Predicting Financial Time Series using Deep Learning

Answer on Overfitting Issues

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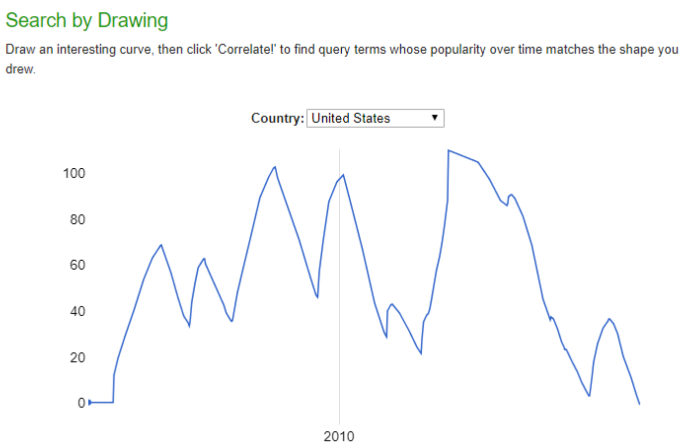
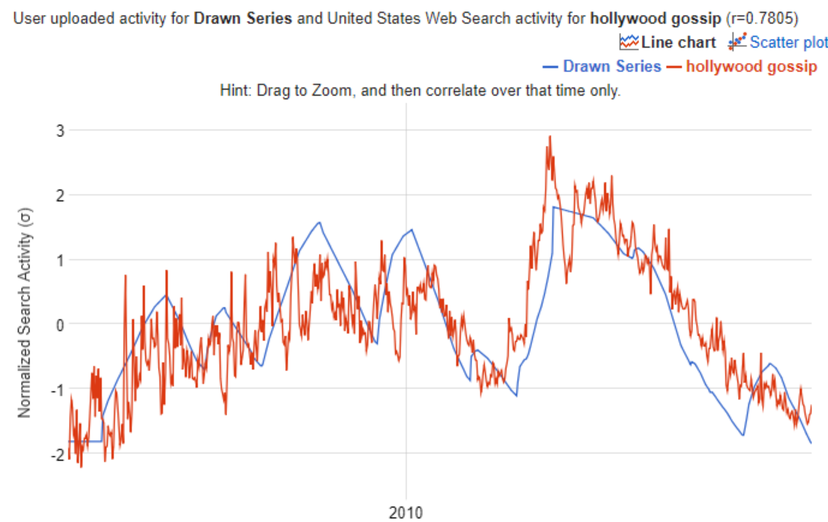
Note. This content mainly refers the summer session of KAIST organized by Jiyong Park(2018)

Overfitting is Easy

- When I draw a random curve of Google search trends...



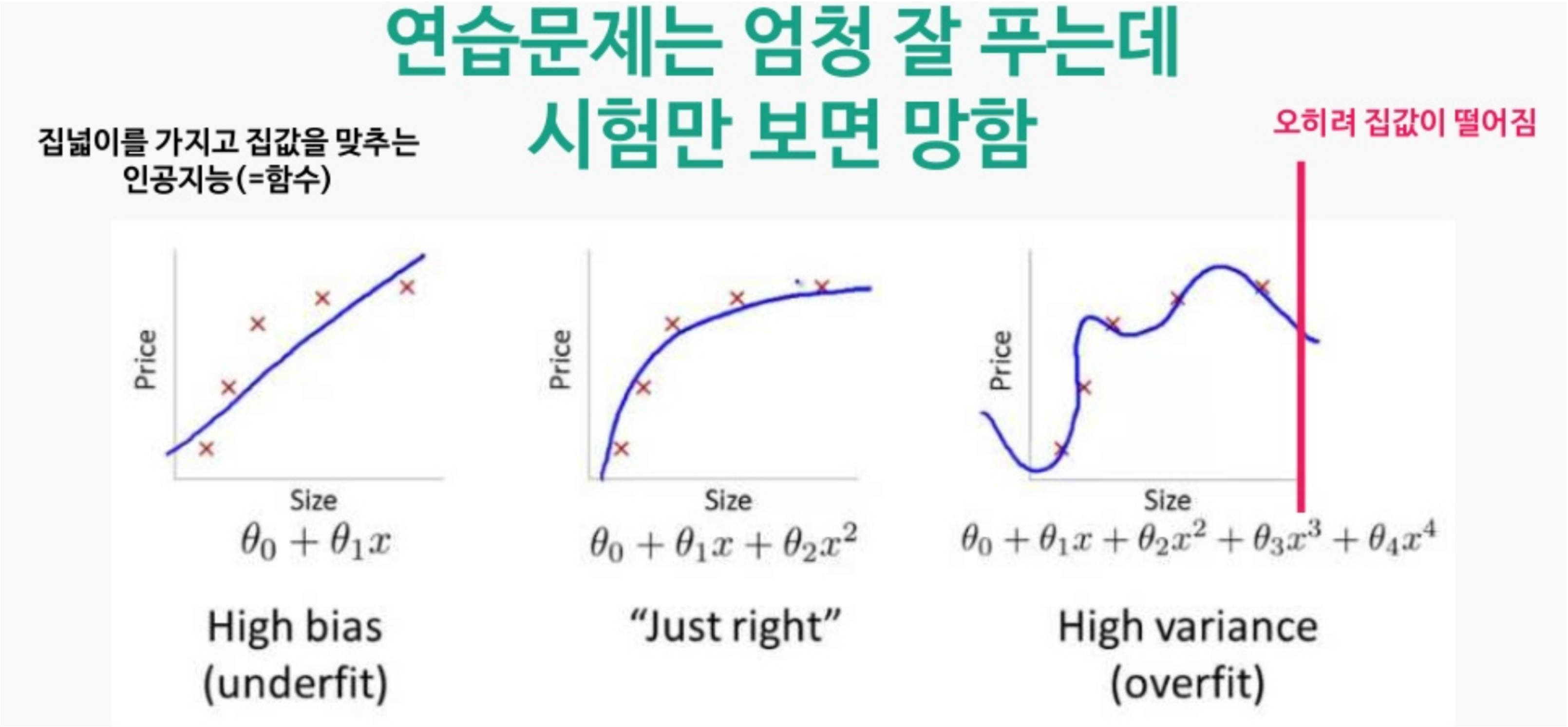
https://www.google.com/trends/correlate/draw



