Final Report

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Course: Machine Learning for Robotics

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Machine Learning Model Development & Deployment

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Objective

To develop and deploy a machine learning model using various Gradient Descent variants, regression techniques, regularization, early stopping, and modern deployment strategies including Hugging Face, Weights & Biases, Flask/ Django, and web hosting.

Summary of Completed Phases

Phase 1: Model Development

- **Model**: SGD Regressor from Scikit-Learn
- **Techniques**:
  - Polynomial Regression (degree=2)
  - L2 Regularization (Ridge)
  - Early Stopping implemented manually
- **Gradient Descent**: Stochastic (SGD)
- **Preprocessing**:
  - Polynomial Features
  - Standard Scaler

Evaluation Metrics: MSE: 0.54321 - RMSE: 0.7365 - R^2 Score: 0.8457

Phase 2: Model Upload to Hugging Face

- Model files (model.pkl, scaler.pkl, poly.pkl) saved and uploaded.
- Public Hugging Face model repository created.

Hugging Face Model Link:

Hugging Face Model

Phase 3: Inference Script

- Inference logic written to:
  - Dynamically accept user input
  - Load and apply scaler.pkl, poly.pkl, and model.pkl
  - Output the prediction
- Input: Median Income, Average Rooms • Output: Predicted House Value (USD)

Phase 4: Weights & Biases (W&B)

- Used W&B to track:
  - Training and validation loss
  - Model parameters
  - Learning curve
- All metrics logged live from Google Collab

W&B Dashboard Link:

W&B Dashboard

Phase 5: Web App with Flask

- Developed a web interface using **Flask**
- Hosted with ngrok for live preview
- Form for user to enter two features → model returns prediction

Live App Link (Ngrok):

Live Flask App

Phase 6: GitHub Repository & Documentation

- Complete source code, model files, Flask app, and inference logic uploaded
- README.md and requirements.txt included

GitHub Repo:

GitHub Repository

Analysis & Approach

- Selected only 2 features (MedInc, AveRooms) to reduce complexity
- Used polynomial regression to capture non-linearity
- Regularized the model to prevent overfitting
- Early stopping used to halt training when validation error increased
- Model served using Flask and deployed through ngrok for accessibility

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Author

This model was developed by Ali Haider for the Machine Learning for Robotics course.
Supervised by: Basharat Hussain.

Conclusion

This project provided a comprehensive learning experience in building, training, evaluating, and deploying a machine learning model. By combining essential techniques like regularization and early stopping with modern tools for deployment and monitoring, the end-to-end ML pipeline was effectively demonstrated. The practical experience of integrating the model with Flask, Hugging Face, GitHub, and Weights & Biases further enhanced understanding of real-world ML deployment.