CV Course 2 SOTA CNN

Blake

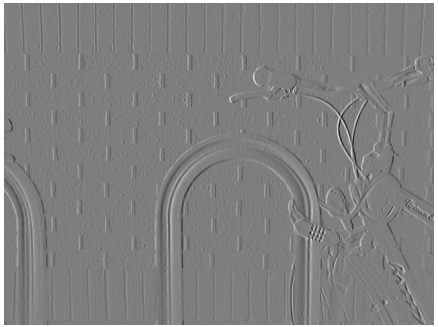
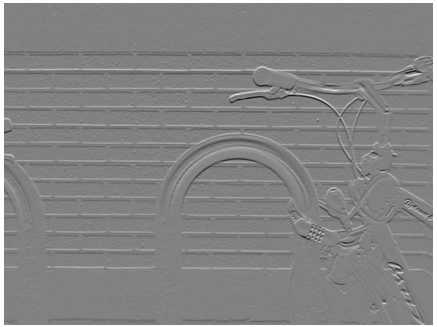
Outline

- Basic concept and principle of CNN
- Classic
  - VGG
- SOTA
  - Inception structure (Inception V1-V4)
  - Residual block (ResNet)
- Hands-on

Convolution

Sobel filter

$$\mathbf{G_x} = \begin{bmatrix} +1 & 0 & -1 \\ +2 & 0 & -2 \\ +1 & 0 & -1 \end{bmatrix} * \mathbf{A} \quad \text{and} \quad \mathbf{G_y} = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * \mathbf{A}$$


CNN (Convolutional Neural Network)

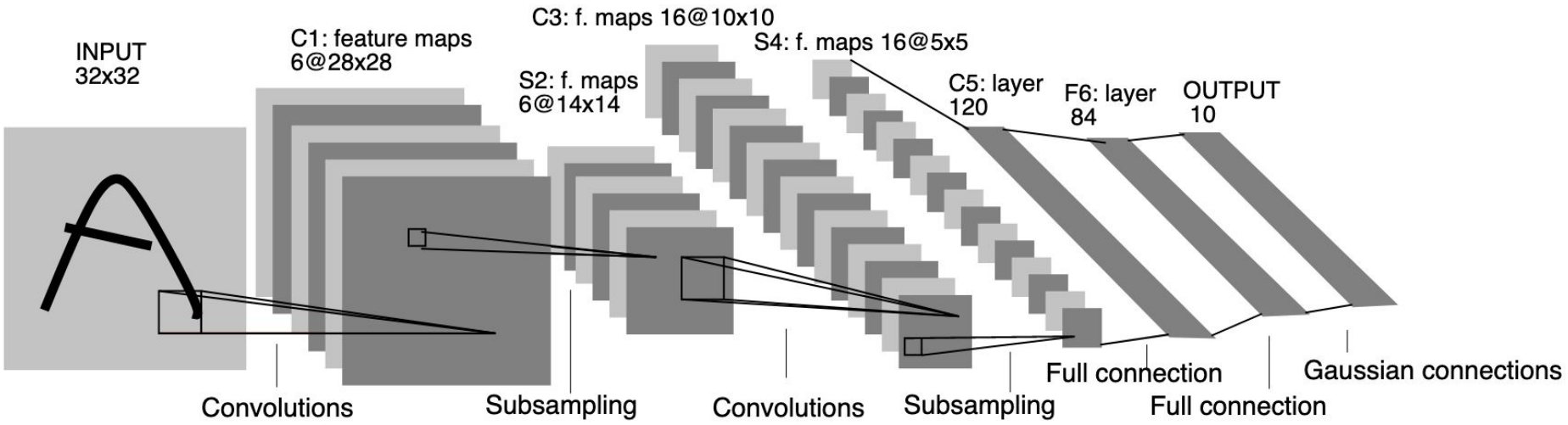
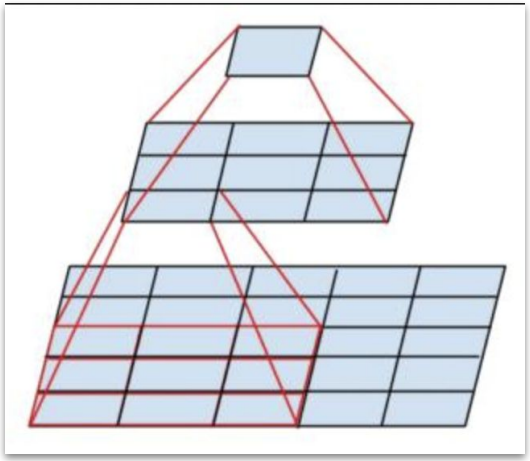


Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.

