Validate and monitor machine learning models

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Objectives

Discuss the importance to validate properly statistical models

Share techniques to validate different dimensions of a model

Demonstrate some of the techniques in a tutorial

Demo our internal tool to validate models

87% of machine learning proof of concepts are never put in production

How Can Model Validation Help?

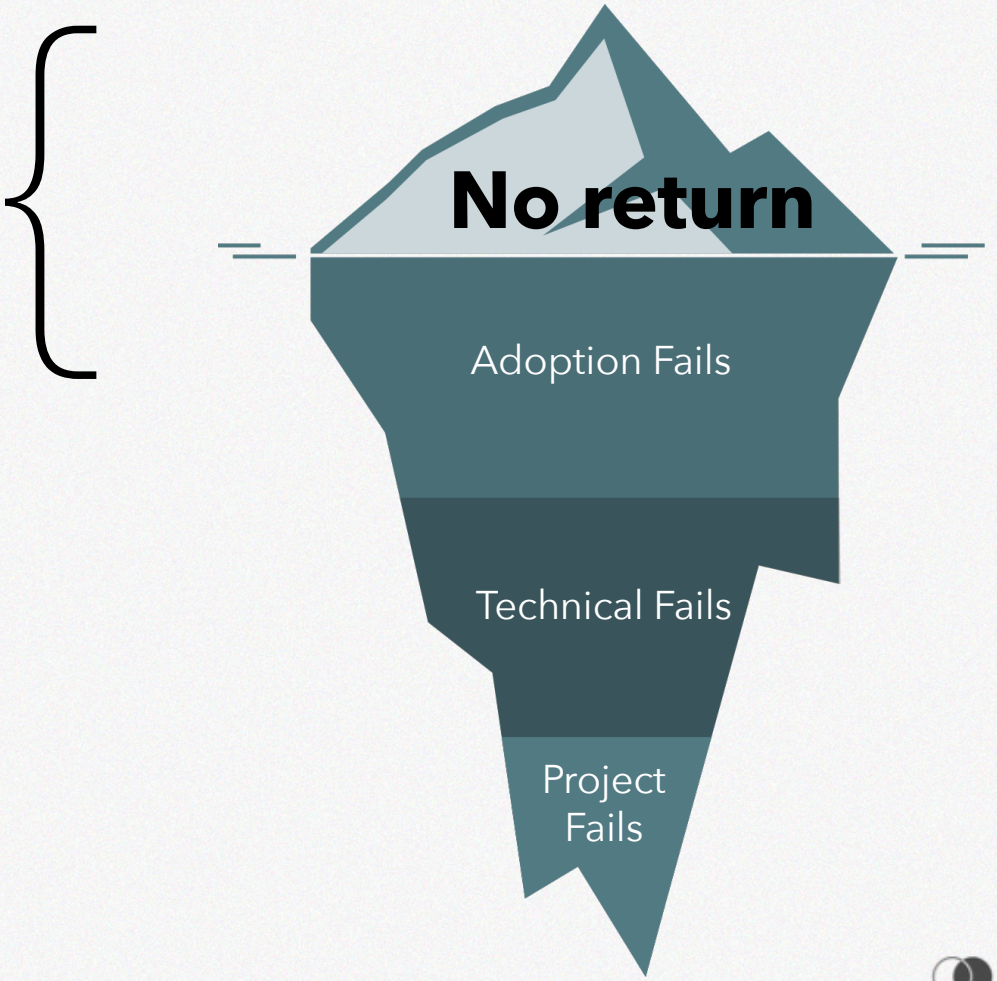
Assessing model's initial ability to deliver value

