Pattern Recognition
Homework 5 announcement

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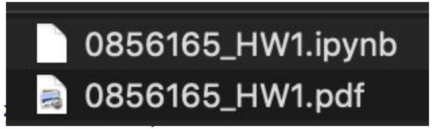
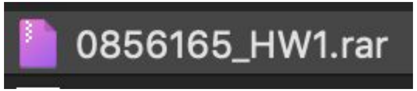
Homework 5

- **Deadline: June 23, Fri at 23:59.**
  1. Code assignment (100%): implement the deep neural network by any deep learning framework, e.g. Pytorch, TensorFlow and Keras, and then train DNN model by the Cifar-10 dataset
- Submit your **1) code (.py/.ipynb)** and **2) reports (.pdf)** on E3
  - Sample Code
  - HW5 questions
- Please follow the **file naming rules <STUDENT ID>_HW5.pdf,** otherwise, you will get penalty of your scores


0856165_HW1.ipynb
0856165_HW1.pdf

Compress

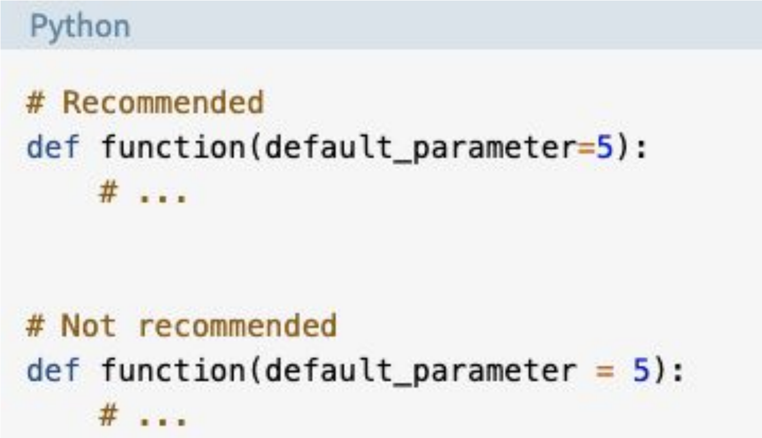

0856165_HW1.rar

submit

E3

Coding

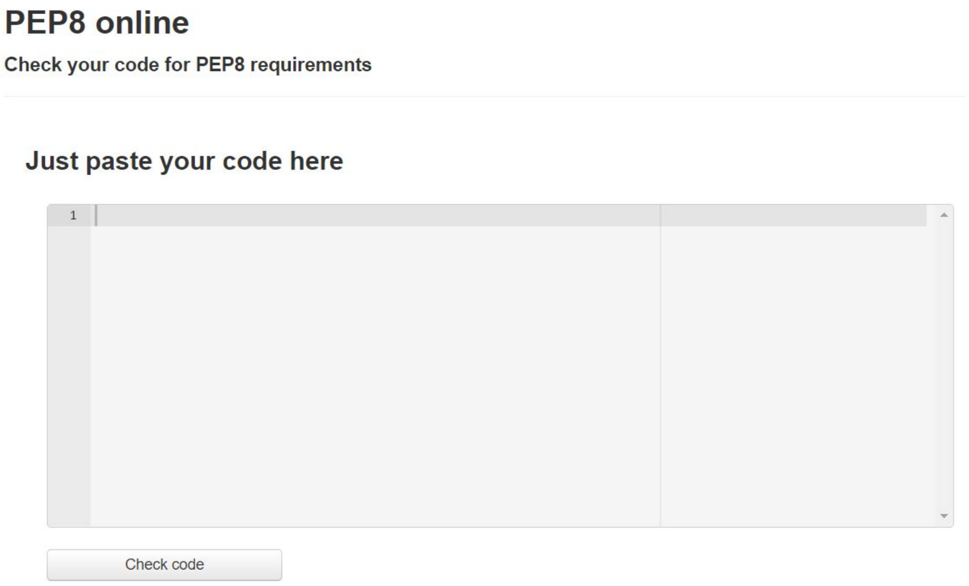
- Write beautiful Python codes with PEP8 guidelines for readability. Basic requirement: use whitespace correctly!
- PEP8 online checker



