Lecture 9/3: Instance-Based Learning

Monday, September 2, 2019 9:54 AM

Supervised learning for Binary Classification

- Money
  Pos: banknote, penny → dime is pos
  Neg: Bottle, Pen

- Movie preferences
  Pos: thumbs up → movies TJ likes
  Neg: thumbs down

How would you classify $x' = (\text{complete}, \text{no}, \text{no}, \text{clear}, \text{no})$

→ Inductive bias for today: find closest weighbors in training data

→ x' is similar to x_2 → yes

Notation:

$$1[P] = \begin{cases} 1 & \text{if } P \text{ is true} \\ 0 & \text{if } P \text{ is false} \end{cases}$$

$\underset{y \in Y}{\text{argmax}} \{g(y)\}$ is the value $y \in Y$ that maximizes $g(y)$

Similarity measure: $K(x_i, x') =$ number of matching features

Example 1: $x' = (\text{complete}, \text{no}, \text{no}, \text{clear}, \text{no})$

1 NN(x') = {2} with $K(x', x_2) = 4$ → vote $y_2 =$ yes → classify y': yes

2 NN(x') = {2, 1} with $K(x', x_1) = 3$ → two votes for yes → y' = yes

Example 2: $x' = (\text{partial}, \text{yes}, \text{no}, \text{clear}, \text{no})$

2 NN(x') = {3, 1} → 1 vote yes and 1 vote no → y' = flip coin

Similarity weighted kNN:

Example: $x' = (\text{complete}, \text{yes}, \text{no}, \text{clear}, \text{no})$

Most similar: x_4 → $K(x_4, x') = 4$
Second similar: x_{21} →

KNN for Real-valued attributes

- Gaussian: $K(x_i, x') = e^{-(x_i - x')^2}$
  - → $K(x_i, x') = 1$ $x_i = x'$
  - → $K(x_i, x') \to 0$ as x_i and x' increase in Eudidian dist
- Cosine: $K(x, x') = \cos(x, x') + 1$

Supervised learning Naming

if $y \in \{-1, +1\}$, then called binary classification

if y is discrete and size greater 2, then multi-class classification

if y is real number, then called regression

if y is combinatorial object (eg tree), structured output prediction

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KNN Advantages and Disadvantages

simple

flexible

computationally expensive

keep all data