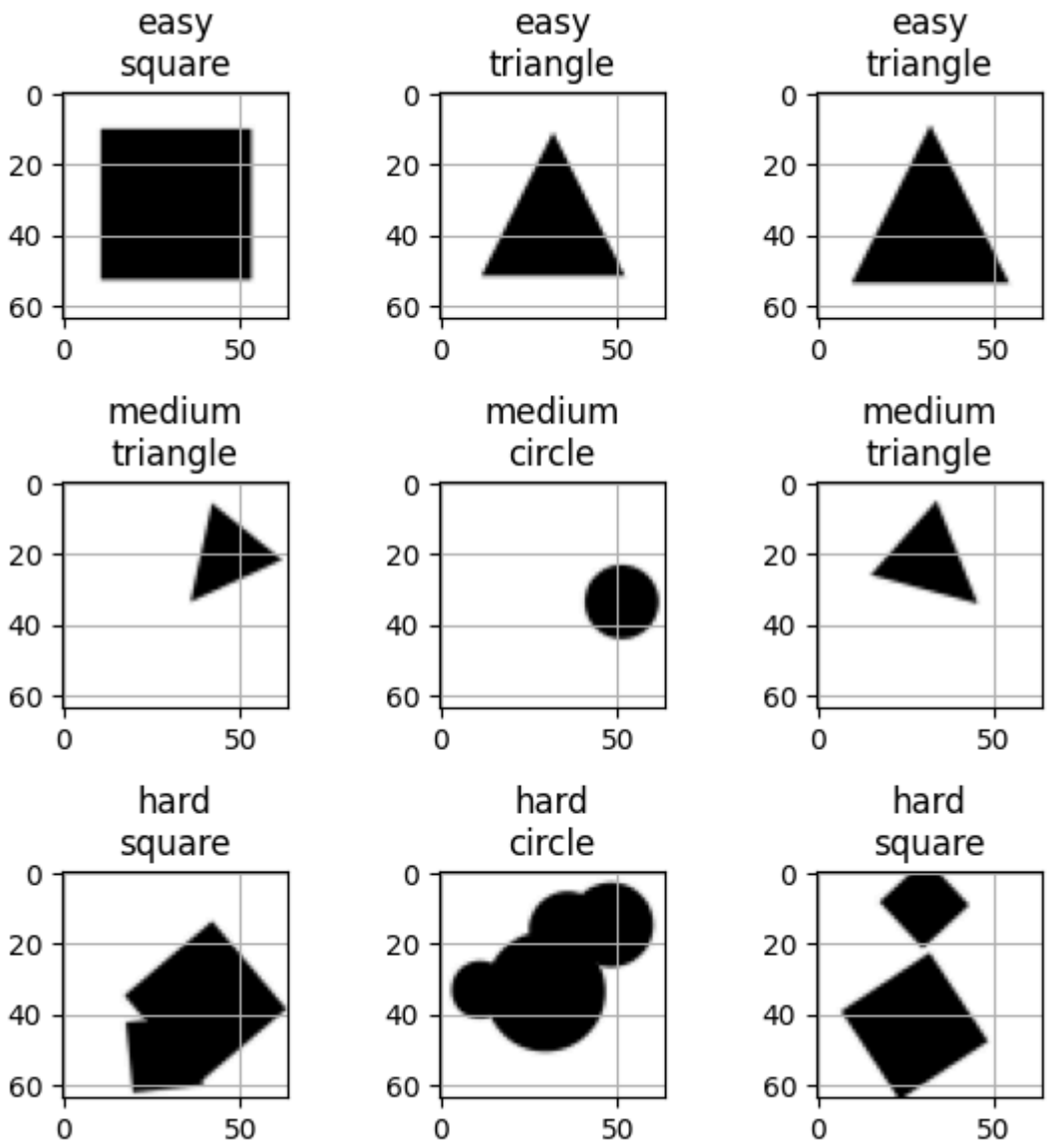
DL - LAB 8

Analysis of the obtained results

Task: *(Static vs Dynamic Model)*

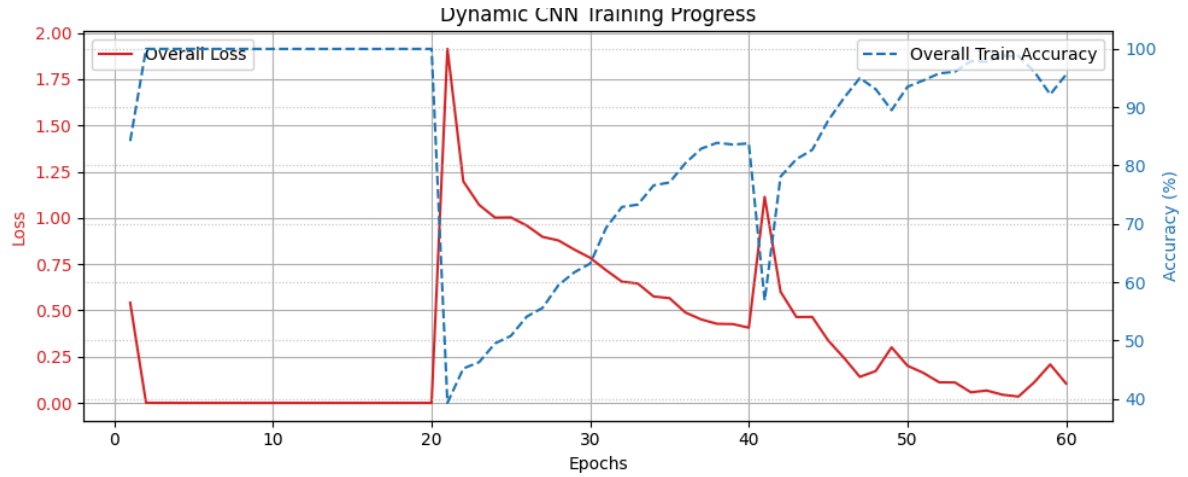
> Dataset sample



> Experiment

- This experiment explores comparisons of a Static CNN and