AI Expert 프로그램 실습

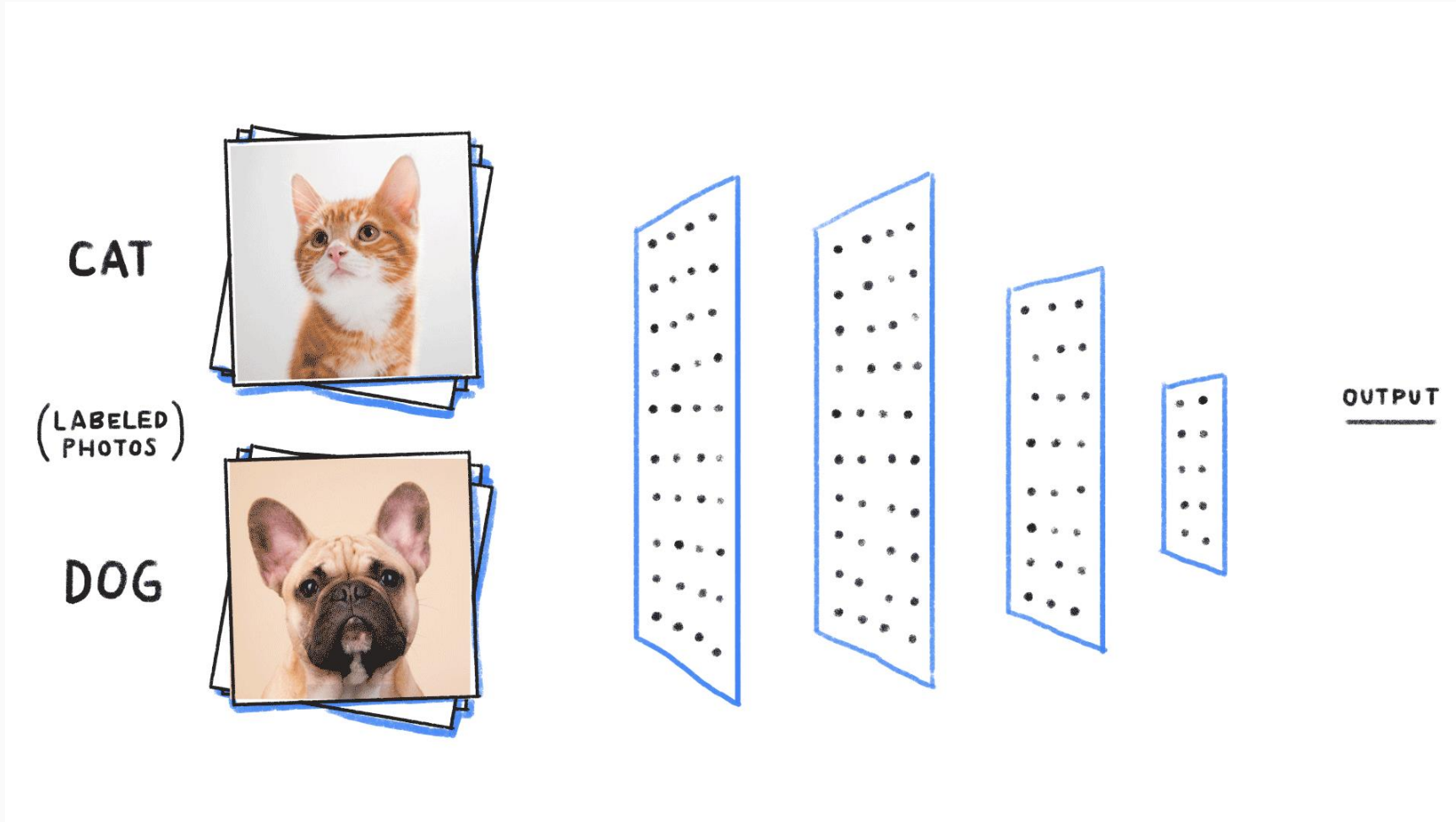**7/10 Basic of CNN, Image Classification, Style Transfer**

Overview

This tutorial is three-fold as follows:

1. Basics of CNN
2. Image Classification
3. Style Transfer

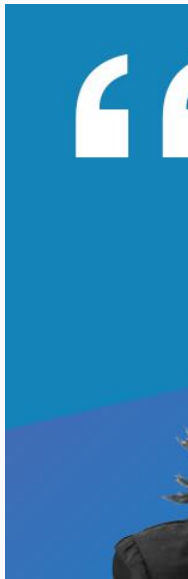* 10 minutes break between each part.

What is Image Classification ?

Launch of ImageNet (2009)