Making the product team more efficient

Getting approval from compliance authorities

Monitoring on-going model's contribution

Iceberg of Machine Learning Failure



Project Development

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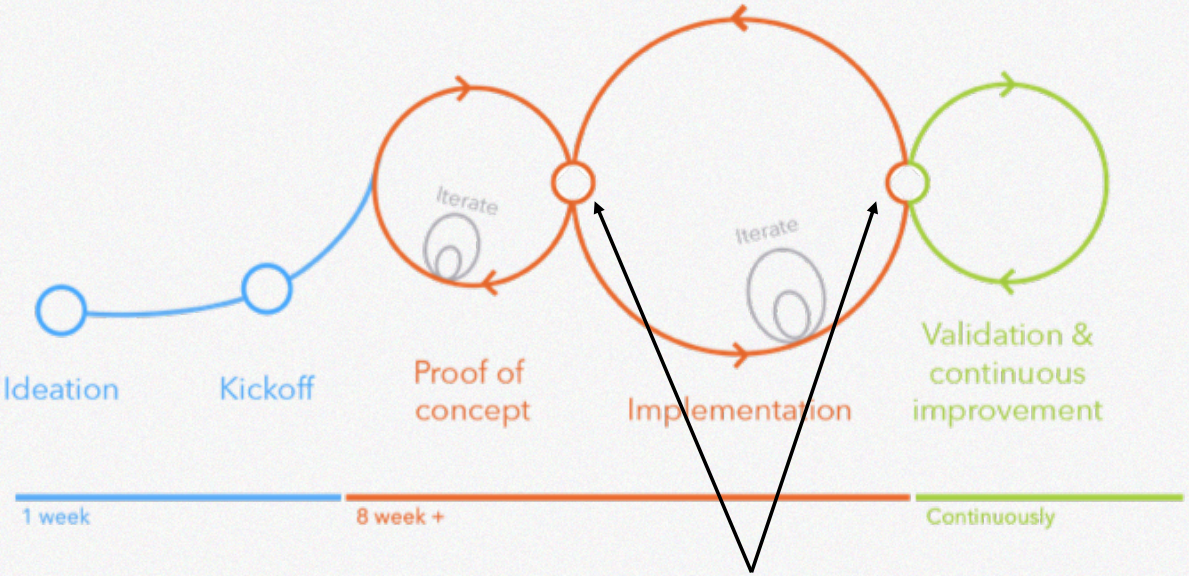

Project Validation

Define/ prevent project risks	Define/ prevent technical risks	Validation prior To deployment	On-going monitoring

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Define Project Risks

Training data quality

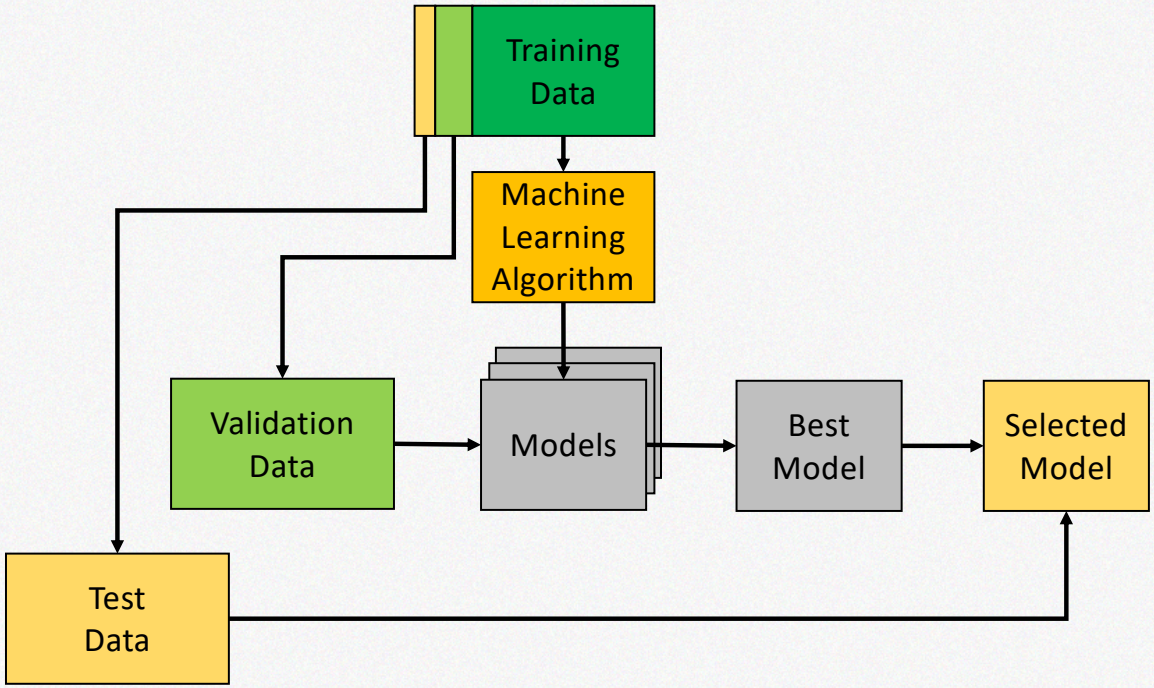
False positive and false negative biases