Python

```python
# Recommended
def function(default_parameter=5):
    # ...


# Not recommended
def function(default_parameter = 5):
    # ...
```



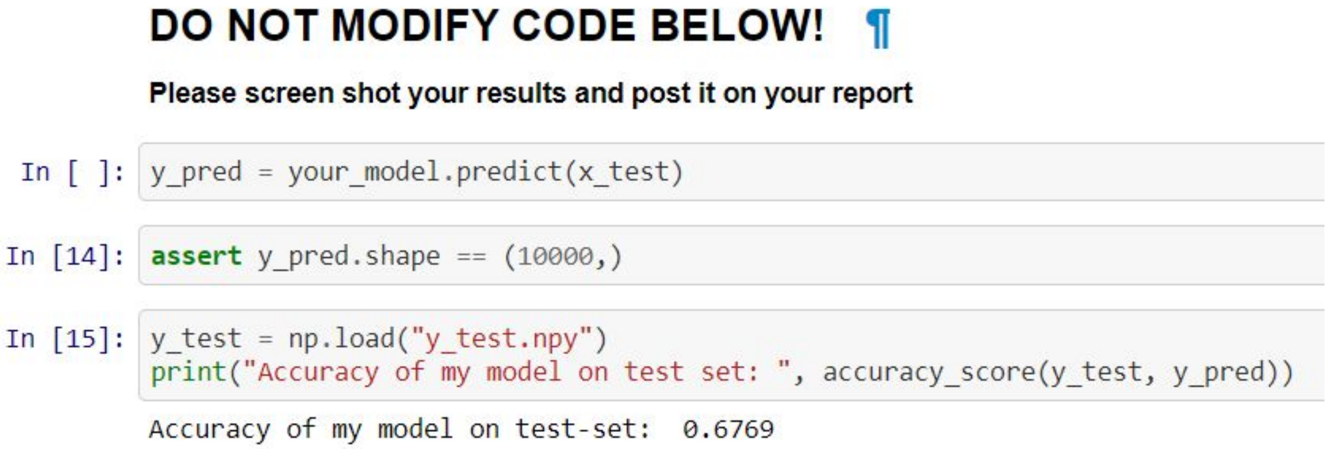
PEP8 online

Check your code for PEP8 requirements

Just paste your code here

Reports

- Include the implementation details and hyperparameters of your model
  - https://github.com/paperswithcode/releasing-research-code
- Include the accuracy of your model in the reports!



