Data Science Career Track: Capstone Project Proposal

Smart Basket for Automatic Product Classification and Counting

1. Problem Identification

Problem Statement:

In supermarkets and grocery stores, the process of identifying and counting products often requires manual input, which can be slow and prone to errors. This inefficiency can lead to longer checkout times and inaccurate pricing, which negatively impacts both customer experience and store operations. Developing a "smart basket" that automatically recognizes products based on images can significantly speed up the shopping process.

Context:
As the retail industry increasingly moves towards automation and efficiency, there is a growing need for smart solutions that can streamline the shopping experience. A smart basket that uses image processing to identify and count products can reduce the need for manual scanning and entry, making the checkout process faster and more accurate. This project aims to bridge this gap by leveraging image processing techniques to develop a model capable of classifying and counting products in real-time.

Criteria for Success:
The success of this project will be measured by the model's ability to accurately classify different types of fruits and vegetables from images and correctly count the number of items in the basket.

Scope of Solution Space:
The primary focus of this project will be on building a robust image classification model using Convolutional Neural Networks (CNNs) trained on the Fruits-360 dataset. The model will be capable of identifying a variety of fruits and vegetables. The solution will also include functionality for counting the number of identified items.

Constraints:

Limited to the types of fruits and vegetables available in the Fruits-360 dataset.

Stakeholders:

Supermarket and Grocery Store Owners: Interested in reducing checkout times and improving customer satisfaction.

Customers: Beneficiaries of a faster, more accurate checkout experience.

Technology Providers: Companies interested in developing or deploying smart retail solutions.

Data Scientists and Engineers: Professionals interested in developing and refining image processing models for retail applications.

Data Sources:

Primary Dataset: Fruits-360 dataset containing over 70,000 images of 120 types of fruits and vegetables. This dataset will be used to train and validate the image classification model.

2. Proposed Solution

Data Acquisition and Preprocessing:

- Acquire the Fruits-360 dataset and explore it to understand the distribution of images across different classes.
- Preprocess the images (e.g., resizing, normalization) to prepare them for model training.

Model Development:

- Develop a Convolutional Neural Network (CNN) for classifying images of fruits and vegetables.
- Train the model on the preprocessed dataset, and use data augmentation techniques to improve generalization.
- Validate the model using a portion of the dataset reserved for testing.

4. Deliverables

- **Code:** Python code for data preprocessing, model development, and system integration.
- **Documentation:** Detailed documentation explaining the methodology, implementation, and instructions for use.
- **Report/Presentation:** A report or slide deck summarizing the project's objectives, methodology, results, and conclusions.
- **PDF Proposal:** The finalized project proposal, converted to PDF format, and added to the GitHub repository.
- **GitHub Repository:** A repository containing all code, documentation, and the PDF proposal, made publicly accessible.

5. Timeline

Week 1: Data Wrangling and Exploration

- **Data Wrangling:** Clean and preprocess the Fruits-360 dataset, handling any missing or inconsistent data.

- **Exploratory Data Analysis (EDA):** Perform EDA to understand the distribution of classes, visualize data, and gain insights into the dataset.

Week 2: Model Setup and Initial Development

- **Model Setup:** Design and implement the initial Convolutional Neural Network (CNN) architecture.
- **Initial Model Training:** Begin training the CNN model and perform initial evaluations.

Week 3: Model Optimization

- **Data Augmentation:** Apply data augmentation techniques to enhance the model's generalization.
- **Hyperparameter Tuning:** Optimize the model through hyperparameter tuning to improve accuracy.

Week 4: Feature Development

- **Counting:** Develop features for counting items.

Week 5: Finalization and Testing

- **Final Model Refinement:** Fine-tune and finalize the model and its features.

Week 6: Documentation and Submission

- **Documentation:** Complete all project documentation, including data wrangling and EDA details.
- **Final Report:** Prepare the final report or presentation.

4. Review and Feedback

Regularly scheduled calls every two weeks with a mentor to review progress, discuss challenges or changes, and refine strategies.

Participate in the Springboard online forum on Slack.