ILSVRC: ImageNet Large Scale Visual Recognition Competition
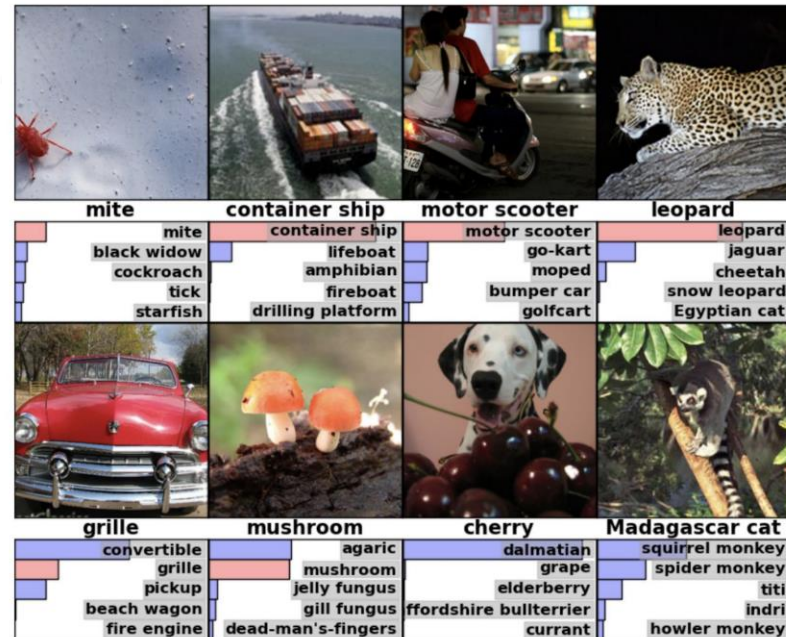
Top-1 one-crop accuracy versus amount of operations required for a single forward pass
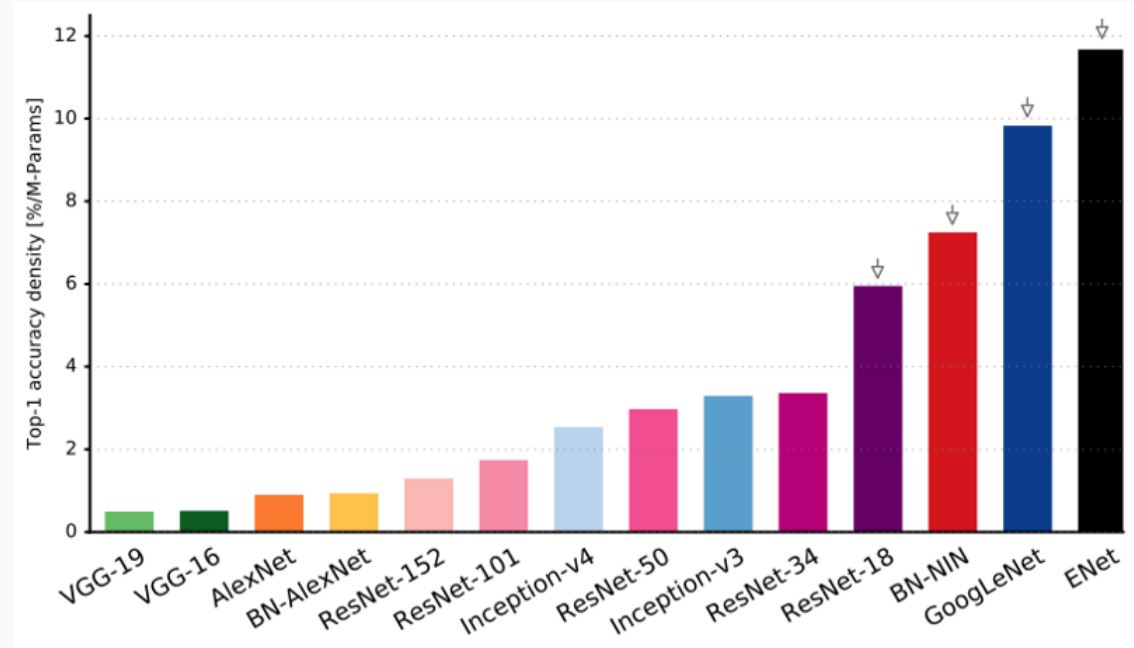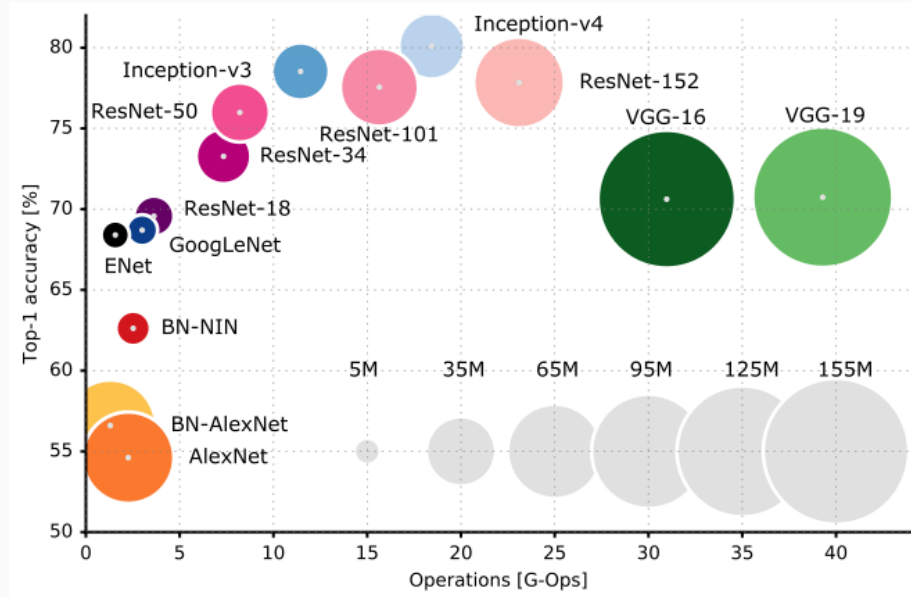
LeNet (1998), LeNet5 (2010)

AlexNet (2012)