DO NOT MODIFY CODE BELOW! ¶

Please screen shot your results and post it on your report

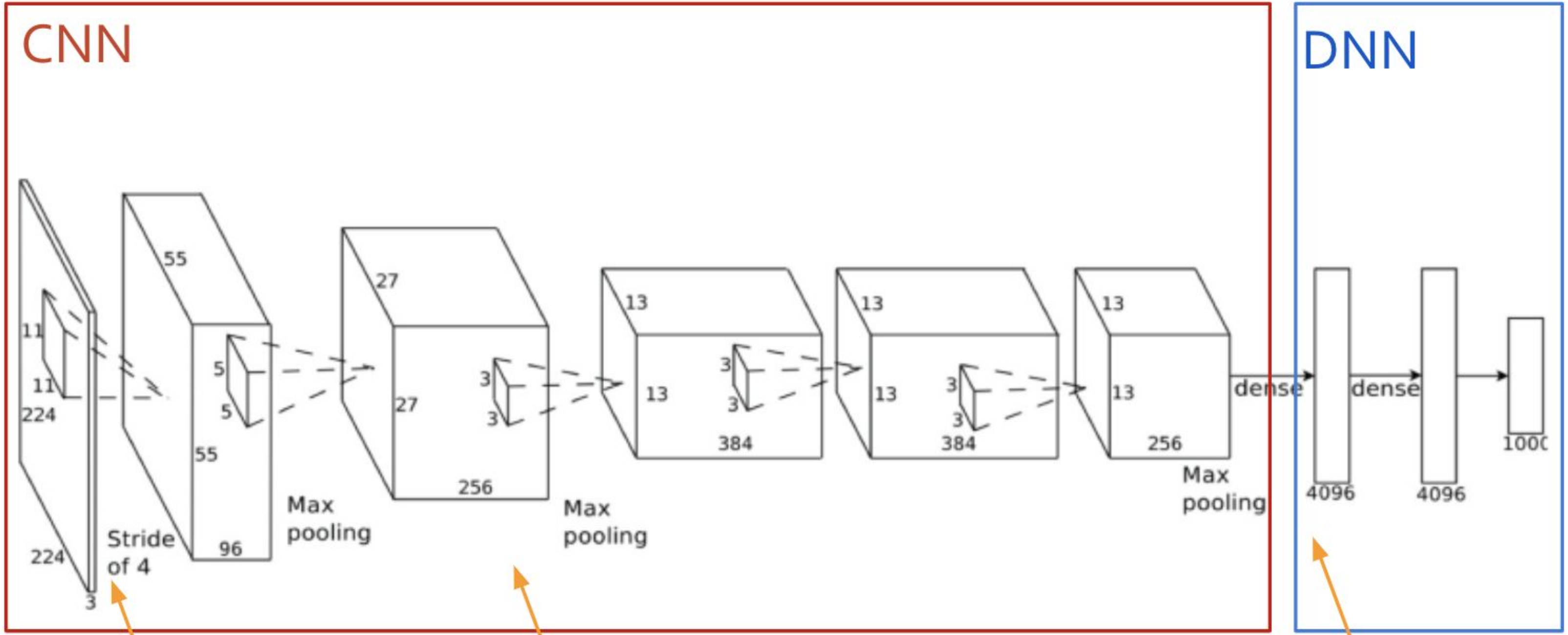
```
In [ ]:  y_pred = your_model.predict(x_test)

In [14]: assert y_pred.shape == (10000,)

In [15]: y_test = np.load("y_test.npy")
         print("Accuracy of my model on test set: ", accuracy_score(y_test, y_pred))

         Accuracy of my model on test-set:  0.6769
```

