图像分类 ResNet

PyTorch版

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环境配置

1.驱动+CUDA11.8+cuDNN8.6.0

2. Python 3.8.12（conda）

3. PyTorch 2.1.2

v2.1.2

Conda

OSX

```
# conda
conda install pytorch==2.1.2 torchvision==0.16.2 torchaudio==2.1.2 -c pytorch
```

Linux and Windows

```
# CUDA 11.8
conda install pytorch==2.1.2 torchvision==0.16.2 torchaudio==2.1.2 pytorch-cuda=11.8 -c pytorch -c nvidia
# CUDA 12.1
conda install pytorch==2.1.2 torchvision==0.16.2 torchaudio==2.1.2 pytorch-cuda=12.1 -c pytorch -c nvidia
# CPU Only
conda install pytorch==2.1.2 torchvision==0.16.2 torchaudio==2.1.2 cpuonly -c pytorch
```

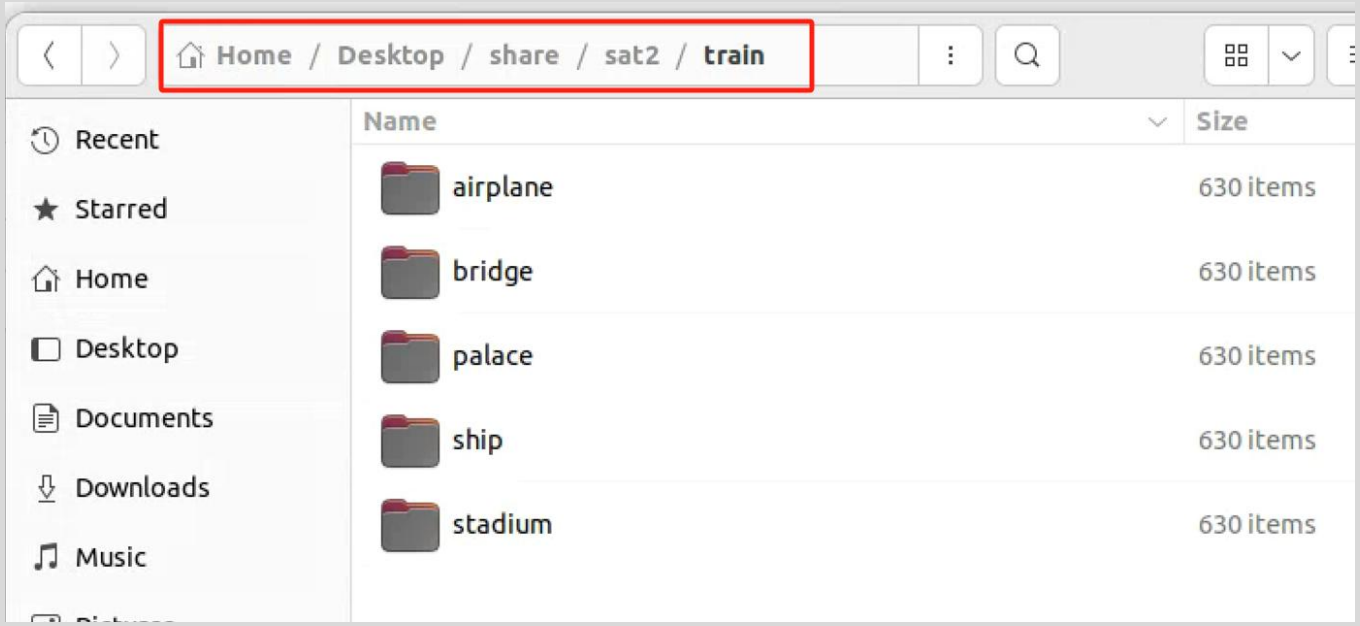
Wheel

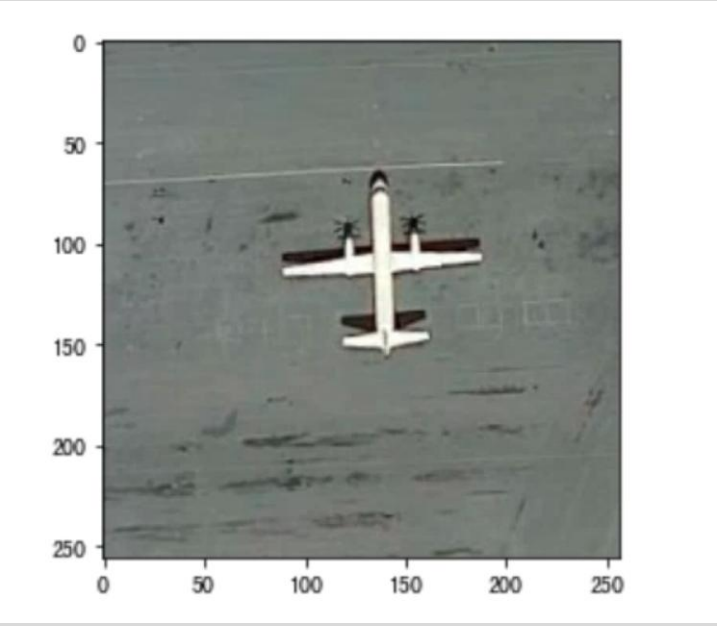
OSX

```
pip install torch==2.1.2 torchvision==0.16.2 torchaudio==2.1.2
```