Ranking of the best results from each team
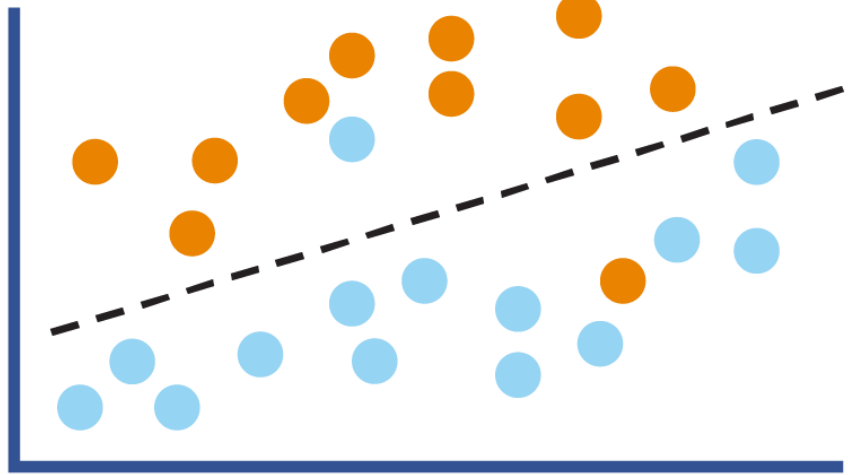
Error (5 predictions)
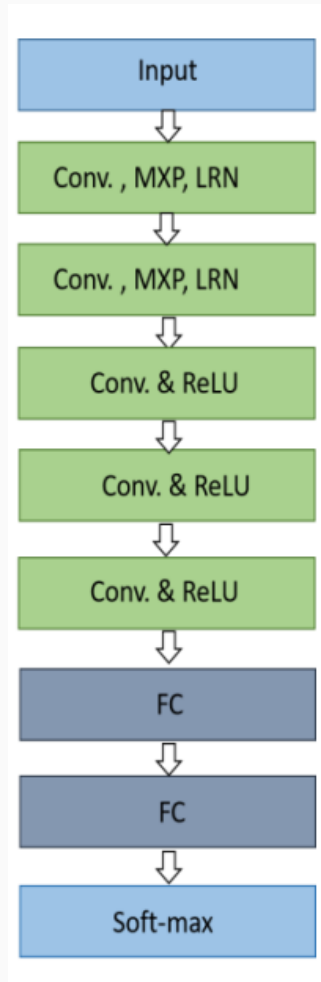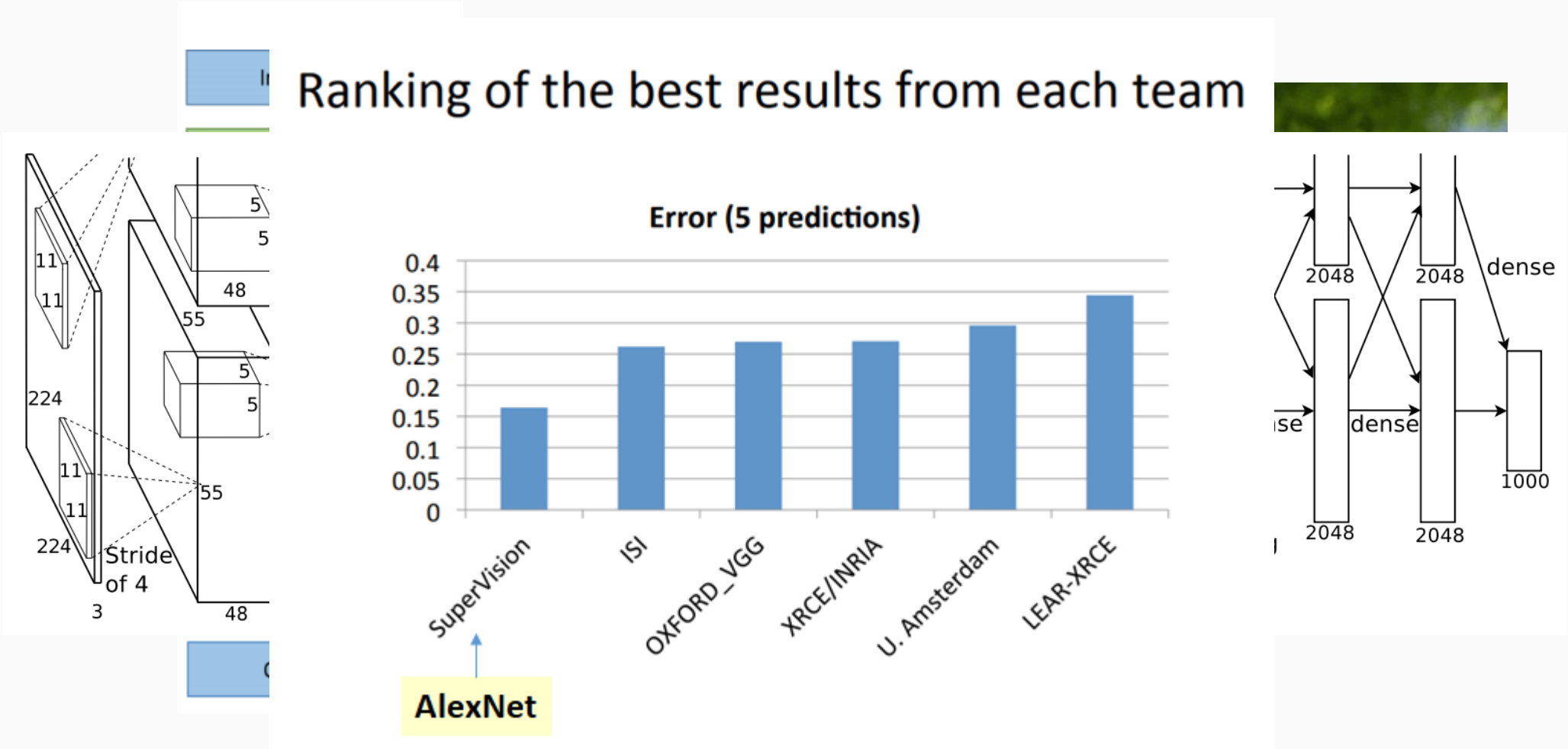
AlexNet

AlexNet (2012)

AlexNet (2012)

