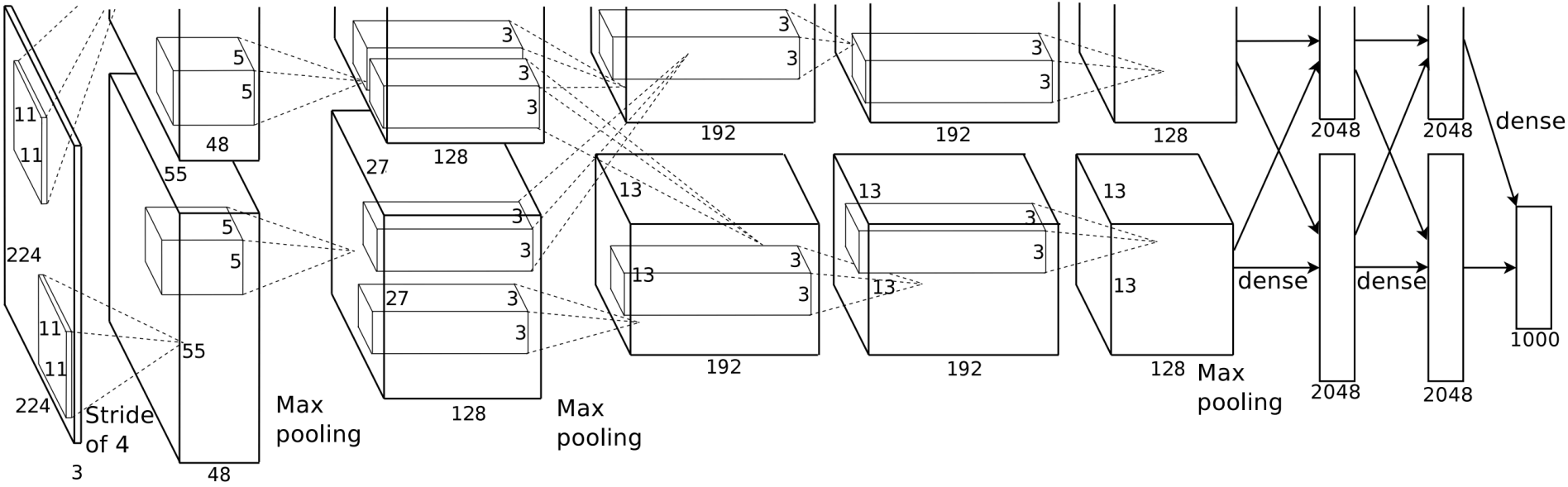
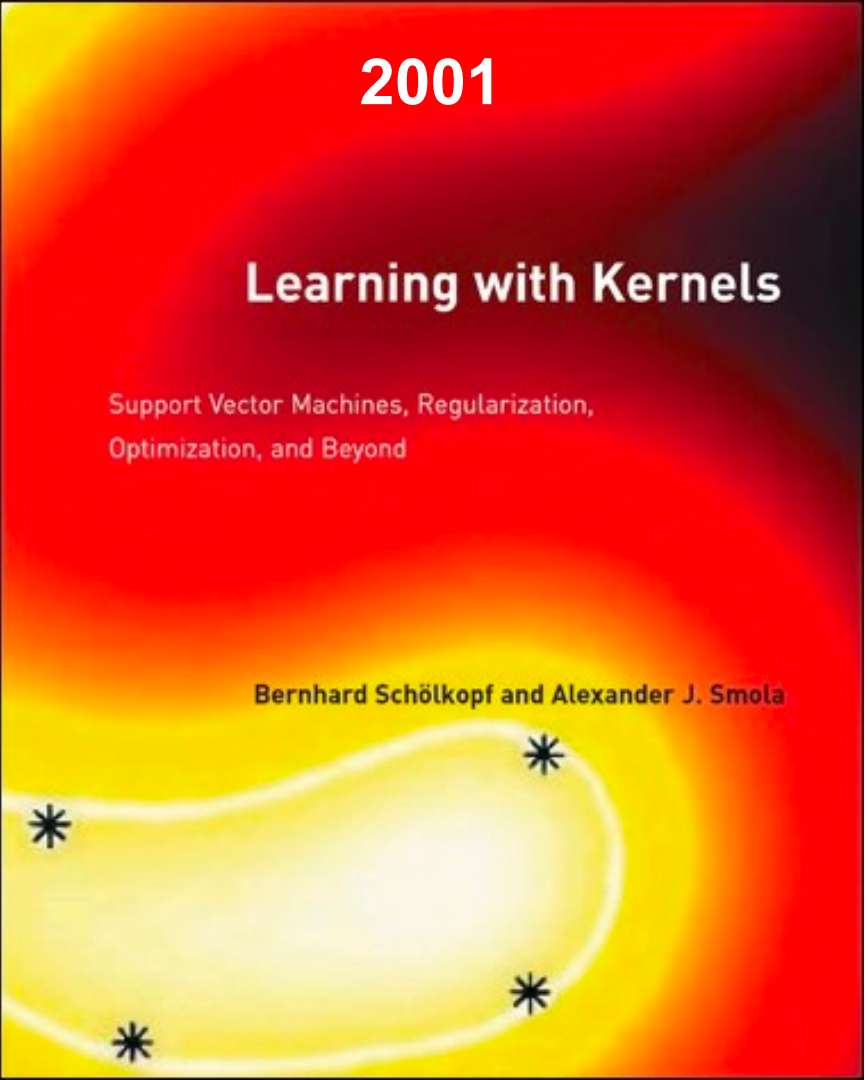
AlexNet

