Mini Project: Image Classification

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Abstract

This is the summary report of my mini-project, which is about building image classification models and testing them using cifar-10.

1 Environment

I use pytorch as the tool to build the models and tensorboardX to visualize them. Both can be installed by *conda* or *pip*.

2 My Alex Model

我在这个模板中定义了一个语言选项 `lang`，可以选择英文模式 `lang=en`（默认）或者中文模式 `lang=cn`。当选择中文模式时，图表的标题引导词以及参考文献，定理引导词等信息会变成中文。你可以通过下面两种方式来选择语言模式：

2.1 Original Alex Model

Alexnet was a pioneer network that proposed many new ideas and got a high accuracy in the competition. Generally, it uses five layers of CNN and ReLU and then followed by some layers of full connection network. And it also uses local response normalization (LRN) and drop out to avoid overfitting. But as it used two gpu to calculate and its structure got a little complex because of the limitation of hardware at that time, I try to follow its basic principle but simplify it.

2.2 Simplify the two gpu structure

At first, I built a model nearly the same as the Alexnet, but not impliment his tow gpu structure. (Another difference is that Alex's model dealt with the 227 * 227 image but cifar-10 is 32 * 32). See

And then I am just curious about the real effect of every layer – the LRN, the maxpool, the drop out and the kernel size of the CNN. So I do some changes to the model and compare them with my first model.