Production data accessibility

Integration to systems

User experience

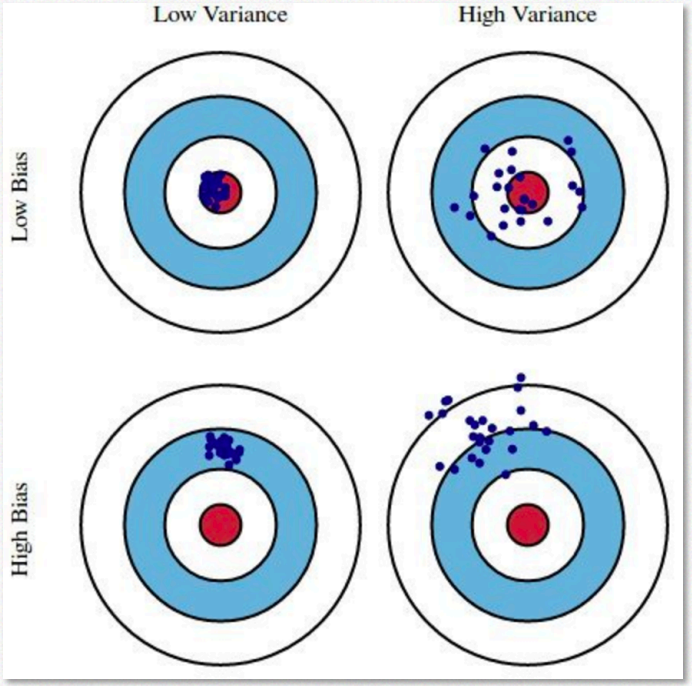
Model Validation Basics

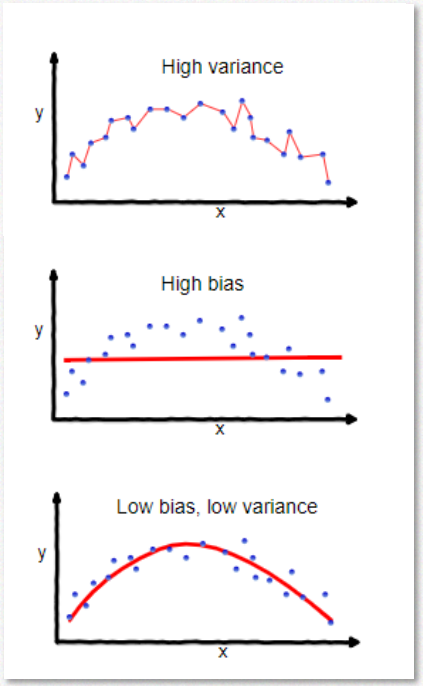


Things To Validate

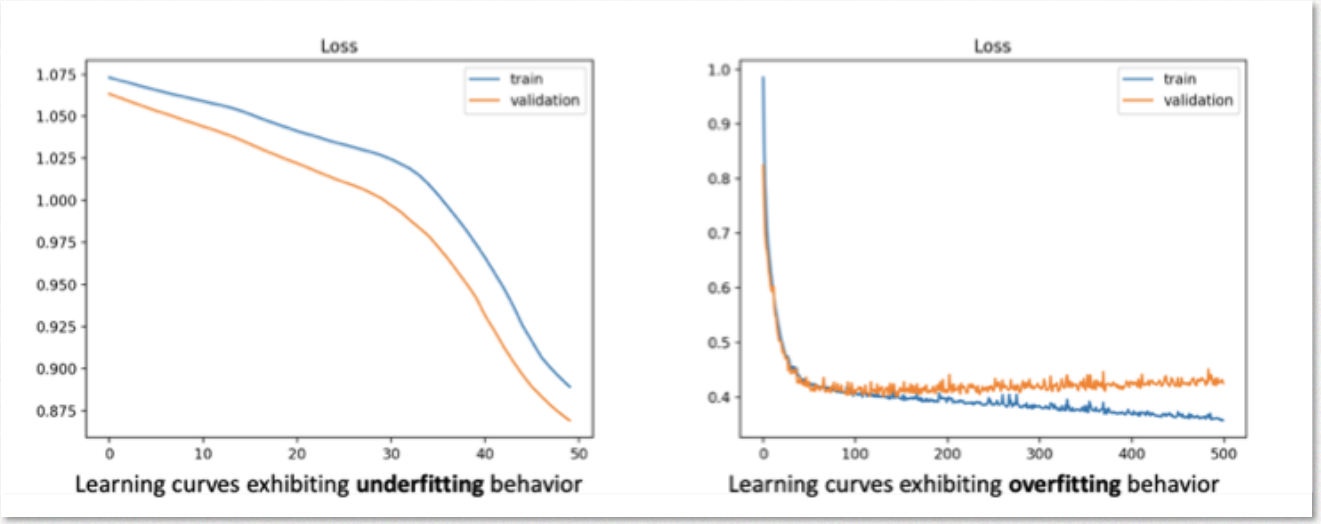
Dimensions	Main Objective
Bias Error	Is the data useful?
Variance Error	Is the model robust?
Model Fit	Is the model predicting well new data?
Model Comparison	Is the new model better than simpler alternatives?
Discrimination Bias	Is the model too biased towards certain variables?
