

Assignment 1, Eka Ebong

Question 1

A. 99388 bytes

$$120 \times 256 + 256 = 30976$$

$$256 \times 256 + 256 = 65792$$

$$256 \times 10 + 10 = 2570$$

$$30976 + 65792 + 2570 = 99338$$

B. 98,816 MACs

$$(120 \times 256) + (256 \times 256) + (256 \times 10) = 98816$$

C. 512 bytes

Question 2

A. 3.74 MB

$$(1280 \times 512) + 512 = 655872$$

$$(512 \times 512) + 512 = 262656$$

$$(512 \times 32) + 32 = 16416$$

$$= 934944 / 4 = 3739776 = 3.74 \text{ MB}$$

B. 46.7 ms

$$(1280 \times 512) + (512 \times 512) + (512 \times 32) = 933,888 \text{ MACs}$$

$$933,888 \times 4$$

$$46.7 \text{ ms}$$

C. 4096 bytes

$$(512 \times 512) \times 4 = 4096$$

Question 3

A. 8.34 MB

$$(3 \times (128+1) \times 3 \times 3) = 3483$$

$$(128 \times 128 \times 9) = 147,456$$

$$(80 \times 80 \times 128 \times 10) = 8192000$$

Total 8342939 bytes

B. 2.023 seconds

$$(80 \times 80 \times 128 \times 27) = 22118400$$

$$(80 \times 80 \times 128 \times 1152) = 943718400$$

$$(80 \times 80 \times 128 \times 10 \times 10) = 8192000$$

$$\text{Total: } 22118400 + 943718400 + 8192000 = 974028800$$

$$(974028800/4)/120 \text{ million} = 2.023$$

C. 1.64 MB

$$(80 \times 80 \times 128) \times 2 = 1638400$$

Code Model Performance Analysis

Model 1

- **Final Training Accuracy:** 64.43%
- **Final Training Loss:** 0.9921
- **Final Validation Accuracy:** 50.48%
- **Final Validation Loss:** 1.5571
- **Test Accuracy:** 50.46%
- **Training Speed:** 4-5 ms/step
- **Convergence Point:** ~20 epochs

Assessment: Moderate overfitting observed determined by the gap between train/validation accuracy

Given an image of a dog, the prediction from the model was bird, so it was not accurate. It was calculated in less than a second.

Model 2

- **Final Training Accuracy:** 98.40%

- **Final Training Loss:** 0.0480
- **Final Validation Accuracy:** 71.48%
- **Final Validation Loss:** 2.0018
- **Test Accuracy:** 71.48%
- **Training Speed:** 30 ms/step
- **Convergence Point:** ~5 epochs

Assessment: After about 5 Epochs, The training loss continues to decrease but the validation loss and the validation accuracy begins vacillate. 5 epochs of training would prevent overfitting and since the testing accuracy is around 70 and the training accuracy is around the same after.

Model 3

- **Final Training Accuracy:** 95.21%
- **Final Training Loss:** 0.1355
- **Final Validation Accuracy:** 59.80%
- **Final Validation Loss:** 2.4682
- **Test Accuracy:** 59.02%
- **Training Speed:** 18 ms/step
- **Convergence Point:** ~5 epochs

Assessment: Severe overfitting as seen by the large gap between the final training accuracy and test accuracy.

Summary table

Metric	Model 1 (FC)	Model 2 (CNN)	Model 3 (SepCNN)
Test Accuracy	50.46%	71.48%	59.02%
Training Accuracy	64.43%	98.40%	95.21%
Accuracy Gap (Train-Val)	13.95%	26.92%	35.41%
Speed (ms/step)	4-5 ms	30 ms	18 ms
Average Epoch	2 s	20 s	11 s
Optimal Epochs	20	5	5

Overfitting Severity	Moderate	High	Very High
Final Validation Loss	1.5571	2.0018	2.4682

Key Observations

While Model 2 achieved the highest test accuracy, it also took the longest to train per step and showed high amounts of overfitting early on. Model 3 was low in test accuracy compared to train accuracy and showed the highest amounts of overfitting. Model 1 required the most epochs to train but considering it also had the fastest steps, it's likely comparable to the other models. Overall, model 2 is the best performing model.