https://pytorch.org/get-started/previous-versions/

数据集结构





包含31500张遥感图像（45类*700张），256x256像素的彩色图。

本次使用其中的5类，划分每类630张为训练集，70张为测试集。

Pytorch 数据处理

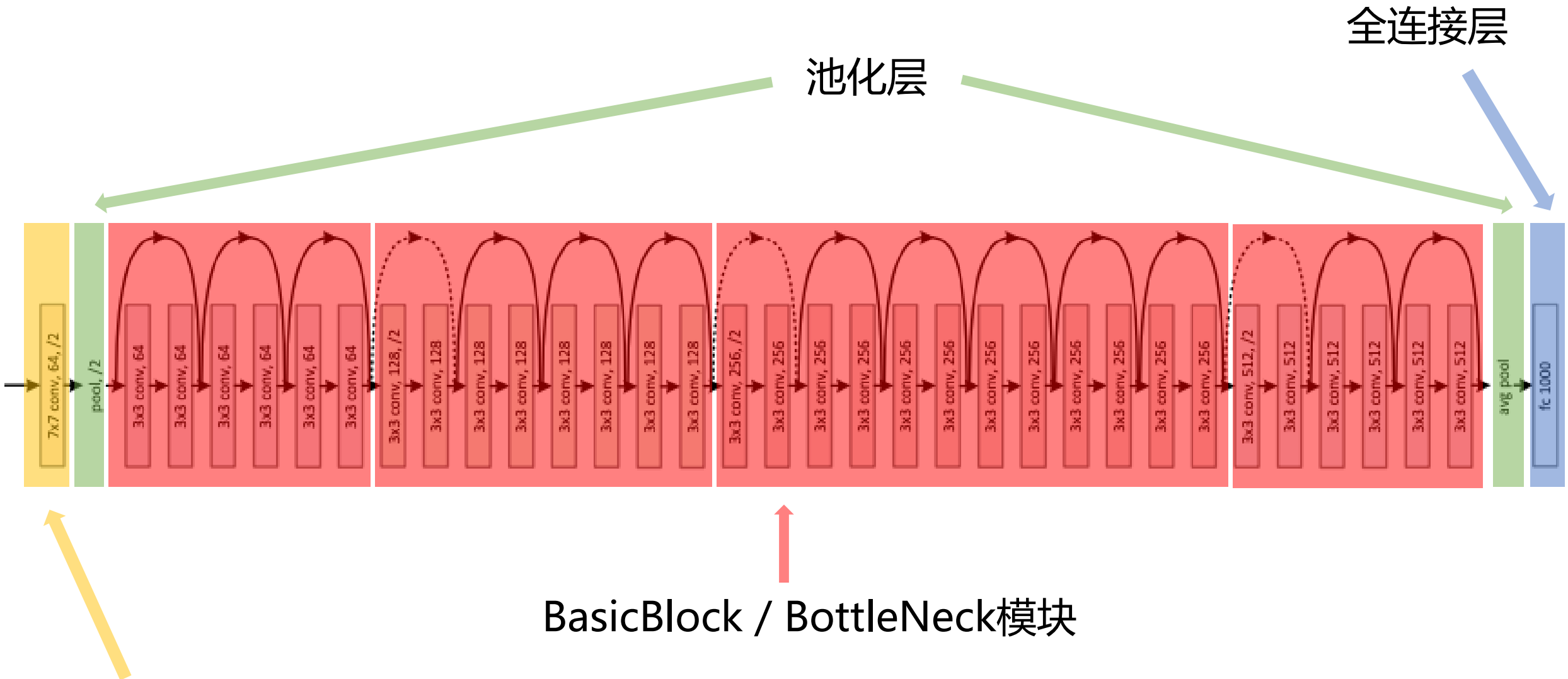
1. 按文件夹读取数据：

train_dir = '../sat2/train’　　datasets.ImageFolder(train_dir，……)

