictions:** Allowing users to upload a CSV file to get predictions for multiple employees at once.