

# Regularization in Neural Networks

By

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Some Slides from

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# Acknowledgments

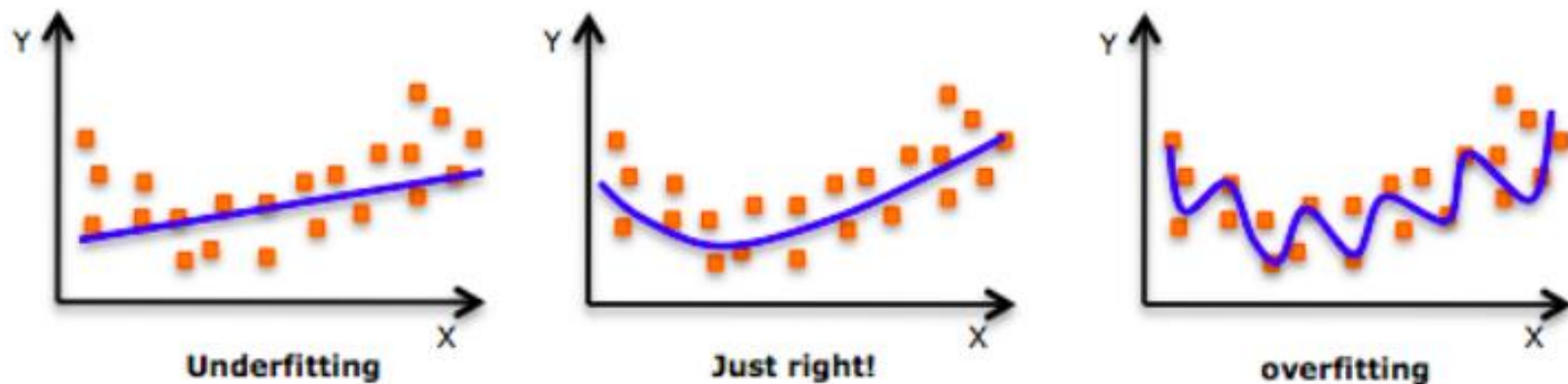
This presentation is heavily based on:

<https://visualstudiomagazine.com/articles/2017/09/01/neural-network-l2.aspx>

<https://towardsdatascience.com/regularization-in-deep-learning-l1-l2-and-dropout-377e75acc036>

