



In the name of God  
Deep Learning Course (Fall 2021)  
Assignment #4  
Due date: 26<sup>th</sup> December

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In this assignment, you will design and implement a Convolutional Neural Network (CNN)

▪ **Part 0: Dataset**

At first, download the CIFAR-10 dataset, which is available [HERE](#). Use data\_batch\_1 to data\_batch\_5 for the training samples and test\_batch for the test samples.

▪ **Part 1: Build your network**

Your network should have at least 3 convolutional layers and 1 fully connected layer. Describe your network in a table like Table 1 for each layer of your network.

▪ **Part 2: Train your network**

Use google collaboratory to train your network based on your network structure. Describe your training procedure. Plot the following:

- (a) Training and test losses (not classification accuracy) vs. training iterations.
- (b) Classification accuracy on the test set vs. training iterations.

▪ **Part 3: Experiment with preprocessing the input data.**

Start from the network in the last part. Subtract the mean and perform global contrast normalization of the images. Train your network.

- (a) Plot classification accuracy on the test set vs. training iterations. Comment on the change of performance.

Does the network train faster? Generalize better? Discuss your results.

▪ **Part 4: Experiment with network structure.**

Some people argue that deep convolutional networks are successful because they have many more parameters than shallow ones. Here we want to test whether depth matters if the networks have similar parameters. Calculate the total amount of parameters in your network in part 1. Then try the following:



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(a) Create a network that only has one hidden convolutional layer. Increase the number of feature maps and/or the size of kernels to have the number of trained parameters be similar to your network in part 1.

(b) Create a network with at least one more hidden layer than your network in part a. Decrease the number of feature maps and/or the size of kernels to have the number of trained parameters be similar to your network in part a.

(c) Train your networks (a) and (b), plot classification accuracy on the test set vs. the number of training iterations. Comment on the change of performance. Is depth important?

Layer	Type	Input Size	Kernel Size	# Filters	Nonlinearity	Pooling	Stride	Size	Output Size	Parameters
1	Conv	32*32*3	3*3	48	ReLU	Average	2	2*2	16*16*48	1344
2	FC	16*16*48	1*1		ReLU				100*1	1228900
...										

Table 1: Example of network structure

**Notes:**

- Feel free to use any programming language.
- Pay extra attention to the due date. It will not extend.
- Be advised that submissions after the deadline would not grade.
- Prepare your entire report in PDF format and include the figures and results.
- Submit your assignment using a zipped file with the name of "StdNum\_FirstName\_LastName".zip