

# Active learning for efficiently constructing surrogate models

AA 222 | Engineering Design Optimization | Spring 2020

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# Efficiently learning a surrogate model using adaptive sampling

## Goal

*Given an arbitrary objective function, efficiently construct a surrogate model*

## Approach

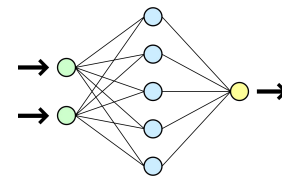
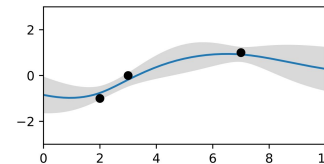
*Utilize active learning (adaptive sampling) to improve sample efficiency*

Consider only Gaussian process and neural network surrogates

- Construct and fit GPs using scikit-learn
- Construct and fit NNs using tensorflow.keras

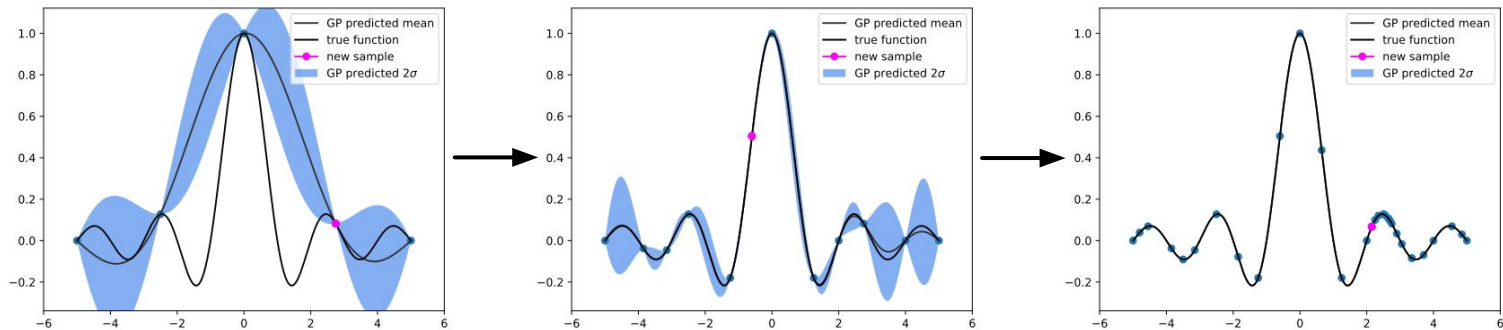
Select next sample based on:

- Maximum variance estimator (GP only)
- Maximum k-fold cross-validation variance estimator
- Maximum linear approximation error using surrounding samples
- Random sampling and space-filling sequences



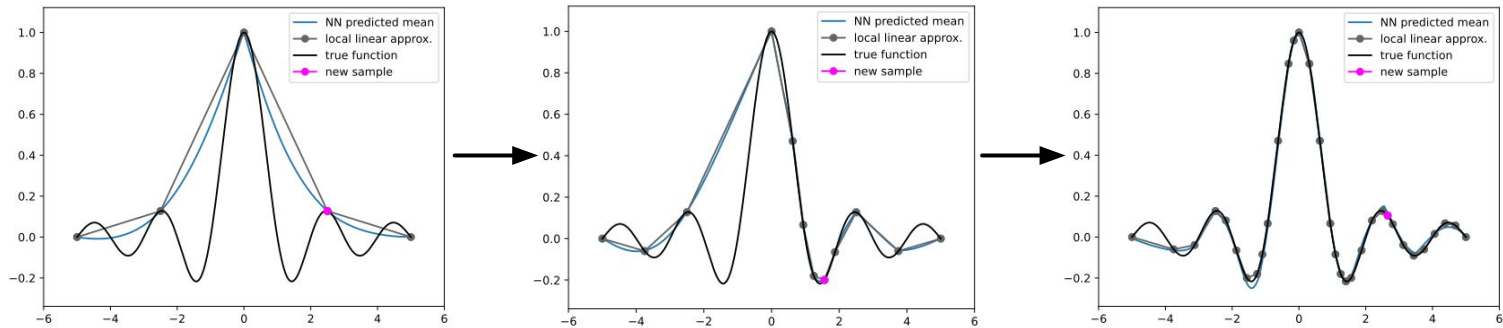
# GP

## Variance-based sampling

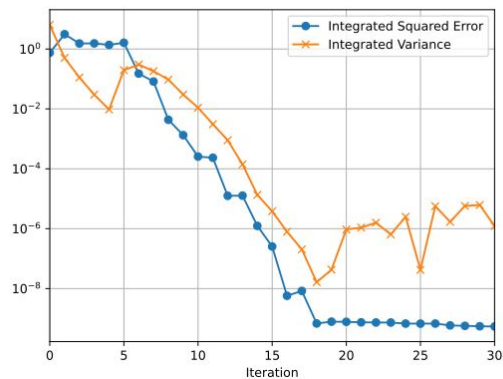


# NN

## Local approximation error-based sampling

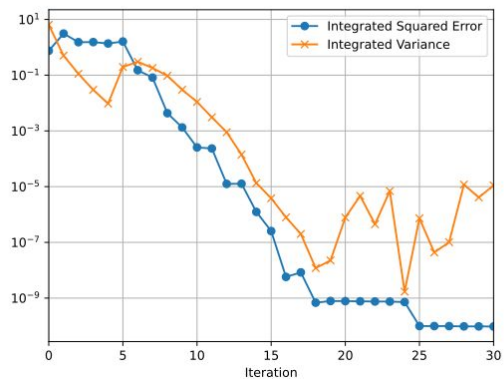


# Compare model errors to examine sample efficiency



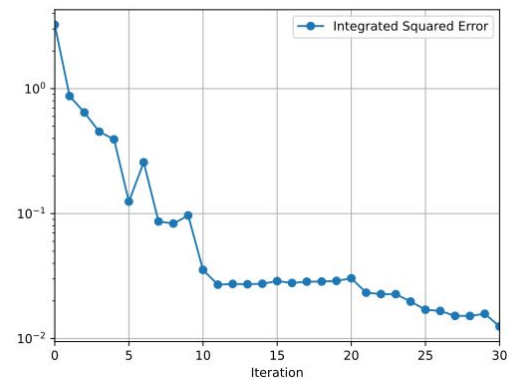
**GP**

Variance-based  
sampling



**GP**

Local approximation  
error-based sampling



**NN**

Local approximation  
error-based sampling