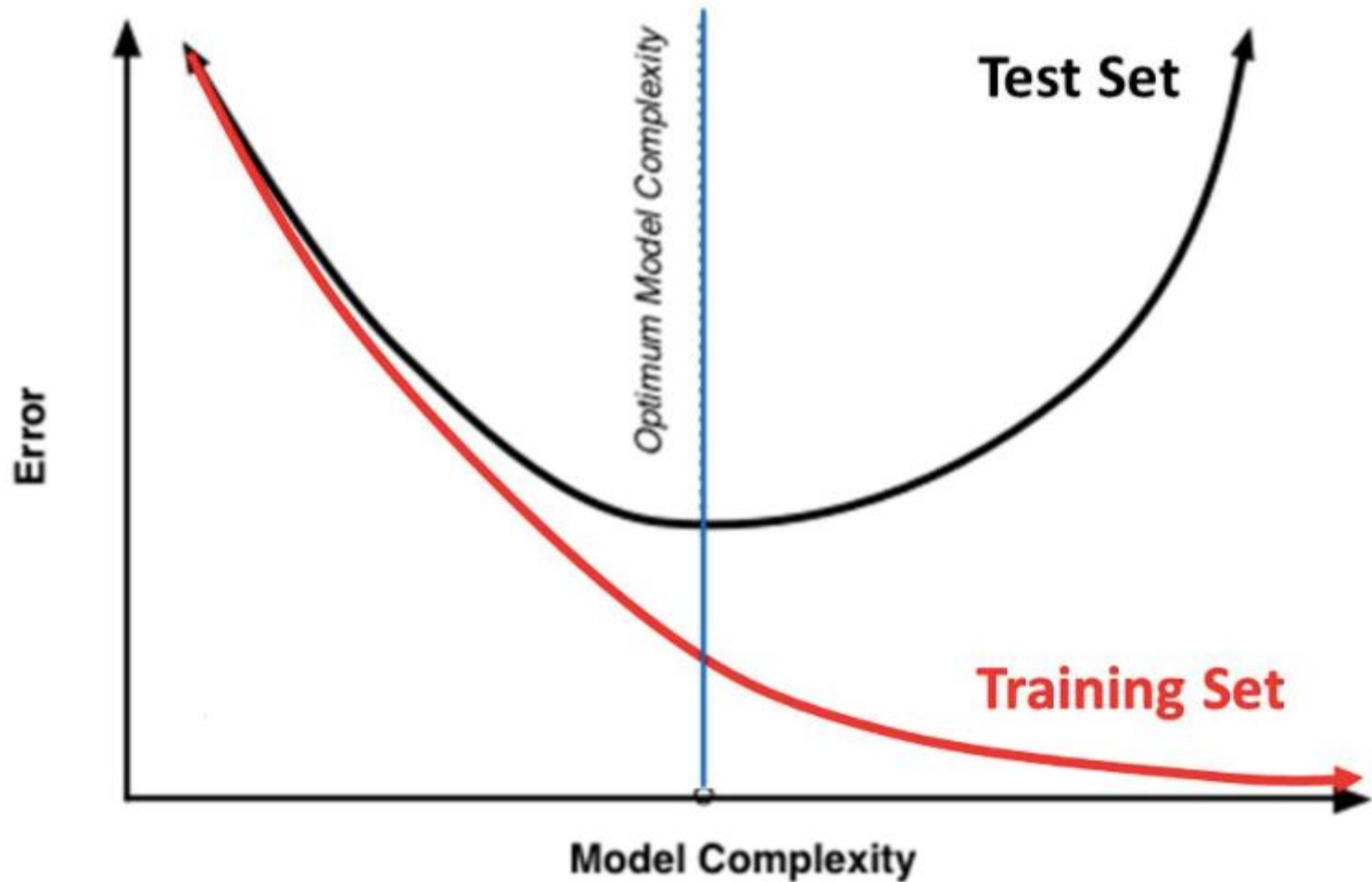
... and many other

# Background

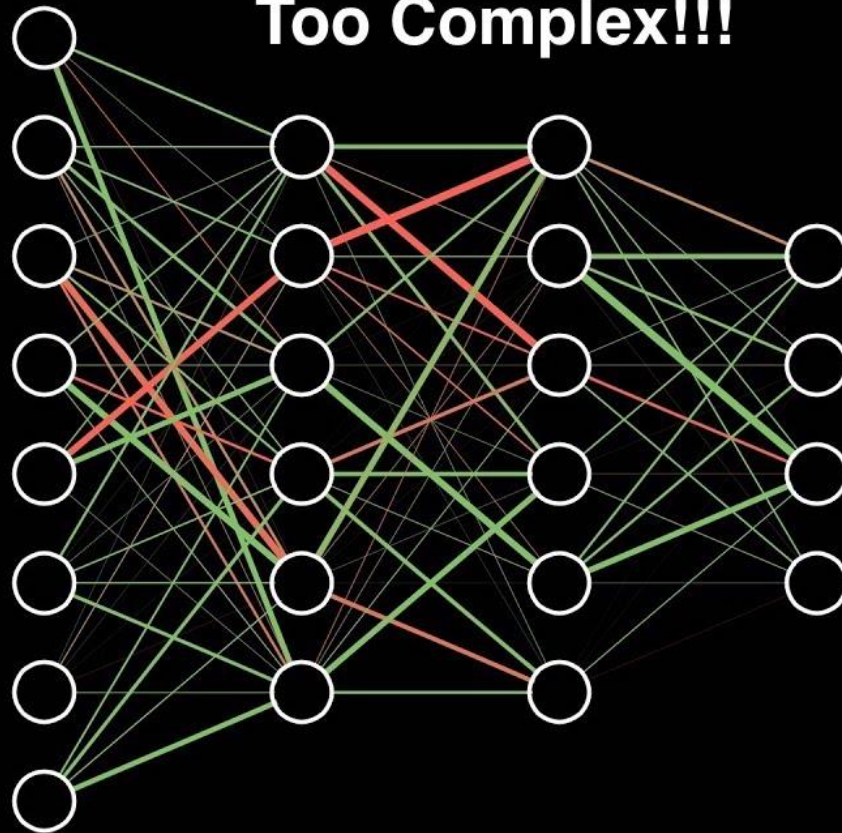


**As move towards right, poor performance on unseen data**

# Training Vs. Test Set Error



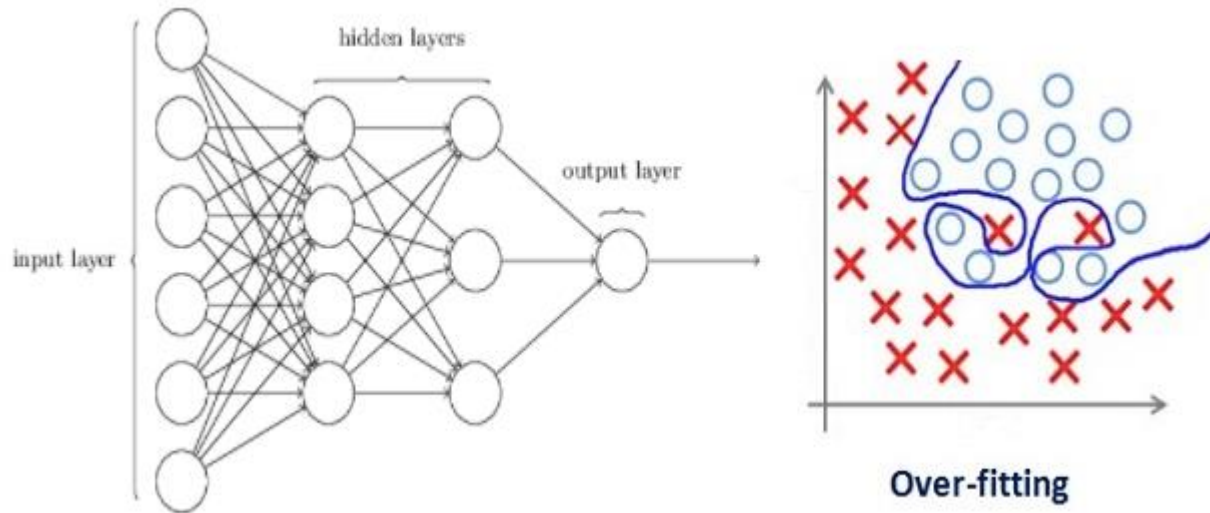
