Introduction to Machine Learning

Machine Learning

- Can we learn about the world around us using data?

- Model building from data

  - Take data as input

  - Find patterns in the data

  - Summarize the pattern in a mathematically precise way

- <u>Machine learning</u> automates this model building.

The Challenge

- Data unfortunately contains noise. If not, machine learning would be trivial!

- Think of   Data = Information + Noise

- The challenge is to identify the information content and distill away the noise.

- To help do this, machine learning uses a train and test approach.

Over fitting Vs under fitting

- If the model we finish with ends up

  - modeling the noise as well, we call it "over fitting" - bad for prediction!

  - not modeling all the information, we call it "under fitting" - bad for prediction!

- The hope is that the model that does the best on testing data manages to capture/model all the information but leave out all the noise.

1. Supervised learning: Building a mathematical model using data that <u>contains both the inputs and the desired outputs (ground truth)</u>.

- Examples:

    - Determining if an image has a horse. The data would include images with and without the horse (the input), and for each image we would have a label (the output) indicating if there is a horse in that image.

    - Determining is a client might default on a loan

    - Determining if a call center employee is likely to quit

- Since we have desired outputs, model performance can be evaluated by comparisons.

2. **Unsupervised learning:** Building a mathematical model using data that <u>contains only inputs and no desired outputs</u>.

- Used to find structure in the data, like grouping or clustering of data points. To discover patterns and group the inputs into categories.

- Example: an advertising platform segments the population into smaller groups with similar demographics and purchasing habits. Helping advertisers reach their target market with relevant ads.

- Since no labels are provided, there is no specific way to compare model performance in most unsupervised learning methods.

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Learning for Life

- Supervised learning

  - Regression: desired output is a continuous number

  - Classification: desired output is a category

- Unsupervised learning

  - Clustering: Grouping data

  - Dimensionality reduction: Compressing data

  - Association rule learning: If X then Y