Typical struture of CNN



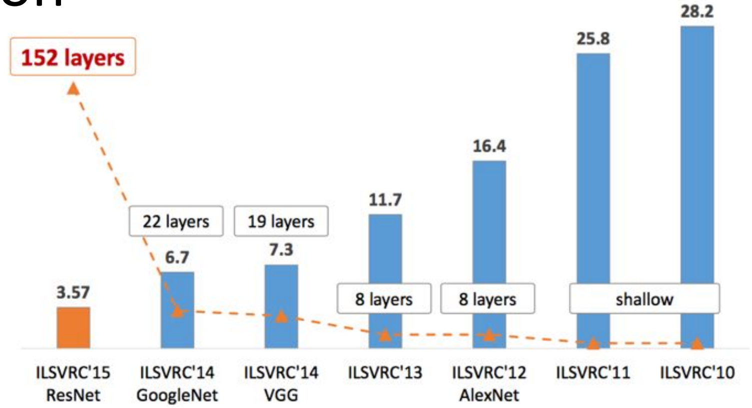
Input

Convolutional Layer

Dense Layer

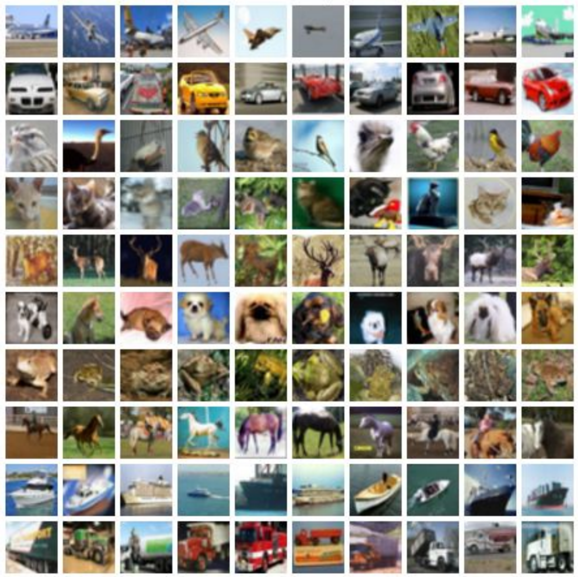
Deep neural networks

- Deep neural networks are a powerful category of machine learning algorithms implemented by stacking layers of neural network
- Convolutional neural networks (CNN), which at least one layer is a convolutional layer, have had great success in certain kinds of problems, such as image recognition



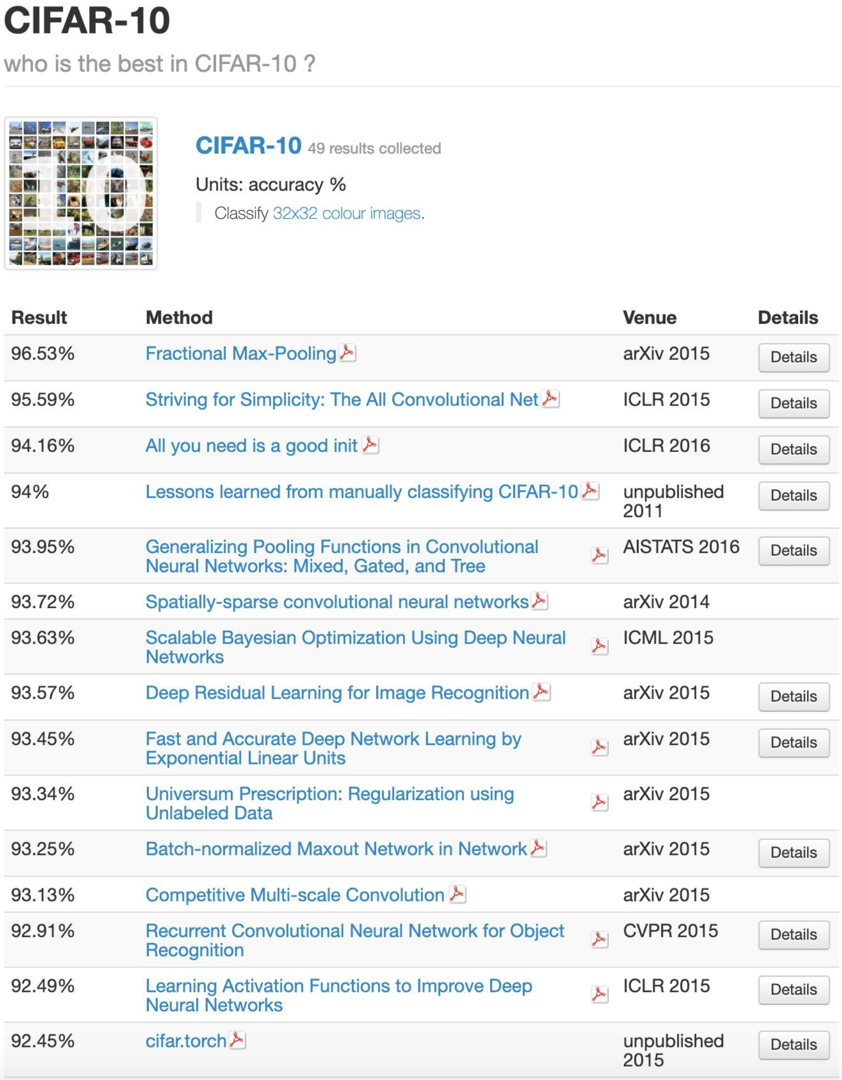
Cifar-10 dataset

- 60,000 (50,000 training + 10,000 testing) samples, 32x32 RGB images in 10 classes
  - airplane, automobile, ship, truck, bird, cat, deer, dog, frog, horse



