Exercise 11: Adaboost

Knowledge Discovery in Databases I
SS 2016
Initialize $w_1, \ldots, w_N = \frac{1}{N}$ \hspace{1cm} (N: number of training instances)

For $m = 1, \ldots, M$:

- Fit a classifier $K_m(x)$ to the training data by minimizing weighted error function $J_m = \sum_{n=1}^{N} w_n I(K_m(x_n) \neq t_n)$ \hspace{1cm} ($t_n$: correct class label, $I$: indicator function)

- Compute weighting coefficient $\alpha_m = \ln \left\{ \frac{1-\epsilon_m}{\epsilon_m} \right\}$ with $\epsilon_m = \frac{J_m}{\sum_{1}^{N} w_n}$

- Update all data weights: $w_{n,old} = w_n$
  \hspace{1cm} $w_n = w_{n,old} \exp \{ \alpha_m I(K_m(x_n) \neq t_n) \}$

Make prediction using final model

$$K_M(x) = \text{sign} \left( \sum_{m=1}^{M} \alpha_m K_m(x) \right)$$
Exercise 11-1: Adaboost

\[ \epsilon_m = \frac{j_m}{\sum_{1}^{N} w_n} \]
\[ 1 - \epsilon_m \]
\[ \alpha_m = \ln \left( \frac{1 - \epsilon_m}{\epsilon_m} \right) \]
\[ w_n = w_{n,old} \exp \{ \alpha_m I(K_m(x_n) \neq t_n) \} \]

<table>
<thead>
<tr>
<th>(w_{n,old} = 0.01)</th>
<th>(w_{n,old} = 0.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I(K_m(x_n) \neq t_n) = 1) (wrongly classified)</td>
<td>(I(K_m(x_n) \neq t_n) = 1) (correctly classified)</td>
</tr>
<tr>
<td>0.01</td>
<td>99</td>
</tr>
<tr>
<td>0.5</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ K_M(x) = \text{sign} \left( \sum_{m=1}^{M} \alpha_m K_m(x) \right) \]