<u>Final exam</u> <u>AT74.08 Deep Learning for Computer Vision</u> <u>10 May 2021 (3 hours, 5 questions)</u>

For all questions, please show your step-by-step solution. For programming questions, please provide Python code. Please justify your answer and explain your code to get full-credits.

Questions 1: Write a Python program:

Given two vectors with 5 elements in Python as shown in an example below. Write a python function to calculate the dot product of any two vector. Note that you have to write program to iterate through the data. You cannot use existing library e.g., numpy library.

Example:

List1 = [15, 22, 3, 49, 16] List2 = [5, 2, -1, 0, -5]

The output in this example is 36.

(20 points)

Question 2: Please compute the feed forward and back propagation for one iteration. We assume that all node uses non-linear RELU functions



Assume that the actual output is 1, calculate the backward propagation to modify all the weight values. Note that you can either compute manually or write the python program. Please write down the code if you decide to write python programing. At the end, you have to report the weight after 1 iteration of back propagation. (20 points)

Question 3: Write an OpenCV program: (20 points)

Given 1,000 images, write an OpenCV program to perform augmentation using existing geometric transfer to generate another 5,000 images randomly. The random images must be either rotated between -30 and 30 degree (1000 images), or scale by the ratio 0.8 till 1.2 times (1000 images), or shear by two either in x or y direction (1000 images) or the combination (2000 images). Note that you cannot use existing Tensorflow/ Keras or other library function apart from OpenCV and standard Python for image augmentation.

Questions 4: a) Write a complete Keras code for below Deep Learning system (20 points)



When Con represents convolution layer, 3x3 is the filter size, and 64 is the number of filters respectively. Relu is used after all convolution layers.

MP represents max pooling layers with stride of 2 by 2.

FC is the fully connected layer. The number followed is the number of nodes. Softmax layer is used for final classification. SGD is used for optimization.

Question 5:

a) Calculate the total precision, recall, and accuracy (F1 score) of this entire vehicle classification system: (15 points)

		Predict				
		Sedan	Truck	Van	Bus	Motorbike
Actual	Sedan	120	5	40	2	1
	Truck	3	100	7	8	0
	Van	25	1	80	3	0
	Bus	5	6	3	50	0
	Motorbike	1	0	0	0	250

b) Your friend has provided you the vehicle dataset including 500,000 training images, 100,000 validation images, and 100,000 test images with the label. After you train your model, you get the accuracy as follows: training accuracy 99%, validation accuracy 95%, and test accuracy 94%. However, once you deploy the model in the real scenario, you get the accuracy of 50%. What could be the cause of this low accuracy and how to fix it? (5 points)