a Dynamic CNN with curriculum learning on a shapes classification task performed on a dataset of circles, squares, and triangles with varying difficulty levels (easy, medium, hard).

> Dynamic CNN



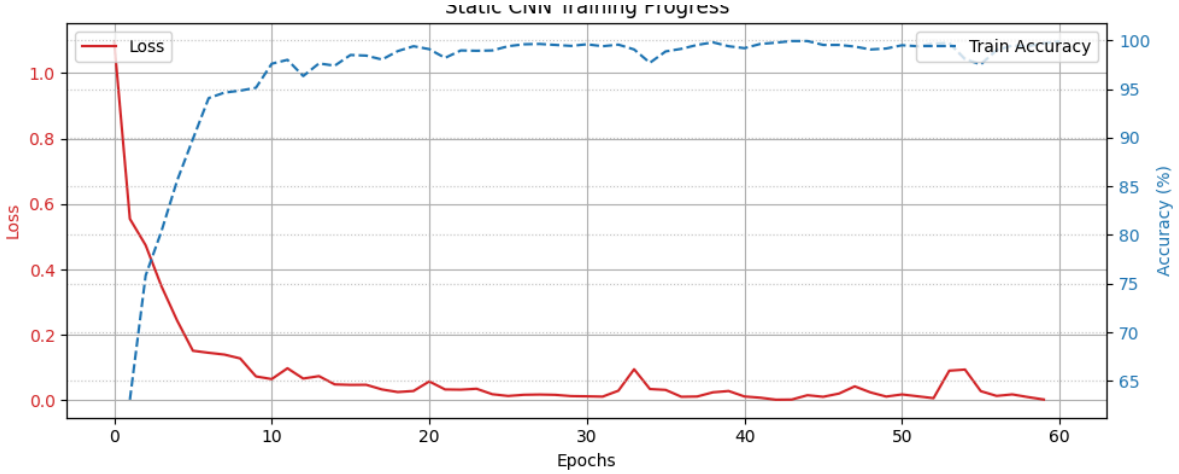
ConsoleOutput:

