Performance Evaluation Report

Models Compared

Model	Description
Custom CNN	A CNN built from scratch with conv + pool layers.
ResNet18 (last layer trainable)	All layers frozen except the final FC layer.
ResNet18 (half layers trainable)	Top 50% of layers unfrozen, enabling partial fine-tuning.
ResNet18 (all layers trainable)	Only the final layer frozen; full model is trained (except last layer).

Training Efficiency & Accuracy (10 Epochs)

Model	Training Time	Accuracy (Correct / Total)	Accuracy (%)
Custom CNN	1m 16s	366 / 418	87.56%
ResNet18 (last layer trainable)	27m 47s	371 / 418	88.76%

ResNet18 (half layers trainable)	60m 42s	413 / 418	98.80%
ResNet18 (all layers trainable)	87m 14s	413 / 418	98.80%

Insights & Comparative Analysis

1. **Accuracy**
    - ResNet18 with half or all layers trainable **achieved the highest accuracy (98.80%)**, significantly outperforming both the CNN and the partially frozen ResNet.
    - Fine-tuning **only the last layer** provided **only a minor boost** over the CNN (88.76% vs. 87.56%).
2. **Training Time**
    - CNN was the fastest to train (just over 1 minute), making it ideal for rapid prototyping or low-resource environments.
    - As expected, ResNet18's training time increases with more trainable layers, nearly doubling with each added level of trainability.
3. **Efficiency Trade-off**
    - While full fine-tuning gives high accuracy, **half-freezing the ResNet18** provides a **great balance** — same accuracy (98.80%) as full fine-tuning, but saves ~26 minutes.