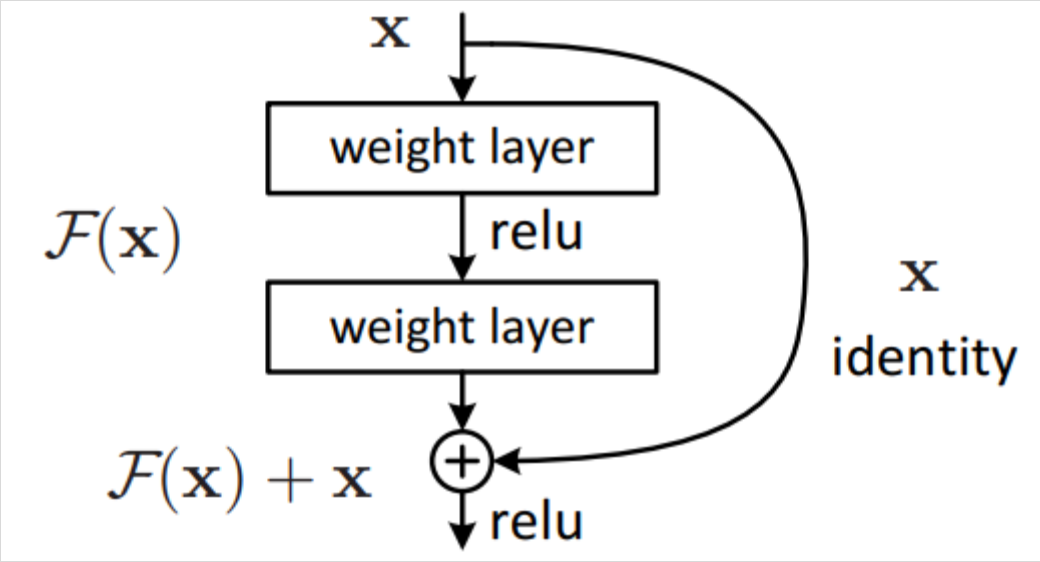
2. 图像调整（尺寸调整、格式转换）： transforms.Compose

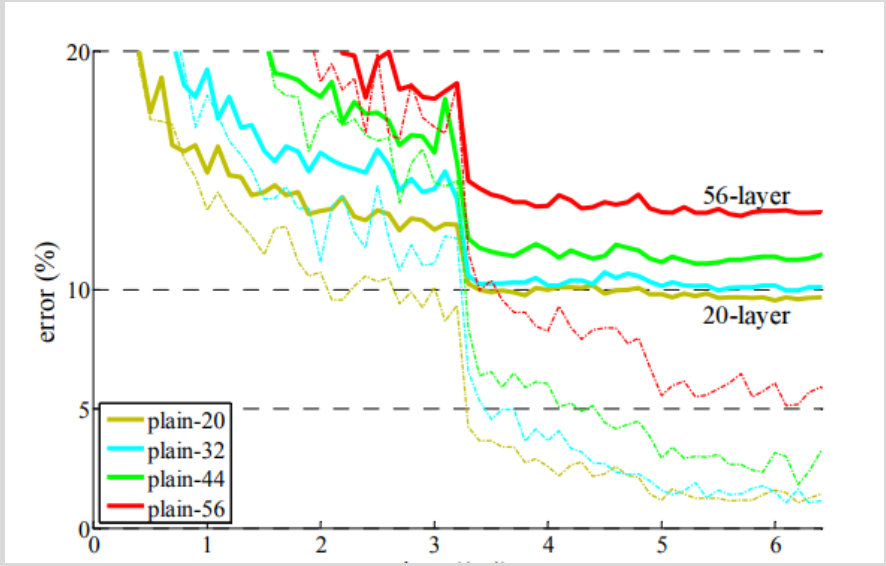
3. 数据迭代（批次数量、随机）： DataLoader

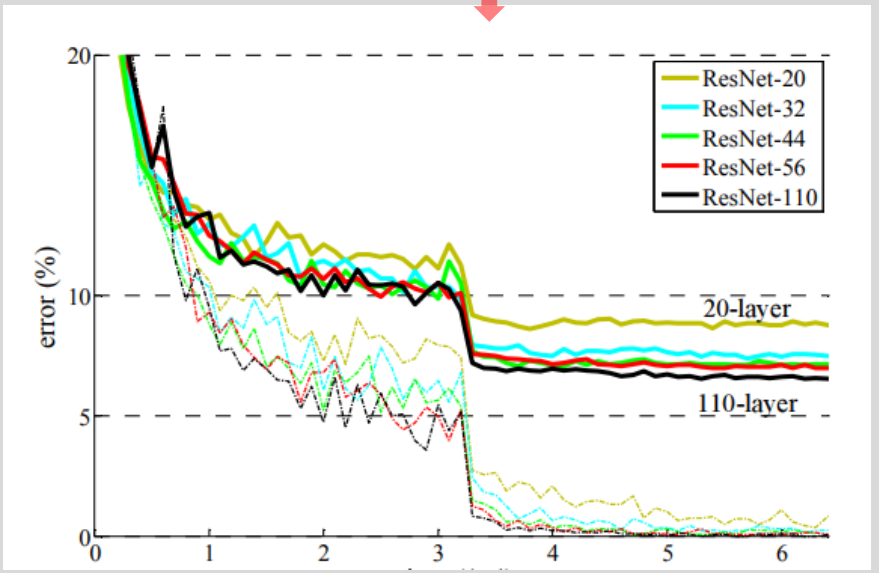
ResNet 结构


全连接层
池化层
7x7 conv, 64, /2
pool, /2
3x3 conv, 64
3x3 conv, 128, /2
3x3 conv, 128
3x3 conv, 256, /2
3x3 conv, 256
3x3 conv, 512, /2
3x3 conv, 512
avg pool
fc 1000
BasicBlock / BottleNeck模块
卷积层