**Too Complex!!!**



# What is Regularization

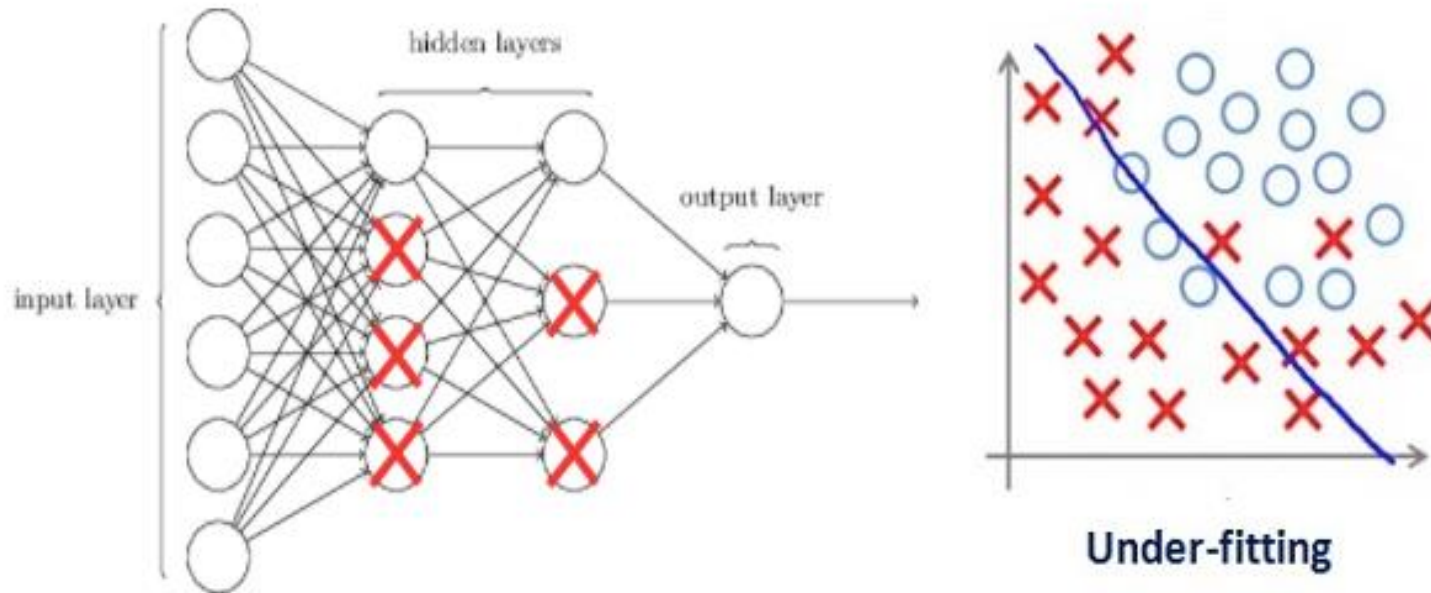
- Regularization is a technique which makes slight modifications to the learning algorithm such that the model generalizes better
- This in turn improves the model's performance on the unseen data as well

