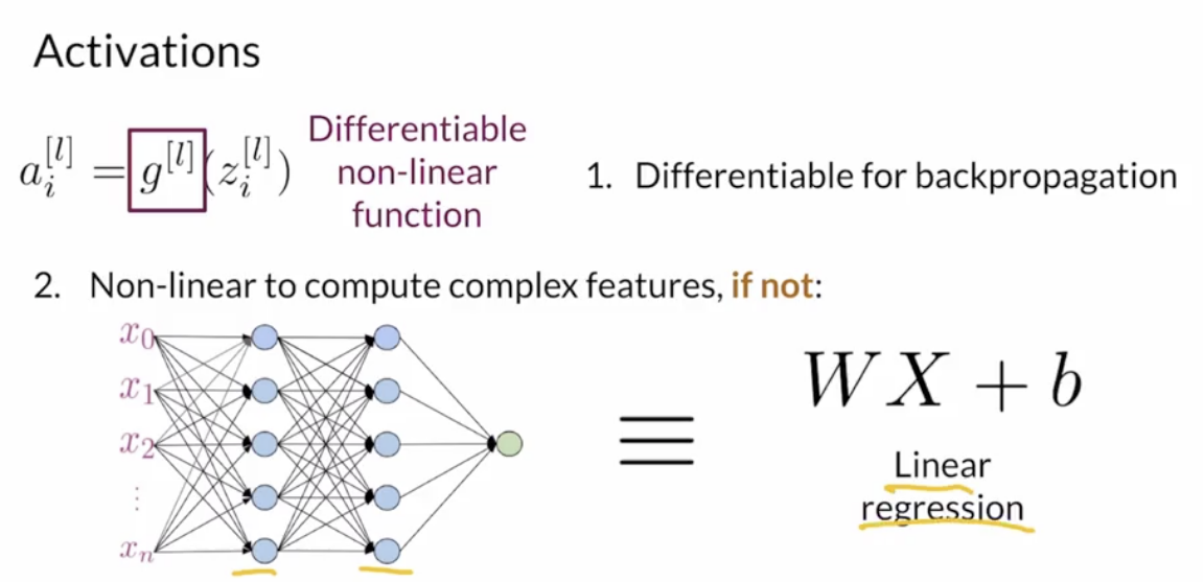
Week 2 - Deep Convolutional GANs

Activations (Basic Properties)

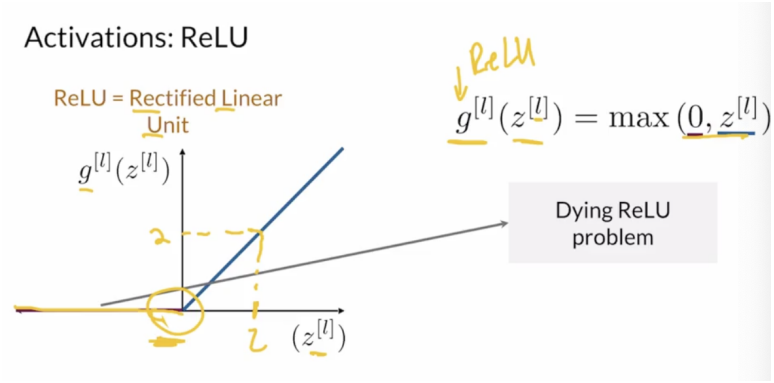


If linear function $h(x) = cx$ and I used it as a activation function with 3 layer neural net. Then, it will be $y(x) = h(h(h(x))) = c * c * c * x = c^3x$. It is still $y = ax$ if $a = c^3$. So activation function should be non-linear function.

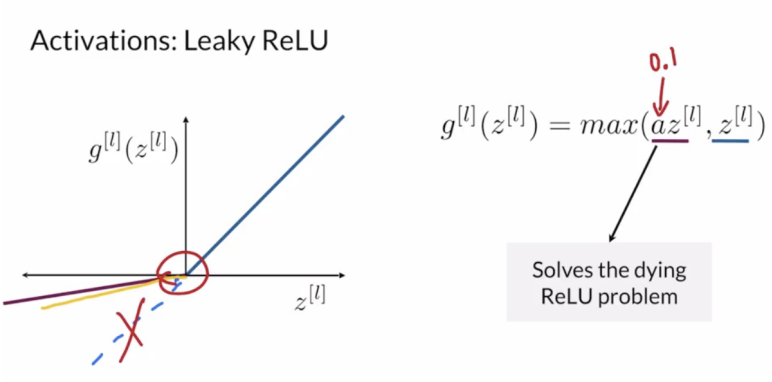
- Activation functions are non-linear and differentiable
- Differentiable for backpropagation
- Non-linear to approssimate complex functions

