16720-A Computer Vision: Homework 1

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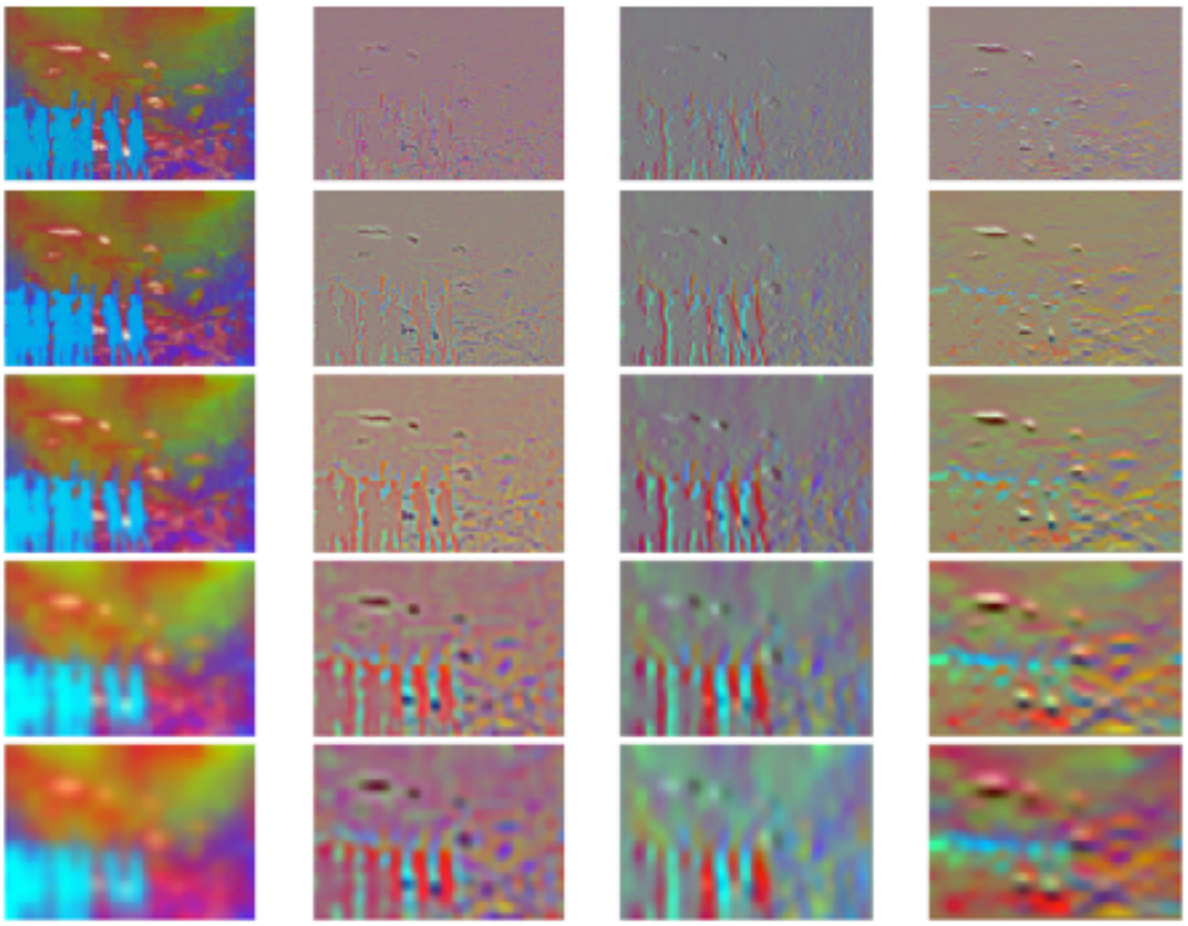
Q 1.1.1