linear seperation   non-linear seperation
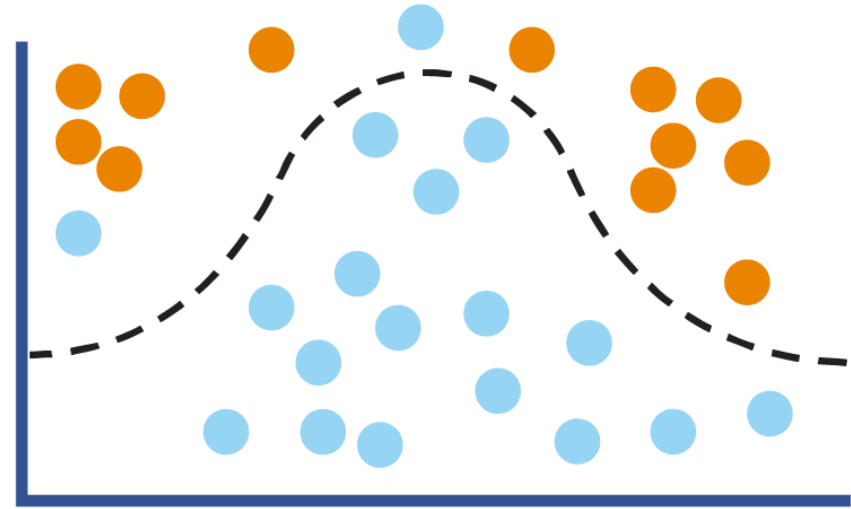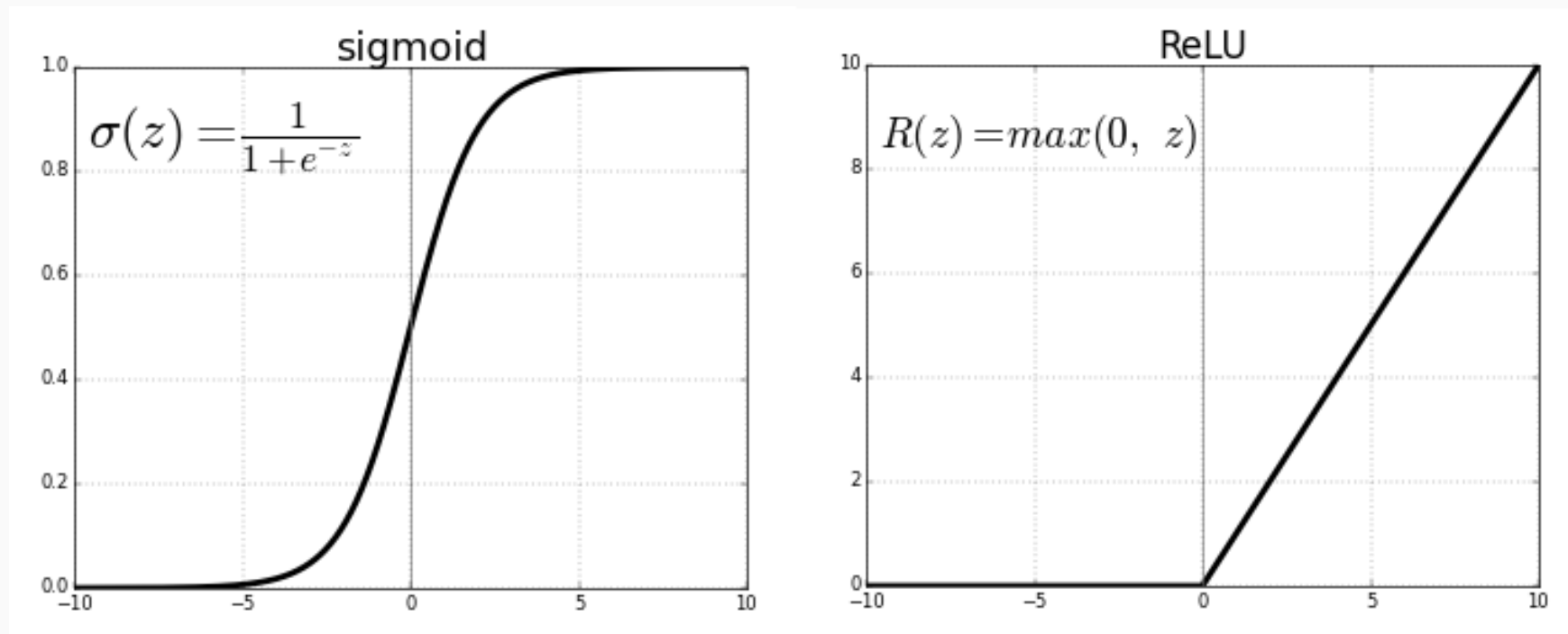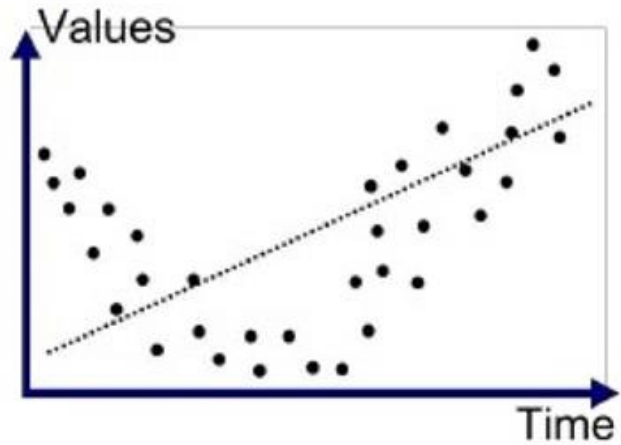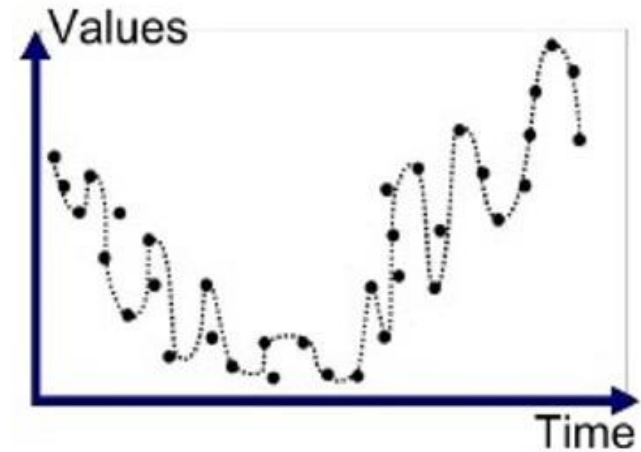
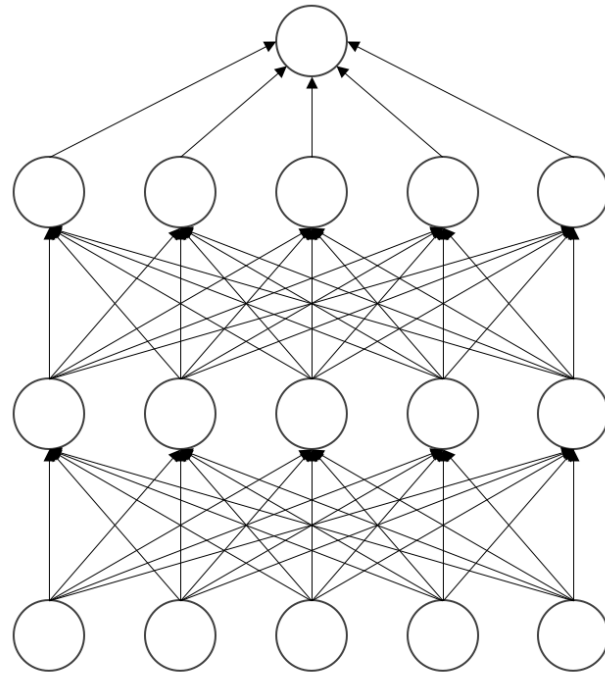## AlexNet (2012)