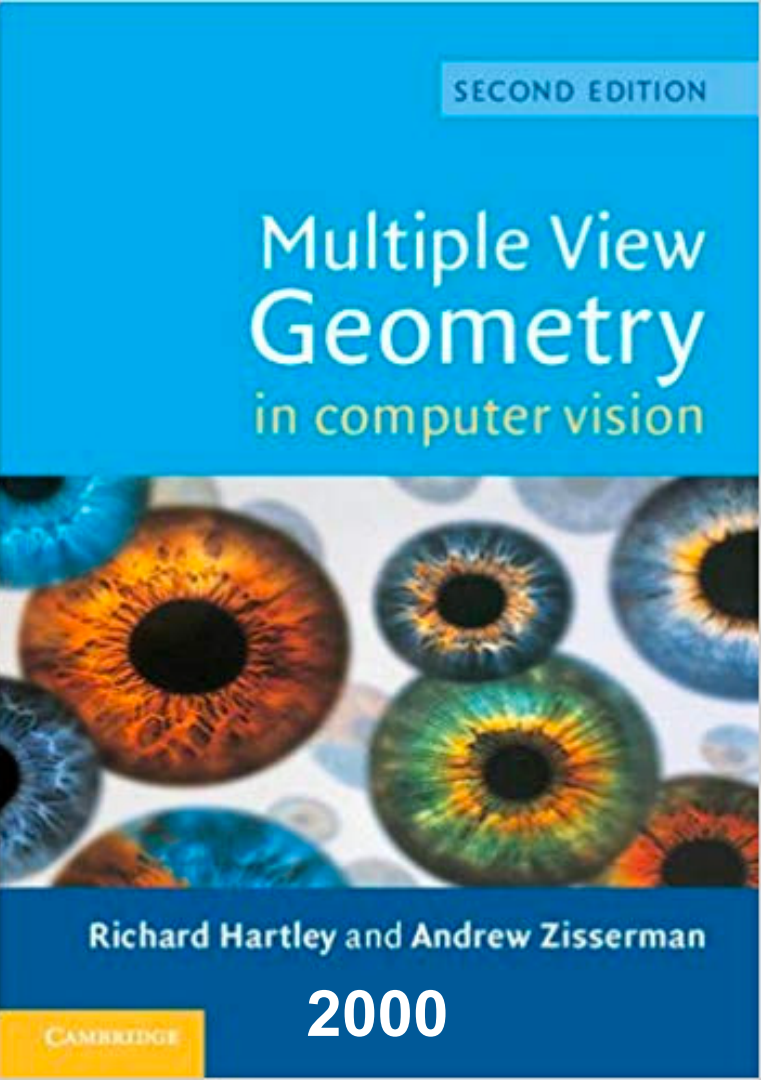

11
11
224
224
3
Stride
of 4
5
5
48
55
48
55
5
5
Max
pooling
3
3
3
128
27
128
27
3
3
3
Max
pooling
3
3
3
192
13
13
3
3
3
192
13
13
3
3
3
192
13
13
128
Max
pooling
dense
dense
2048
2048
2048
2048
dense
1000



