Deep Learning with PyTorch: Object classification

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1 Introduction

In this practical course we will study different structures of deep convolutional neural networks to work on image classification using the *PyTorch* [1] Python library. Material can be downloaded from :
http://perso.ensta-paristech.fr/~filliat/Courses/index.html

Due to the limitation of the machines power (specially the lack of dedicated GPUs), we will work with a smaller network that is partially representative of real applications in order to test the capacity of deep learning techniques. The main objective is to understand the structure of convolutional networks and the influence of their parameters over the learning process.

2 Running the notebook

All required software should be installed on the school computers in a virtual machine on Python 3 that you need to launch by running :
`torchvision`
If you want to use your own computer, see the installation at the end of this file.
Download the notebook from the address :
http://perso.ensta-paristech.fr/~filliat/Courses/Polys/cnn-tutorial.zip

You can then run the notebook by executing, in the main project folder :

`jupyter notebook cifar10_tutorial.ipynb` [2]

The notebook will guide you through the use of the CIFAR10 database (Figure 1) with ten categories of objects and the construction of an artificial neural network to classify them. Each image is 32x32 pixels and examples of categories are planes, cars, birds, etc.

The data can be downloaded automatically by the notebook, or manually from https://drive.google.com/file/d/1LrmhnOvuilYyJ_Gto_r0xjXlNFq8PYPM/view (put the `data/` folder as a subfolder of the one containing `cifar10_tutorial.ipynb`.

3 Reporting

Send a pdf report to `natalia.diaz@ensta-paristech.fr` latest on 2nd Feb. detailing what you have done in part III : explain what neural networks and hyper parameters configurations you tested, and the resulting performances. Most importantly, report the accuracy on the image test set) and plot of losses. The best performance will be used for a leader board. All used parameters must be reported (at least learning rates, batch size, nr of epochs).

You can try to modify :

1. http://pytorch.org/tutorials/index.html
2. On some computers, you may need to add the –ip option : `jupyter notebook -ip=127.0.0.1 cifar10_tutorial.ipynb`

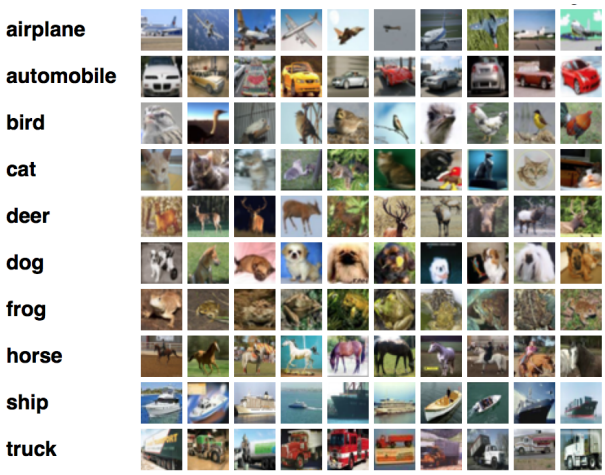

FIGURE 1 – Sample images from CIFAR 10 Database

— The neural network structure (kernel size, number of feature maps, number of convolutional layers, size of fully connected layers, ...
— The size of the training set/validation set
— Batch size, number of epochs, learning rates

4 Installation

Everything should be installed on the school computers. If you want to use your own computer, here are the installation instructions. The notebooks are tested in Python 3 but they should be Python 2 compatible (if you go with Python 3, substitute all pip instructions with pip3) :

4.1 Windows

1. Download and install Anaconda (it includes Jupyter notebook)
   https://www.anaconda.com/download/#download
2. Install PyTorch : run in Anaconda Prompt :
   `conda install -c peterjc123 pytorch`
   `pip install torchvision`

4.2 Linux / Mac Os

4.2.1 Anaconda Users

1. Download and install Anaconda (it includes Jupyter notebook)
   https://www.anaconda.com/download/#download
2. Install PyTorch and Torch vision (here without CUDA support)
   `conda install pytorch torchvision -c soumith`
3. We recommend you create one virtual environment for each of your projects to avoid different external libraries versions break when you install new packages and dependencies. Create a conda virtual environment with `conda create env_name`,
   e.g. : `conda create deeplearning`
   And activate it (install all project related libraries inside) :
   `source activate env_name`
   or deactivate when you no longer work on it :
   `source deactivate`

4.2.2 Pip users (advanced)

1. Make sure Jupyter Notebook is installed
   `pip install -upgrade pip`
   `pip install jupyter`
2. Go to http://pytorch.org/ and select your configuration to get the installation command line.
   For example, with Linux and python 3.5 :
   `pip3 install http://download.pytorch.org/whl/cu75/torch-0.2.0.post3-cp35-cp35m-manylinux1_x86_64.whl`
3. Install torchvision :
   `pip install torchvision`

5 Q & A (Potential issues)

1. Q : If, when running the Jupyter notebook you get : `ImportError: No module named jinja2`
   A : `pip install jinja2`
2. Q : Proxy problem installing pyTorch : `'pip._vendor.requests.exceptions.InvalidSchema: Missing dependencies for SOCKS support.'` A : This was corrected by unsetting the ALL_PROXY : `printenv | grep -i proxy unset ALL_PROXY printenv | grep -i proxy`
   Q : Installing PyTorch may require you to be sudo : A : Use `sudo -H` to get the installations working : `sudo -H pip install http://download.pytorch.org/whl/cu75/torch-0.2.0.post3-cp35-cp35m-man`
   -E option can also be used for commands under proxy, in which case, your ~/.bashrc file must contain : `export http_proxy=http://proxy.ensta.fr:8080 export https_proxy=http://proxy.ensta.fr:8 sudo -H pip install torchvision`

Acknowledgement

This short practical is strongly based on the courses :
— Coursera DeepLearning.ai by Andrew Ng
https://www.coursera.org/learn/convolutional-neural-networks
More complete tutorials and courses can be found at :
— Python Numpy http://cs231n.github.io/python-numpy-tutorial/ and IPython tutorials http://cs231n.github.io/ipython-tutorial/
— Andrej Karpathy course CS231n Convolutional Neural Networks for Visual Recognition http://cs231n.github.io/
— MILA tutorials https://github.com/mila-udem/welcome_tutorials/tree/master/pytorch
— PyTorch's excellent tutorials : http://pytorch.org/tutorials/beginner/blitz/cifar10_tutorial.html
— Applications with PyTorch : https://twitter.com/pytorch
— Learn PyTorch with no Deep Learning background with Sung Kim's PyTorchZeroToAll https://github.com/hunkim/PyTorchZeroToAll
— A guide to convolution arithmetic for deep learning, V. Dumoulin and Francesco Visin https://github.com/vdumoulin/conv_arithmetic.
— Deep Learning. I. Goodfellow, Y. Bengio and A. Courville, MIT Press, http://www.deeplearningbook.org, 2016.
— Deep Learning with Python, Francois Chollet, Manning Publications. 2017, https://github.com/fchollet/deep-learning-with-python-notebooks