# Why Regularization



# Why Regularization

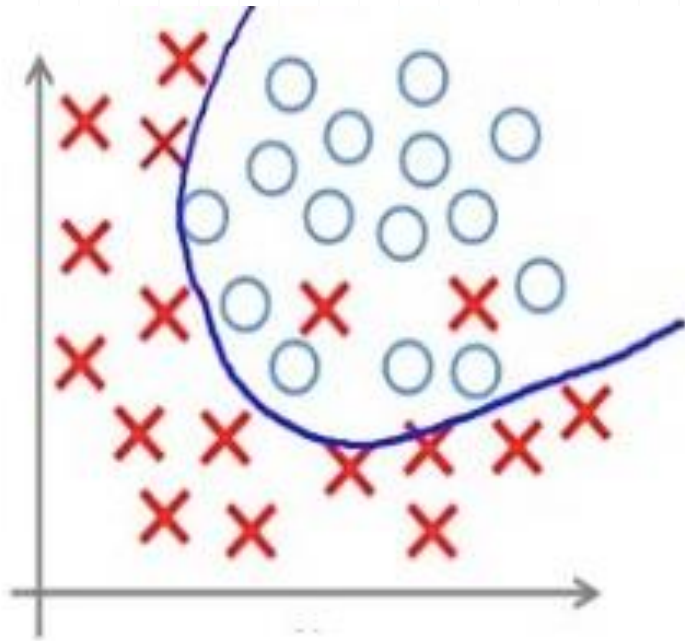
- In machine learning, regularization penalizes the coefficients
- In deep learning, it actually penalizes the weight matrices of the nodes
- Assume that our regularization coefficient is so high that some of the weight matrices are nearly equal to zero



- This will result in a much simpler linear network and slight underfitting of the training data.



# Why Regularization



**Appropriate-fitting**

Such a large value of the regularization coefficient is not that useful

We need to optimize the value of regularization coefficient in order to obtain a well-fitted model as shown in the image below

- Read Neural Network L2 Regularization  
Using Python -- Visual Studio  
Magazine.pdf

Read Neural Network L1 Regularization  
Using Python -- Visual Studio  
Magazine.pdf

# Drop Out

- o Deep-Learning-Seminar-Dropout.ppt
- o <https://www.cs.toronto.edu/~hinton/absps/JMLRdropout.pdf>
- o Cited by 23000 (by 10/09/2020); Journal of ML Research
- o Regularization of Neural Networks using DropConnect
- o ICML 2013