机器学习

In the 1990s, a new type of learning algorithm was developed, based on results from statistical learning theory: the Support Vector Machine (SVM). This gave rise to a new class of theoretically elegant learning machines that use a central concept of SVMs – -kernels – for a number of

- 特征提取
- 选择核函数来计算相似性
- 凸优化问题
- 漂亮的定理



几何学

- 抽取特征
- 描述几何（例如多相机）
- （非）凸优化
- 漂亮定理
- 如果假设满足了，效果很好

特征工程

- 特征工程是关键
- 特征描述子：SIFT，SURF
- 视觉词袋（聚类）
- 最后用 SVM

Hardware

	1970	1980	1990	2000	2010	2020
Data (samples)	10^2 (e.g. iris)	10x 10^3	10x 10^4 OCR	100x 10^{7-8} web	100x 10^{10} advertising	**1,000x** 10^{12} social nets
RAM	1kB	100kB	10MB	100MB	1GB	100GB
CPU	100kF (8080)	1MF (80186)	10MF (80486)	1GF (Intel Core)	100GF NVIDIA	**>1PF (8xP3 Volta)**
		10x	10x	100x	100x	**10,000x**

神经网络

神经网络

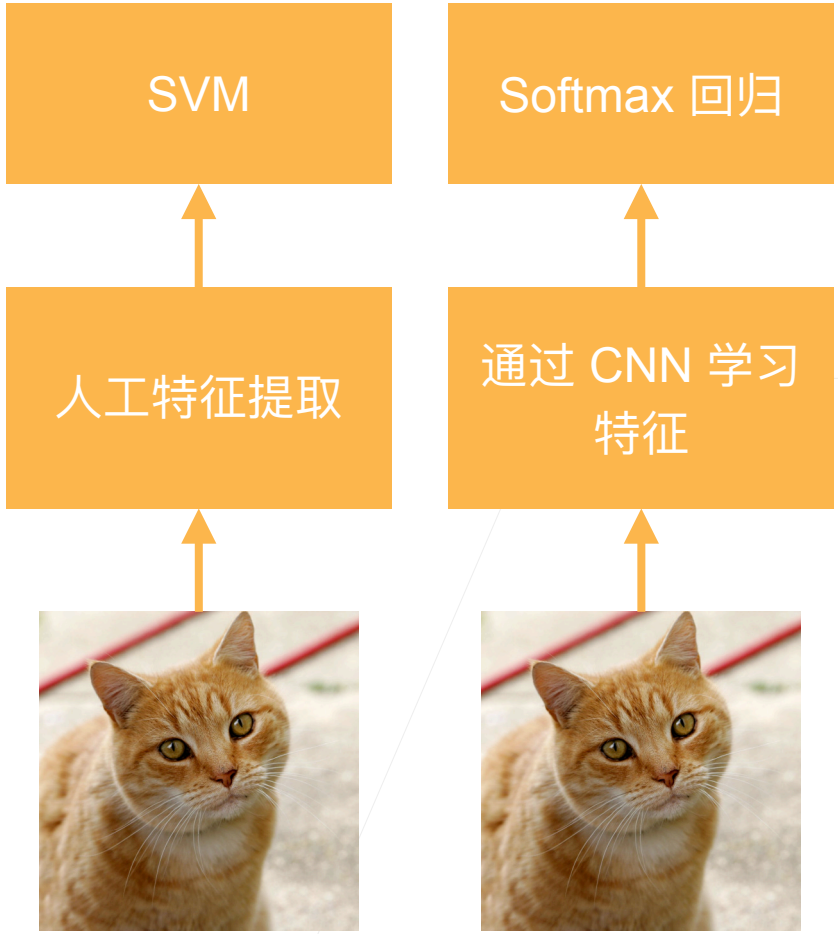
核方法

ImageNet (2010)

