Predicting Financial Time Series using Deep Learning

Module2. Convolutional Neural Network

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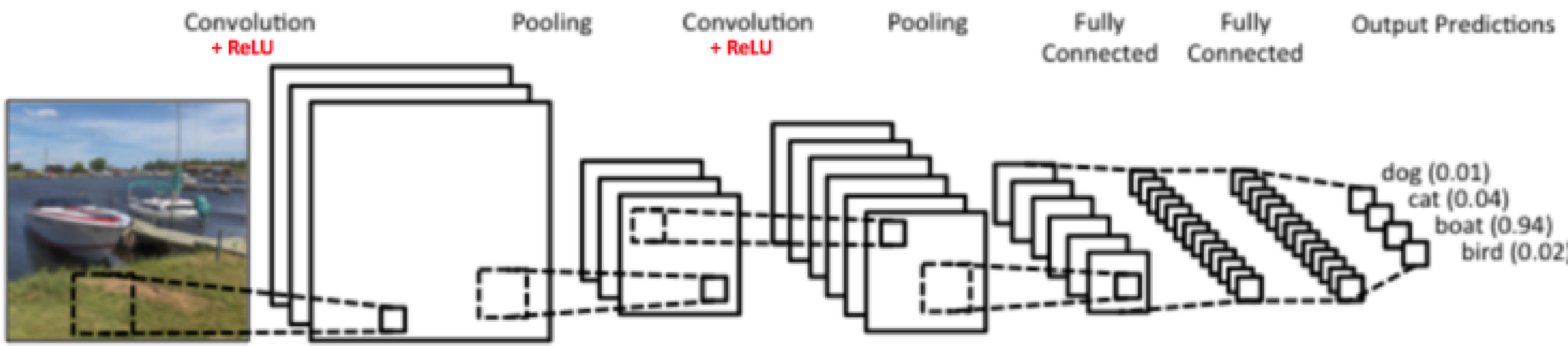
Note. This content mainly refers the summer session of KAIST organized by Jiyong Park(2018)

Convolutional Neural Network

Review: What is CNN?

- A typical example of CNN



➢ Inputs (2-dimension × channels) → [Convolution -> ReLu -> Pooling] → …

→ [Convolution -> ReLu -> Pooling] → Fully connected layer

→ Output prediction (Multi-class classification)

Review: What is CNN?

Keras

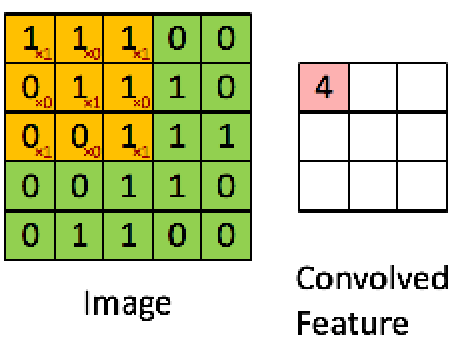
- Convolution

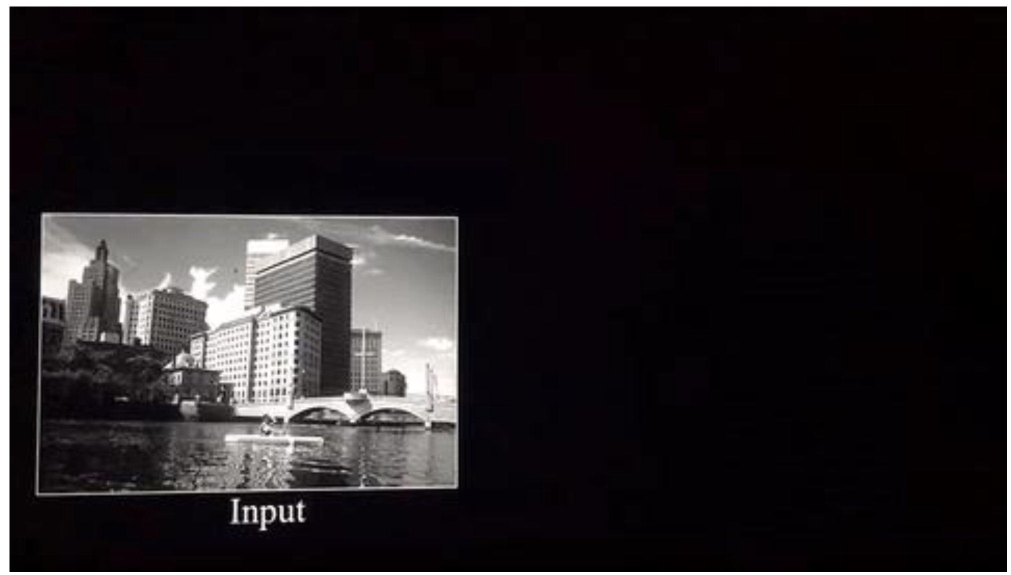
1	1	1	0	0
0	1	1	1	0
0	0	1	1	1
0	0	1	1	0
0	1	1	0	0

