Lecture eleven

April 14, 2016

1   AdaBoost

short for adaptive boosting bindary classifier.

$$Committee = \begin{cases} k_1(\vec{x}) = \pm 1 \\ k_2(\vec{x}) = \pm 1 \\ \vdots \\ k_n(\vec{x}) = \pm 1 \end{cases} \tag{1}$$

$$k(x) = c_1 k_1(\vec{x}) + c_2 k_2(\vec{x}) + \cdots + c_n k_n(\vec{x}) \tag{2}$$

2   Viola-Jones Classifier

5000 face $\in P$ and 5000 non-faces $\in N$.

1. Test the classifiers

	1	2	...	L
$\vec{x}_1$	1	1	...	
$\vec{x}_2$	1	1	...	
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\vec{x}_n$	0	1	...	

Error rate $= \frac{\#hits}{N}$

2. the penalty for a miss is bigger than for a hit.

3. **TEAM**

	k_1	k_2	...	k_m	Total Error
$\vec{x}_1$	e^{-d_1}	e^{-d_2}	...	e^{-d_m}	$\prod_{i=1}^{-k_i(x_1)y_i d_i}$
$\vec{x}_2$	e^{-d_1}	e^{-d_2}	...	e^{-d_m}	$\prod_{i=1}^{-k_i(x_2)y_i d_i}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\vec{x}_n$	e^{-d_1}	e^{-d_2}	...	e^{-d_m}	$\prod_{i=1}^{-k_i(x_n)y_i d_i}$
	α_1	α_2	...	α_m	$\sum$ all team erros

$$E = \sum_{i=1}^{N} e^{-y_i(C_{m-1}(\vec{x}_i) + \alpha_m k_m(\vec{x}_i))} \tag{3}$$

$$C_{m-1}(\vec{x}_i) = \alpha_1 k_1(\vec{x}_i) + \alpha_2 k_2(\vec{x}_i) + \cdots + \alpha_{m-1} k_{m-1}(\vec{x}_i) \tag{4}$$

$$E = \sum_{i=1}^{N} e^{-y_i C_{m-1}(\vec{x}_i)} e^{-y_i \alpha_m k_m(\vec{x}_i)} \tag{5}$$

$$E = \sum_{i=1}^{N} \omega_i^{(m)} e^{-y_i \alpha_m k_m(\vec{x}_i)} \tag{6}$$

Team		
		k_m
$\vec{x}_1$	$\omega_1^{(m)}$	hit
$\vec{x}_1$	$\omega_1^{(m)}$	hit
$\vdots$	$\vdots$	$\vdots$
$\vec{x}_1$	$\omega_1^{(m)}$	hit

$$E = \sum_{y_i = k_m(x_i)}^{N} \omega_i^m e^{-\alpha_m} + \sum_{y_i \neq k_m(x_i)}^{N} \omega_i^m e^{\alpha_m} \tag{7}$$
$$E = W_c e^{-\alpha_m} + W_e e^{\alpha_m}$$

$$e^{\alpha_m} E = W_c + W_e e^{2\alpha_m}$$
$$e^{\alpha_m} E = (W_c + W_e) + W_e(e^{2\alpha_m} - 1) \tag{8}$$

In order to minimize E we need to pick the classifier with the lowest weighted error of misses W_e.

Compute the α_m

$$\frac{dE}{d\alpha_m} = -W_c e * -\alpha_m + W_e e^{\alpha_m} = 0$$
$$= -W_c + W_e e^{2\alpha_m} = 0$$
$$e^{2\alpha_m} = \frac{W_c}{W_e} \tag{9}$$
$$2\alpha_m = ln\left(\frac{W_c}{W_e}\right)$$

If ou want to have 20 classifiers in your committes then you run the algorithm 20 times.