Capstone Project Proposal:
Inventory Monitoring at Distribution Centers

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Domain Background:

The project revolves around inventory monitoring at distribution centers, which is a crucial aspect of supply chain management. By accurately counting the number of objects in each bin, it ensures that the delivery consignments have the correct number of items, and stock management is maintained efficiently. The project is related to the field of computer vision and machine learning, which is currently being used in various industries to solve complex problems.

Problem Statement:

The project aims to build a model that can count the number of objects in each bin using machine learning and computer vision techniques. The problem is to develop a robust model that can accurately detect the number of objects in each bin, even if there are multiple objects in the same bin. This can help distribution centers to track inventory, reduce human error, and improve the overall efficiency of the supply chain management process.

Datasets and Inputs:

The Amazon Bin Image Dataset, containing 500,000 images of bins containing one or more objects, will be used for this project. The dataset also includes a metadata file containing information about each image, such as the number of objects, dimension, and object type. The dataset will be preprocessed and cleaned before training the machine learning model.

Solution Statement:

The proposed solution is to train a machine learning model using the Amazon Bin Image Dataset, which can accurately count the number of objects in each bin. The model will be trained using SageMaker, and different machine learning architectures can be used for this task, such as pre-trained convolutional neural networks or custom neural network architectures. The trained model will be able to predict the number of objects in each bin using the input image.

Benchmark Model:

The benchmark model will be a simple Convolutional Neural Networks that counts the number of objects in each bin, without any hyperparameter optimization or using pretrained weights. The performance of this model will be compared to the performance of the more sophisticated model developed in this project to evaluate the effectiveness of the proposed solution.

Evaluation Metrics:

The model's performance will be evaluated using various evaluation metrics such as accuracy, precision, recall, and F1-score. These metrics will be used to measure the effectiveness of the model and to compare the results with the benchmark model.

Project Design:

The project will be designed using the following steps:

- Setting up AWS SageMaker and creating a folder for the project.
- Uploading the training data to an S3 bucket.
- Preprocessing and cleaning the data before training the model.
- Creating a training script that reads, loads, and preprocesses the training data.
- Training the machine learning model using SageMaker.
- Evaluating the model's performance using various evaluation metrics.
- Submitting the job and obtaining the results.

The proposed solution will be end-to-end machine learning engineering, covering all aspects of data processing, model development, and evaluation. The project will be executed using good machine learning engineering practices and will serve as a demonstration of the skills learned in the nanodegree program.