Title: Conquering Fashion MNIST with CNNs using Computer Vision

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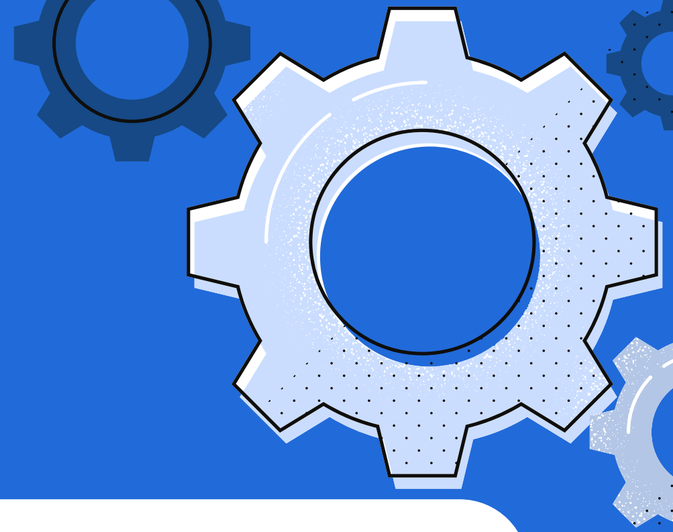
ABSTRACT



ABSTRACT

- This presentation presents the development of an efficient Convolutional Neural Network (CNN) model for clothing classification using the Fashion MNIST dataset. The objective of this project is to accurately classify images of fashion products into their respective categories. The CNN models were trained and evaluated, and Intel optimization techniques were applied to enhance the model's performance. The results demonstrate the effectiveness of the CNN models in achieving high accuracy and the potential of Intel optimization for improving inference speed.

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01 INTRODUCTION

The classification of clothing items plays a crucial role in various applications, such as e-commerce, fashion industry analysis, and personalized recommendation systems. The Fashion MNIST dataset, consisting of grayscale images of fashion products, provides a suitable benchmark for developing clothing classification models. In this project, our aim is to design and train a CNN model capable of accurately categorizing the images into ten clothing classes.

02 MOTIVATION

ACCURATE CLOTHING CLASSIFICATION HAS NUMEROUS PRACTICAL APPLICATIONS AND BENEFITS. IN THE E-COMMERCE INDUSTRY, IT ENABLES AUTOMATED PRODUCT CATEGORIZATION AND PERSONALIZED SHOPPING EXPERIENCES. IN THE FASHION INDUSTRY, IT AIDS IN TREND ANALYSIS AND INVENTORY MANAGEMENT. MOREOVER, EFFICIENT AND ACCURATE CLOTHING CLASSIFICATION IS ESSENTIAL FOR RECOMMENDATION SYSTEMS, ALLOWING USERS TO DISCOVER RELEVANT FASHION ITEMS BASED ON THEIR PREFERENCES. BY DEVELOPING AN EFFICIENT CNN MODEL, WE AIM TO CONTRIBUTE TO THE FIELD OF COMPUTER VISION AND EMPOWER VARIOUS INDUSTRIES WITH ADVANCED IMAGE CLASSIFICATION CAPABILITIES.

03 PRIOR WORK

IN RECENT YEARS, SIGNIFICANT ADVANCEMENTS HAVE BEEN MADE IN IMAGE CLASSIFICATION AND DEEP LEARNING TECHNIQUES. SEVERAL STUDIES HAVE FOCUSED ON THE FASHION MNIST DATASET TO DEVELOP CLOTHING CLASSIFICATION MODELS. FOR INSTANCE, RESEARCHERS HAVE EXPLORED DIFFERENT CNN ARCHITECTURES, SUCH AS LENET-5, VGG, AND RESNET, TO ACHIEVE HIGH ACCURACY IN CLASSIFYING FASHION IMAGES. THESE STUDIES HAVE DEMONSTRATED THE EFFECTIVENESS OF CNNS IN CAPTURING INTRICATE FEATURES AND PATTERNS IN CLOTHING IMAGES.

04 OUR APPROACH

THE IDEA

DATASET PREPROCESSING:

We performed data preprocessing, including scaling the pixel values, reshaping the data, and one-hot encoding the labels.

CNN MODEL ARCHITECTURE:

Designed and implemented three different CNN models. Model 1 consisted of multiple convolutional and pooling layers, followed by fully connected layers. Model 2 incorporated ReduceLROnPlateau callback for learning rate reduction during training. Model 3 utilized the VGG architecture, known for its depth and performance in image classification tasks.

MODEL TRAINING:

We split the dataset into training and testing sets, and the models were trained using the training set. We employed appropriate loss functions, optimizers, and evaluation metrics to train and evaluate the models.

