Machine Learning in Practice

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CIVE 497 – CIVE 700: Smart Structure Technology

Last updated: 2024-03-28

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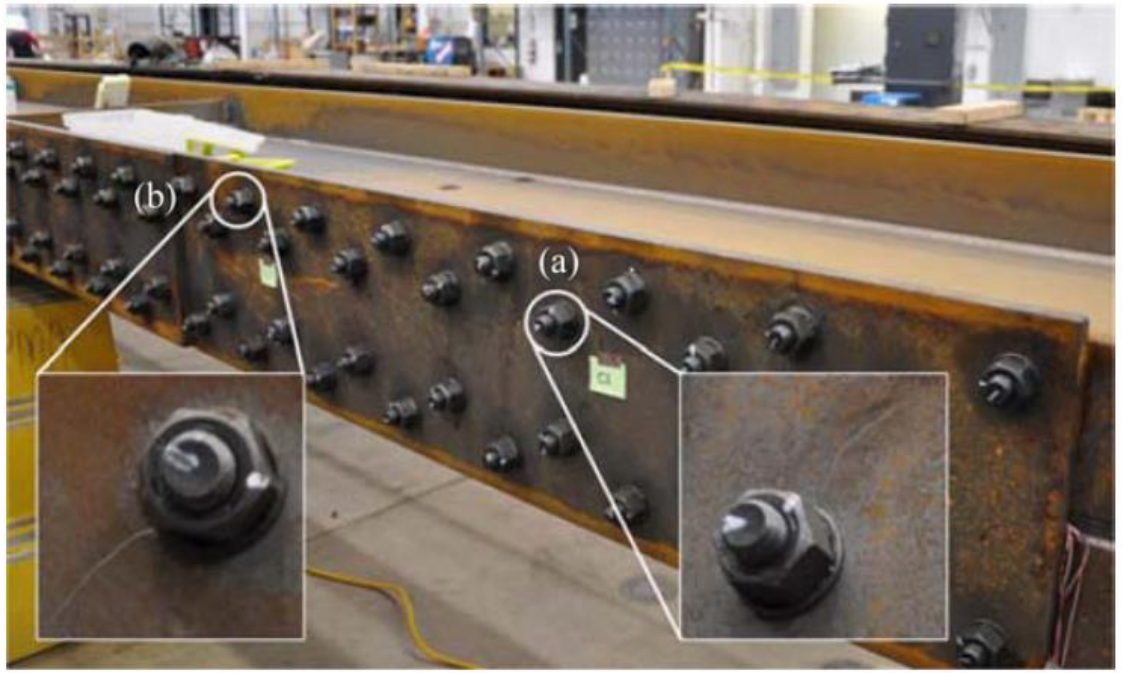
Machine Learning in Practice

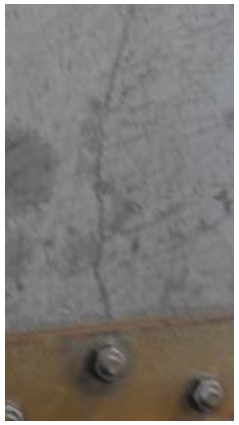
- Step 1: Understand domain, prior knowledge, and goals
- Step 2: Data integration, selection, cleaning, pre-processing, etc.
- Step 3: Learn models
- Step 4: Interpret results
- Step 5: Deploy developed models

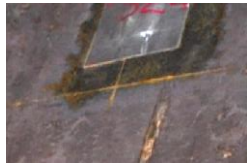
Machine Learning in Practice (Step 1: Understand domain, prior knowledge, and goals)

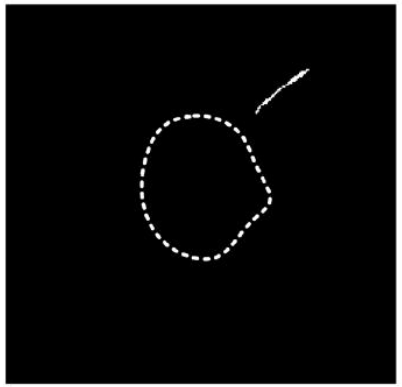
- **Step 1: Understand domain, prior knowledge, and goals**
  - What problems are you going to solve?
  - Do you have to utilize machine learning? (**Complexity** of your problem)
  - What **prior** knowledge do you involve?
- Step 2: Data integration, selection, cleaning, pre-processing, etc.
- Step 3: Learn models
- Step 4: Interpret results
- Step 5: Deploy developed models