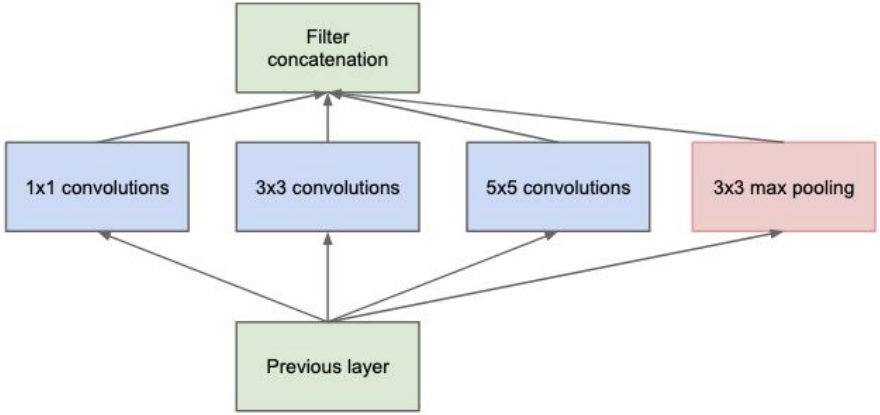
VGG

Increasing depth using an architecture with very small (3×3) convolution filters

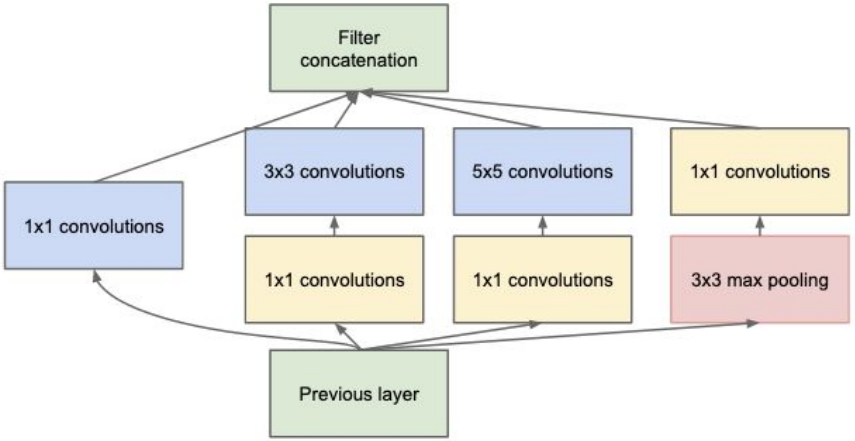


ConvNet Configuration					
A	A-LRN	B	C	D	E
11 weight layers	11 weight layers	13 weight layers	16 weight layers	16 weight layers	19 weight layers
input (224 × 224 RGB image)					
conv3-64	conv3-64 **LRN**	conv3-64 **conv3-64**	conv3-64 conv3-64	conv3-64 conv3-64	conv3-64 conv3-64
maxpool					
conv3-128	conv3-128	conv3-128 **conv3-128**	conv3-128 conv3-128	conv3-128 conv3-128	conv3-128 conv3-128
maxpool					
conv3-256 conv3-256	conv3-256 conv3-256	conv3-256 conv3-256	conv3-256 conv3-256 **conv1-256**	conv3-256 conv3-256 **conv3-256**	conv3-256 conv3-256 conv3-256 **conv3-256**
maxpool					
conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512 **conv1-512**	conv3-512 conv3-512 **conv3-512**	conv3-512 conv3-512 conv3-512 **conv3-512**
maxpool					
conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512	conv3-512 conv3-512 **conv1-512**	conv3-512 conv3-512 **conv3-512**	conv3-512 conv3-512 conv3-512 **conv3-512**
maxpool					
FC-4096					
FC-4096					
FC-1000					
soft-max					

