Chapter_7_Section_2_Autoencoder_Images

February 3, 2019

0.1 Ch 07: Concept 02

0.2 Autoencoder with images

Import the autoencoder class we wrote earlier:

```
In [1]: %matplotlib inline
        from matplotlib import pyplot as plt
        import pickle
        import numpy as np
        from autoencoder_DC import Autoencoder
```

Define some helper function to load and preprocess the data:

```
In [2]: def unpickle(file):
            fo = open(file, 'rb')
            dict = pickle.load(fo, encoding='latin1')
            fo.close()
            return dict

        def grayscale(a):
            # reshape to image shape -> take mean on fist (rgb) axis -> flatten again to (inde
            return a.reshape(a.shape[0], 3, 32, 32).mean(1).reshape(a.shape[0], -1)
```

Download the CIFAR-10 dataset in Python from https://www.cs.toronto.edu/~kriz/cifar.html. Then we can load the data using the following code:

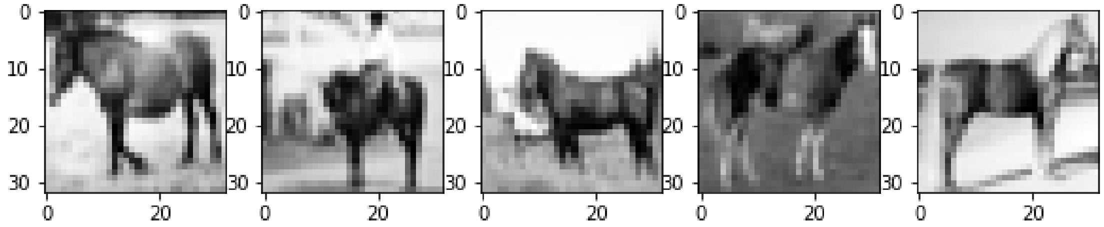
```
In [3]: names = unpickle('./cifar-10-batches-py/batches.meta')['label_names']
        data, labels = [], []
        for i in range(1, 6):
            filename = './cifar-10-batches-py/data_batch_' + str(i)
            batch_data = unpickle(filename)
            if len(data) > 0:
                data = np.vstack((data, batch_data['data']))
                labels = np.hstack((labels, batch_data['labels']))
            else:
                data = batch_data['data']
                labels = batch_data['labels']
        data = grayscale(data)
        # a matrix is the same as an array but with the restriction that is 2D
        # it's slower that an array since it's a subclass
        x = np.matrix(data)
        y = np.array(labels)
```

Train the autoencoder on images of horses:

```
In [4]: horse_indices = np.where(y == 7)[0]
        horse_x = x[horse_indices]
        print(np.shape(horse_x))  # (5000, 3072)

        print('Some examples of horse images we will feed to the autoencoder for training')
        plt.rcParams['figure.figsize'] = (10, 10)
        num_examples = 5
        for i in range(num_examples):
            horse_img = np.reshape(horse_x[i, :], (32, 32))
            plt.subplot(1, num_examples, i+1)
            plt.imshow(horse_img, cmap='Greys_r')
        plt.show()
```

```
(5000, 1024)
Some examples of horse images we will feed to the autoencoder for training
```



```
In [5]: input_dim = np.shape(horse_x)[1]
        hidden_dim = 100
        ae = Autoencoder(input_dim, hidden_dim)
        ae.train(horse_x)
```

```
epoch 0: loss = 129.77084350585938
epoch 100: loss = 56.2933235168457
epoch 200: loss = 54.168724060058594
epoch 300: loss = 50.35117721557617
epoch 400: loss = 51.81658172607422
epoch 500: loss = 57.036746978759766
epoch 600: loss = 47.42890548706055
epoch 700: loss = 48.96802520751953
epoch 800: loss = 49.31039047241211
epoch 900: loss = 48.2364616394043
```

