

7CCSMPNN Pattern Recognition, Neural Networks, and Deep Learning

Coursework Assignment 1

Part 0: Creating Datasets

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Values in the array Xtest:

```
[ [4.43478261 7.91304348 4.86956522 4.      4.86956522 6.17391304
  5.30434783]
[4.25      2.5      2.      2.5      3.25      2.75
  2.25      ]
[2.33333333 1.      2.33333333 4.33333333 3.      1.66666667
  7.      ]
[0.      0.5      1.25      0.75      0.25      2.25
  0.5      ]]
```

Part 1: k-Nearest-Neighbour Classifier

when $k = 3$, the class for each sample in Xtest: [0 0 1 1 1 0 2]

when $k = 7$, the class for each sample in Xtest: [0 0 1 1 0 0 2]

Part 2: Discriminant Functions

	a	yk	ay	a_new
0	[1, 0, 0]	[1, 0, 2]	1.000000	[1.0, 0.0, 0.0]
1	[1.0, 0.0, 0.0]	[1, 1, 2]	1.000000	[1.8, 0.8, 1.6]
2	[1.8, 0.8, 1.6]	[1, 2, 1]	5.000000	[1.5, 0.2, 1.3]
3	[1.5, 0.2, 1.3]	[-1, 3, -1]	-2.200000	[1.28, 0.86, 1.08]
4	[1.28, 0.86, 1.08]	[-1, 2, 1]	1.520000	[1.232, 0.956, 1.128]
5	[1.232, 0.956, 1.128]	[-1, 3, 2]	3.892000	[1.1212, 1.2884, 1.3496]
6	[1.1212, 1.2884, 1.3496]	[1, 0, 2]	3.820400	[0.8392, 1.2884, 0.7855]
7	[0.8392, 1.2884, 0.7855]	[1, 1, 2]	3.698600	[1.3693, 1.8185, 1.8458]
8	[1.3693, 1.8185, 1.8458]	[1, 2, 1]	6.852180	[0.8841, 0.8481, 1.3606]
9	[0.8841, 0.8481, 1.3606]	[-1, 3, -1]	0.299648	[0.914, 0.7582, 1.3905]
10	[0.914, 0.7582, 1.3905]	[-1, 2, 1]	1.992919	[0.9133, 0.7596, 1.3913]
11	[0.9133, 0.7596, 1.3913]	[-1, 3, 2]	4.148048	[0.8281, 1.0152, 1.5616]

Part 3: Neural Networks

(a)

	W	Tk	Xk	H	Wnew
0	[2, 0, 2]	1	[1, 0, 2]	1	[2, 0, 2]
1	[2, 0, 2]	1	[1, 1, 2]	1	[2, 0, 2]
2	[2, 0, 2]	1	[1, 2, 1]	1	[2, 0, 2]
3	[2, 0, 2]	0	[1, -3, 1]	1	[1, 3, 1]
4	[1, 3, 1]	0	[1, -2, -1]	0	[1, 3, 1]
5	[1, 3, 1]	0	[1, -3, -2]	0	[1, 3, 1]
6	[1, 3, 1]	1	[1, 0, 2]	1	[1, 3, 1]
7	[1, 3, 1]	1	[1, 1, 2]	1	[1, 3, 1]
8	[1, 3, 1]	1	[1, 2, 1]	1	[1, 3, 1]
9	[1, 3, 1]	0	[1, -3, 1]	0	[1, 3, 1]
10	[1, 3, 1]	0	[1, -2, -1]	0	[1, 3, 1]
11	[1, 3, 1]	0	[1, -3, -2]	0	[1, 3, 1]

(b) the parameter is [2.1, 0.48, 2.34, -4.81, 3.02]

	W	Xk	Tk	H	Wnew
0	[2, 0, 2, -5, 3]	[1.0, 5.1, 3.5, 1.4, 0.2]	1	1	[2.0, 0.0, 2.0, -5.0, 3.0]
1	[2.0, 0.0, 2.0, -5.0, 3.0]	[1.0, 4.9, 3.0, 1.4, 0.2]	1	1	[2.0, 0.0, 2.0, -5.0, 3.0]
2	[2.0, 0.0, 2.0, -5.0, 3.0]	[1.0, 4.7, 3.2, 1.3, 0.2]	1	1	[2.0, 0.0, 2.0, -5.0, 3.0]
3	[2.0, 0.0, 2.0, -5.0, 3.0]	[1.0, 4.6, 3.1, 1.5, 0.2]	1	1	[2.0, 0.0, 2.0, -5.0, 3.0]
4	[2.0, 0.0, 2.0, -5.0, 3.0]	[1.0, 5.0, 3.6, 1.4, 0.2]	1	1	[2.0, 0.0, 2.0, -5.0, 3.0]
...
145	[2.1, 0.48, 2.34, -4.81, 3.02]	[0.0, 6.7, 3.0, 5.2, 2.3]	0	0	[2.1, 0.48, 2.34, -4.81, 3.02]
146	[2.1, 0.48, 2.34, -4.81, 3.02]	[0.0, 6.3, 2.5, 5.0, 1.9]	0	0	[2.1, 0.48, 2.34, -4.81, 3.02]
147	[2.1, 0.48, 2.34, -4.81, 3.02]	[0.0, 6.5, 3.0, 5.2, 2.0]	0	0	[2.1, 0.48, 2.34, -4.81, 3.02]
148	[2.1, 0.48, 2.34, -4.81, 3.02]	[0.0, 6.2, 3.4, 5.4, 2.3]	0	0	[2.1, 0.48, 2.34, -4.81, 3.02]
149	[2.1, 0.48, 2.34, -4.81, 3.02]	[0.0, 5.9, 3.0, 5.1, 1.8]	0	0	[2.1, 0.48, 2.34, -4.81, 3.02]

150 rows × 5 columns

(c)

	Xtest	class
0	[4.434782608695652, 4.25, 2.333333333333333, 0.0]	1
1	[7.91304347826087, 2.5, 1.0, 0.5]	1
2	[4.869565217391305, 2.0, 2.333333333333333, 1.25]	0
3	[4.0, 2.5, 4.333333333333334, 0.75]	0
4	[4.869565217391305, 3.25, 3.0, 0.25]	0
5	[6.173913043478262, 2.75, 1.6666666666666665, ...]	1
6	[5.304347826086957, 2.25, 7.0, 0.5]	0