Inception v1



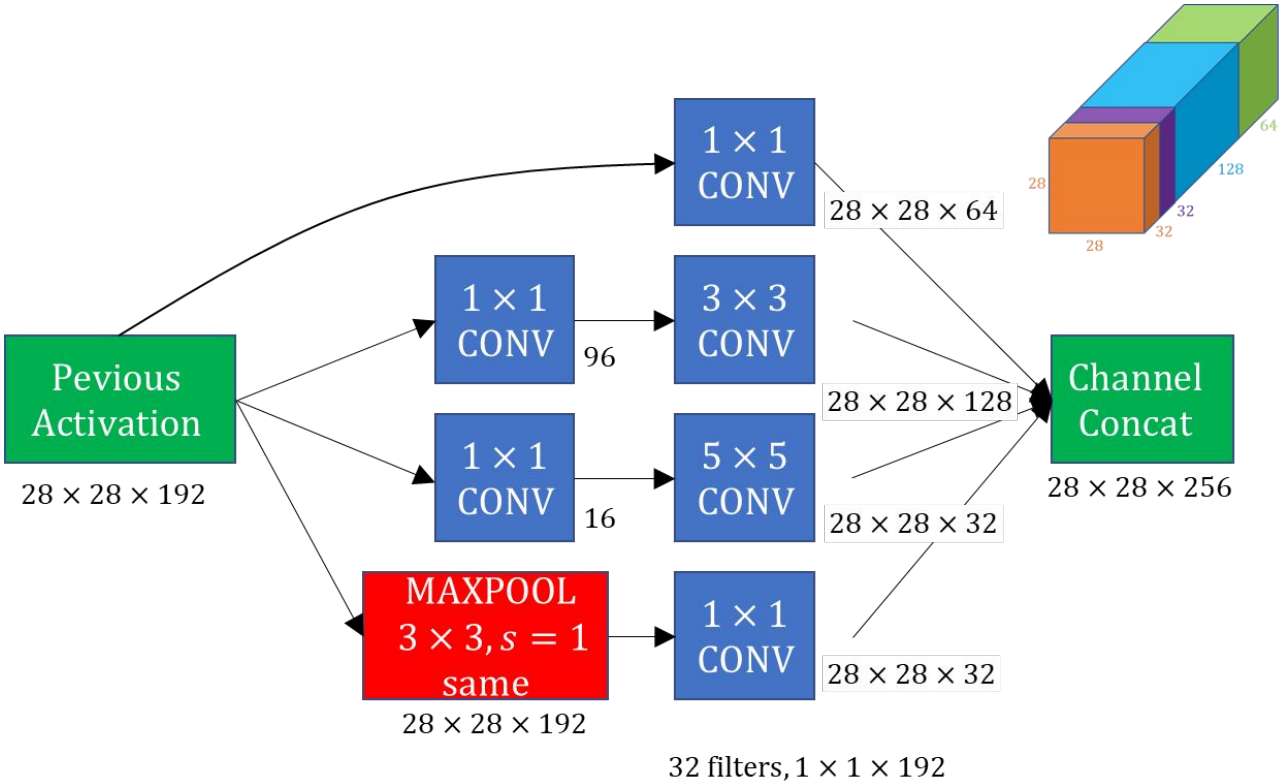
(a) Inception module, naïve version



(b) Inception module with dimension reductions

Figure 2: Inception module

Inception v1



Hands-on

Inception v2/v3

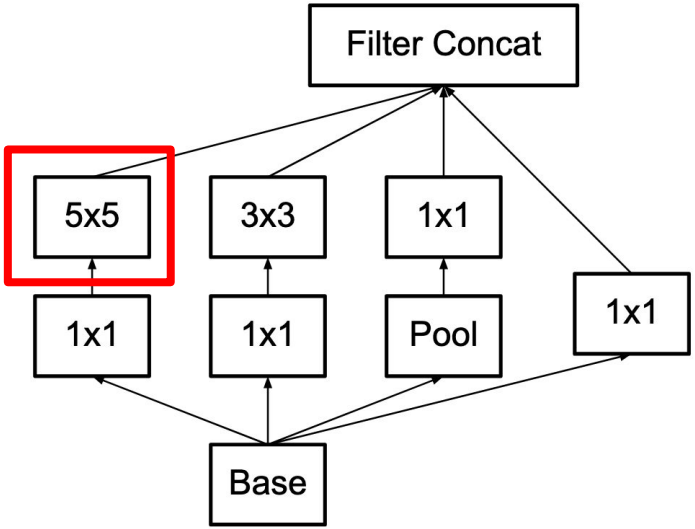


Figure 4. Original Inception module as described in [20].