AlexNet (2012)
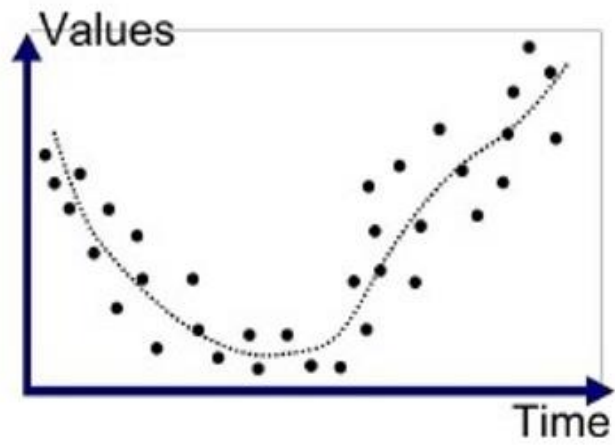
Underfitted   Good Fit/Robust   Overfitted

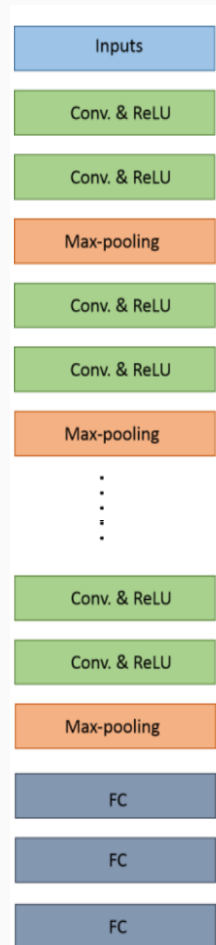## AlexNet (2012)

Standard Neural Net   After applying dropout

VGGNet (2014)

| Inputs |
| Conv. & ReLU |
| Conv. & ReLU |
| Max-pooling |
| Conv. & ReLU |
| Conv. & ReLU |
| Max-pooling |
| ⋮ |
| Conv. & ReLU |
| Conv. & ReLU |
| Max-pooling |
| FC |
| FC |
| FC |
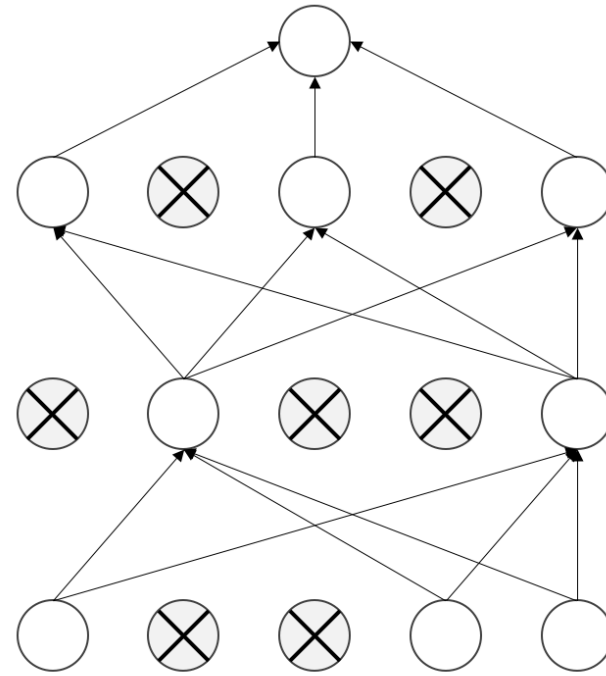
ConvNet Configuration					
A	A-LRN	B	C	D	E
11 weight layers	11 weight layers	13 weight layers	16 weight layers	16 weight layers	19 weight layers
input (224 × 224 RGB image)					
conv3-64	conv3-64 **LRN**	conv3-64 **conv3-64**	conv3-64 conv3-64	conv3-64 conv3-64	conv3-64 conv3-64
maxpool					
conv3-128	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					

Table 2: **Number of parameters** (in millions).