Vision-based Crack Detection









Detection of crack damage

Prior knowledge:

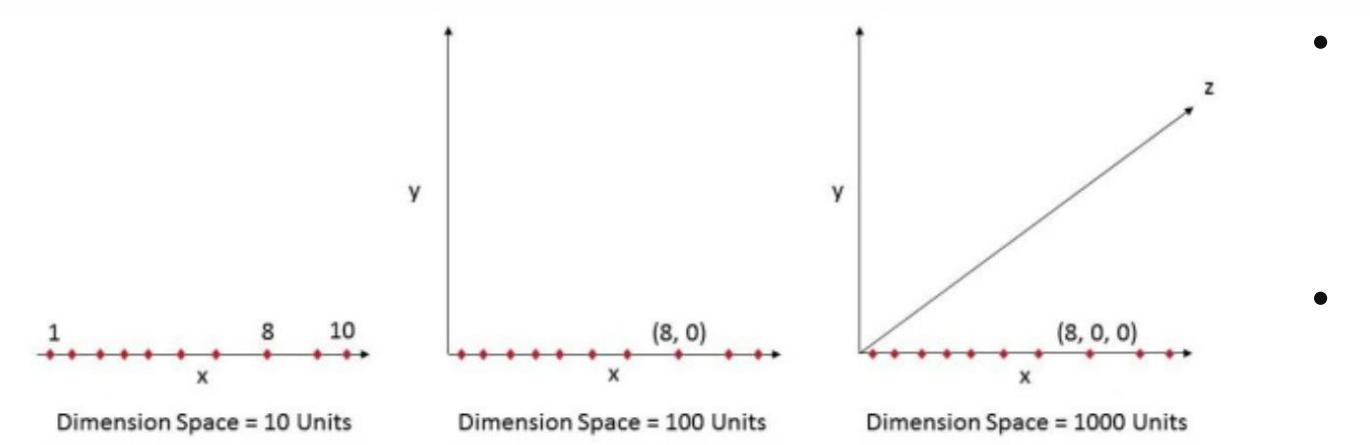
- Bolt holes have an initial flaw.
- Fatigue crack damage is initiated from a bolt hole boundary

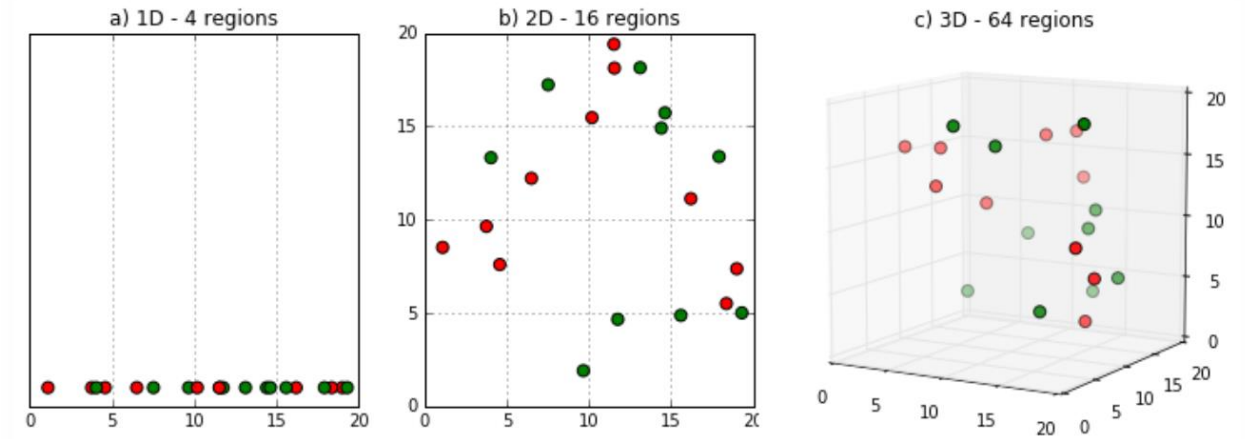
Machine Learning in Practice

- Step 1: Understand domain, prior knowledge, and goals
- **Step 2: Data integration, selection, cleaning, pre-processing, etc.**
  - How to collect data?
  - How to pre-process the data?
  - What features/data are using for model development?
- Step 3: Learn models
- Step 4: Interpret results
- Step 5: Deploy developed models

Post Earthquake Disaster Image Classification

Curse of Dimensionality





- As the number of features or dimensions grows, the amount of data we need to generalize accurately grows exponentially
- Think of image recognition problem of high resolution images 1280 × 720 = 921,600 pixels i.e. 921600 dimensions.
- That's why it's called **Curse of Dimensionality**. Value added by additional dimension is much smaller compared to overhead it adds to the algorithm.