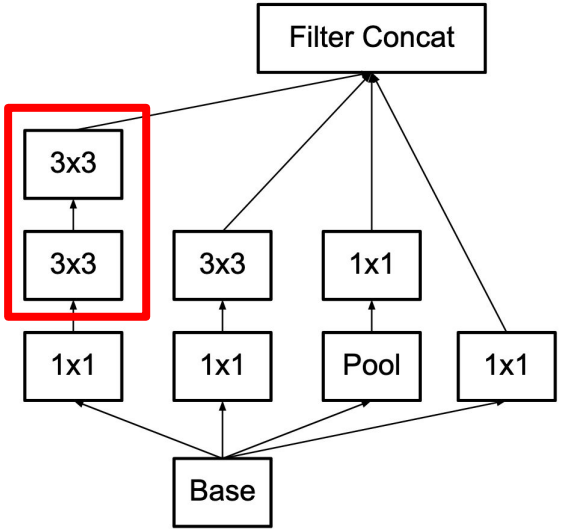
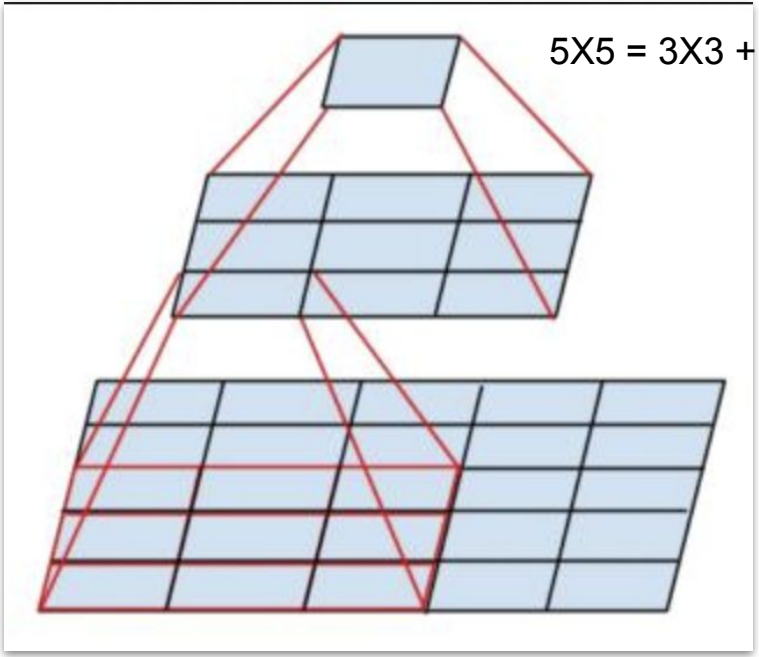
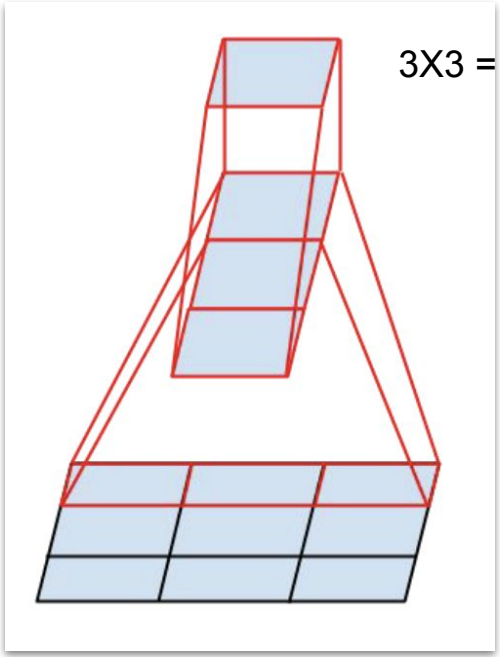


Figure 5. Inception modules where each 5×5 convolution is replaced by two 3×3 convolution, as suggested by principle 3 of Section 2.

Inception v2/v3 factorization





Inception v2/v3

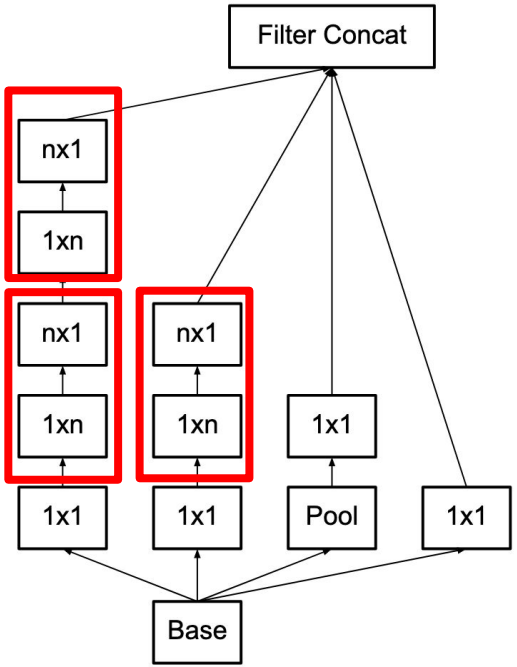


Figure 6. Inception modules after the factorization of the $n \times n$ convolutions. In our proposed architecture, we chose $n = 7$ for the 17×17 grid. (The filter sizes are picked using principle 3)