Network	A,A-LRN	B	C	D	E
Number of parameters	133	133	134	138	144

GoogLeNet (2014)
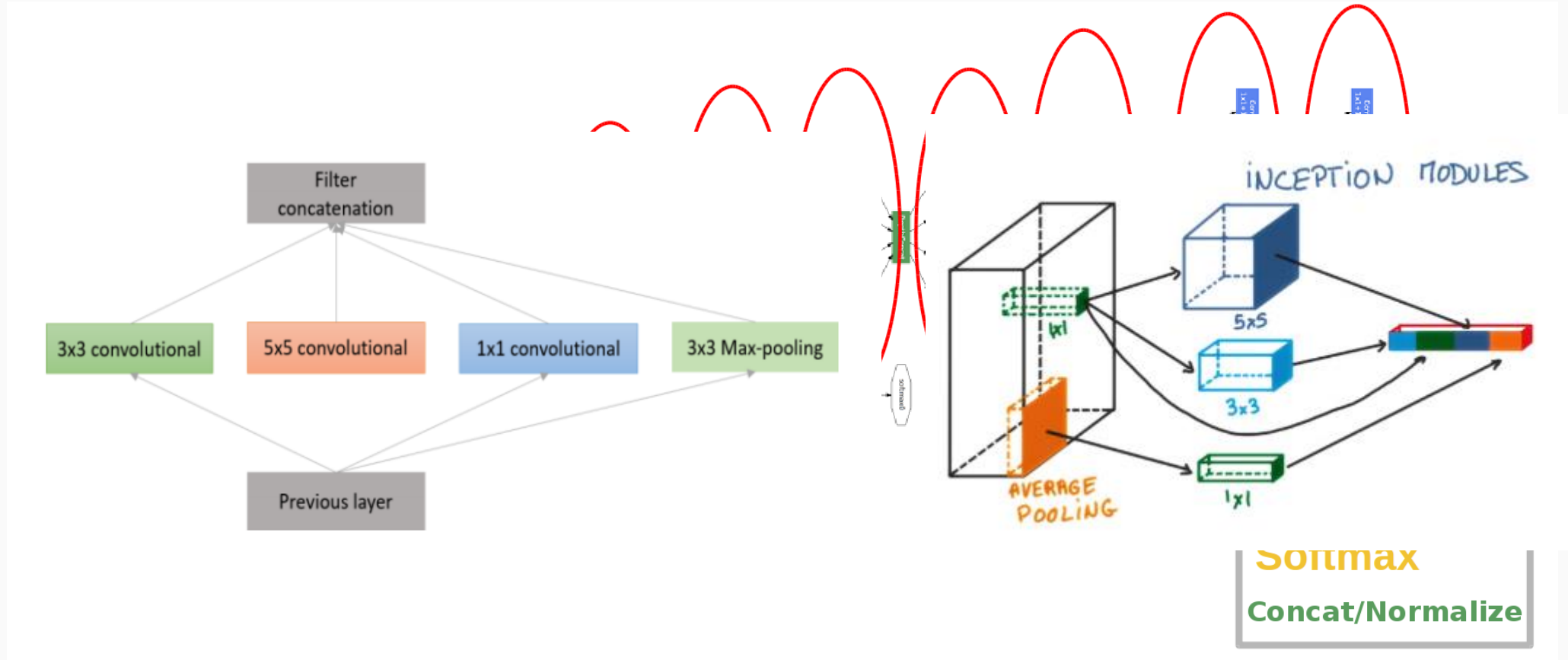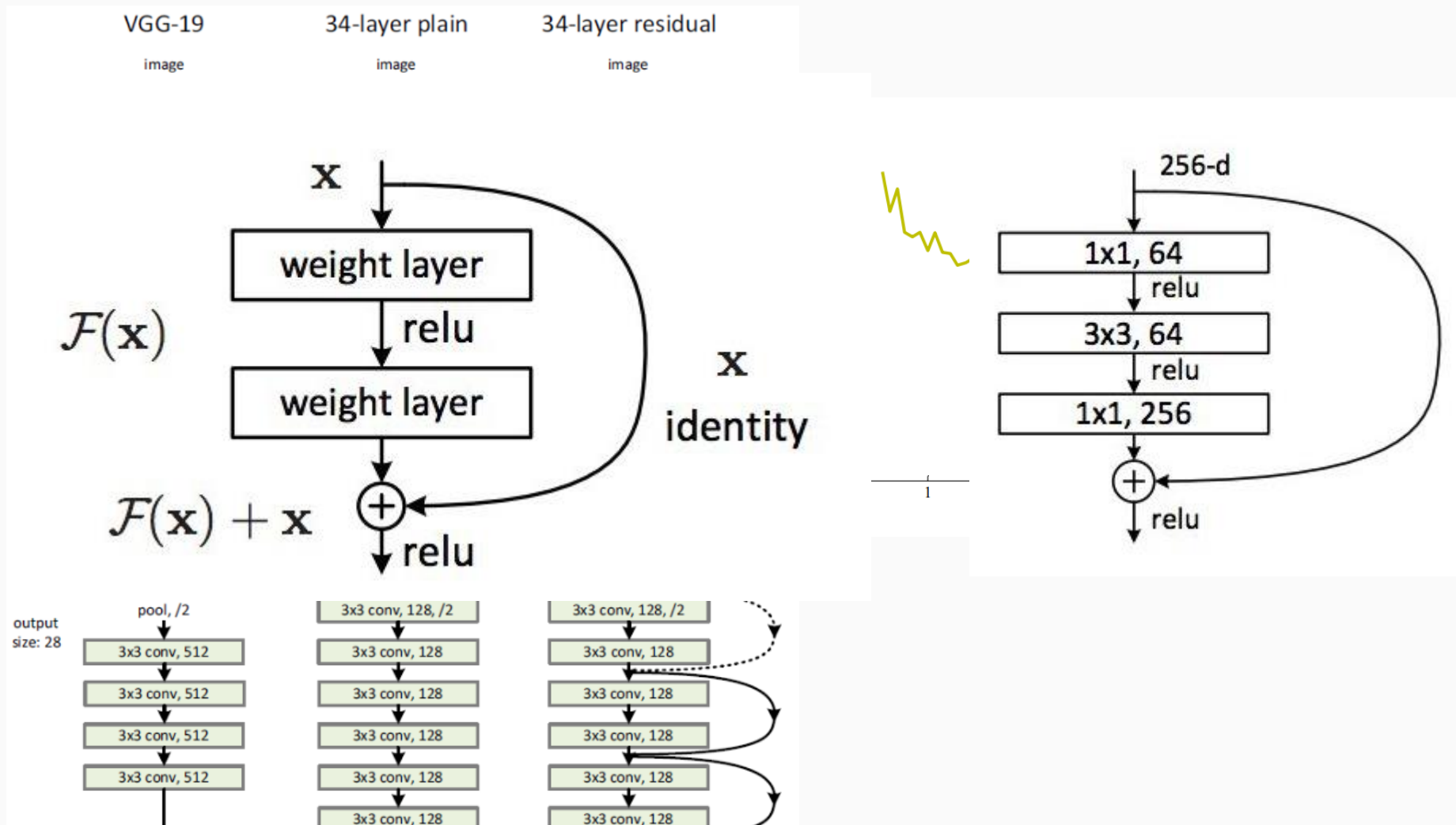
ResNet (2015)