捷径分支

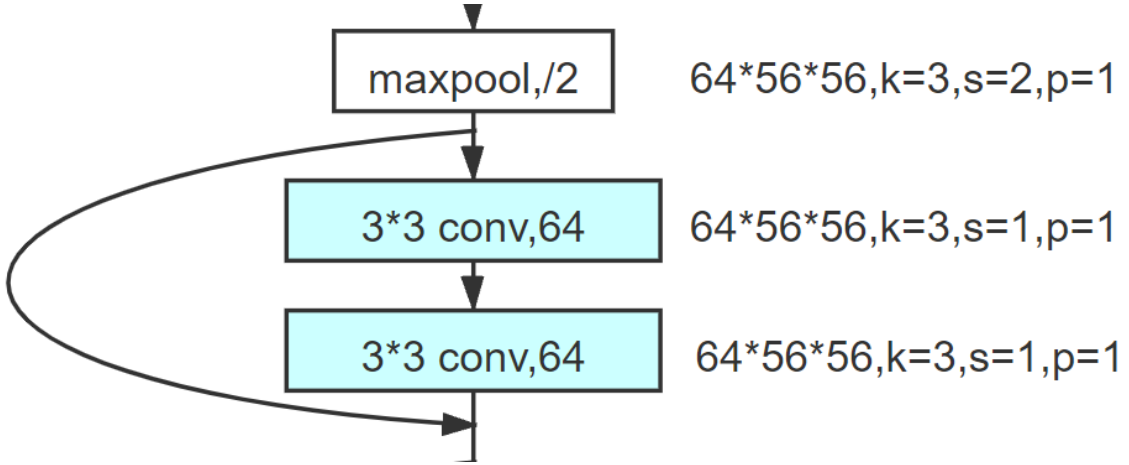






输出为 H (x) = F (x) + x,
权重层实际上是学习一种残差映射：F (x) = H (x) - x

BasicBlock 残差模块

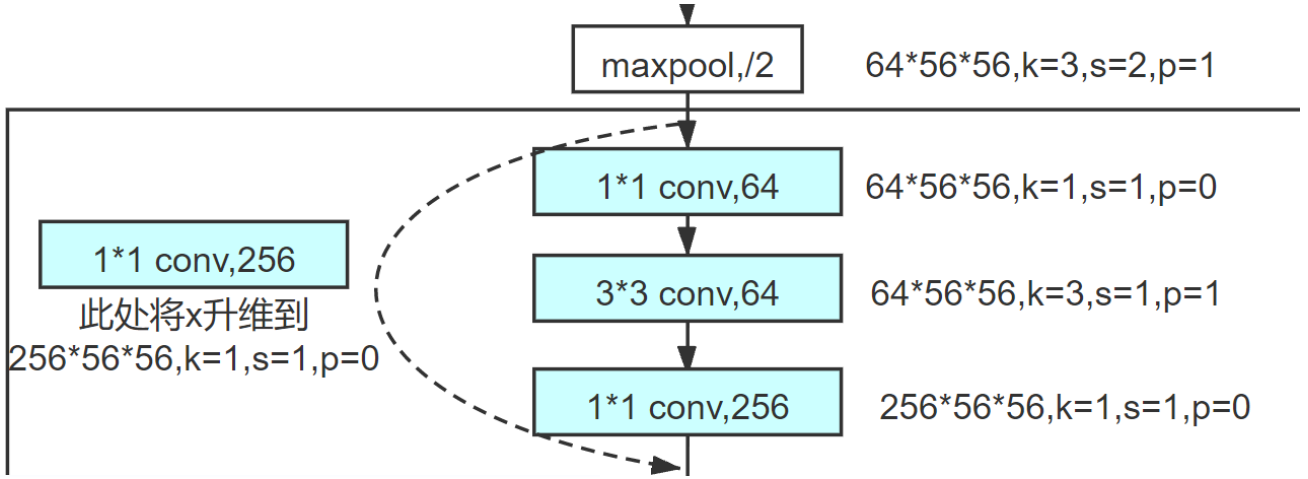



```python
class BasicBlock(nn.Module):
    expansion = 1  # 输出通道不变

    def __init__(self, in_channels, out_channels, stride=1, downsample=None):
        super().__init__()
        self.conv1 = nn.Conv2d(in_channels, out_channels, kernel_size=3,stride=stride, padding=1, bias=False)
        self.bn1 = nn.BatchNorm2d(out_channels)
        self.relu = nn.ReLU(inplace=True)
        self.conv2 = nn.Conv2d(out_channels, out_channels, kernel_size=3,stride=1, padding=1, bias=False)
        self.bn2 = nn.BatchNorm2d(out_channels)
        self.downsample = downsample  # 用于匹配维度

    def forward(self, x):
        identity = x if self.downsample is None else self.downsample(x)
        out = self.relu(self.bn1(self.conv1(x)))
        out = self.bn2(self.conv2(out))
        out += identity
        out = self.relu(out)
        return out
```

BottleNeck 残差模块




```python
class BottleNeck(nn.Module):
    expansion = 4  # 输出通道为输入的4倍

    def __init__(self, in_channels, out_channels, stride=1, downsample=None):
        super().__init__()
        self.conv1 = nn.Conv2d(in_channels, out_channels, kernel_size=1,stride=1, bias=False)
        self.bn1 = nn.BatchNorm2d(out_channels)
        self.conv2 = nn.Conv2d(out_channels, out_channels, kernel_size=3,stride=stride, padding=1, bias=False)
        self.bn2 = nn.BatchNorm2d(out_channels)
        self.conv3 = nn.Conv2d(out_channels, out_channels * 4, kernel_size=1,stride=1, bias=False)
        self.bn3 = nn.BatchNorm2d(out_channels * 4)
        self.relu = nn.ReLU(inplace=True)
        self.downsample = downsample  # 用于匹配维度

    def forward(self, x):