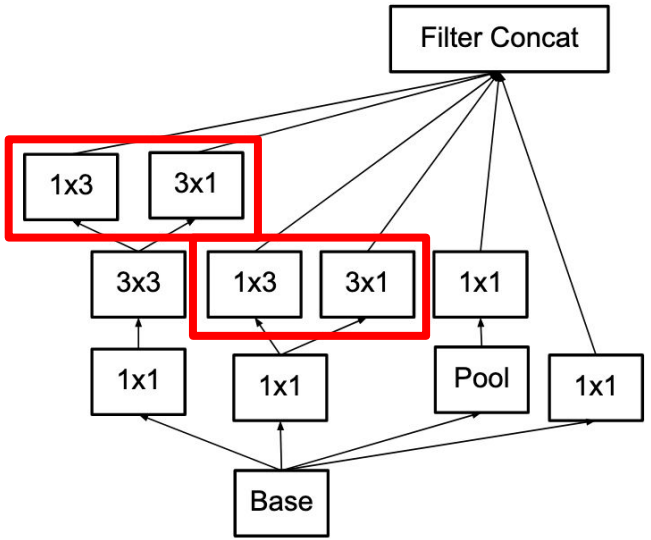


Figure 7. Inception modules with expanded the filter bank outputs. This architecture is used on the coarsest (8×8) grids to promote high dimensional representations, as suggested by principle 2 of Section 2. We are using this solution only on the coarsest grid, since that is the place where producing high dimensional sparse representation is the most critical as the ratio of local processing (by 1×1 convolutions) is increased compared to the spatial aggregation.

Hands-on

ResNet v1

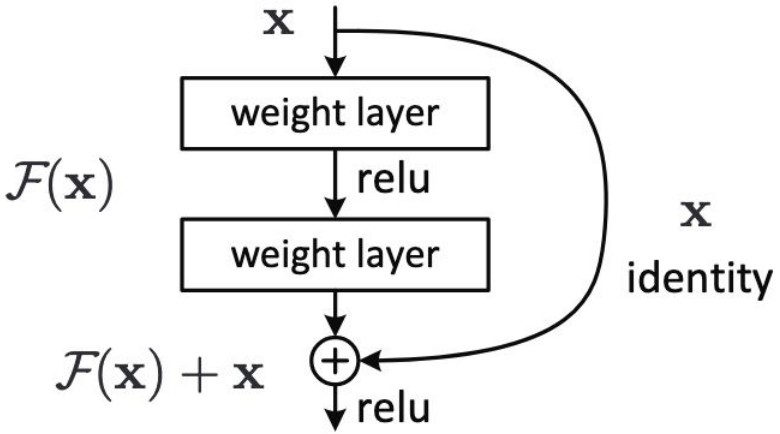
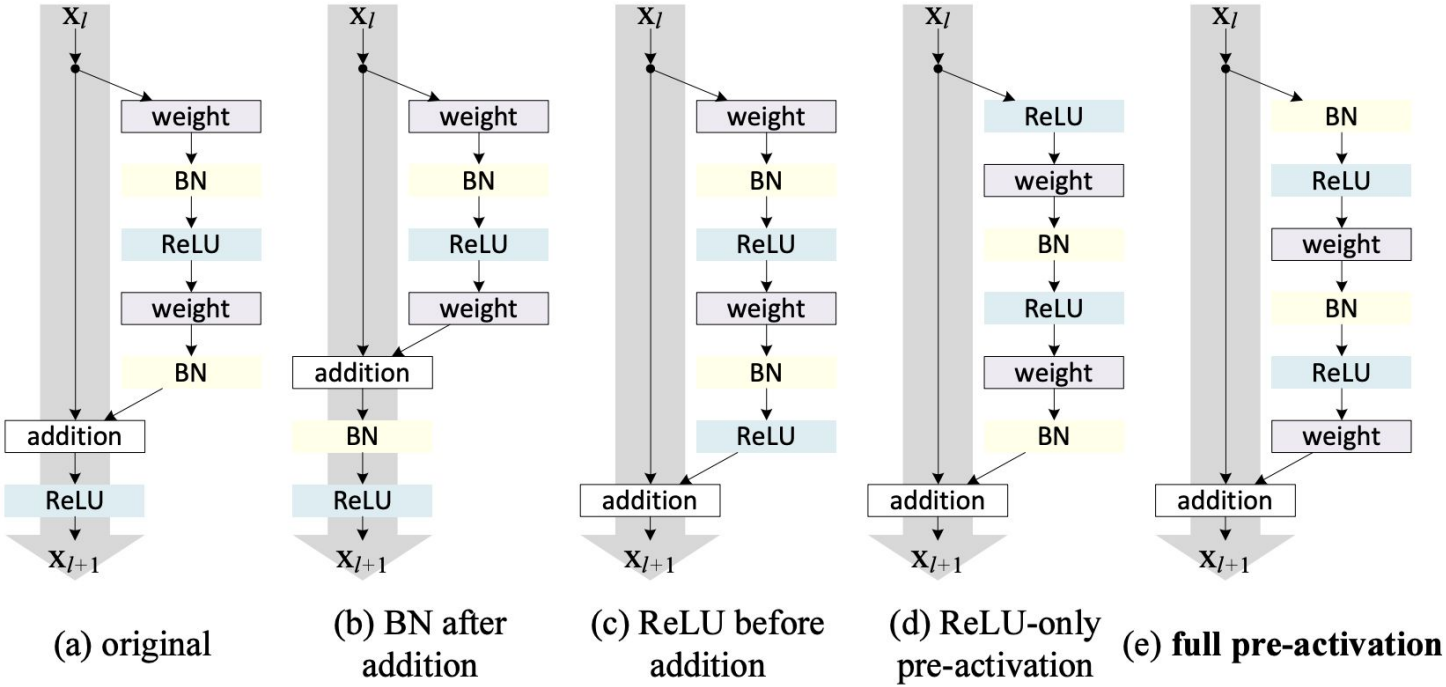