Image data

1	0	1
0	1	0
1	0	1

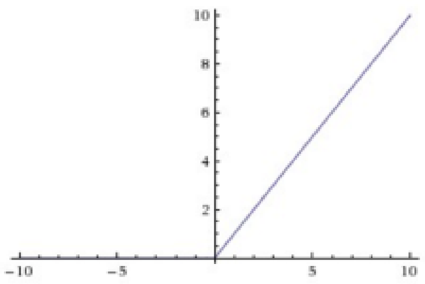
Convolution filter



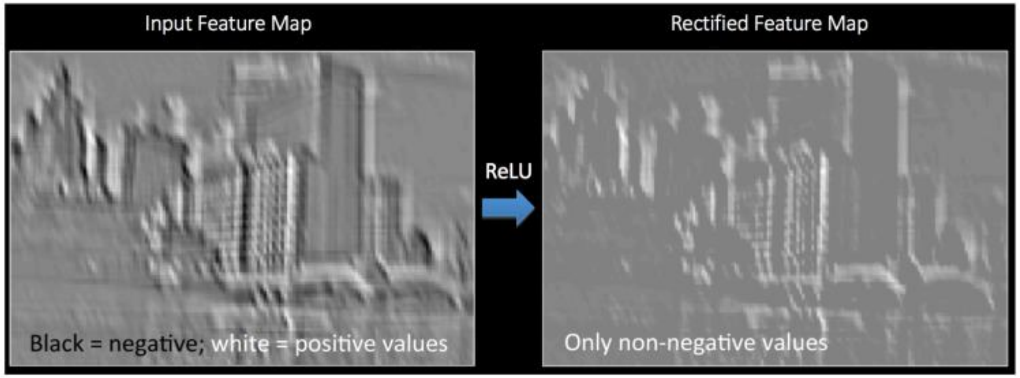


Review: What is CNN?

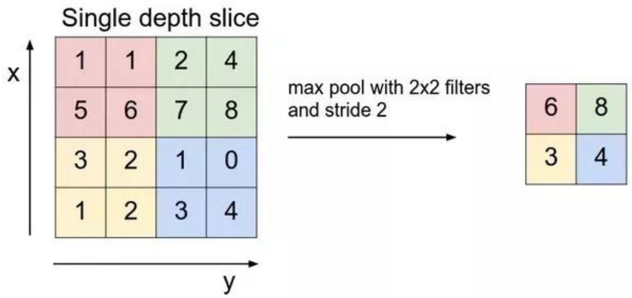
- ReLU

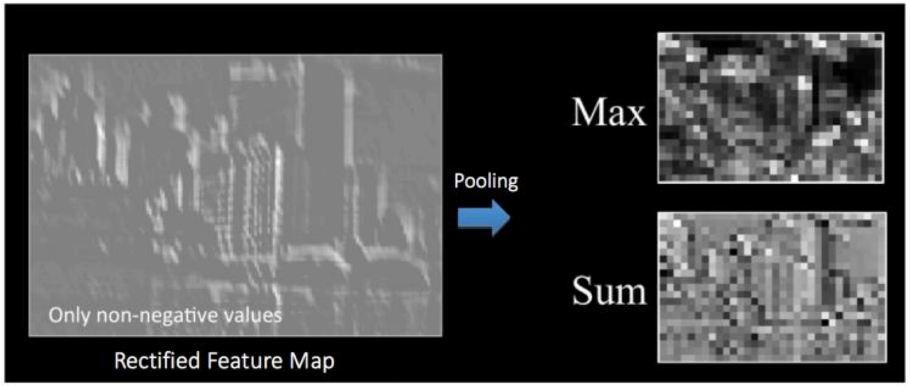


Output = Max(zero, Input)