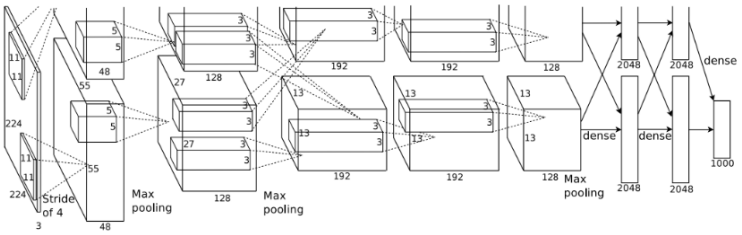

Figure 1: Original Alexnet

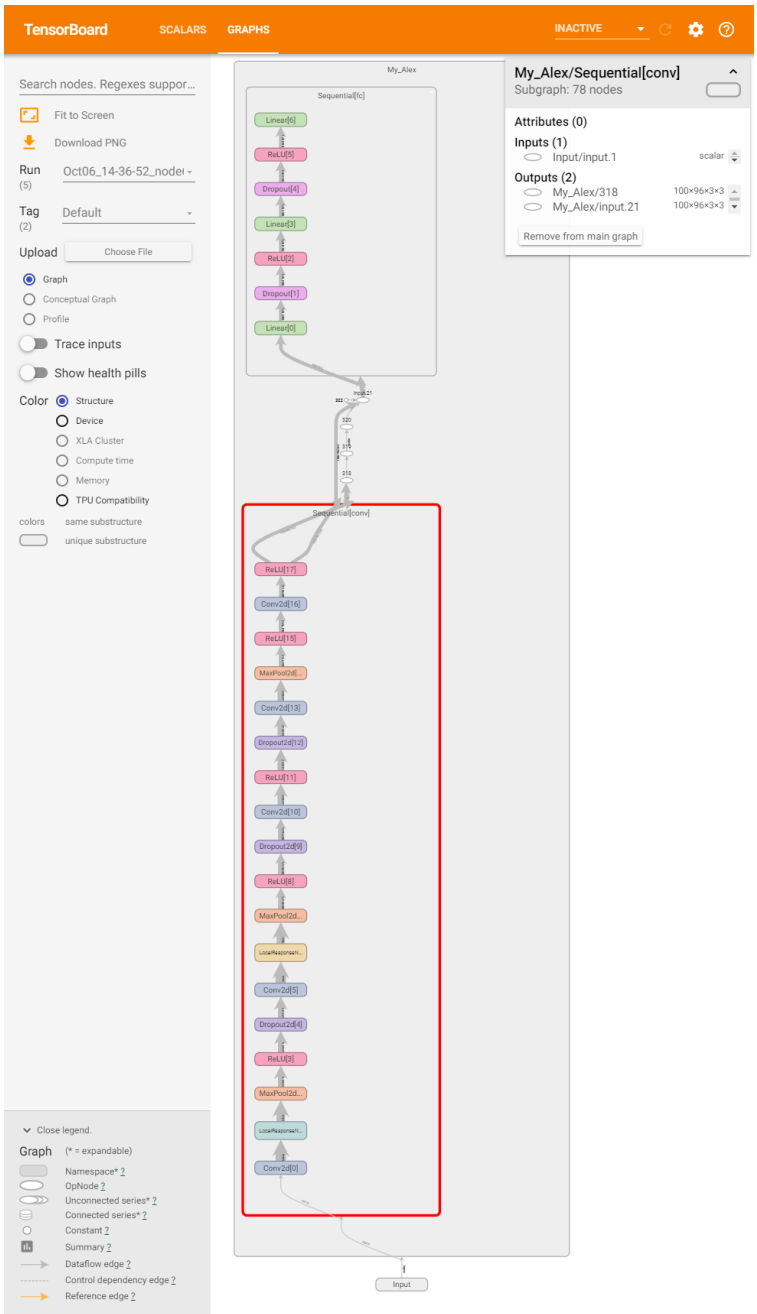

Figure 2: My first Alexnet

2.3 Replace LRN with BN

The difference between LRN and BN is that LRN do normalization on different layer but BN on different sample in the same batch. And I find that LRN doesn't work as well as BN. See , you can see that the network using BN gets a high accuracy on both train and test process but the network using lrn looks not so good.

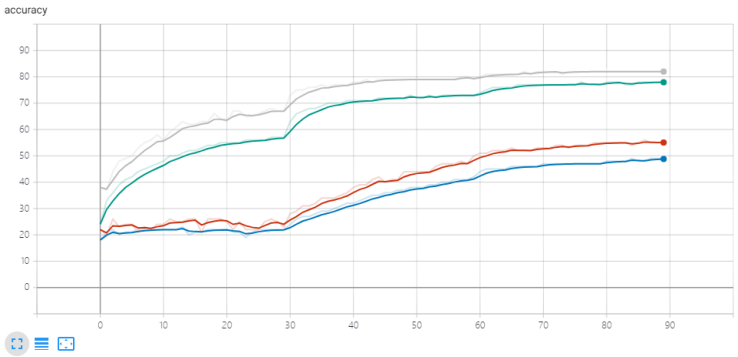

Figure 3: LRN VS BN

2.4 Drop out and Maxlpool

Then I build three models to test the affect of the drop out and the maxpool layer.

Table 1: Five Alexnets

	drop out	maxpool
alex1	yes	yes
alex2	no	yes
alex3	yes	no

The alex1 and alex2 use the 'same' padding on conv2d which keep the feature map size and use maxpool to decrease the feature map size, while the alex3 use conv2d to decrease the feature map size without the maxpool layer.

$$new\_size = (old\_size - kernel\_size + 2 * padding)/stride + 1 \quad (1)$$

As you can see alex2(no drop out) 's loss decreases more quickly that the other two's and it gets higher accuracy in both train and test phase. But its train accuracy is 8% higher than its test accuracy, which means it gets a little overfitting. And I find that alex3(no maxpool) works as well as (even a little better than) alex1. What an amazing result! Are they useless at all? Then I realize that maybe I drop out too much. So I tune down the drop out probability to 0.2 0.4, and the result suppose my conjecture!