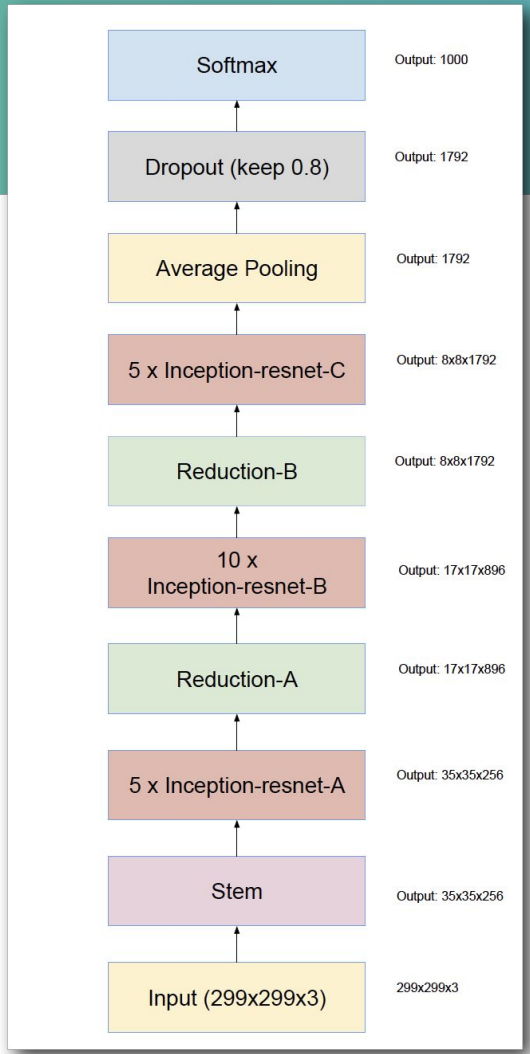
Figure 2. Residual learning: a building block.

