Assignment 1 CNN for image recognition (20p)

Goal

To familiarize yourself with which you have learned for building a new CNN model.

Due Date

October 25, 2019 at 08:00am.

Note that it is a **DEADLINE**. You will grade as zero if you return your report and code after the deadline unless you have good reasons and let me know in advance.

Steps

1 Dataset download

1.1 Please use the training set and testing set of CIFAR-10 dataset: https://www.cs.toronto.edu/~kriz/cifar.html

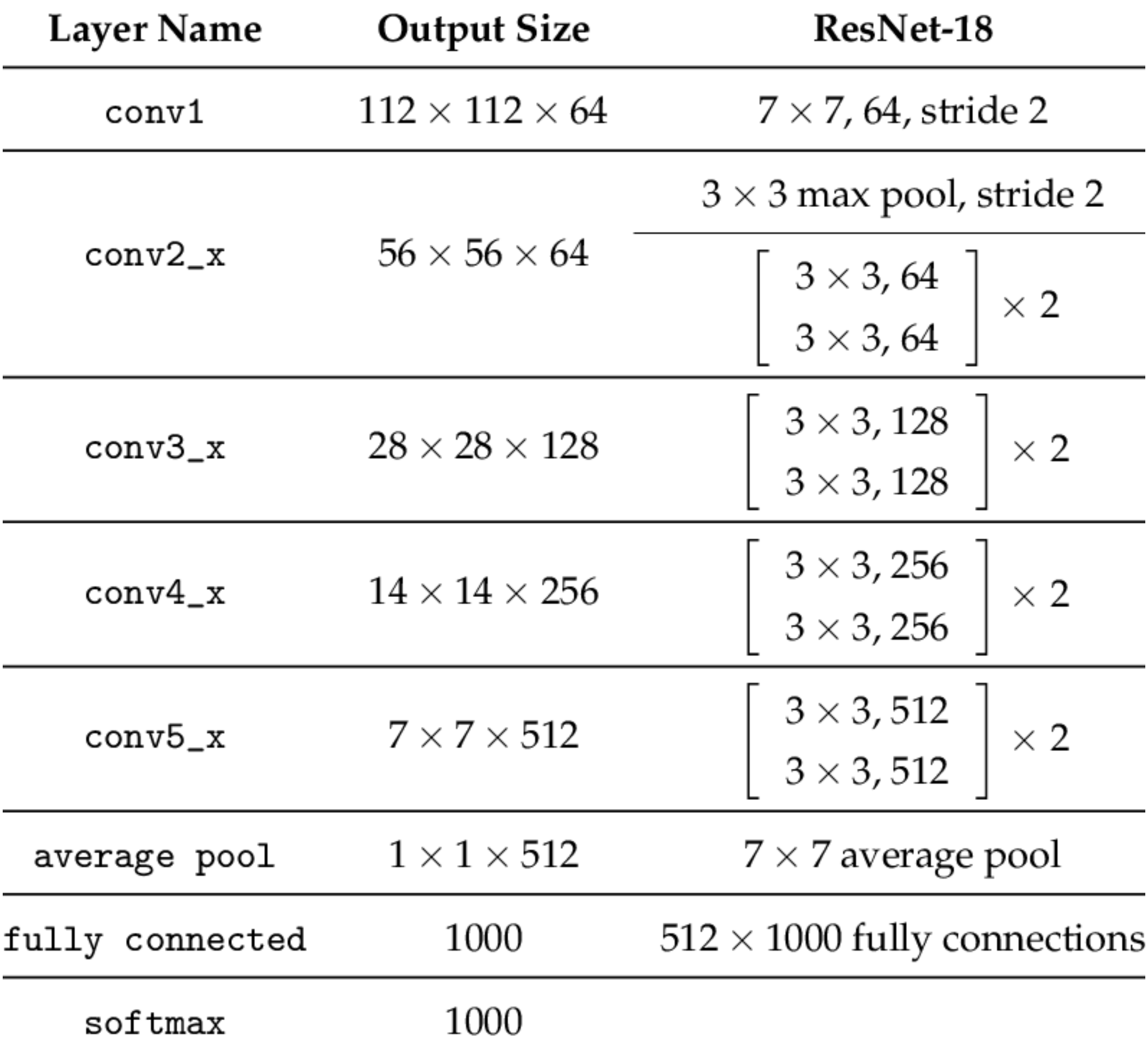
1.2 Downloading CIFAR-10 dataset following this link: https://pytorch.org/tutorials/beginner/blitz/cifar10_tutorial.html

1.3 If you have no GPU at hand, please do it like this:

```
device = torch.device("cuda:0" if torch.cuda.is_available() else "cpu")
model = model.to(device)
```

If you have more questions, please contact our **TA (Qian Ren)**.