Adversarial Sensitivity	Is the model robust to extreme scenarios?

Bias vs. Variance



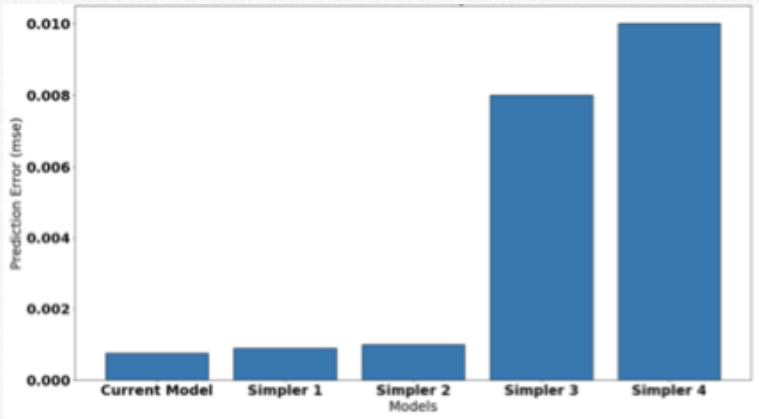


Model Fit Assessment



Model Comparison Assessment

Model Error comparison between models



Model Comparison
(Original Model vs Best Comparative Model)

	Original Model	Best comparative Model
Prediction Error (mean)	0.00076	0.001
Prediction Error (std)	0.00023	0.000008
Training Time	17 min.	0.2 min.
Prediction Time	0.2 sec.	0.002 sec.
Storage needed	510 mb	1.6 mb