Common Activation Functions

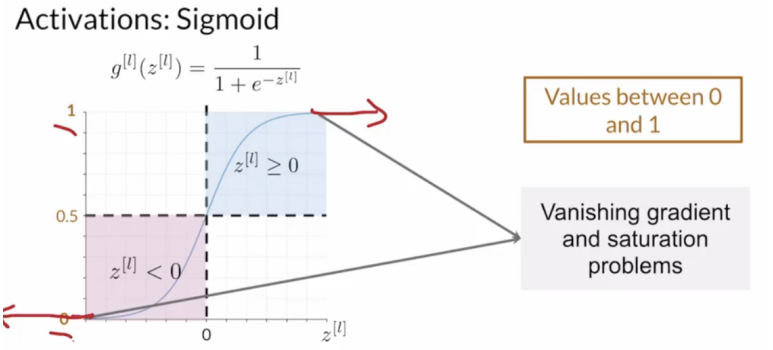
- Common activations
  - ReLU



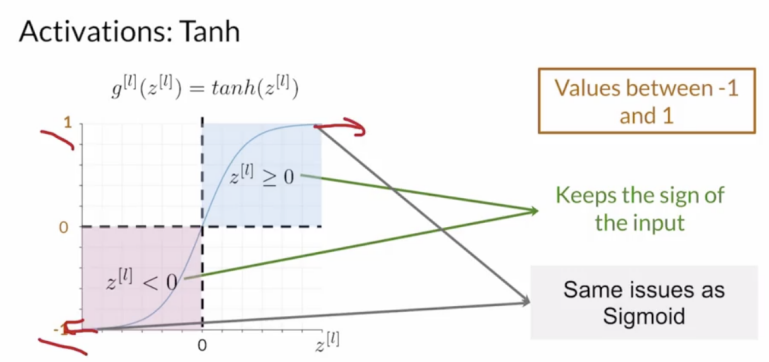
- LeakyReLU



- Sigmoid

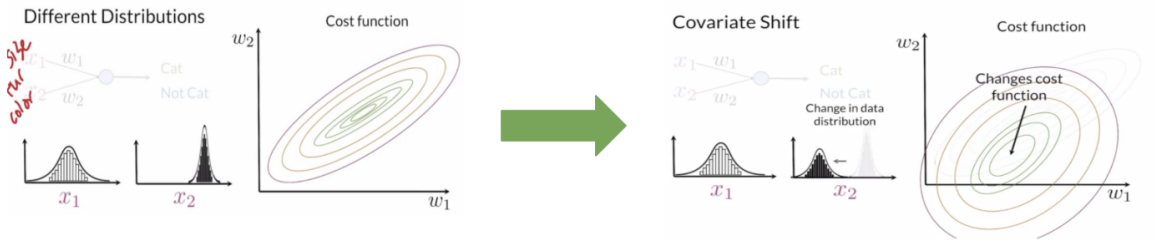


- Tanh

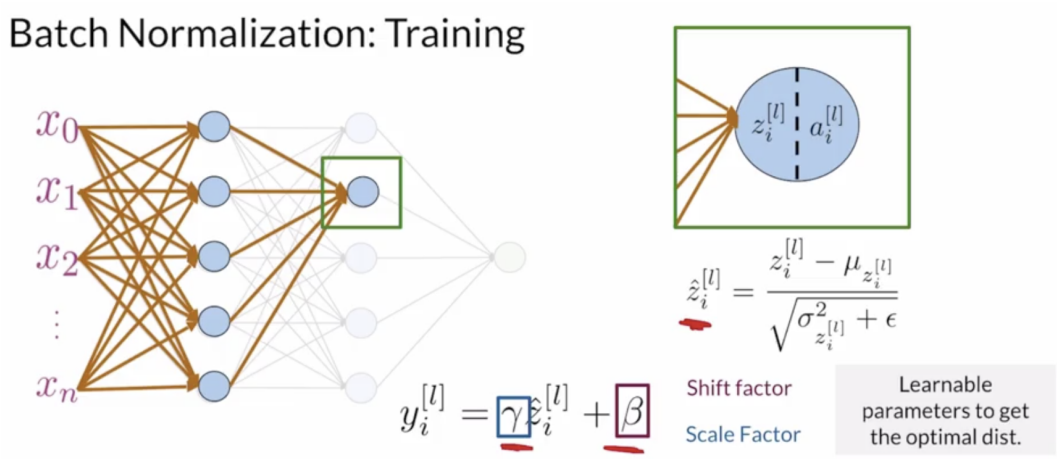


- ReLU activation suffer from dying ReLU
- Leaky ReLU solve the dying ReLU problem
- Sigmoid and Tanh have vanishing gradient and saturation problems

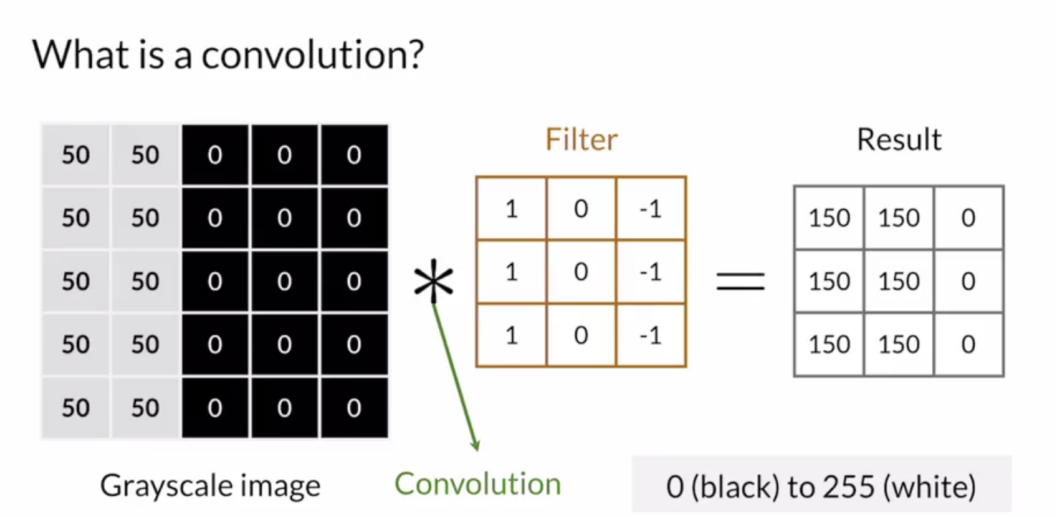
Batch Normalization



Input data for the input layer can be normalized, but the hidden layer receives the activation $f(XW)$ from the previous layer as input. However, if the value of weights updates as the neural net learns, it will change to activation $f(XW')$ of the previous layer and the distribution of input values will continue to change from the hidden layer's point of view. This problem is called **international collaborative shift**, and Batch Normalization is designed to solve it.