--- Training Stage 1 (Easy Data) ---
Stage 1 Ep 1/20, Loss: 0.5413, Acc: 84.20%
Stage 1 Ep 5/20, Loss: 0.0001, Acc: 100.00%
Stage 1 Ep 10/20, Loss: 0.0001, Acc: 100.00%
Stage 1 Ep 15/20, Loss: 0.0000, Acc: 100.00%
Stage 1 Ep 20/20, Loss: 0.0000, Acc: 100.00%

--- Training Stage 2 (Medium Data) ---
Stage 2 Ep 1/20, Loss: 1.9130, Acc: 39.30%
Stage 2 Ep 5/20, Loss: 1.0026, Acc: 50.80%
Stage 2 Ep 10/20, Loss: 0.7842, Acc: 63.20%
Stage 2 Ep 15/20, Loss: 0.5663, Acc: 77.10%
Stage 2 Ep 20/20, Loss: 0.4066, Acc: 83.80%

--- Training Stage 3 (Hard Data) ---
Stage 3 Ep 1/20, Loss: 1.1134, Acc: 56.90%
Stage 3 Ep 5/20, Loss: 0.3379, Acc: 87.70%
Stage 3 Ep 10/20, Loss: 0.2012, Acc: 93.50%
Stage 3 Ep 15/20, Loss: 0.0670, Acc: 97.80%
Stage 3 Ep 20/20, Loss: 0.1050, Acc: 95.60%
Dynamic CNN Training Time: 136.59 seconds

> Static CNN



ConsoleOutput:

--- Training Static CNN ---
Ep 1/60, Loss: 1.0975, Acc: 63.07%
Ep 5/60, Loss: 0.2438, Acc: 89.87%
Ep 10/60, Loss: 0.0734, Acc: 97.60%
Ep 15/60, Loss: 0.0490, Acc: 98.50%
Ep 20/60, Loss: 0.0289, Acc: 99.10%
Ep 25/60, Loss: 0.0189, Acc: 99.40%
Ep 30/60, Loss: 0.0132, Acc: 99.60%
Ep 35/60, Loss: 0.0349, Acc: 98.87%
Ep 40/60, Loss: 0.0288, Acc: 99.20%
Ep 45/60, Loss: 0.0160, Acc: 99.53%
Ep 50/60, Loss: 0.0118, Acc: 99.50%
Ep 55/60, Loss: 0.0942, Acc: 97.53%
Ep 60/60, Loss: 0.0028, Acc: 99.90%
Static CNN Training Time: 481.93 seconds

> Performance:

- **Training Time**
  - Static CNN: 481.93 seconds
  - Dynamic CNN: 136.59 seconds (~70% faster)

  > Obs: The Dynamic CNN trained significantly faster, taking less than 1/3 of the time required by the Static CNN. This demonstrates one of the key advantages of curriculum learning - more efficient training.

- **Training Convergence**
  - Static CNN:
    - Steady improvement over 60 epochs, reaches 99% training accuracy

- Dynamic CNN :
    - Stage 1 (Easy): Reached 100% accuracy very quickly (by epoch 5)
    - Stage 2 (Medium): Struggled more, reaching 83.80% by epoch 20
    - Stage 3 (Hard): Improved to 95.60% by epoch 20

> Obs: The Dynamic CNN showed extremely fast convergence on easy data but had more difficulty adapting to medium and hard data, suggesting that the architectural changes between stages might need refinement.

> Accuracy:

- **Overall Performance**
    - Static CNN: 99.87% overall accuracy
    - Dynamic CNN: 78.53% overall accuracy

> Obs: Despite training faster, the Dynamic CNN's overall performance was significantly lower than the Static CNN.

- **Performance by Difficulty Level**

Difficulty	Static CNN	Dynamic CNN
Easy	Acc: 99.90%	Acc: 100.00%
Medium		Acc: 83.80%
Hard		Acc: 95.60%

> Obs: Interestingly, the Dynamic CNN performed best on easy and hard examples (100%, respectively ~96%) but struggled a bit with medium level examples. This suggests a manifestation of some forgetting - as the model adapted to harder examples, it lost some ability to classify simpler-medium ones.