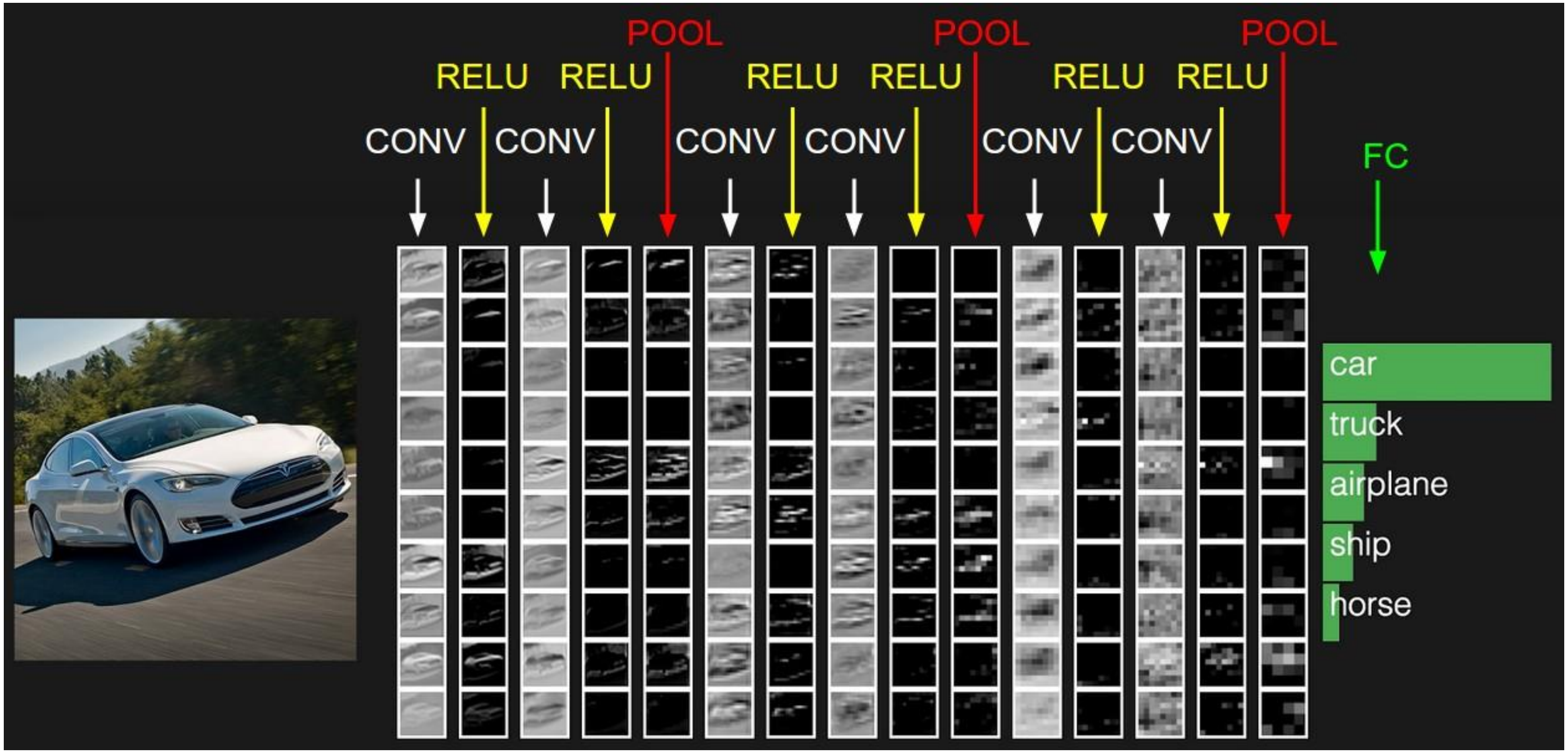
- Max pooling





Review: What is CNN?

