

1. Machine Learning Algorithms Pseudocode

Algorithm 1 k-Nearest Neighbor

Input: X: training data, Y: Class labels of X, x : unknown sample

Output: Class with the highest number of occurrence

```
1: function CLASSIFY( $X, Y, x$ )
2:   for  $i = 1$  to  $m$  do
3:     Compute distance  $d(X_i, x)$ 
4:   end for
5:   Compute set  $I$  containing indices for the  $k$  smallest distances  $d(X_i, x)$ 
6:   Return majority label  $\{Y_i \text{ where } i \in I\}$ 
7: end function
```

1. Ensemble Algorithm

Algorithm 2 Adaboost

Input:

Training data $\{(x_i, y_i)_{i=1}^N$ where $x_i \in \mathbb{R}^k$ and $y_i \in \{-1, 1\}\}$

Large number of classifiers denoted by $f_m(x) \in \{-1, 1\}$

0-1 loss function I defined as

$$I(f_m(x, y)) = \begin{cases} 0, & \text{if } f_m(x_i) = y_i \\ 1, & \text{if } f_m(x_i) \neq y_i \end{cases} \quad (1)$$

(2)

Output: The final classifier

```
1: for  $i = 1$  to  $N$  do
2:   for  $i = 1$  to  $M$  do
3:     Fit weak classifier  $m$  to minimize the objective function:
4:      $\epsilon_m = \frac{\sum_{i=1}^N w_i^m I(f_m(x_i) \neq y_i)}{x^2 + 2x + 1}$ 
5:     where  $I(f_m(x_i) \neq y_i) = 1$  if  $f_m(x_i) \neq y_i$  and 0 otherwise
6:      $\alpha_m = \ln \frac{1 - \epsilon_m}{\epsilon_m}$ 
7:   end for
8:   for all  $i$  do
9:      $w_i^{m+1} = w_i^{(m)} e^{\alpha_m I(f_m(x_i) \neq y_i)}$ 
10:  end for
11: end for
```