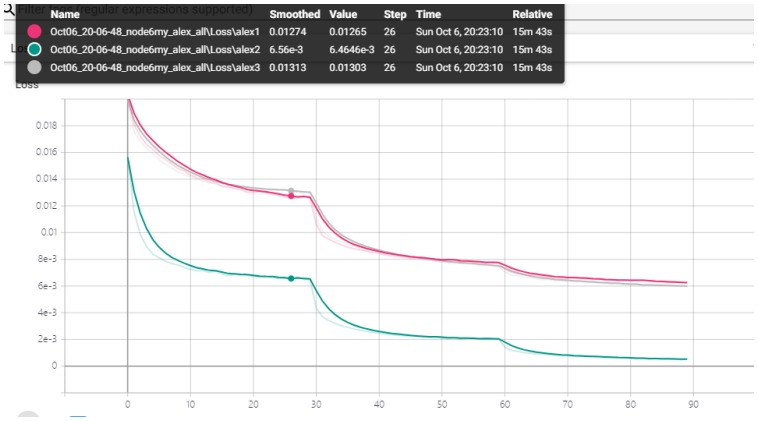

Figure 4: loss

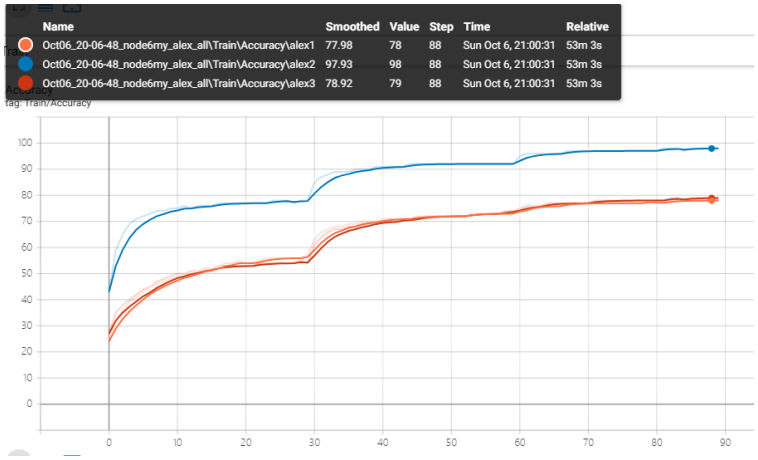

Figure 5: train accuracy

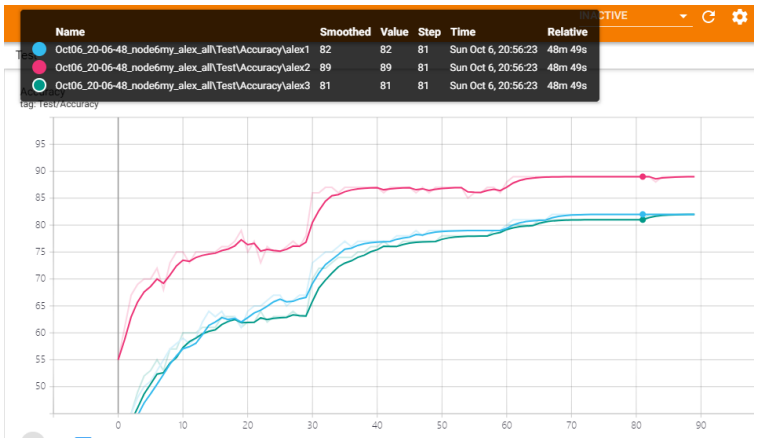

Figure 6: test accuracy

2.5 CNN kernel

I also do some changes to the CNN kernel, such as changing the kernel size, the kernel channel, the stride and the padding. And finaly I come to a conclusion that it doesn't matter a lot, as long as the kernel is not so strange, and it would be better to increase or decrease the channel no more than 2 times between different layers.

2.6 Conclusion

- Batch normalization works better that local response normalization.
- Drop out can avoid overfitting, but too much drop out will affect the performance of the model.
- Maxlpool is not necessary, but it is a good choice to reduce parameters and accelerate model training.
- Ultimately, I achieve my highest accuracy of 89% on the test dataset.

3 Pretrain ResNet-18

3.1 ResNet-18

Compared to Alexnet, ResNet-18 add a residual block to the CNN layer, which can catch the relation between different layer.

4 示例

在这部分，我提供一个示例文档：

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\documentclass[lang=cn]{elegantpaper}

% title information
\title{A Working Paper Example}
\author{ddswhu}
\institute{Elegant\LaTeX{} Group}
\version{1.00}
\date{\today}