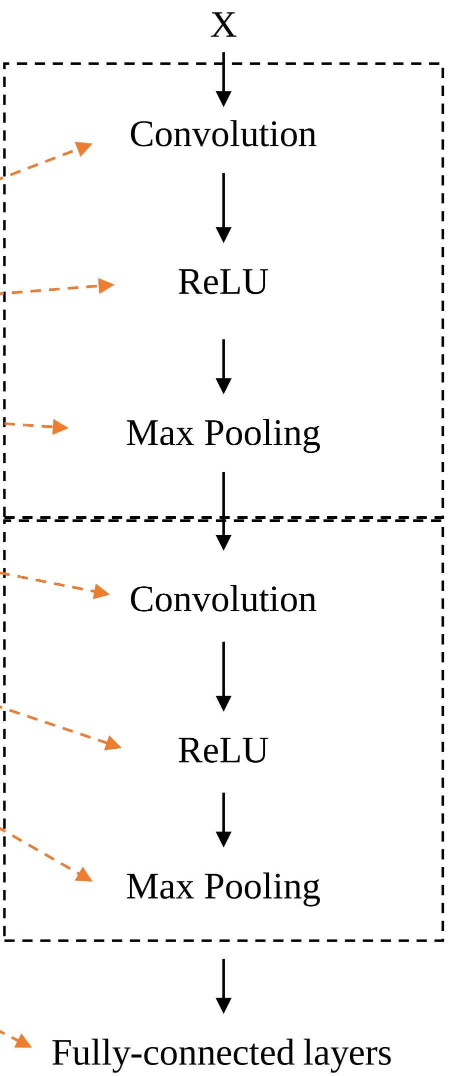
- Hierarchical feature representation (multiple convolution layers)



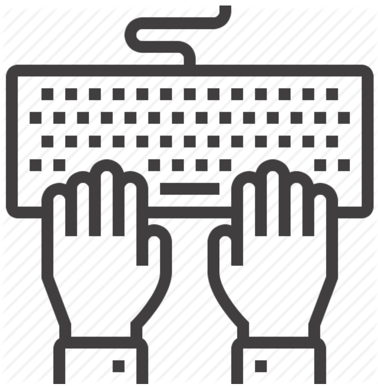
CNN in Keras

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Activation, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D
```

```
model = Sequential()

model.add(Conv2D(256, (3, 3), input_shape=X.shape[1:]))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Conv2D(256, (3, 3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Flatten())  # this converts our 3D feature maps to 1D feature vectors

model.add(Dense(64))

model.add(Dense(1))
model.add(Activation('sigmoid'))

model.compile(loss='binary_crossentropy',
              optimizer='adam',
              metrics=['accuracy'])