        identity = x if self.downsample is None else self.downsample(x)
        out = self.relu(self.bn1(self.conv1(x)))
        out = self.relu(self.bn2(self.conv2(out)))
        out = self.bn3(self.conv3(out))
        out += identity
        out = self.relu(out)
        return out
```

layer name	output size	18-layer	34-layer	50-layer	101-layer	152-layer
conv1	112×112	7×7, 64, stride 2				
conv2_x	56×56	3×3 max pool, stride 2				
		$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 64 \\ 3\times3, 64 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 64 \\ 3\times3, 64 \\ 1\times1, 256 \end{bmatrix}\times3$
conv3_x	28×28	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 128 \\ 3\times3, 128 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times4$	$\begin{bmatrix} 1\times1, 128 \\ 3\times3, 128 \\ 1\times1, 512 \end{bmatrix}\times8$
conv4_x	14×14	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 256 \\ 3\times3, 256 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times6$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times23$	$\begin{bmatrix} 1\times1, 256 \\ 3\times3, 256 \\ 1\times1, 1024 \end{bmatrix}\times36$
conv5_x	7×7	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times2$	$\begin{bmatrix} 3\times3, 512 \\ 3\times3, 512 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$	$\begin{bmatrix} 1\times1, 512 \\ 3\times3, 512 \\ 1\times1, 2048 \end{bmatrix}\times3$
	1×1	average pool, 1000-d fc, softmax				
FLOPs		1.8×10^9	3.6×10^9	3.8×10^9	7.6×10^9	11.3×10^9

Downsampling is performed by conv3 1, conv4 1, and conv5 1 with a stride of 2

https://www.bilibili.com/video/BV1n7Viz9EXQ

https://www.bilibili.com/video/BV1Ru411f7Y6

图像分类数据集下载： https://pan.baidu.com/s/1FCOUlhpll7aObASpBwNlhw 提取码: yqvb