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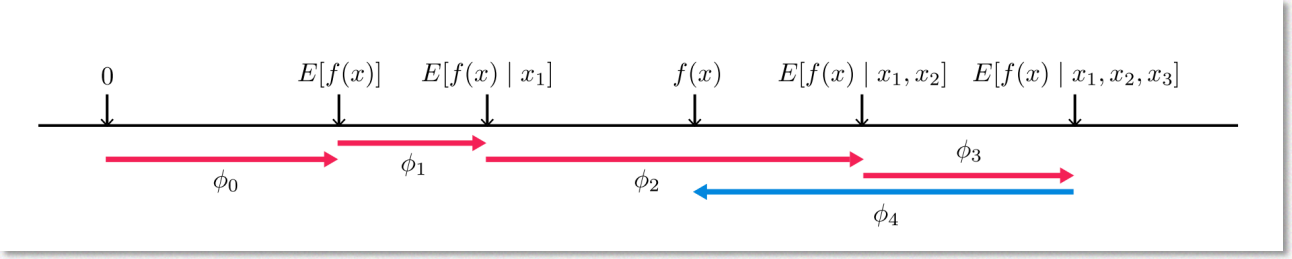
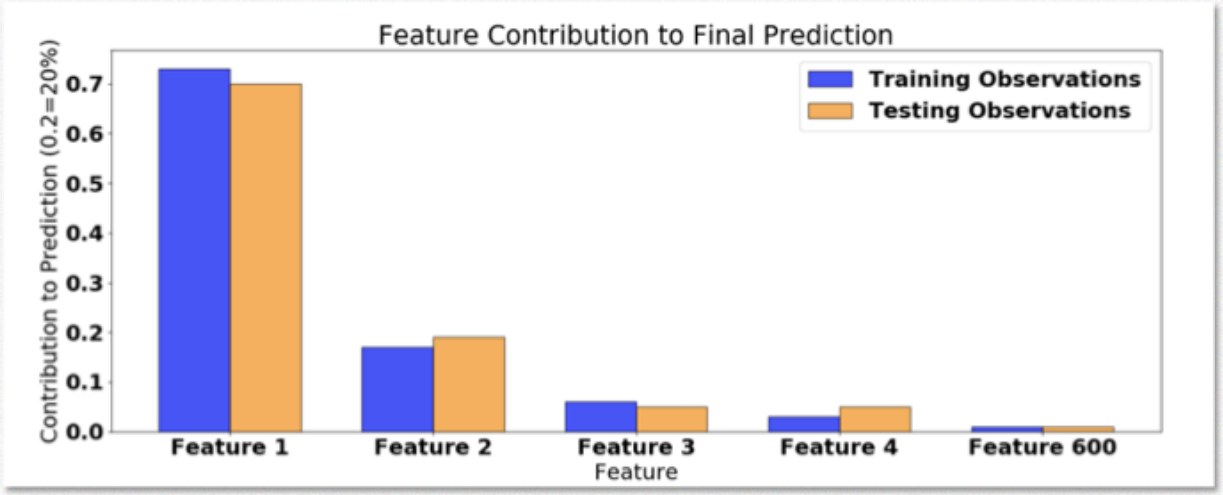
Discriminatory Features Assessment

SHAP, an agnostic interpretability technique is a good tool to assess the impact of the features on predictions.