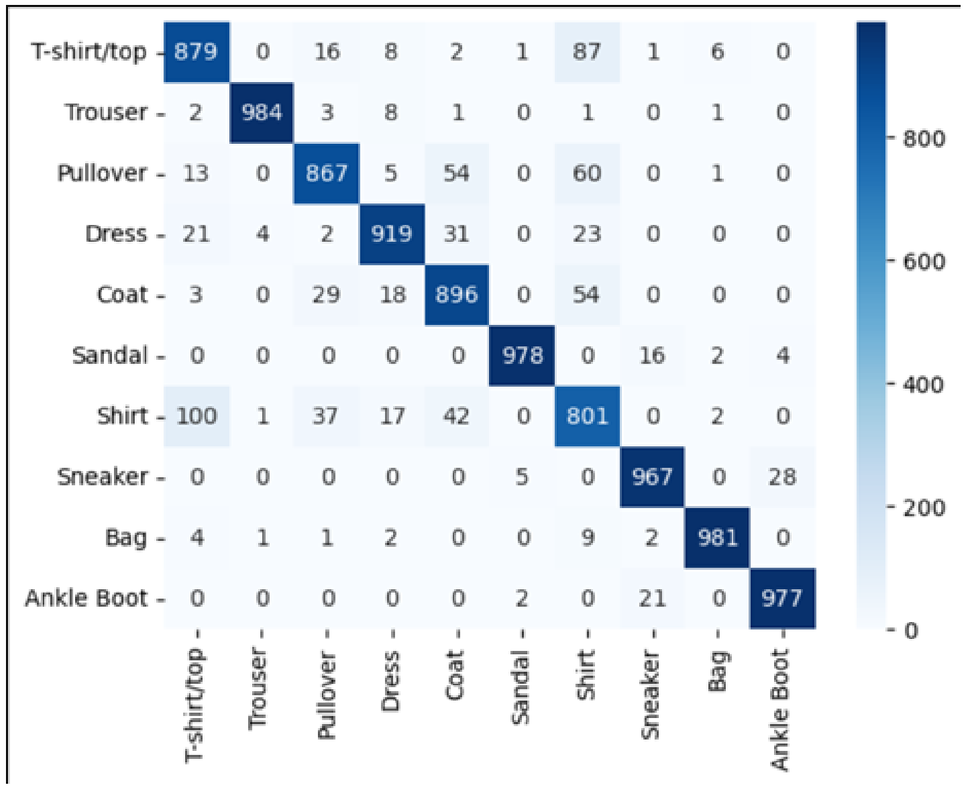
INTEL OPTIMIZATION:

We explored Intel optimization tool OPENVINO to accelerate the inference speed of our trained models. We evaluated the performance improvements achieved through Intel optimization.

05 RESULTS

MODEL 1:

The efficient CNN model achieved an accuracy of 92.25% on the test set. It demonstrated effective feature extraction and classification capabilities



MODEL 2:

The CNN model with ReduceLROnPlateau callback achieved a similar accuracy of 92.06% on the test set. The learning rate reduction strategy helped improve model convergence and generalization.

```
563/563 [==============================] - 3s 5ms/step - loss: 0.2623 - accuracy: 0.9206
Accuracy: 92.06%
```

MODEL 3:

The VGG-based CNN model achieved an accuracy of 91.5% on the test set. The deeper architecture provided a better understanding of complex fashion patterns.

```
563/563 [==============================] - 9s 15ms/step - loss: 0.3066 - accuracy: 0.915
Accuracy of VGG16 model: 91.56%
```

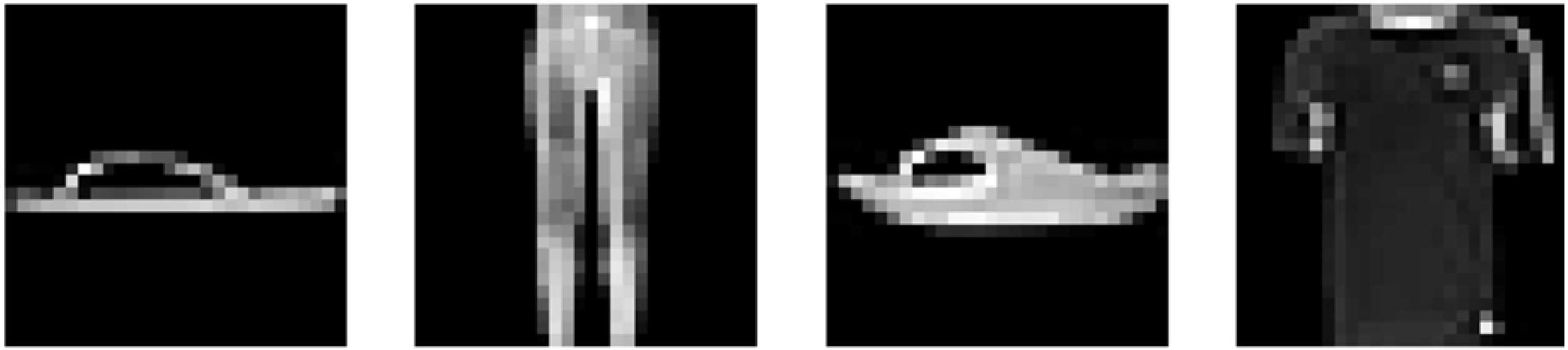
INTEL OPTIMIZATION(OPENVINO):

By utilizing Intel optimization tool OPENVINO we observed a noticeable improvement in inference speed compared to the TensorFlow implementation.

```
Inference Time (Before Optimization): 1.6256859302520752
Inference Time (After Optimization): 1.5785918235778809
```

PREDICTION:

```
1/1 [==============================] - 0s 16ms/step
```



06 CONCLUSION

In conclusion, we have successfully developed an efficient clothing classification model using Convolutional Neural Networks (CNNs) and Intel optimization techniques. Our models achieved high accuracy in classifying fashion images from the Fashion MNIST dataset, with our custom CNN model achieving an accuracy of 92% on the test set. By leveraging Intel optimization tools, such as OpenVINO, we were able to improve the inference speed of our models. These outcomes contribute to the advancement of image classification algorithms and have practical implications in various industries, including e-commerce and fashion analysis. Moving forward, we can further fine-tune our models and explore advanced techniques to enhance performance.

References

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Code Repository (GitHub) Link:

https://github.com/URK21CS1072/intelunnati_Duality