DenseNet (2016)
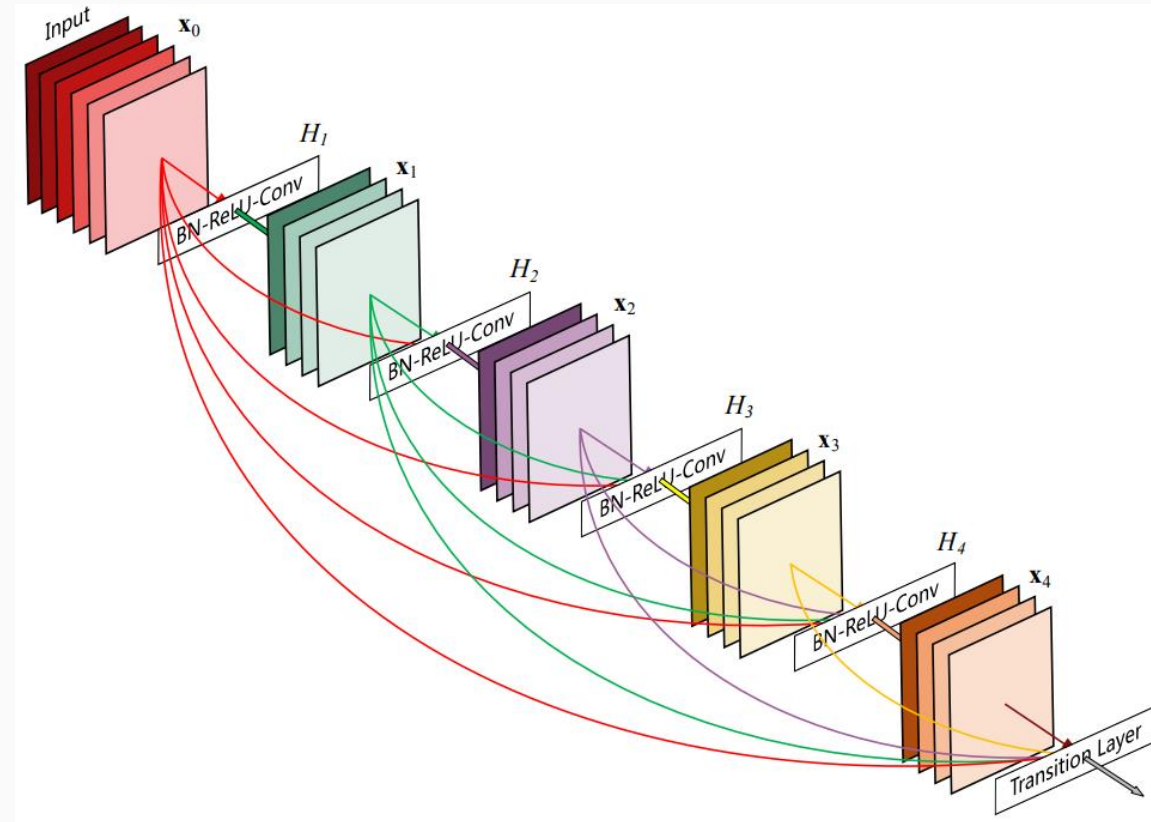
ResNet

- 2015 ILSVRC 1st ranked / error − 3.6%
- Human error − 5 ~10 %
- Vanishing gradient problem
- Residual block
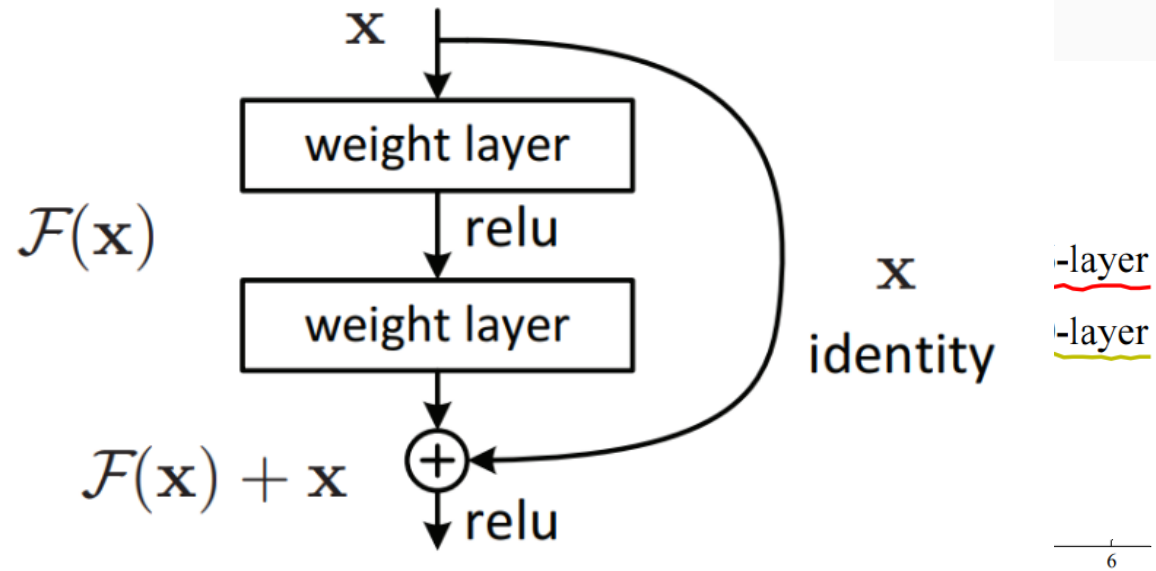
$$x_l = \mathcal{F}(x_{l-1}) + x_{l-1}$$