图片	自然物体的彩色图片	手写数字的黑白图片
大小	469 x 387	28 x 28
样本数	1.2 M	60 K
类数	1,000	10

AlexNet

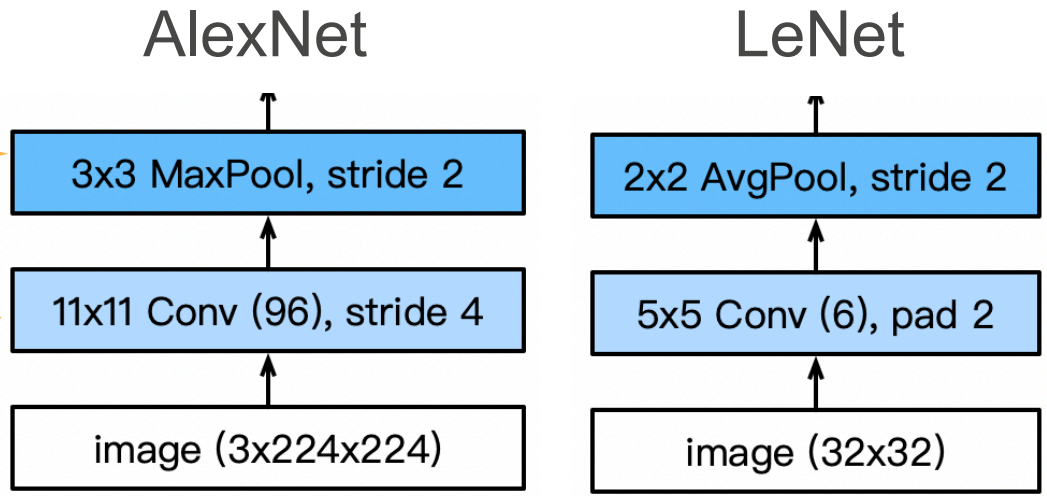
- AlexNet 赢了 2012 年 ImageNet 竞赛
- 更深更大的 LeNet
- 主要改进：
  - 丢弃法
  - ReLu
  - MaxPooling
- 计算机视觉方法论的改变



