United International University (UIU)

Dept. of Computer Science and Engineering (CSE)

Midterm Assignment, Summer 2024

Course: CSE 4883, Digital Image Processing

Total Marks: 20, Deadline: Friday, 22 Sep 2024

There are THREE questions. Answer all of them. Figures in the right-hand margin indicate full marks.

Fig. 1(a) Champa

Fig. 1(b) Shapla

Fig. 1(c) Beli

Bangladesh is home to an astonishing variety of flowering plants, with some estimates putting the number at nearly 5700. However, increasingly, many of us can't recognize different types of flowers, even common ones! Hence, knowing DIP and ML, you thought you could create a model that can recognize common flowers of Bangladesh. You started collecting your dataset with 3 flowers as pictured in Fig 1(a)-1(c). **You collected 1000, 200, and 2000 pictures of "Champa", "Shapla" and "Beli" flowers respectively.**

Now, based on this scenario, answer questions 1 and 2:

1a. Consider that Fig 1(a) is 1288x1080 pixels with RGB color scheme. Determine the size of this image. Also, explain how we store visual information such as this picture in digital computers by **only** explaining the concept of "pixels". 2+2

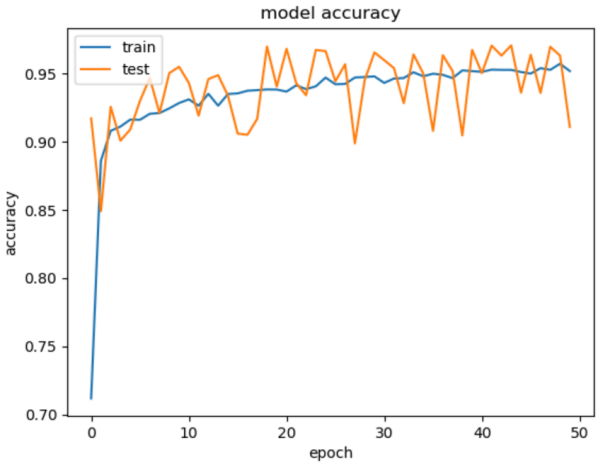
1b. Then, explain the concept of "sampling" and "quantization" in digital image processing. If we want our eventual model to be more sensitive towards shape variations in the image (for instance, be able to recognize the shape differences), which resolution should we increase - spatial or intensity? Justify your answer with proper reasoning. 3+1

2a. Design an ANN-based deep learning model for the classification of these three flowers. Draw just the diagram of the model. Choose the number of input layers on your own, but note the number of neurons, connections, and activation functions in the diagram's subsequent hidden and output layers. 4

2b. Take a look at the graph given in Fig 2 (given on page 2). showing your supposed model's performance throughout 50 epochs and with 32 batch sizes. Then, answer the following: 2+2

I. Explain the meaning of 50 epochs and a batch size of 32.

II. Based on the graph, do you think there's an issue with any image dataset in particular (among the test and training datasets)? Propose ways to solve it with proper explanation.



2c. Suppose, you charted the performance of your model in the following confusion matrix. 2+2

Predicted Class	**Actual Image Class**		
	Champa	Shapla	Beli
Champa	950	10	5
Shapla	30	70	45
Beli	20	120	1950

Now, answer the following:

I. Calculate the model's accuracy. Comment if accuracy would be a good metric to reflect the model's performance here given the number of images in the class (1000, 200 and 2000 images in "Champa", "Shapla" and "Beli" classes respectively).

II. Calculate Maro Precision, Recall and F1 Score and then comment how the image classification in "Shapla" class may be improved.

3a. When should we use lossless image compression over lossy? Explain your position. 2

3b. Pixel intensity values of a 5x5 image are given below. 6+2

197	18	151	151	18
197	151	18	18	151
18	197	18	18	151
15	197	197	12	18
15	15	15	12	18

Now, answer the following:

I. Use "Huffman Coding" to reduce the coding redundancy of this 5x5 image. Start with frequency analysis and end at the huffman table for this image.

II. Then, find the size of the image after the Huffman coding process. Also, find the compression ratio and bits per pixel. **Consider that the original image used 8 bits per pixel.**