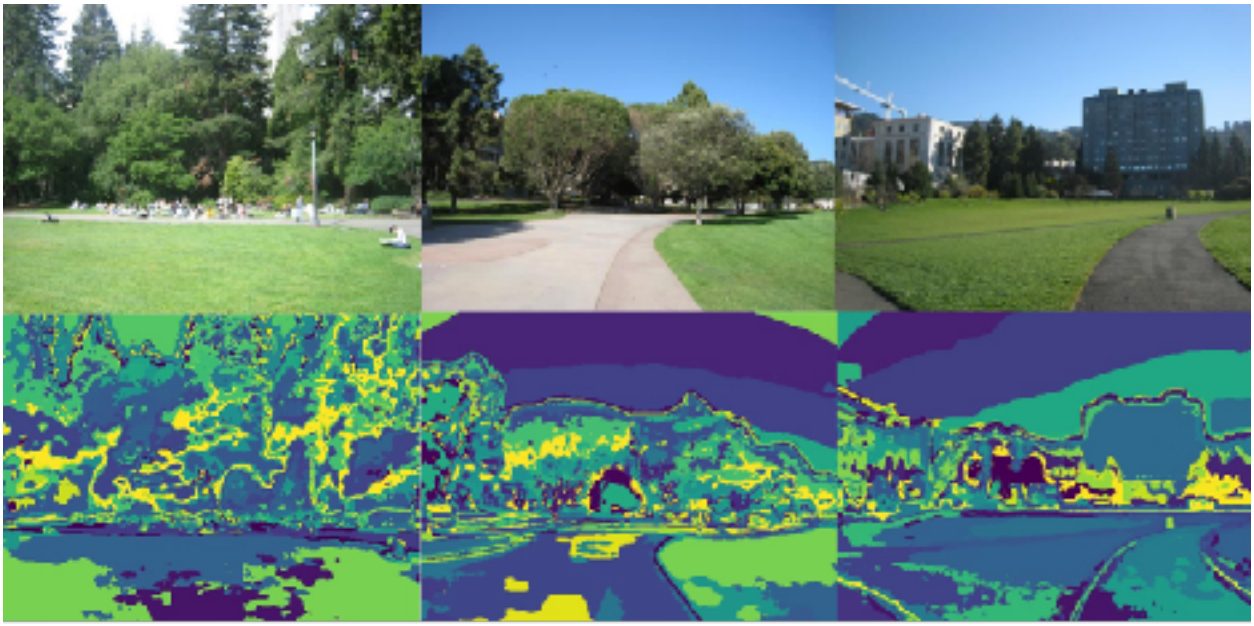
Gaussians filters blur the image and pick up the large concatenated regions in the image. Laplacian of Gaussian filters pick up the edges in the image. Derivative of Gaussian in the x direction filters pick up the edges with vertical component in the image. Derivative of Gaussian in the y direction filters pick up the edges with horizontal component in the image.

The reason why we need multiple scales of filter responses is that filters with different scales extract local features with different scales. The filter with larger scale calculate the response of more number of pixels in a local region. Therefore, filters with multiple scales could make our extracted features for a single image more comprehensive, and thereby improve the performance of later classification task.

Q 1.1.2



Q 1.3



I think the word boundaries make sense to me. The particular region with in the image is attached with one or a few number of colors, which means that that region is mapped to one or some particular visual words. The sky, grass, road regions can still be recognized in the word maps. For the blue sky regions in picture 2 and 3, they are all attached with same kind of colors.

Q 2.5

Confusion Matrix：

```
[[53.  3.  0.  0.  3.  0.  2.  0.]
 [ 2. 52.  0.  3.  1.  3.  3.  3.]
 [ 0.  2. 50.  9.  7.  5.  3. 11.]
 [ 1.  4.  4. 44.  0.  4.  2. 13.]
 [ 3.  1.  0.  1. 47.  6.  2.  0.]
 [ 4.  5.  3.  2. 31. 32.  4.  0.]
 [ 7. 12.  0.  1.  7.  7. 47.  2.]
 [ 1.  3.  3. 12.  2.  2.  4. 39.]]
```

Accuracy: 63%

Q 2.6

My classifier performs bad on class “laundromat”. It predict a lot of images belong to this category as category “kitchen”. I think this is because that the images of the two categories are very similar. Both laundromat and and kitchen are indoor rooms. Most of them tend to contain floor, ceiling, etc. Therefore, classification between these two class are difficult. Another example is highway and windmill. Images in these two category tend to have large regions of sky and ground. And my classifier made some mistakes predict windmill as highway.

Extra Credit:

Deep Learning has become a popular technique nowadays. Convolution neural network has shown outstanding performance on several computer vision tasks. So I decided to apply CNN to this classification task. I expect CNN to have a better performance compared with non-neural model. Due to my computational resource limitation, I was only able to apply a pretty naive CNN. But I still got an accuracy of 72% on test set, which is better than the previous classifier. The image below shows the structure of my network.