SIFT Descriptor

https://www.kdnuggets.com/2017/04/must-know-curse-dimensionality.html

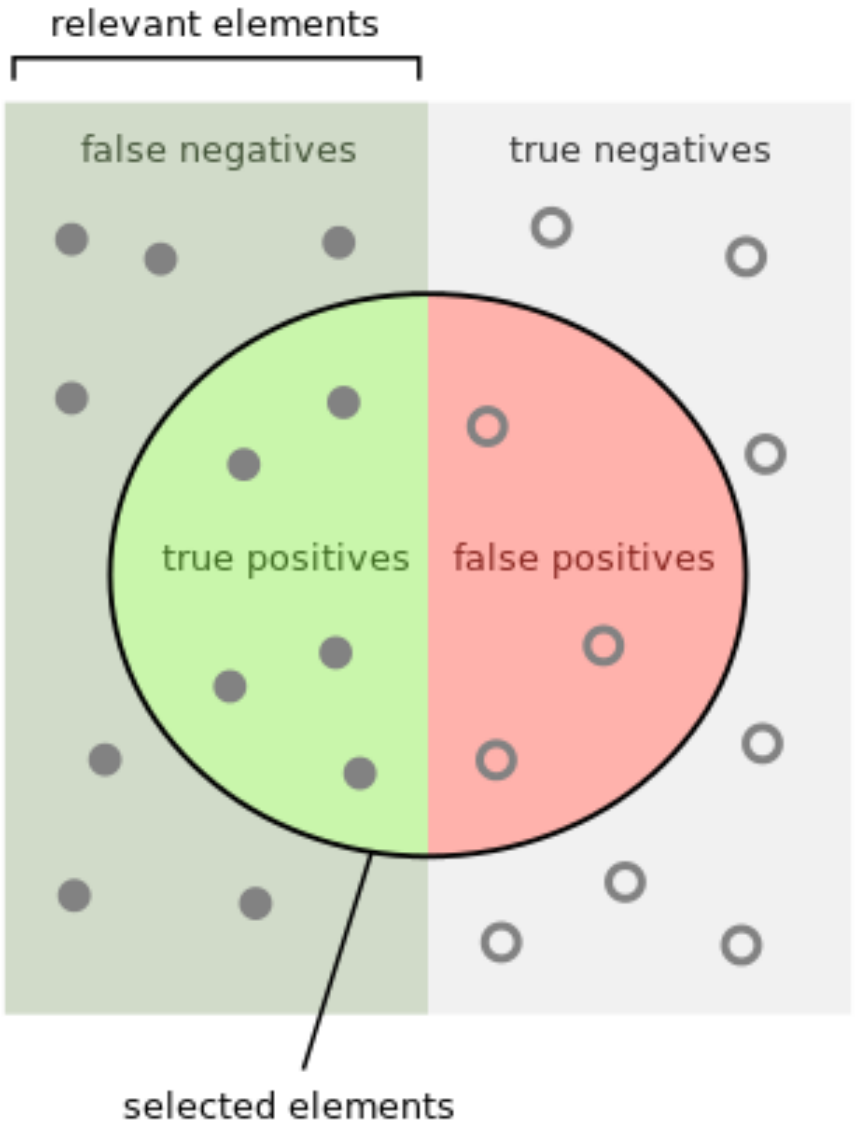
Machine Learning in Practice

- Step 1: Understand domain, prior knowledge, and goals
- Step 2: Data integration, selection, cleaning, pre-processing, etc.
- **Step 3: Learn models**
  - How to represent the target function or algorithm
  - How to explore and determine the optimum hyper-parameters
- Step 4: Interpret results
- Step 5: Deploy developed models

Machine Learning in Practice

- Step 1: Understand domain, prior knowledge, and goals
- Step 2: Data integration, selection, cleaning, pre-processing, etc.
- Step 3: Learn models
- **Step 4: Interpret results**
  - Performance metric
  - Explainablitiy or interpretability
- Step 5: Deploy developed models

Precision and Recall



How many selected items are relevant?

$$\text{Precision} = \frac{\text{true positives}}{\text{selected elements}}$$

How many relevant items are selected?

$$\text{Recall} = \frac{\text{true positives}}{\text{relevant elements}}$$

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- **Step 5: Deploy developed models**