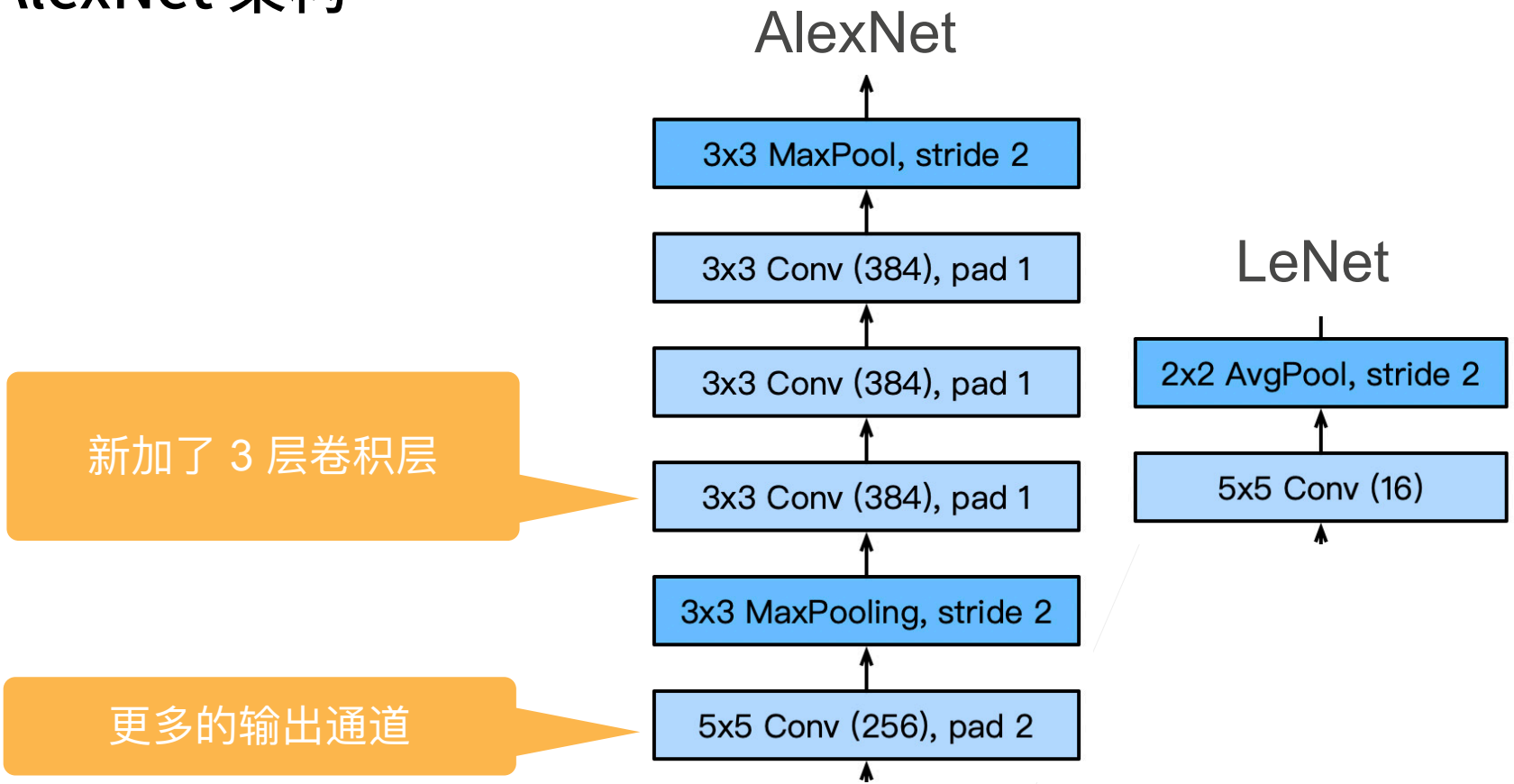
AlexNet 架构

更大的池化窗口，使用最大池化层

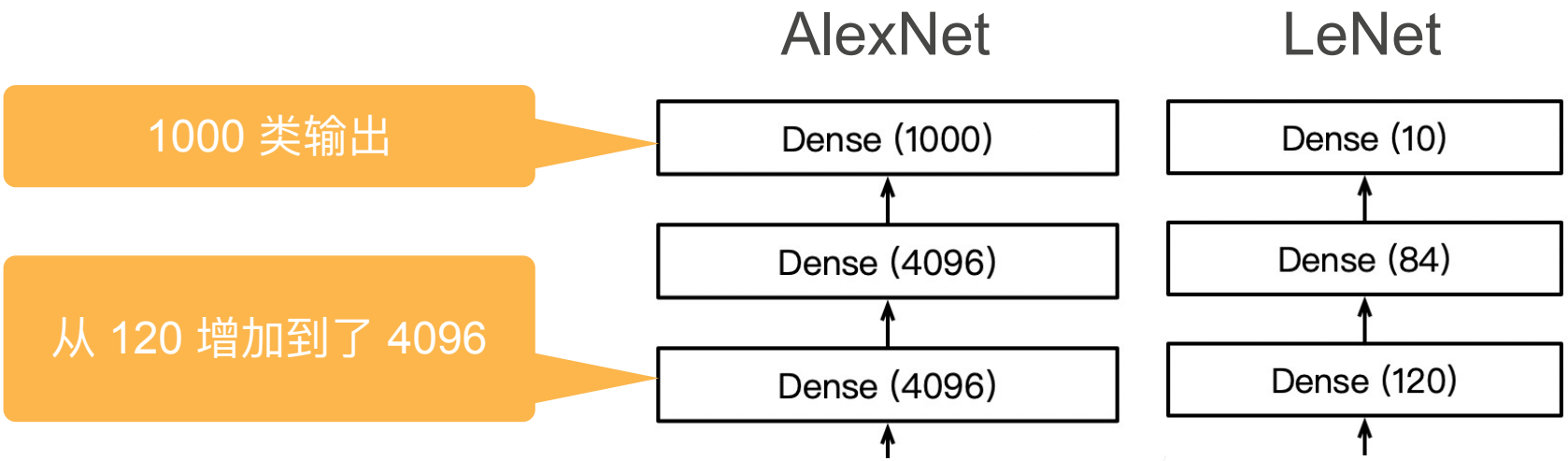
更大的核窗口和步长，因为图片更大了



AlexNet 架构

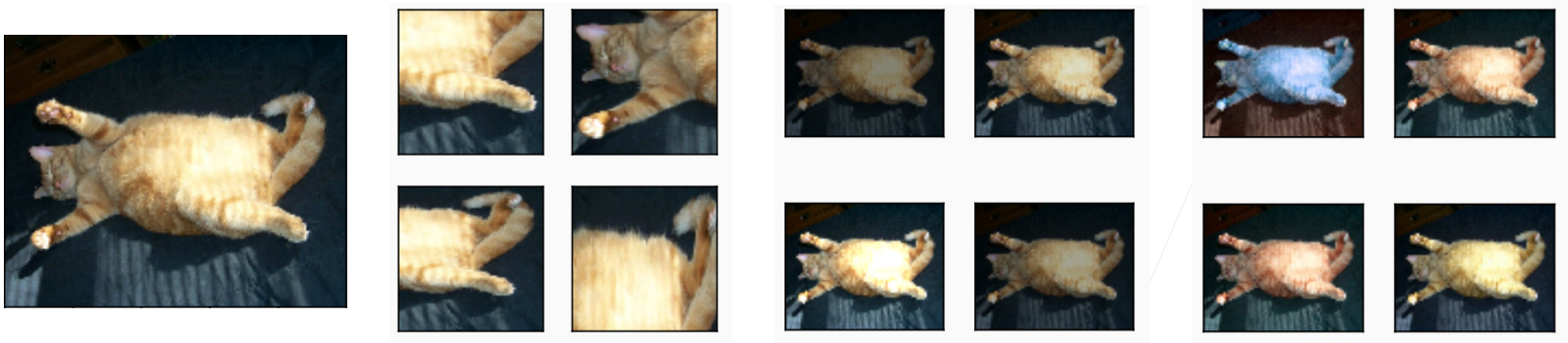

AlexNet
3x3 MaxPool, stride 2
3x3 Conv (384), pad 1
3x3 Conv (384), pad 1
3x3 Conv (384), pad 1
3x3 MaxPooling, stride 2
5x5 Conv (256), pad 2
新加了 3 层卷积层
更多的输出通道
LeNet
2x2 AvgPool, stride 2
5x5 Conv (16)

AlexNet 架构


AlexNet
LeNet
1000 类输出
从 120 增加到了 4096
Dense (1000)
Dense (4096)
Dense (4096)
