

# Answer Key for Practice Quiz 2

## CS 591Q/791V - Pattern Recognition

Posted on April 15, 2009

1. (a) Exhaustive search: The algorithm will consider all possible subsets of cardinality less than or equal to 10. Thus, the number of subsets considered =

$$\sum_{i=1}^{10} \binom{15}{i}.$$

- (b) SFS: The algorithm begins with an empty set of features. It then successively adds features to this set. The following table lists the number of feature subsets that will be considered (i.e., the number of subsets for which the  $J()$  value will be computed) at each iteration.

Cardinality of set of selected features	Number of subsets considered
1	15
2	14
3	13
4	12
5	11
6	10
7	9
8	8
9	7
10	6
Total	105

- (c) SBS: The algorithm begins with a set consisting of all 15 features. It then successively drops features from this set. The following table lists the number of feature subsets that will be considered (i.e., the number of subsets for which the  $J()$  value will be computed) at each iteration.

Cardinality of set of selected features	Number of subsets considered
14	15
13	14
12	13
11	12
10	11
9	10
8	9
7	8
6	7
5	6
4	5
3	4
2	3
1	2
Total	119

	$C_1 (t = +1)$	$C_2 (t = -1)$
2. (a)	$\mathbf{y}_1 = (1,3,4)$	$\mathbf{y}_4 = (1,1,1)$
	$\mathbf{y}_2 = (1,3,5)$	$\mathbf{y}_5 = (1,1,2)$
	$\mathbf{y}_3 = (1,4,4)$	$\mathbf{y}_6 = (1,2,1)$

- (b) •  $\mathbf{w} = (-12, 8, 10)^T$ .

Input vector $[\mathbf{y}_i]$	Linear discriminant function $[t_i(\mathbf{w}^T \mathbf{y}_i)]$	Correctly classified?
$\mathbf{y}_1$	52	Yes
$\mathbf{y}_2$	62	Yes
$\mathbf{y}_3$	60	Yes
$\mathbf{y}_4$	-6	No
$\mathbf{y}_5$	-16	No
$\mathbf{y}_6$	-14	No

The weight vector is updated based on the misclassified samples. So,  $\mathbf{w} = (-12, 8, 10)^T + (-1, -1, -1)^T + (-1, -1, -2)^T + (-1, -2, -1)^T = (-15, 4, 6)^T$ .

- $\mathbf{w} = (-15, 4, 6)^T$ .

Input vector $[\mathbf{y}_i]$	Linear discriminant function $[t_i(\mathbf{w}^T \mathbf{y}_i)]$	Correctly classified?
$\mathbf{y}_1$	21	Yes
$\mathbf{y}_2$	27	Yes
$\mathbf{y}_3$	25	Yes
$\mathbf{y}_4$	5	Yes
$\mathbf{y}_5$	-1	No
$\mathbf{y}_6$	1	Yes

The weight vector is updated based on the misclassified samples. So,  $\mathbf{w} = (-15, 4, 6)^T + (-1, -1, -2)^T = (-16, 3, 4)^T$ .

- $\mathbf{w} = (-16, 3, 4)^T$ .

Input vector $[\mathbf{y}_i]$	Linear discriminant function $[t_i(\mathbf{w}^T \mathbf{y}_i)]$	Correctly classified?
$\mathbf{y}_1$	9	Yes
$\mathbf{y}_2$	13	Yes
$\mathbf{y}_3$	12	Yes
$\mathbf{y}_4$	9	Yes
$\mathbf{y}_5$	5	Yes
$\mathbf{y}_6$	6	Yes

Since all the samples are correctly classified by  $\mathbf{w} = (-16, 3, 4)^T$ , no further modification of the weight vector is necessary.

3. Fisher's criterion tries to maximize the distance between multiple classes while minimizing the scatter within each class by computing a suitable projection matrix/vector. In other words, this criterion maximizes inter-class variations while simultaneously minimizing intra-class variations.