Test the autoencoder on other images:

```
In [6]: test_data = unpickle('./cifar-10-batches-py/test_batch')
        test_x = grayscale(test_data['data'])
        test_labels = np.array(test_data['labels'])
        encodings = ae.classify(test_x, test_labels)
```

```
INFO:tensorflow:Restoring parameters from ./model.ckpt
data (10000, 1024)
reconstructed (10000, 1024)
loss (10000,)
horse SSD 47.57014168709842
not horse SSD 49.15958528592328
```

```
In [9]: # visualise only images of horses
        test_horse_indices = np.where(test_labels == 7)[0]
        plt.figure(figsize=(32,20))
        for i in range(5):
            plt.subplot(5, 2, i*2 + 1)
            original_img = np.reshape(test_x[test_horse_indices[i], :], (32, 32))
            plt.imshow(original_img, cmap='Greys_r')

            plt.subplot(5, 2, i*2 + 2)
            reconstructed_img = ae.decode([encodings[test_horse_indices[i]]])
            plt.imshow(reconstructed_img, cmap='Greys_r')

        plt.show()
```

```
INFO:tensorflow:Restoring parameters from ./model.ckpt
INFO:tensorflow:Restoring parameters from ./model.ckpt
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```

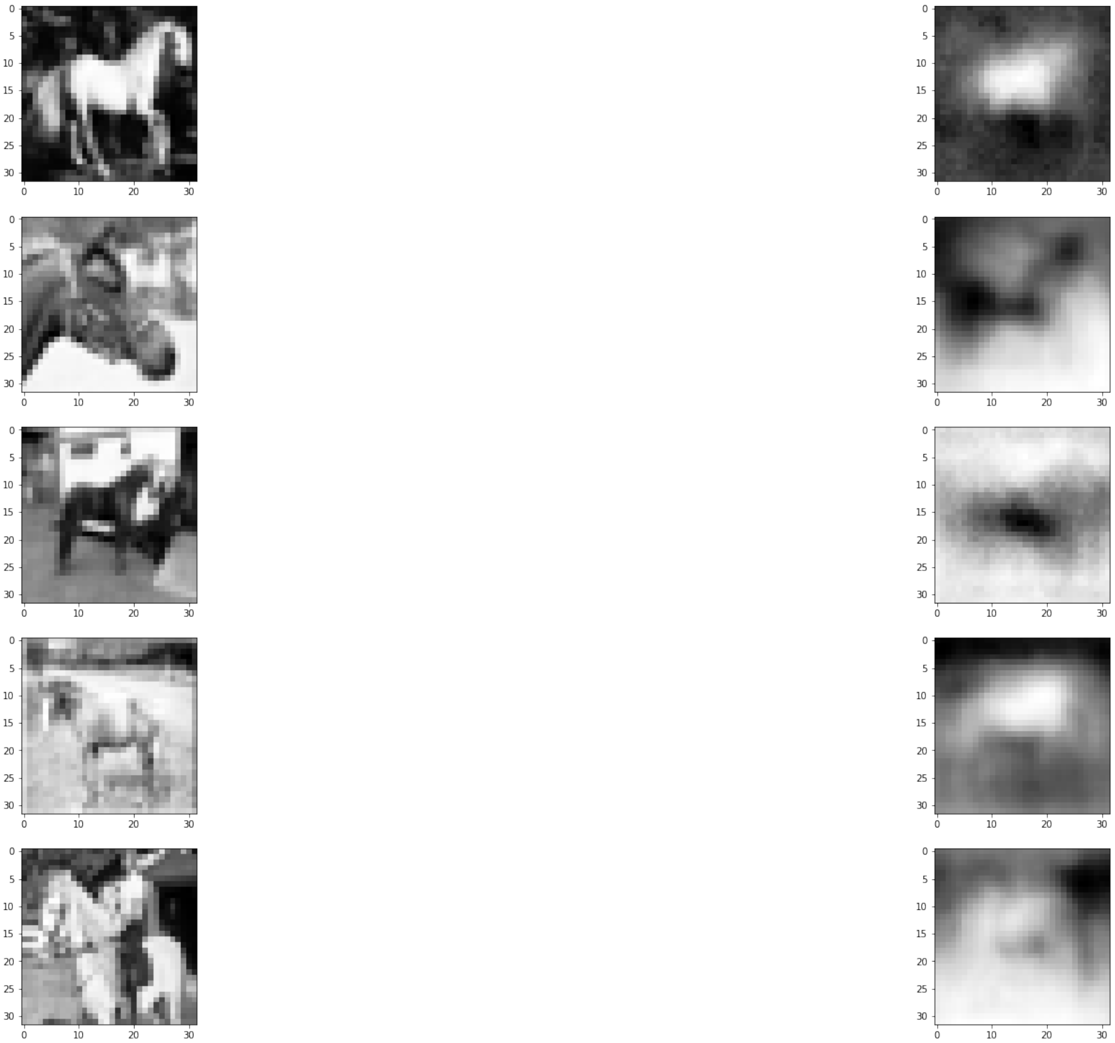
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