Dense (10)
Dense (84)
Dense (120)

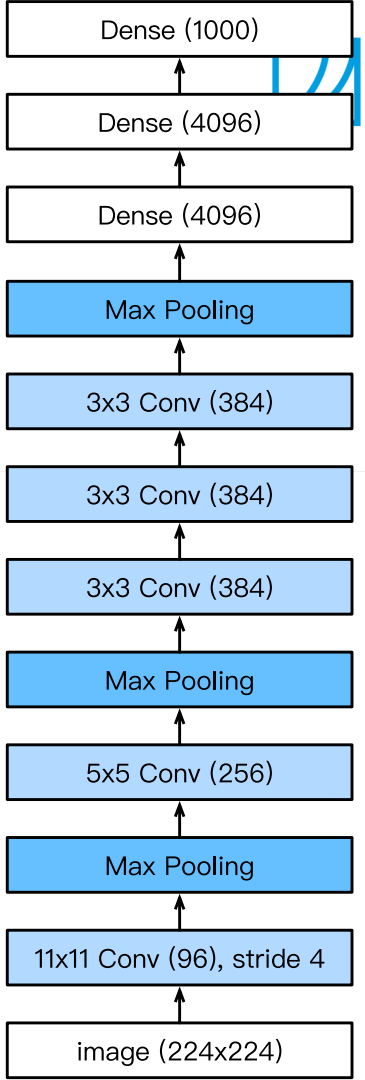
更多细节

- 激活函数从 sigmoid 变到了 ReLu （减缓梯度消失）
- 隐藏全连接层后加入了丢弃层
- 数据增强



复杂度

	参数个数		FLOP	
	AlexNet	LeNet	AlexNet	LeNet
Conv1	35K	150	101M	1.2M
Conv2	614K	2.4K	415M	2.4M
Conv3-5	3M		445M	
Dense1	26M	0.48M	26M	0.48M
Dense2	16M	0.1M	16M	0.1M
Total	46M	0.6M	1G	4M
Increase	11x	1x	250x	1x



总结

- AlexNet 是更大更深的 LeNet，10x 参数个数，260x 计算复杂度
- 新进入了丢弃法，ReLU，最大池化层，和数据增强
- AlexNet 赢下了 2012 ImageNet 竞赛后，标志着新的一轮神经网络热潮的开始