## Part 4: Image Classification using Transfer Learning

Objective: The objective of this assignment is to develop an image classification model using transfer learning. You will find a pretrain a neural network model, and then use **transfer learning** to classify logos of popular food chains.

**Summary Report:**

**First Model (Pre-trained Model with Fine-Tuning - VGG-16)**

Model Details:

Total Parameters: 25,636,712 (97.80 MB)

Trainable Parameters: 25,583,592 (97.59 MB)

Non-trainable Parameters: 53,120 (207.50 KB)

Dataset Details:

Training Dataset: 1393 images belonging to 6 classes

Validation Dataset: 345 images belonging to 6 classes

Training Process:

Epochs: 10

Training Accuracy (Final Epoch): 100.00%

Training Loss (Final Epoch): 0.0014

Validation Accuracy (Final Epoch): 94.78%

Validation Loss (Final Epoch): 0.1706

Evaluation on Validation Set:

Validation Accuracy: 97.13%

Validation Loss: 0.0885

Analysis:

The model was fine-tuned with all layers trainable.

During training, the model achieved perfect accuracy on the training set (indicative of potential overfitting).

Validation accuracy reached approximately 94.78% after 10 epochs.

The final evaluation on the validation set showed a high accuracy of 97.13% and a low validation loss of 0.0885, indicating good generalization on unseen data.

**Second Model (Fine-Tuned Model)**

Model Details:

Total Parameters: 21,139,014 (80.64 MB)

Trainable Parameters: 13,503,750 (51.51 MB)

Non-trainable Parameters: 7,635,264 (29.13 MB)

**Dataset Details:**

Training Dataset: 1393 images belonging to 6 classes

Validation Dataset: 345 images belonging to 6 classes

Training Process:

Epochs: 4

Training Accuracy (Final Epoch): 97.16%

Training Loss (Final Epoch): 0.0880

Validation Accuracy (Final Epoch): 93.62%

Validation Loss (Final Epoch): 0.2580

Evaluation on Validation Set:

Validation Accuracy: 95.99%

Validation Loss: 0.1575

**Analysis:**

The model was fine-tuned by unfreezing specific layers of the pre-trained model.

The training accuracy reached approximately 97.16% after 4 epochs.

Validation accuracy achieved approximately 93.62% after 4 epochs, indicating good generalization.

The final evaluation on the validation set showed a high accuracy of 95.99% and a relatively low validation loss of 0.1575.

**Summary:**

Both models demonstrated strong performance on the validation set, with high accuracy and relatively low loss.

The first model achieved a higher validation accuracy after fine-tuning all layers but showed signs of potential overfitting.

The second model achieved slightly lower validation accuracy but with more controlled overfitting by selectively unfreezing and training specific layers.

Overall, the fine-tuned models exhibit good generalization to new data, indicating successful transfer learning and fine-tuning of the pre-trained models for the specific classification task.