# Data Augmentation



4



4

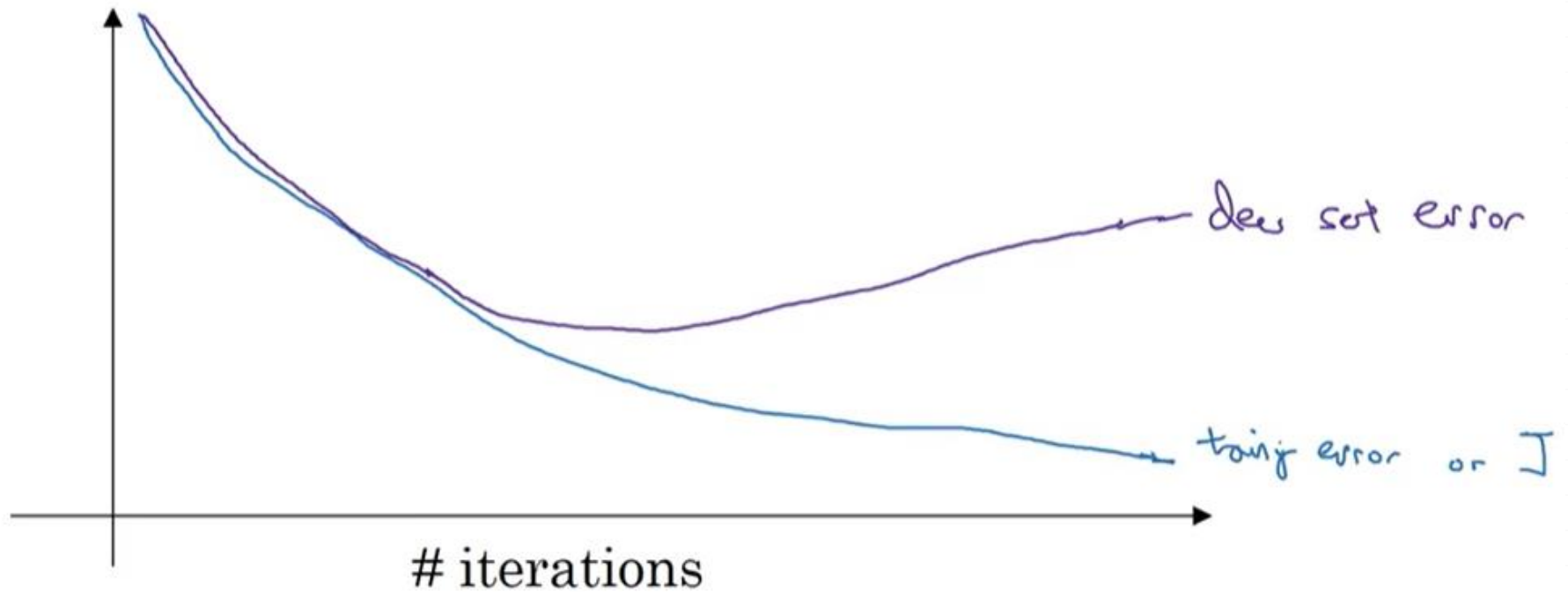
4

4

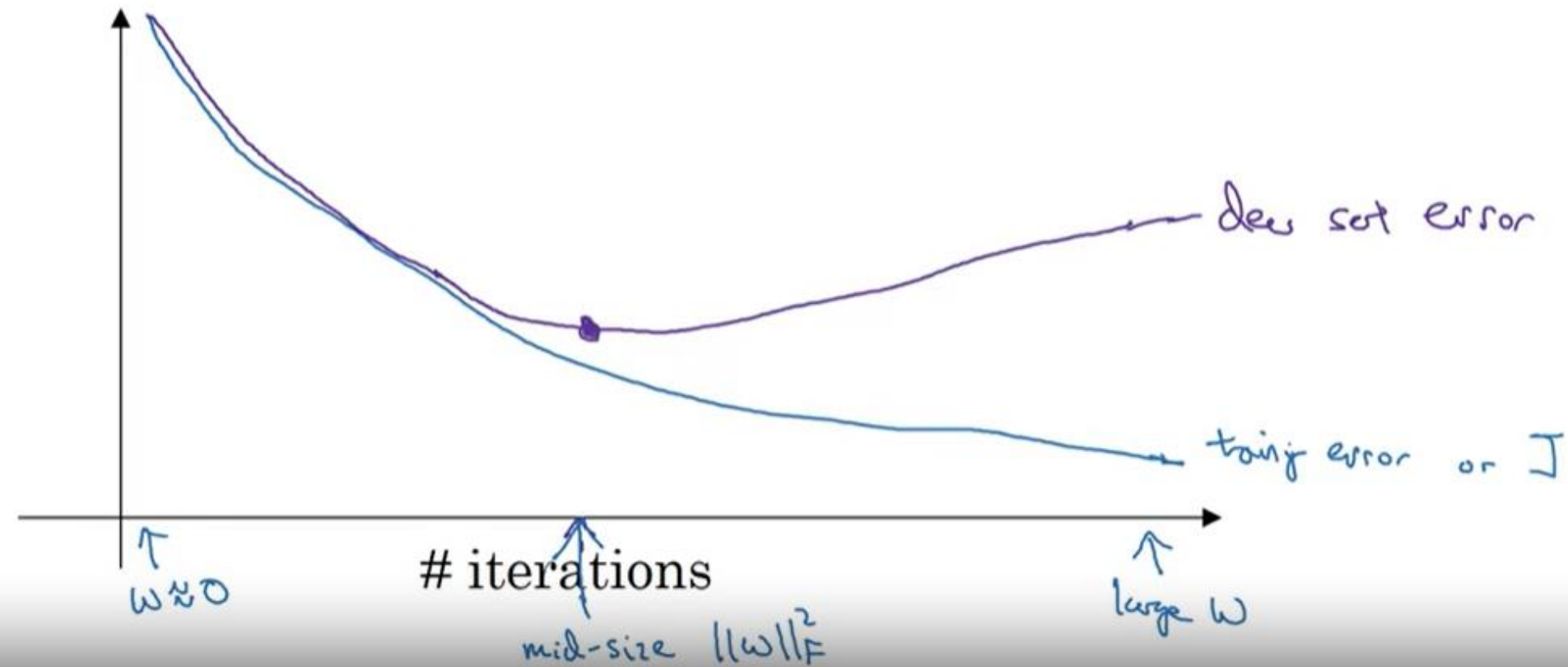
# Why Data Augmentation

o <http://ai.stanford.edu/blog/data-augmentation/>

# Early Stopping



# Early Stopping



Thank you