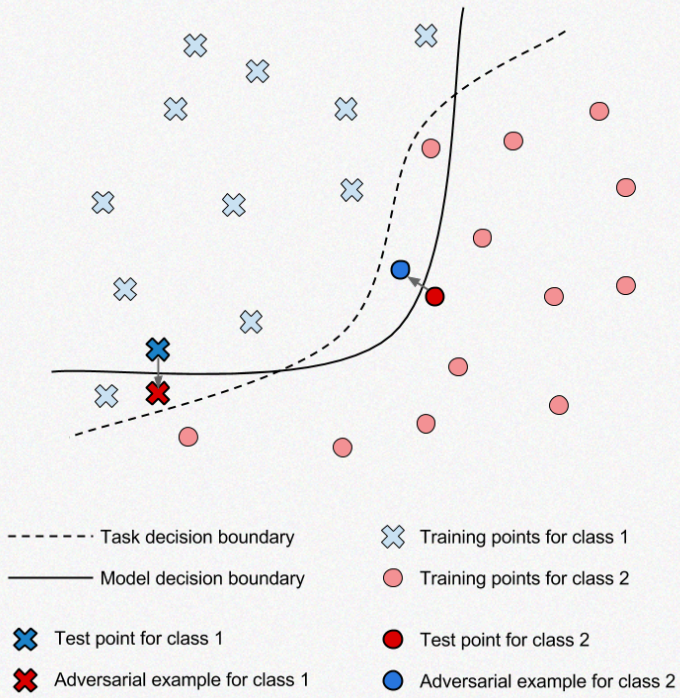
SHAP is able to get marginal importance per feature.



Discriminatory Features Assessment



Sensitivity Assessment



X **δ** **X'**

Original input + perturbation = adversarial example
(correctly classified) (misclassified)

Adversarial examples differ based on the method used to craft the perturbation (e.g. Fast Gradient Sign Method, FGSM).

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Sensitivity Assessment

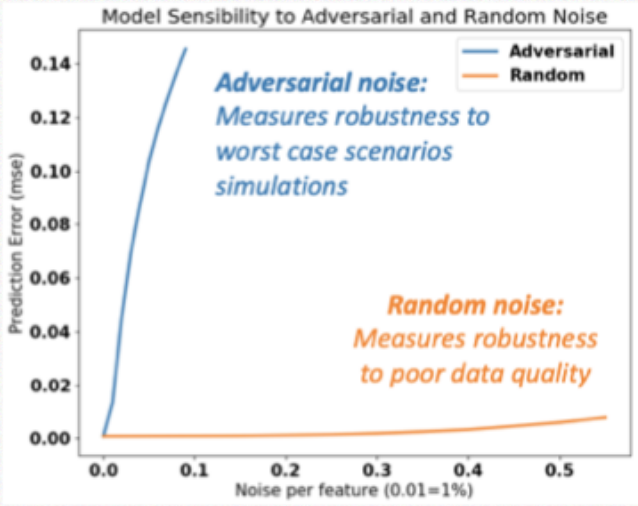
Noise is a slight modification in the input data

Random noise

random noise can be added to each feature.

Adversarial noise

modifying each feature of the perfect amount and in the perfect direction to intentionally decrease the model's performance.



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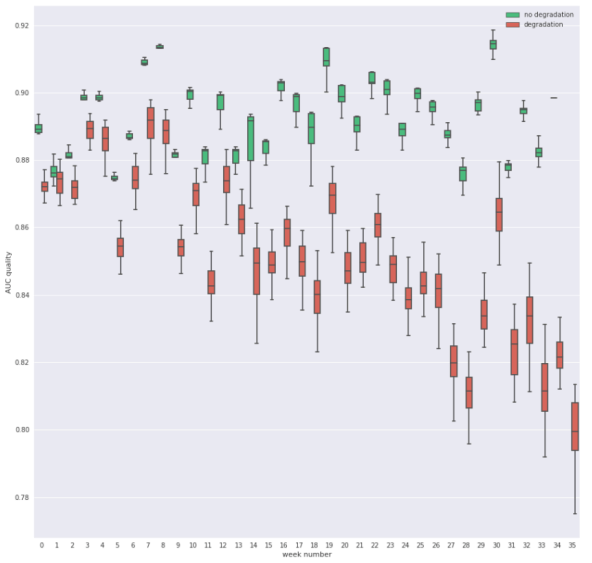
Monitor your Model



It is critical to monitor model's performance

Same assessments for initial validation using new data works fine

Look at prediction error increase for proactive maintenance

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Conclusions

Models have to be validated in-depth before launch

Validation has to be more than simply about accuracy

Models have to be monitored frequently to avoid degradation

Thank you!