Report on Learning Python

NumPy and Matplotlib using Google Colab or Anaconda Virtual Environment

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6. Numpy

[Numpy](http://www.numpy.org/) is the core library for scientific computing in Python. It provides a high-performance multidimensional array object, and tools for working with these arrays. If you are already familiar with MATLAB, you might find [this tutorial useful](https://docs.scipy.org/doc/numpy/user/numpy-for-matlab-users.html) to get started with Numpy.

Before using NumPy module, it is necessary to import. There are several ways to import NumPy. The standard approach of simple import is using the statement: import numpy. However, contrasting to the standard importing method, it is also available to import as the followings: import numpy as np, and from numpy import \*. Importing numpy as np is providing the name np for numpy. From numpy import \* is equivalent to the standard approach since it is importing all functions in numpy.

A numpy array is a grid of values, all of the same type, and is indexed by a tuple of nonnegative integers. The number of dimensions is the rank of the array; the shape of an array is a tuple of integers giving the size of the array along each dimension.

Arrays in numpy are similar to lists in Python, and they can be created from a list. They can form multi-dimension. These are the basic elements of array that can implement the kernels in the ConvNet convolution part.

As the advanced functions, arrays provide methods that can reshape the dimensions, copy the function, convert the array raw data to binary string, transpose the axes of arrays, concatenate arrays and slice.

They are also available for simple and standard mathematical arithmetic to each array elements. It signifies that the math on array can compile with matching sizes. However, arrays that do not match will be broadcasted by Python to perform the operations. This automatic broadcasting provided in Python sometimes occurs error. The equivalent method can be done by using [newaxis, :] constant to reshape the array and apply math for each.

The array operations mostly satisfies and are the same with the list functions provided by Python itself. It has sorting, calculating the means, obtaining minimum and maximum, and simple comparisons. The difference from list is that array has functions that return the indices of the minimum and maximum values, which are argmin and argmax, as well as computing the statistical quantities such as variance and standard deviation.

NumPy also provides many functions for performing standard vector and matrix multiplication routines. They are available for dot product examination with dot() method. It also generalizes to matrix multiplication, and possible for inner, outer and cross product implementations. They are utilizable in convolution and fully-connected layers of CNN, where it needs the dot product to convolute the image with filters. Not only the dot products, but it also provide the methods that can generate eigenvalues, eigen vectors, singular value decomposition and inverse of matrices.

As for the last functionality of NumPy, it supplies methods for working with polynomial. It is possible to find the polynomial coefficients with given set of roots, or opposingly finding the roots of given polynomial coefficients. These functions are written with poly() and roots() methods. It is also able to integrate and derive the polynomial functions, evaluating the polynomial at a particular point, as well as fitting a polynomial of a specified order to a set of data by using polyint(), polyder(), polyval() and polyfit() correspondingly.

1. Matplotlib

[Matplotlib](http://matplotlib.org/) is probably the most used Python package for 2D-graphics. It provides both a quick way to visualize data from Python and publication-quality figures in many formats. We are going to explore matplotlib in interactive mode covering most common cases.

[Matplotlib](http://matplotlib.org/) is a plotting library. In this section give a brief introduction to the matplotlib.pyplot module, which provides a plotting system similar to that of MATLAB.

Before any executions, %matplotlib magic is added to connect to a GUI loop. This is operated with “%matplotlib inline”.

There are two main functions provided by Matplotlib. First of all, plotting 2D data in graphs is possible. Importing matplotlib.pyplot module and computing the 2D data with numpy ahead of the process is required. Then, plotting the output data with plot() method will allow the analysis. It is important to note that to visualize, it is necessary to use show() function before running the code. Equivalent to the MATLAB plotting functions, the labeling, putting the title and legends can be done with xlabel(), ylabel(), title() and legend() methods. When plotting, the module also provides the subplot function that data can be appeared in two different windows. The first two arguments assigned represent the height and width of the window, where the third value is for the window hierarchies for demonstration.

Another function that Matplotlib provides is imshow that displays images. The images are searched in the same folder, and returns error if it cannot find. The image can be showed with modified colors by rescaling the image channels or displayed in numbers by printing the values read from the image.