\begin{document}

\maketitle

\begin{abstract}
```

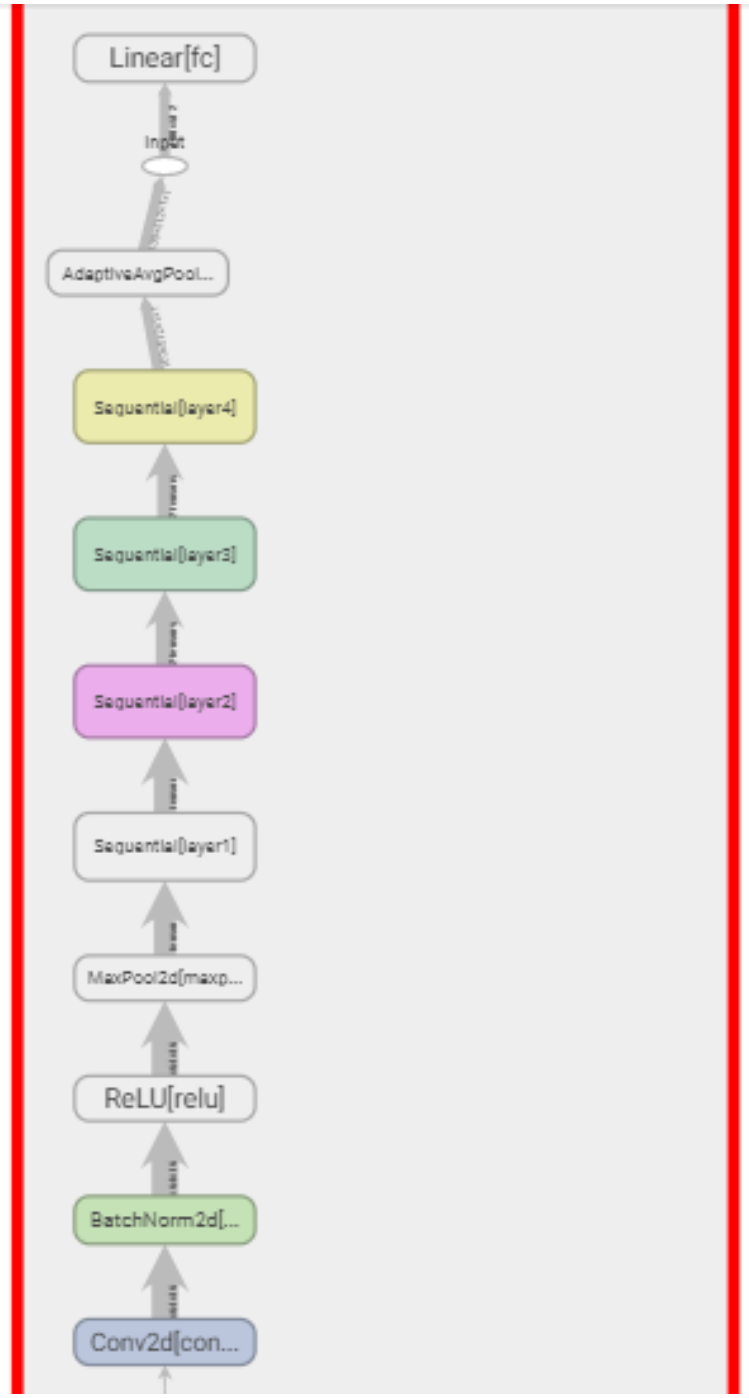

Figure 7: ResNet-18 Structure

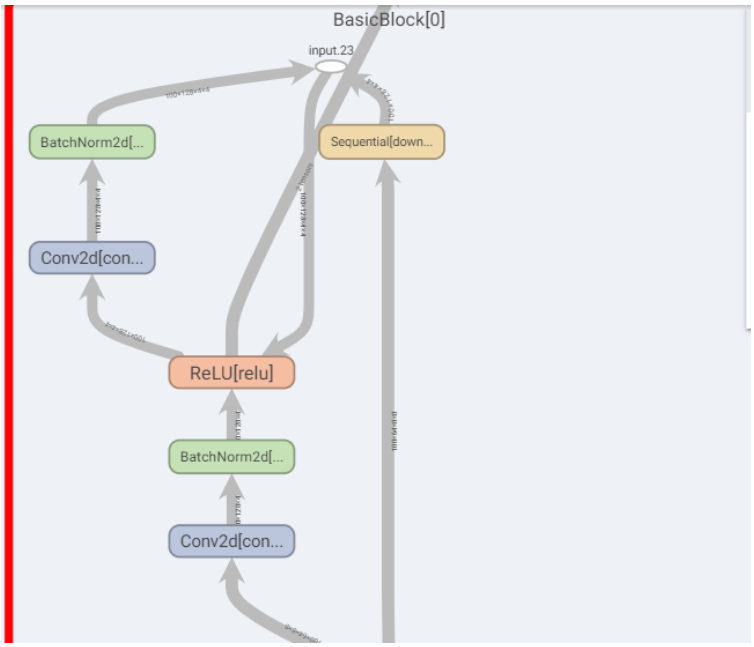

Figure 8: ResNet-18 Structure BasicBlock

```
Your abstract goes here.
\keywords{keyword1, keyword2}
\end{abstract}

\section{Introduction}
The content of introduction section.

\section{Conclusion}
The content of conclusion section.

% include the noncited reference
\nocite{ref1, ref2}
\bibliography{wpref}
\end{document}
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