Table 1 your own ResNet model



Layer Name	Output Size	ResNet-18
conv1	$112 \times 112 \times 64$	7×7, 64, stride 2
conv2_x	$56 \times 56 \times 64$	3×3 max pool, stride 2 $\begin{bmatrix} 3 \times 3, 64 \\ 3 \times 3, 64 \end{bmatrix} \times 2$
conv3_x	$28 \times 28 \times 128$	$\begin{bmatrix} 3 \times 3, 128 \\ 3 \times 3, 128 \end{bmatrix} \times 2$
conv4_x	$14 \times 14 \times 256$	$\begin{bmatrix} 3 \times 3, 256 \\ 3 \times 3, 256 \end{bmatrix} \times 2$
conv5_x	$7 \times 7 \times 512$	$\begin{bmatrix} 3 \times 3, 512 \\ 3 \times 3, 512 \end{bmatrix} \times 2$
average pool	$1 \times 1 \times 512$	7×7 average pool
fully connected	1000	512×1000 fully connections
softmax	1000	

2 Create your own ResNet work shown in Table 1 (19p)

2.1 Table 1 is an 18-layer ResNet model. Each block “conv_i-x” has a “shortcut connection”. For details, see the Fig. 2 in the paper https://arxiv.org/pdf/1512.03385.pdf

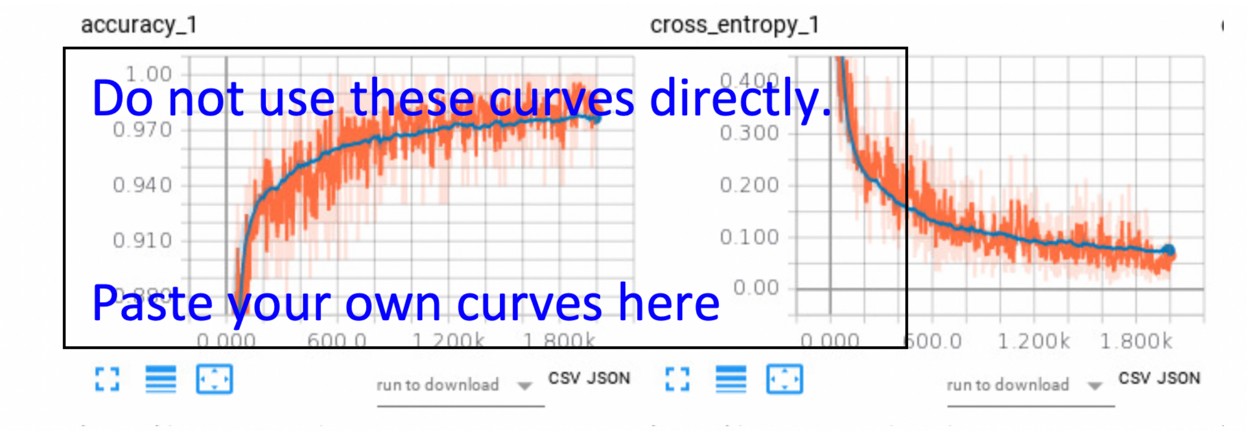
2.2 Create this model in Table 1 (**8p**)

2.3 The code in this link might help you https://pytorch.org/docs/stable/_modules/torchvision/models/resnet.html

2.4 Use the downloaded training dataset (see Section 1) to train your created model

2.5 Report the final accuracy (10,000 steps) of training and testing for the CIFAR-10 dataset (see Section 1.1) (**2x1=2p**). **Note**: For training in task 2, 10,000 iterations are good. 1,000 iterations are fine if your computation power is limited. However, 100 steps are the **minimum**. Try to train **more iterations** to observe the variations of loss function, cross entropy, accuracy for training dataset and testing set. It would help you to tune the model, parameters for your future task. ***(Sum: 10p)***

2.6 Visualize the learning progress (e.g., tensorboardX in Pytorch). Please take a picture for the visualized curves in tensorboardX or visdom in Pytorch then paste them here



Do not use these curves directly.

