CS 66: Machine Learning

Prof. Sara Mathieson

Spring 2019
Outline for March 8

• AdaBoost
  – Handout 8

• Midterm 1

• Lab 4 due TONIGHT
• Office hours TODAY 1-3pm
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• AdaBoost
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• Midterm 1
Today
- AdaBoost
- Midterm 1
* Office Hours
  1 - 3 pm
  TODAY
* Lab 4 due
  TONIGHT

Boosting Idea

Train (start w/ equal weights)
  for T iters:
  * learn classifier
  * update weights

Test
  for test example:
  * use all classifiers
to predict
  * vote based on
  training score
AdaBoost

\[ \text{set } w_i = \frac{1}{n} \text{ A train examples} \]

for \( T \) iterations (index: \( t \))

* fit \( h^{(t)}(x) \) to weighted training data

* compute weighted error

\[ \varepsilon_t = \sum_{i=1}^{n} w_i^{(t)} \cdot 1(y_i \neq h^{(t)}(x_i)) \]
* Compute Score

\[ \alpha_t = \frac{1}{2} \left( \ln \left( \frac{1 - e^{t}}{e^{t}} \right) \right) \]

natural log

\[ \text{score} \]

\[ \frac{1}{2} \]

\[ e_t = \frac{1}{4} \]

\[ a_t = \frac{1}{2} \ln \left( \frac{1 - e^{t}}{e^{t}} \right) \]

\[ e_t = \frac{1}{4} \]

\[ \varepsilon_t = \frac{3}{4} \]

\[ \text{flip!} \]

* update

\[ \text{int} \]

\[ \text{in} \]
update weights

\[ y \in \{ -1, 1 \} \]

\[ w_i^{(t+1)} = \sum_k w_i^{(t)} \exp(-y_i + h(x_i)) \]

intuition:

correctly classified:

\[ w_i^{(t+1)} = \sum_k w_i^{(t)} \exp(-y_i + h(x_i)) \]

incorrectly classified:

\[ w_i^{(t+1)} = \sum_k w_i^{(t)} \exp(-y_i + h(x_i)) \]

{\text{less than 1}}

\[ y_i = h(x_i) \]

{\text{greater than 1}}

\[ y_i \neq h(x_i) \]
testing

\[ h(\mathbf{x}) = \text{sign} \left( \sum_{t=1}^{\infty} \alpha_t h_t^* (\mathbf{x}) \right) \uparrow \{ -1, 1 \} \]
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\[ \omega_{i1}^{(1)} = \frac{1}{10} \]
\[ \omega_{i2}^{(2)} \quad \text{if correct?} \quad c_1 \frac{1}{10} \exp\left(\ln\frac{\sqrt{3}}{3}\right) \]
\[ \omega_{i2}^{(2)} \quad \text{if incorrect?} \quad c_1 \frac{1}{10} \exp\left(\ln\frac{\sqrt{3}}{3}\right) \]
\[ c_i \frac{7}{10} + c_i \frac{3}{10} = 1 \]
\[ c_1 = \frac{5}{21} \cdot \sqrt{21} \]
\[ \frac{1}{14} \]
\[ \frac{1}{6} \]
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Midterm 1 Curve

- A: 88-100
- B: 76-87
- C: 64-75
- D: 52-63
- Below 52: not passing (please meet with me)
Midterm 1 Solutions
(not posted in slides)