Leaderboard of CIFAR-10

- **Baseline: accuracy over 70%**
- Note that you should only train and evaluate your model on the provided dataset HERE
- **DO NOT** download the data from other resources.



CIFAR-10

who is the best in CIFAR-10 ?

CIFAR-10 49 results collected

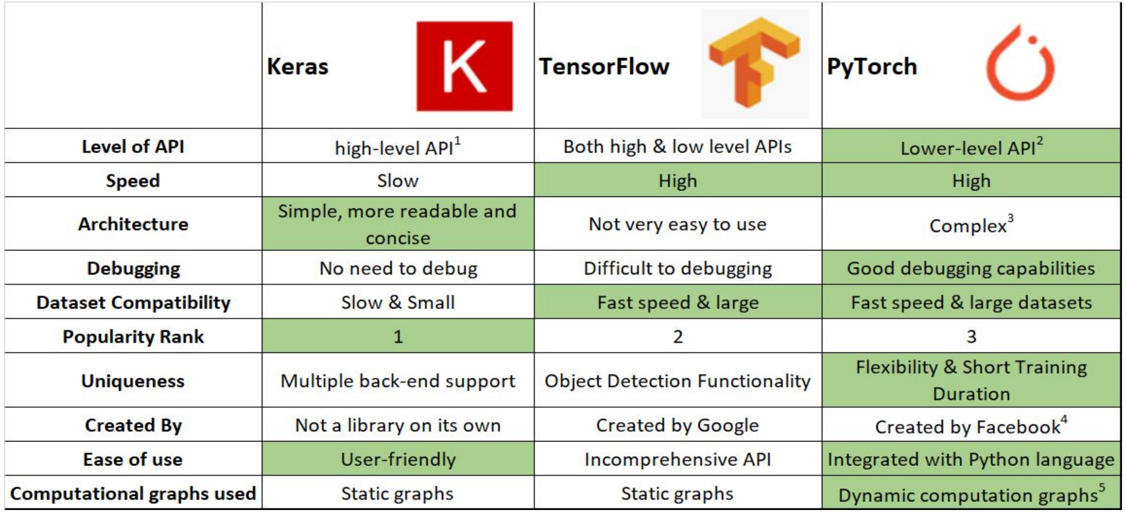
Units: accuracy %

> Classify 32x32 colour images.

Result	Method	Venue	Details
96.53%	Fractional Max-Pooling	arXiv 2015	Details
95.59%	Striving for Simplicity: The All Convolutional Net	ICLR 2015	Details
94.16%	All you need is a good init	ICLR 2016	Details
94%	Lessons learned from manually classifying CIFAR-10	unpublished 2011	Details
93.95%	Generalizing Pooling Functions in Convolutional Neural Networks: Mixed, Gated, and Tree	AISTATS 2016	Details
93.72%	Spatially-sparse convolutional neural networks	arXiv 2014	
93.63%	Scalable Bayesian Optimization Using Deep Neural Networks	ICML 2015	
93.57%	Deep Residual Learning for Image Recognition	arXiv 2015	Details
93.45%	Fast and Accurate Deep Network Learning by Exponential Linear Units	arXiv 2015	Details
93.34%	Universum Prescription: Regularization using Unlabeled Data	arXiv 2015	
93.25%	Batch-normalized Maxout Network in Network	arXiv 2015	Details
93.13%	Competitive Multi-scale Convolution	arXiv 2015	
92.91%	Recurrent Convolutional Neural Network for Object Recognition	CVPR 2015	Details
92.49%	Learning Activation Functions to Improve Deep Neural Networks	ICLR 2015	Details
92.45%	cifar.torch	unpublished 2015	Details