> ➢ "Eureka! I accidently succeed in predicting how people search about 'Hollywood gossip' on Google. Its correlation is 0.78!"
>
> ➢ … Really?

Overfitting is Common in Prediction

- Overfitting often results from (i) too complex models and (ii) too few data.



Source: https://www.slideshare.net/modulabs/2-cnn-rnn

Occam's Razor

- Occam's razor is still valid (that is, simple is best).
  - ➢ For out-of-sample predictions, simpler models are more likely to hold up on future observations than more complex ones, all else being equal (Dhar 2013).
- Sometimes, machine learning algorithms might have poorer performances than a simple logistic regression.
  - ➢ It may be especially when (1) there is relatively simple relationships, or (2) there are too few data to learn about the relationships.
  - ➢ Example: Predicting movie success (Lee et al. 2018)

Logistic Regression		Deep NN		Random Forest		Support Vector Machine	
LR		*NN (MLP)*		*RF*		*SVC*	
Bingo	1-Away	Bingo	1-Away	Bingo	1-Away	Bingo	1-Away
36.0 %	85.3 %	48.0 %	86.7 %	46.7 %	84.0 %	26.7 %	64.0 %
45.3 %	93.3 %	40.0 %	88.0 %	56.0 %	90.7 %	30.7 %	62.7 %
61.3 %	88.0 %	38.7 %	84.0 %	53.3 %	90.7 %	26.7 %	56.0 %
54.7 %	86.7 %	50.7 %	88.0 %	56.0 %	86.7 %	26.7 %	48.0 %
56.0 %	90.7 %	42.7 %	81.3 %	62.7 %	89.3 %	26.7 %	61.3 %
54.7 %	89.3 %	36.0 %	82.7 %	49.3 %	88.0 %	41.3 %	74.7 %
50.7 %	90.7 %	49.3 %	85.3 %	57.3 %	81.3 %	29.3 %	44.0 %
45.3 %	86.7 %	34.7 %	75.7 %	49.3 %	86.7 %	28.0 %	65.3 %
42.7 %	89.3 %	45.3 %	86.7 %	50.7 %	90.7 %	25.3 %	53.3 %
50.7 %	82.7 %	38.7 %	81.3 %	49.3 %	76.0 %	25.3 %	60.0 %
49.7 %	**88.3 %**	**42.4 %**	**84.0 %**	**53.1 %**	**86.4 %**	**28.7 %**	**58.9 %**
7.5 %	3.1 %	5.7 %	3.9 %	4.9 %	4.8 %	4.8 %	8.9 %

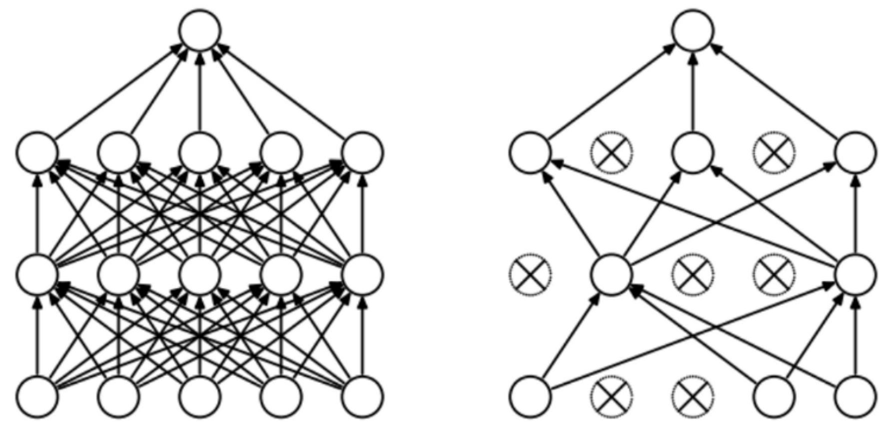
Accuracy

Dhar, V., 2013. Data Science and Prediction. *Communications of the ACM*, 56(12), pp.64-73.
Lee, K., Park, J., Kim, I. and Choi, Y., 2018. Predicting Movie Success with Machine Learning Techniques: Ways to Improve Accuracy. *Information Systems Frontiers*, 20(3), pp.577-588.

How Does Deep Learning Overcome Overfitting?

- Allowing white-noise or loose-fit (= 적당히 빈틈을 허용하자)

- Examples
  - ➢ Debiasing autoencoder
  - ➢ Data augmentation
  - ➢ Pooling in CNN
  - ➢ Taking noise as input in GAN



(a) Standard Neural Net (b) After applying dropout.

- Regularization
  - ➢ Dropout
  - ➢ Penalizing model complexity (e.g., ridge regression)

Thank you ☺

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