model.fit(X_train, y_train, batch_size=32, epochs=30, validation_split=0.3)
```



Hands-on-Labs Convolutional Neural Network



Dogs & Cats Classifier using CNN

Lab1_Convolutional_Neural_Network.ipynb

https://colab.research.google.com/drive/1qKSNVWgBkqi7S4KL-pTnbBawmv7hT2fP

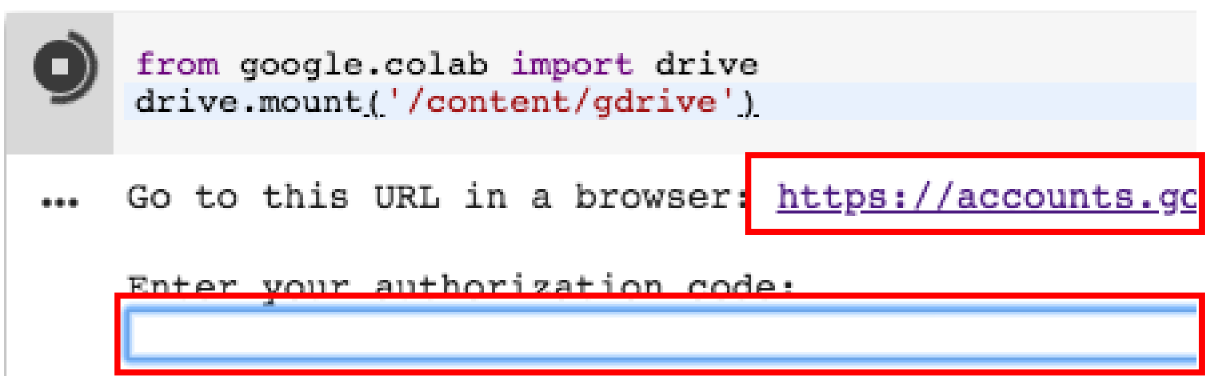
Upload Data on Colab

- First Step: Upload your data on Google Drive

http://drive.google.com

Data Download at:
https://drive.google.com/open?id=1Dje13qjGZwtaVhhjp-ZJVzeyzJrG6oc1

- Second Step: Enter Authentication Code on Google Colab



- Go to Url
- Type Code

Check Data Available

- !ls "/content/gdrive/My Drive/”

```
[ ]  !ls "/content/gdrive/My Drive/Lecture/StudyPie/Data"
```

```
crypto_data.zip  kagglecatsanddogs_3367a.zip  PetImages.zip
```

- Set data path on the code according to the your local environment
  - In my case:

```
[3]  DATA_PATH = "/content/gdrive/My Drive/Lecture/StudyPie/Data/"
```

CNN Input Shape

Keras

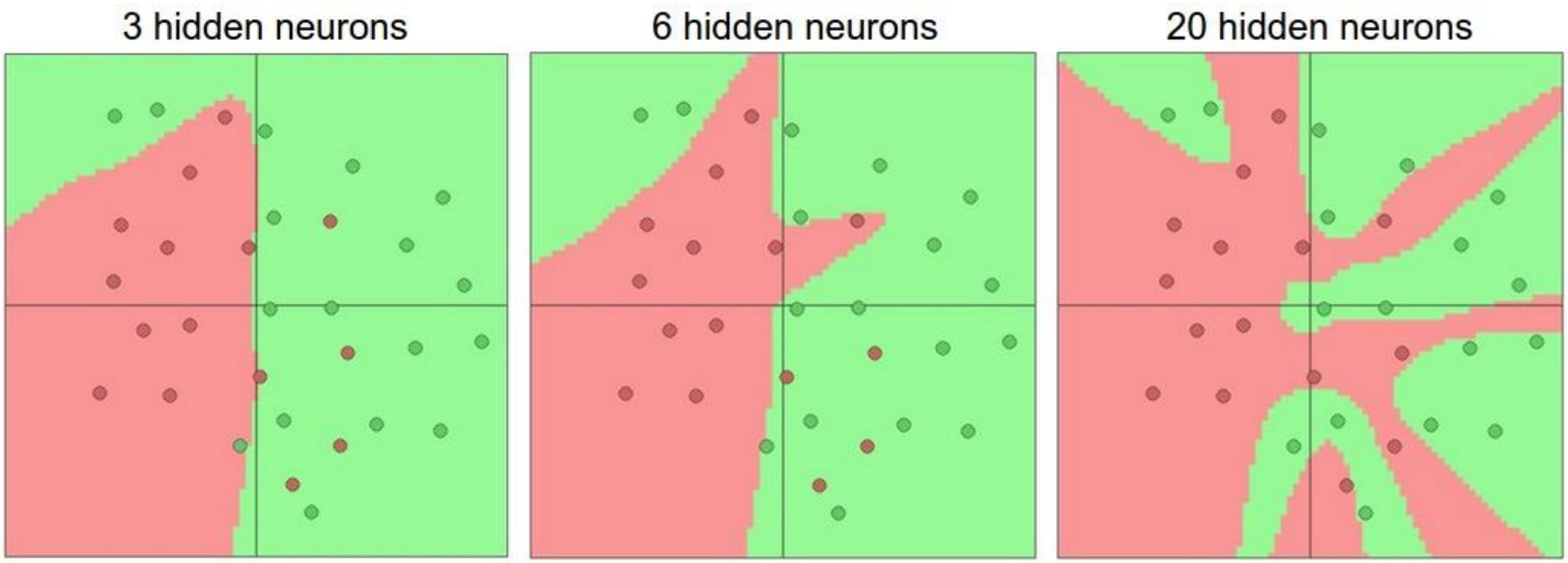
- Regular Image Shape
  - (N, H, W, C)
    - N: Number of image
    - H: Height of image
    - W: Width of image
    - C: Color channel (or output channel)

- Conv2D(256, (3, 3), input_shape = (H, W, C)))
  - Number of filter: 256
  - Kernel: (3: Height, 3: Width)
  - Input Shape: H, W, C (Number of Sample will be inferred during training)

Improving Performance on CNN

Improving Performance (1) Capacity

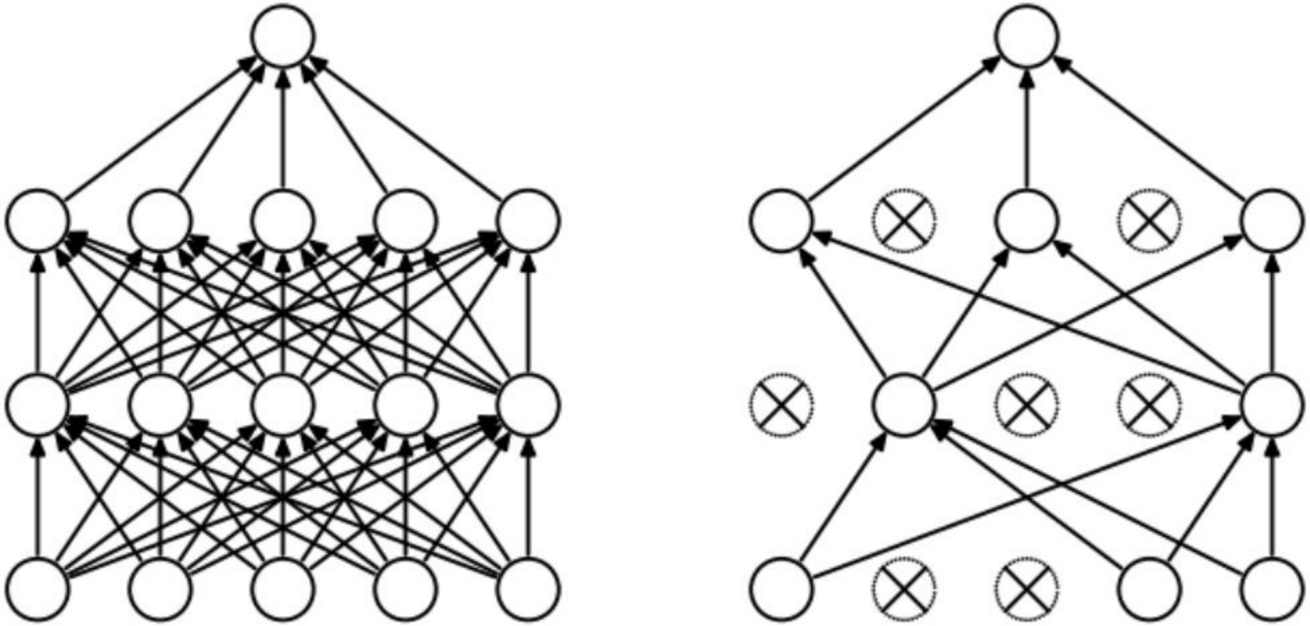
- As we increase the size and number of layers in a Neural Network, the capacity of the network increases.
- Overfitting occurs when a model with high capacity fits the noise in the data instead of the (assumed) underlying relationship.



Reference: http://cs231n.github.io/neural-networks-1/

Improving Performance (2) Dropout

- Dropout avoids overfitting of neural networks



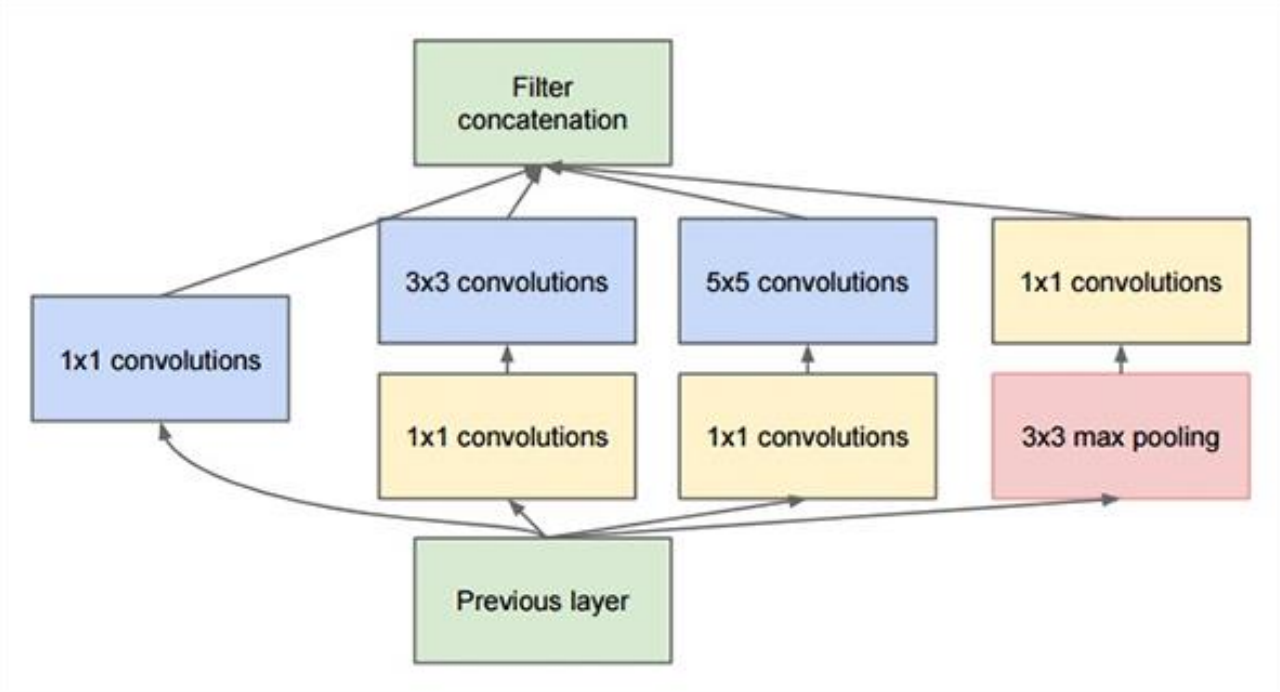
(a) Standard Neural Net

(b) After applying dropout.

Improving Performance (3) Inception

Keras

- CNN can have filters with multiple sizes operating on the same level.
  - ➢ CNN with inception tends to be more efficient and has better performance (Szegedy et al. 2015)



Szegedy, C., Liu, W., Jia, Y., Sermanet, P., Reed, S., Anguelov, D., Erhan, D., Vanhoucke, V. and Rabinovich, A., 2015. Going Deeper with Convolutions. *In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition.*

Assignment: 1D Convolution

1D Convolution

Keras

- How can we apply convolution on time series data?
- 1D Convolution of discrete time signals
- Example
  - Kernel:

-1	1

  - Time series data:

0	0	0	1	0	1	1	1

1D Convolution

Keras

- Example
    - N = 0: -1*0 + 1*0 = 0

-1	1

0	0	0	1	0	1	1	1

    - N = 1: -1*0 + 1*0 = 0

-1	1

0	0	0	1	0	1	1	1

    - N = 2: -1*0 + 1*1 = 1

-1	1

0	0	0	1	0	1	1	1

Thank you ☺

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References

- Jiyong Park (2018), KAIST Summer Session, Retrieved from https://sites.google.com/view/kaist-mis-session2018/overview?authuser=0