Deep learning framework

- If you are a newbie in a deep learning framework, we recommend you learn Keras or Pytorch.
  - Keras: Only Few lines of code to build a CNN model
  - TensorFlow: Easy for depolyment
  - Pytorch: Flexible for research



	Keras	TensorFlow	PyTorch
Level of API	high-level API[1]	Both high & low level APIs	Lower-level API[2]
Speed	Slow	High	High
Architecture	Simple, more readable and concise	Not very easy to use	Complex[3]
Debugging	No need to debug	Difficult to debugging	Good debugging capabilities
Dataset Compatibility	Slow & Small	Fast speed & large	Fast speed & large datasets
Popularity Rank	1	2	3
Uniqueness	Multiple back-end support	Object Detection Functionality	Flexibility & Short Training Duration
Created By	Not a library on its own	Created by Google	Created by Facebook[4]
Ease of use	User-friendly	Incomprehensive API	Integrated with Python language
Computational graphs used	Static graphs	Static graphs	Dynamic computation graphs[5]

Keyword for boosting your performance

- Beat the baseline
  - CNN structure (number of filters, number of CNN layers,...)
  - Data augmentation
  - Regularization

- Score over 90%!
  - Read some paper from leaderboard of Cifar-10

Accelerate your training by GPU

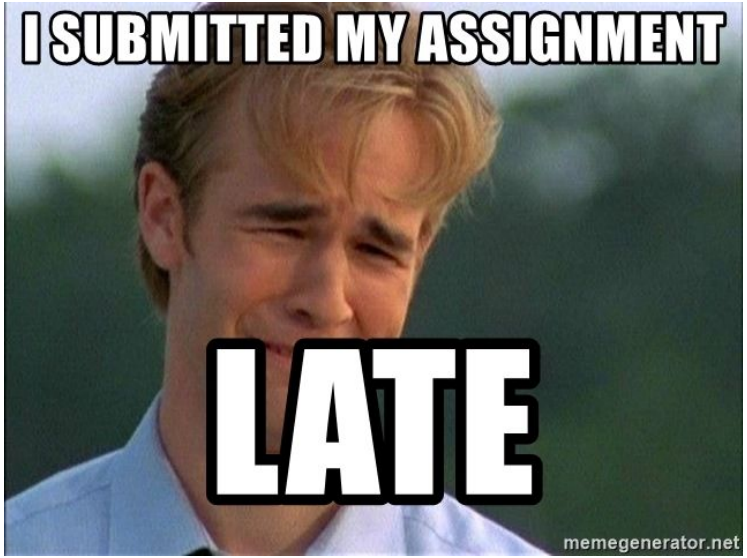
- You may need GPU to accelerate the training of deep neural network. We provide several free GPU resources for you, some of resources need registration and limited by usage.
    - □ Google Colab: Free GPU usage for continuous 24 hours
    - □ FloydHub: Registration for free GPU trials
    - □ Microsoft Azure: Registration for free GPU trials

Reference

- Convolutional Neural Networks Tutorial in PyTorch
- Building a Convolutional Neural Network (CNN) in Keras

Late Policy

- We will deduct a late penalty of 20 points per additional late day
- For example, If you get 90 points of this HW but delay for two days, your will get only 90- (20 x 2) = 50 points!



Notice

- Submit your homework on E3-system !
- Check your email regularly, we will mail you if there are any updates or problems of the homework
- If you have any questions or comments for the homework, please mail TAs and cc Prof. Lin
    - Prof. Lin, lin@cs.nctu.edu.tw
    - TA Jimmy, d08922002@csie.ntu.edu.tw
    - TA 柏聲, bensonliu0904@gmail.com
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Have fun!