ResNet v2



Hands-on

Inception v4, Inception-ResNet



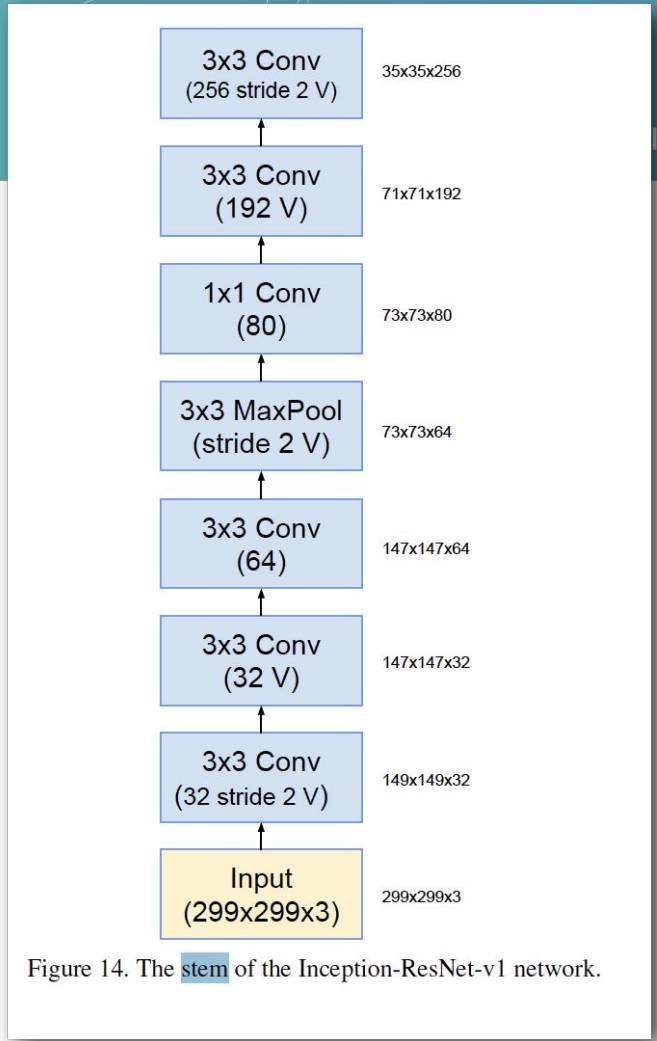


Figure 14. The stem of the Inception-ResNet-v1 network.

Inception v4, Reduction A/B

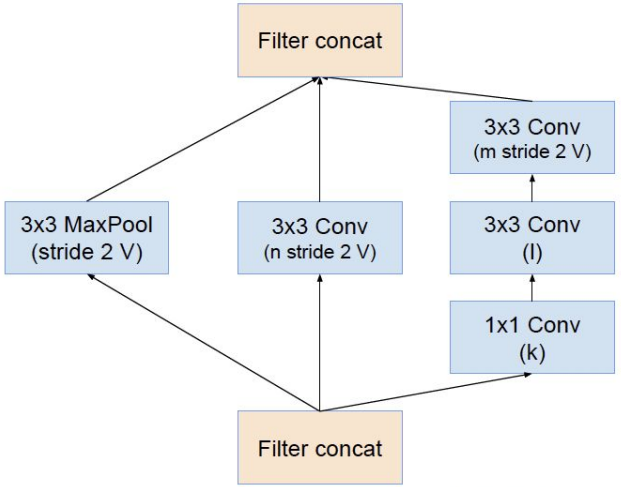


Figure 7. The schema for 35×35 to 17×17 reduction module. Different variants of this blocks (with various number of filters) are used in Figure 9, and 15 in each of the new Inception(-v4, -ResNet-v1, -ResNet-v2) variants presented in this paper. The k, l, m, n numbers represent filter bank sizes which can be looked up in Table 1.

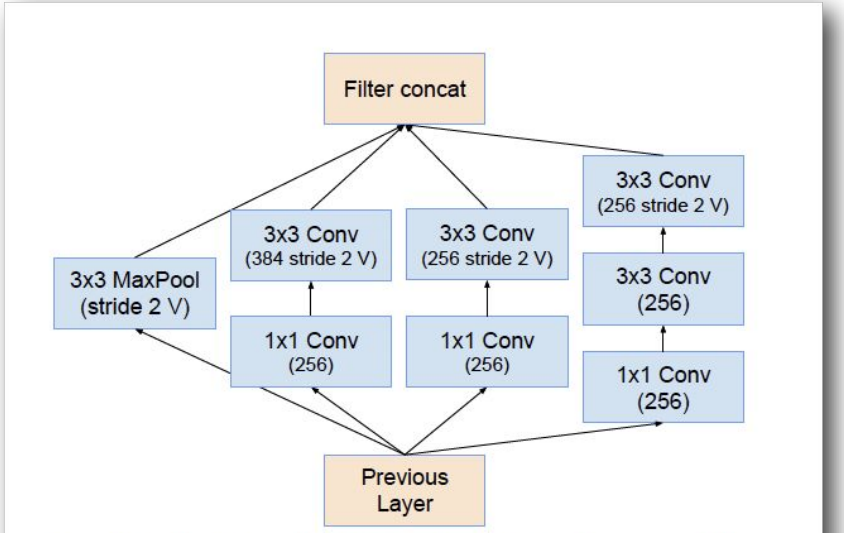


Figure 12. "Reduction-B" 17×17 to 8×8 grid-reduction module. This module used by the smaller Inception-ResNet-v1 network in Figure 15.