ResNet

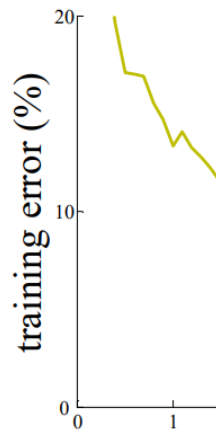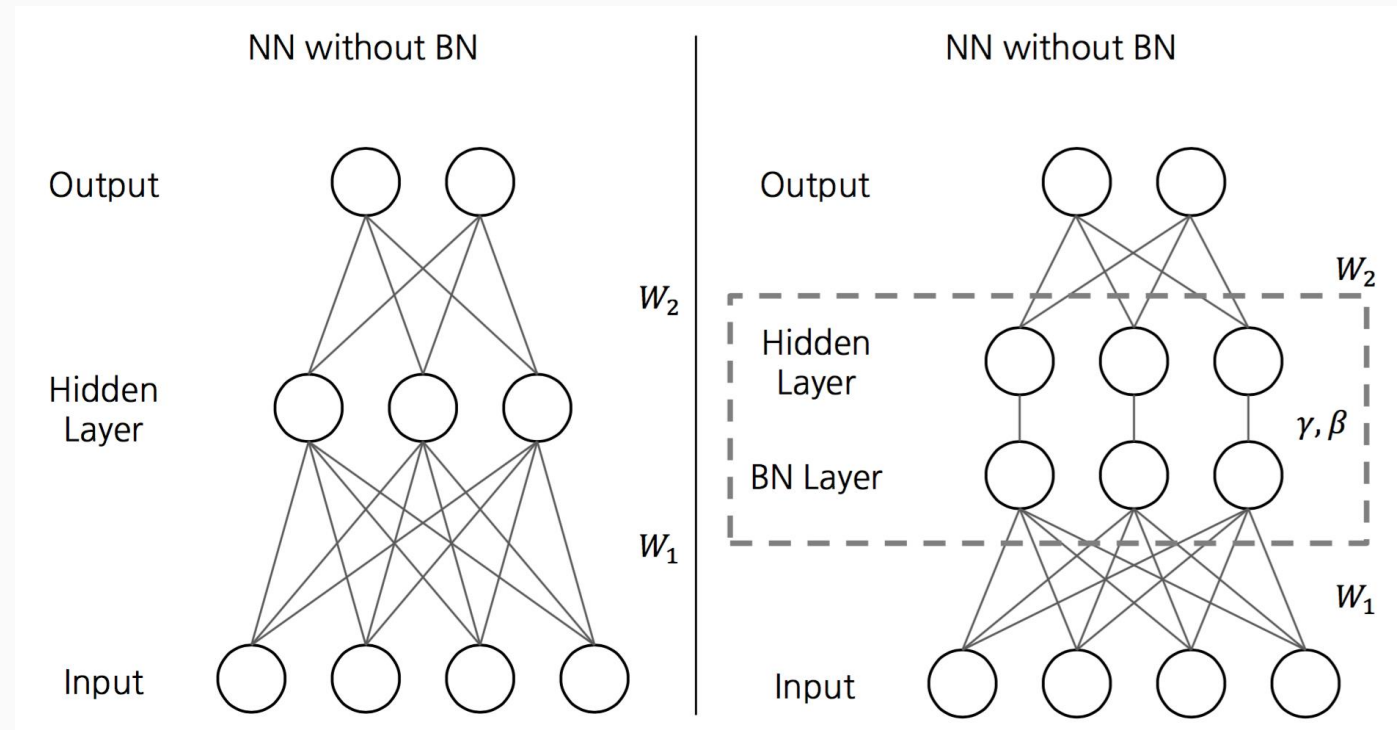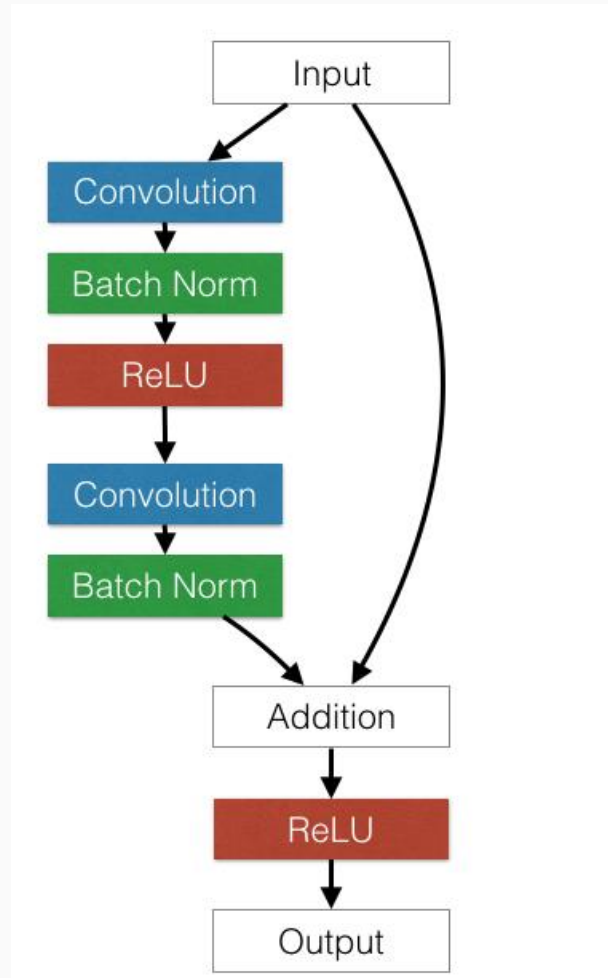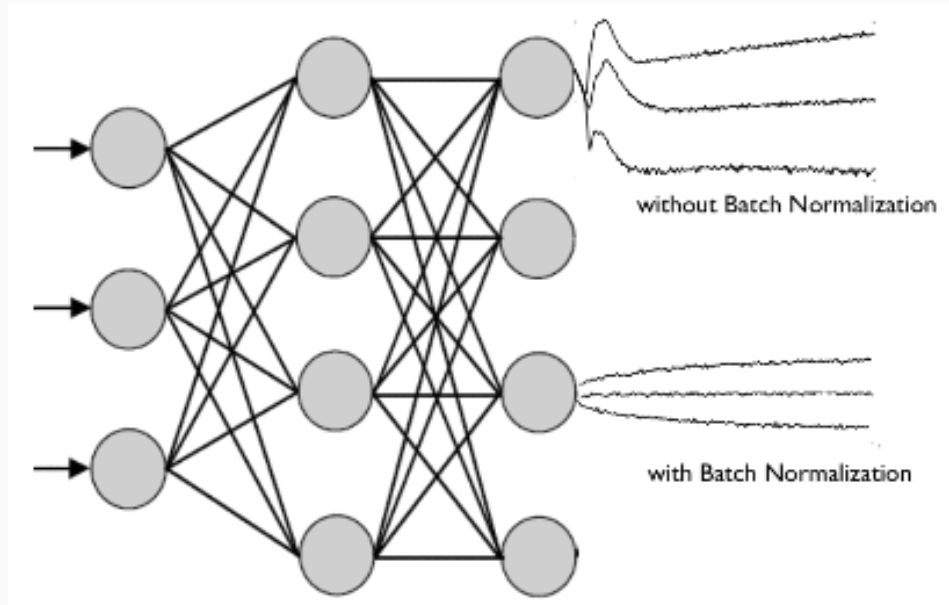- Batch Normalization

- Batch Normalization

without Batch Normalization

with Batch Normalization

ResNet

- Batch Normalization

Input: Values of x over a mini-batch: $\mathcal{B} = \{x_{1...m}\}$;
Parameters to be learned: γ, β
Output: $\{y_i = \mathrm{BN}_{\gamma,\beta}(x_i)\}$

$$\mu_{\mathcal{B}} \leftarrow \frac{1}{m}\sum_{i=1}^{m} x_i \qquad \text{// mini-batch mean}$$

$$\sigma_{\mathcal{B}}^2 \leftarrow \frac{1}{m}\sum_{i=1}^{m}(x_i - \mu_{\mathcal{B}})^2 \qquad \text{// mini-batch variance}$$

$$\widehat{x}_i \leftarrow \frac{x_i - \mu_{\mathcal{B}}}{\sqrt{\sigma_{\mathcal{B}}^2 + \epsilon}} \qquad \text{// normalize}$$

$$y_i \leftarrow \gamma\widehat{x}_i + \beta \equiv \mathrm{BN}_{\gamma,\beta}(x_i) \qquad \text{// scale and shift}$$

Algorithm 1: Batch Normalizing Transform, applied to activation x over a mini-batch.

Training: batch-specific moment averages are collected

moments μ, σ

Testing: moment averages are used instead of batch-specific moments