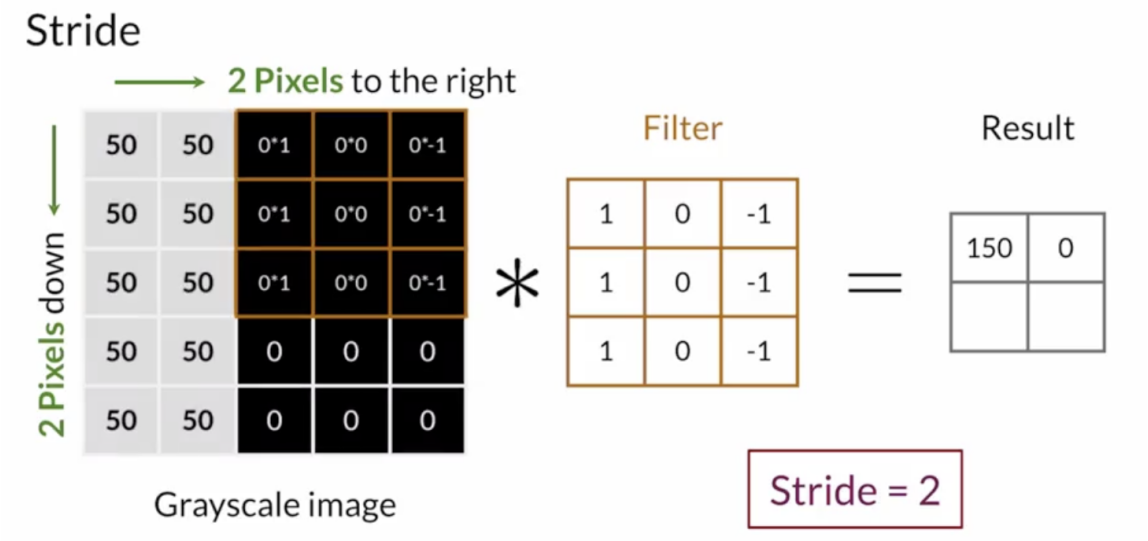


Review of Convolutions



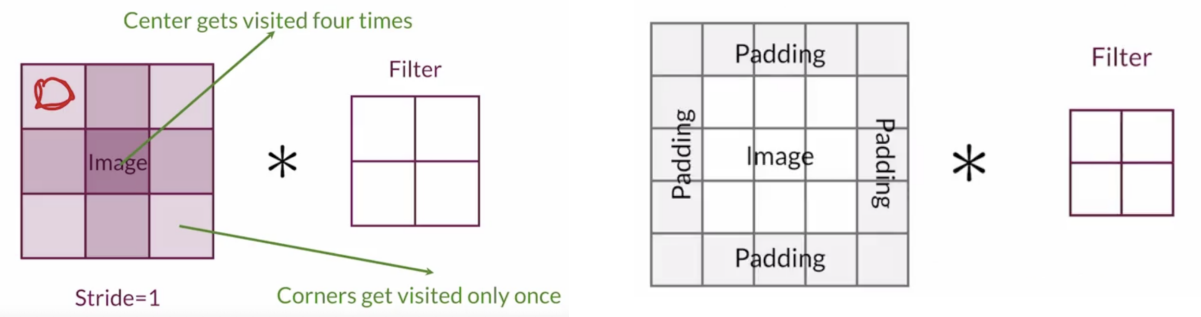
Padding and Stride

- Stride



- Padding

  In the left image below, filter pass some pixel 4 times, and some pixels are only 1 time. But if there's some important features of image on a pixel with a red circle, it's focused on a pixel that's less important. This is wrong. Therefore, padding around the image ensures that it is not concentrated on a specific pixel.



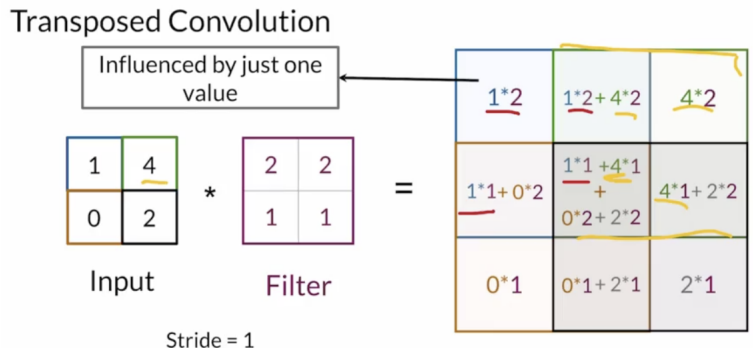
- Stride determines how the filter scans the image
- Padding is like a frame on the image
- Padding gives similar importance to the edges and the center

Pooling and Upsampling

Pooling is used to reduce the size of the input while up-sampling is used to increase the size of that input. And there are **no learnable parameters!**

- Pooling : Max Pooling, Average Pooling, Min Pooling
- Upsampling : Nearest Neighbors, Linear Interpolation, Bi-linear Interpolation

Transposed Convolutions



There is an issue that this center pixel is visited four times and is influenced by all pixels while the other ones. It is called Checkerboard Pattern.

- Transposed convolutions upsample
- Have learnable parameters.
- Problem : results have a checkerboard pattern

- Reference
  - https://www.coursera.org/learn/build-basic-generative-adversarial-networks-gans/lecture/o8Vi4/batch-normalization-explained
  - https://de-novo.org/2018/05/28/batch-normalization-이해하기/