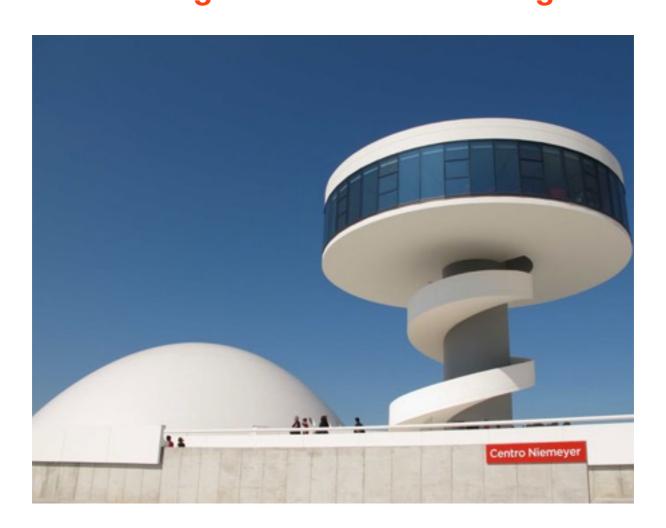Wen Sheng
STAT 665
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Problem Set 07

Data Mining and Machine Learning

I.   Convolution model kernel size

The results shows that the classification rate is much higher than the previous techniques used problem set 06. The pattern is the classification rate is increasing with the increasing kernel size.

When the kernel size is 1, every unit (or in other words, pixel) is multiplied by a same fixed value Alpha, which output a similar but pixel value is Alpha * inputX which constitutes the

first hidden layer, thus only consider the unit itself not consider the locality problem.

Kernel Size	1	3	5
Classification Rate	0.918	0.947	0.948

II.   Convolution model as autoencoder

The result shows that the mean square error is increasing with the kernel size increasing, which means the accuracy is decreasing. This decreased accuracy pattern differs from the part I.

This is due to with the kernel size increased, more other units around the center unit will be taken into calculation, in other words the weight of its center unit is decreased. Other units affects the center units output information and influentially impact the performance of autoencoder.

Kernel Size	1	3	5
Mean Square Error	0.0588	0.0610	0.0613

III.   Freezing the features

With the freezing layers, the classification rates of Model 1 is 0.948, nearly the same without freezing, while the classification rate of Model 2 is 0.327 remains pretty low.

This is due to with freezing layer the autoencoder of Model II make the input information of each image is conciser by distorted. The distorted input makes the classification rate pretty low.

Freezing Layers	Part I	Part II
Classification Rate	0.948	0.327

IV. Transfer learning

Compare to problem set 05, the classification rate is increased (in pset05, the classification rate is 0.4829) because we change the techniques here using convolutional networks. This shows that convolutional networks is better at handling complicated image classification problems.

Freezing Layers	Part I	Part II
Classification Rate	0.597	0.318

V. Double Convolution

With the double convolutional layer with kernel size 3, <u>the classification rate is higher than previous 0.947 in part 1 and higher than with only one convolution layer.</u>

This is due to with double convolutional layers, the range of center units' locality is widen and more surrounding units will be taken into consideration. This impact is served similar to have the kernel size of 6 - 9, which definitely increase the classification rate.

Kernel Size	3
Classification Rate (Cfar-2 class)	0.954

VI. Extensions

(Kernel Size, Convolution Number, Optimizer)	(5, 2, Adam)
Classification Rate (Cfar-10 class)	0.698

According to previous questions I found convolution with <u>kernel size of 5 and 2 convolution layer</u> have the highest performance. Combine this two features, I change the <u>optimizer to Adam</u> which generate the final classification rate of 0.698.