

CSE426 Pattern Recognition – Homework Assignment #6

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1. Summary Error Table

Table 1: Total error counts & average computational cost of five nonparametric classifiers

Method:	Errors	Costs
1	186	10,000
2	195	30,000
3	173	10,000
4	6	256,000
5	6	256,000

2. Confusion Tables

Table 2: Method 1 – 1-NN in moment space under L2 metric

	0	1	2	3	4	5	6	7	8	9	Error Type I
0	53	0	0	0	0	0	1	0	44	2	47
1	0	92	0	5	0	0	0	1	2	0	8
2	5	1	68	12	0	8	0	0	0	6	32
3	0	1	10	86	0	1	0	2	0	0	14
4	0	1	0	0	99	0	0	0	0	0	1
5	1	1	5	2	0	88	1	0	2	0	12
6	1	0	0	0	1	0	96	0	2	0	4
7	0	2	0	0	0	0	0	93	0	5	7
8	42	0	1	0	0	0	4	0	52	1	48
9	0	1	1	1	0	0	0	10	0	87	13
Error Type II	49	7	17	20	1	9	6	13	50	14	186

Table 3: Method 2 – 1-NN in moment space under L4 metric

	0	1	2	3	4	5	6	7	8	9	Error Type I
0	55	0	2	0	0	0	1	1	40	1	45
1	0	93	0	5	0	0	0	1	1	0	7
2	5	1	70	11	0	8	0	0	0	5	30
3	0	1	12	83	0	2	0	2	0	0	17
4	0	1	0	0	99	0	0	0	0	0	1
5	1	1	6	2	0	87	1	0	2	0	13
6	1	0	0	0	1	0	96	0	2	0	4
7	0	0	0	0	0	0	0	92	0	8	8
8	47	1	1	0	0	0	5	0	45	1	55
9	0	1	1	0	0	0	0	13	0	85	15
Error Type II	54	6	22	18	1	10	7	17	45	15	195

Table 4: Method 3 – 5-NN in moment space under L2 metric

	0	1	2	3	4	5	6	7	8	9	Error Type I
0	52	0	1	0	0	0	2	0	45	0	48
1	0	100	0	0	0	0	0	0	0	0	0
2	3	1	75	12	0	6	0	0	0	3	25
3	0	3	14	82	0	0	0	1	0	0	18
4	0	2	0	0	98	0	0	0	0	0	2
5	1	2	1	5	1	87	2	0	1	0	13
6	0	1	0	0	1	0	97	0	1	0	3
7	0	2	0	0	0	0	0	94	0	4	6

8	35	0	0	1	0	0	4	0	59	1	41
9	0	1	2	1	0	0	0	13	0	83	17
Error Type II	39	12	18	19	2	6	8	14	47	8	173

Table 5: Method 4 – 1-NN in pixel space under L2 metric

	0	1	2	3	4	5	6	7	8	9	Error Type I
0	100	0	0	0	0	0	0	0	0	0	0
1	0	99	0	1	0	0	0	0	0	0	1
2	0	0	98	1	0	0	0	1	0	0	2
3	0	0	0	100	0	0	0	0	0	0	0
4	0	0	0	0	100	0	0	0	0	0	0
5	0	1	0	1	0	98	0	0	0	0	2
6	0	0	0	0	0	0	99	0	1	0	1
7	0	0	0	0	0	0	0	100	0	0	0
8	0	0	0	0	0	0	0	0	100	0	0
9	0	0	0	0	0	0	0	0	0	100	0
Error Type II	0	1	0	3	0	0	0	1	1	0	6

Table 6: Method 5 – 5-NN in pixel space under L2 metric

	0	1	2	3	4	5	6	7	8	9	Error Type I
0	100	0	0	0	0	0	0	0	0	0	0
1	0	100	0	0	0	0	0	0	0	0	0
2	0	1	98	0	0	0	0	1	0	0	2
3	0	2	0	98	0	0	0	0	0	0	2
4	0	0	0	0	100	0	0	0	0	0	0

5	0	0	0	2	0	98	0	0	0	0	2
6	0	0	0	0	0	0	100	0	0	0	0
7	0	0	0	0	0	0	0	100	0	0	0
8	0	0	0	0	0	0	0	0	100	0	0
9	0	0	0	0	0	0	0	0	0	100	0
Error Type II	0	3	0	2	0	0	0	1	0	0	6

3. Comments

Number of features

From the error table in Section 1, we can observe that the first 3 methods perform worse than method 4 and 5. The common thing is that the first 3 methods take moment space features (10 dimensions) for the experiment while method 4 and 5 use pixel space features (256 dimensions) directly. In a conclusion, a larger number of features are more likely to make better performance. But the problem is that more features require more multiplications and the computation always consumes more time.

The value k in K-NN

Even though the difference of results between different values of k is not apparent in this experiment, the selection of k is usually an important problem in practice. The thing is that a small value of k makes the classifier too sensitive to neighbor data samples. Namely, noises can influence a lot if k is too small. On the contrary, a larger value of k alleviates this issue since the classification result is made based on more votes from k samples, making the classifier more robust to noises.

The metric

I didn't see any big changes when using different distance metrics. In method 1 and 2, we used L2 and L4 for the distance calculation respectively. But their experiment results look similar. In this situation, I prefer the one with fewer calculations which is L2.

The computational cost of each decision

The cost of each decision is summarized in the beginning of this report. We can see that method 4 and 5 have larger computational costs. The main reason is that they are running in the pixel feature space which has 256 dimensions. In practice, people always try to decrease the dimension of features while retaining useful information.