Inception v4, Inception-ResNet
Inception-Resnet-A/B/C

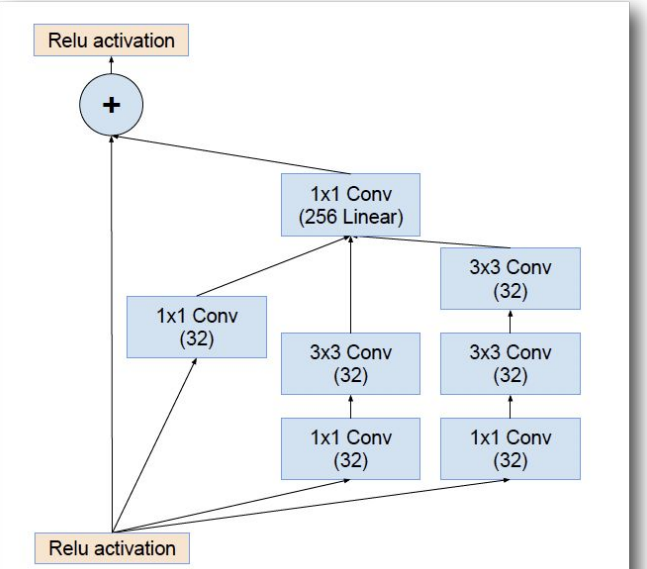


Figure 10. The schema for 35 × 35 grid (Inception-ResNet-A) module of Inception-ResNet-v1 network.

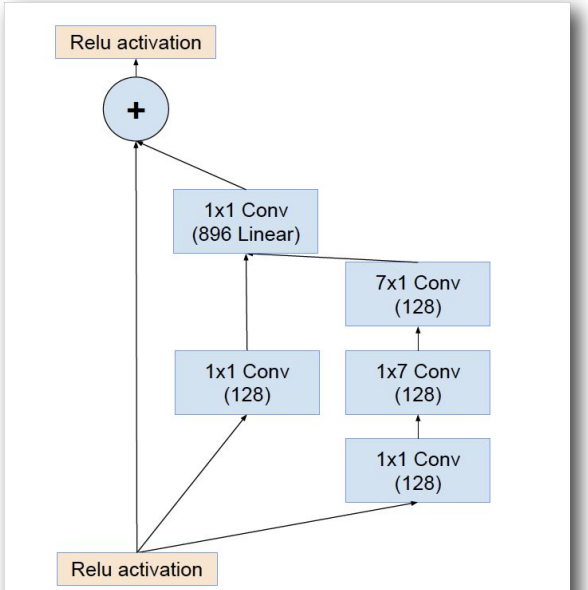


Figure 11. The schema for 17 × 17 grid (Inception-ResNet-B) module of Inception-ResNet-v1 network.

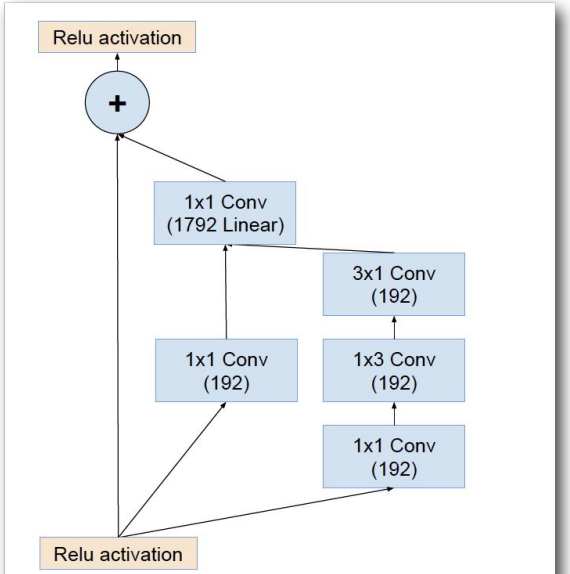


Figure 13. The schema for 8×8 grid (Inception-ResNet-C) module of Inception-ResNet-v1 network.

Hands-on

Reference

1. Cinnamon AI medium: CNN https://cinnamonaitaiwan.medium.com/%E6%B7%B1%E5%BA%A6%E5%AD%B8%E7%BF%92-cnn%E5%8E%9F%E7%90%86-keras%E5%AF%A6%E7%8F%BE-432fd9ea4935
2. Sobel https://zh.wikipedia.org/wiki/%E7%B4%A2%E8%B2%9D%E7%88%BE%E7%AE%97%E5%AD%90
3. LeNet paper http://yann.lecun.com/exdb/publis/pdf/lecun-98.pdf
4. VGG https://arxiv.org/abs/1409.1556
5. Inception v1 https://arxiv.org/abs/1409.4842
6. Inception v2/v3 https://arxiv.org/abs/1512.00567
7. Inception v4 https://arxiv.org/abs/1602.07261
8. Restnet https://arxiv.org/abs/1512.03385

Thank You!