Assignment - 08

Q. ANS:-

1. Design Choices for Architecture:

a) Transfer Learning with Fine-Tuning
b) Feature Extraction with Pre-trained Model
c) Hybrid Approach (Combination of Fine-Tuning and Feature Extraction)

2. Merits and Demerits of Design Choices:

—->Transfer Learning with Fine-Tuning

Merits:

1. High Accuracy: Fine-tuning allows the model to adapt to the specific dataset, potentially leading to higher accuracy.
2. Flexibility: Can be adapted to various tasks by adjusting the layers.

Demerits:

1. Computationally Intensive: Requires significant computational resources and time.
2. Risk of Overfitting: If not done carefully, it can lead to overfitting, especially with small datasets.

—->Feature Extraction with Pre-trained Model

Merits:

1. Efficiency: Faster and less computationally intensive since only the final layers are trained.
2. Reduced Overfitting: Less risk of overfitting as the majority of the model remains unchanged.

Demerits:

1. Lower Accuracy: May not achieve as high accuracy as fine-tuning, especially if the new dataset is very different from the original dataset.
2. Limited Adaptability: Less flexible in adapting to new tasks compared to fine-tuning.

—->Hybrid Approach

Merits:

1. Balanced Performance: Combines the benefits of both fine-tuning and feature extraction, potentially leading to better performance.
2. Adaptability: Can be tailored to specific needs by selectively fine-tuning certain layers.

Demerits:

1. Complexity: More complex to implement and requires careful tuning.
2. Resource Intensive: Can be computationally demanding, though less so than full fine-tuning.

3. Fine-Tuning Shallower vs. Deeper Layers:

—> Fine-Tuning Shallower Layers:

Merits:

1. Adaptability to New Features: Helps the model learn new low-level features specific to the new dataset.
2. Potential for Higher Accuracy: Can lead to better performance if the new dataset has significantly different low-level features.

Demerits:

1. Computational Cost: More computationally intensive as more layers are being trained.
2. Risk of Overfitting: Higher risk of overfitting, especially with small datasets.

—> Fine-Tuning Deeper Layers:

Merits:

1. Efficiency: Less computationally intensive as fewer layers are being trained.
2. Stability: Lower risk of overfitting as the core features learned by the pre-trained model are retained.

Demerits:

1. Limited Adaptability: May not perform as well if the new dataset has significantly different high-level features.
2. Potential Lower Accuracy: Might not achieve the highest possible accuracy if the new dataset requires significant adaptation.

—> Better Choice:-

Context-Dependent: The choice between fine-tuning shallower or deeper layers depends on the specific characteristics of the new dataset.

General Recommendation: For most image classification problems, fine-tuning the deeper layers is often a better starting point. This approach leverages the robust feature representations learned by the pre-trained model while adapting to the new dataset with less risk of overfitting and lower computational cost. If the new dataset is significantly different in terms of low-level features, then fine-tuning shallower layers might be necessary.