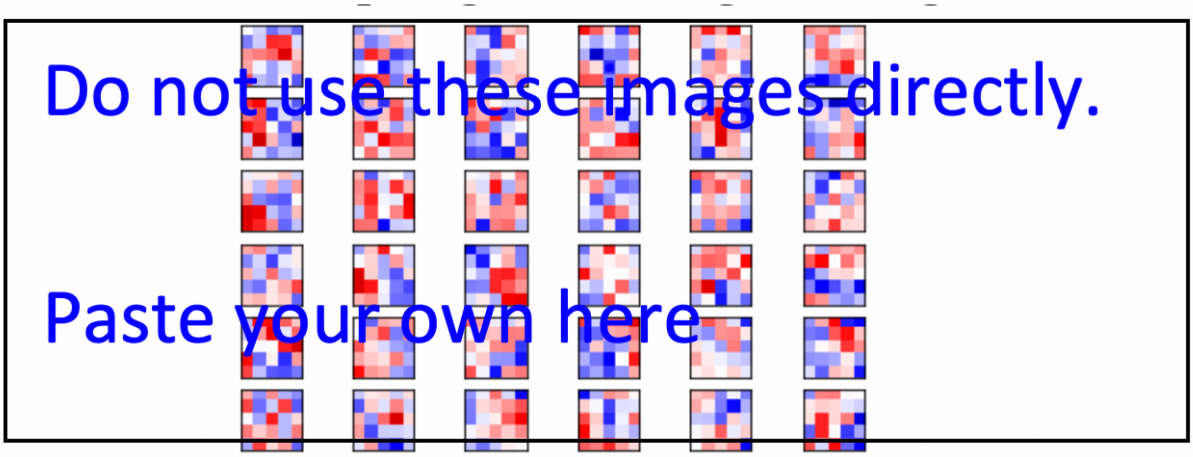
Paste your own curves here

Fig.1. Accuracy and cross_entropy (or loss function)

- accuracy (**1p**) and
- cross_entropy (or loss function) (**1p**) as shown in Fig. 1. ***(Sum: 12p)***

2.7 Filter visualization

- Visualization the 64 filters in the layer 'Conv1'(Layer-1 in Table 2) after retraining the whole model by 10,000 steps (**3p**) and show them in your report. Some examples are shown in Fig. 2. **Note**: For training in task 2.7, 10,000 iterations are good. 1,000 iterations are fine if your computation power is limited. However, 100 steps are the **minimum**. ***(Sum: 15p)***
- You might refer to this link : https://github.com/grishasergei/conviz



Do not use these images directly.

Paste your own here

Fig.2. Filter visualization

2.8 Feature mapping visualization

- Visualize the feature maps of the layer 'Conv1'(Layer-1 in Table 2) and also the last layer in the block Conv5_x (**2*2=4p**)
- Some example figures can be found in Figure 2 of this paper: https://arxiv.org/pdf/1311.2901.pdf
- I want both
  - the reconstructed patterns from the validation set that cause high activations in a given feature map (**2p**).
  - the corresponding image patches for each feature map (**2p**).
- Some example code can be found here: https://github.com/kvfrans/feature-visualization

  https://github.com/utkuozbulak/pytorch-cnn-visualizations

- Document for these code:

  http://kvfrans.com/visualizing-features-from-a-convolutional-neural-network/

(Sum: 19p)

3. Feedback (1p)

- Time your spend for this assignment, i.e., how many hours? (**0.1p**)
- Comments for this course? (**0.3p**)
- Comments for this assignment? (**0.3p**)
- Suggestion for the following lectures? (**0.3p**)

(Sum: 20p)

Report

- **Code** for Task 2. The code should be based on **Pytorch(Version 1.3 is required)** platform and using python language.
- The **results**, curves and filter visualization are suggested to include in report.
- **Feedback**
- Your code should be **bug free**. You would get **zero point** if there are bugs and we can not run your code to get the results.

Note

- If you have questions about the project, please contact with (**Qian Ren**) as early as possible, **two days or more** before the deadline are preferred

How to submit

- Send an email (renq2019@pku.edu.cn), with the title **AI_homework_1_X_Y**:
  - where AI is the abbreviation for artificial intelligence;
  - X is your name in Chinese;
  - Y is your studentID;
  - We are sorry that we do not provide file server for you to upload your homework.
  - If you have any questions about this course or assignment, please use a separate email. Do not ask any questions in this assignment-return email.
- Pack your code AND report in one package, using the file name **AI_homework_1_X_Y** instead of AI or something like that.
  - Report is not suggested to put in the email.
  - You are suggested to pack report with your code in one package with the title: Report_AI_homework_1_X_Y.
  - Report is suggested to be in PDF and in **ENGLISH**.
  - The default package might be in ".zip" format. If not, please show your format and how we can unpack it (i.e., software).
- **Attach your package** which includes the code and report you have created.

- My email: (**renq2019 @pku.edu.cn**)

Honor Code

- The honor code applies to all work turned in for this course.
- You must write and debug your own code.
- In particular, all code and documentation should be entirely your own work. You may consult with other students about high-level design strategies related to programming assignments, but you may not copy code or use the structure or organization of another student's program.
- If you use any code or functions found from the internet, please tell us the reference link and how do you use it. **Direct code copy from the internet would be considered violation of this policy**.
- **If we find there are two returned assignments same in large proportional code, both of the assignments would be considered violation of this policy**