

神经网络作业报告

数 41 李博扬 2014012118

(1)

(a)

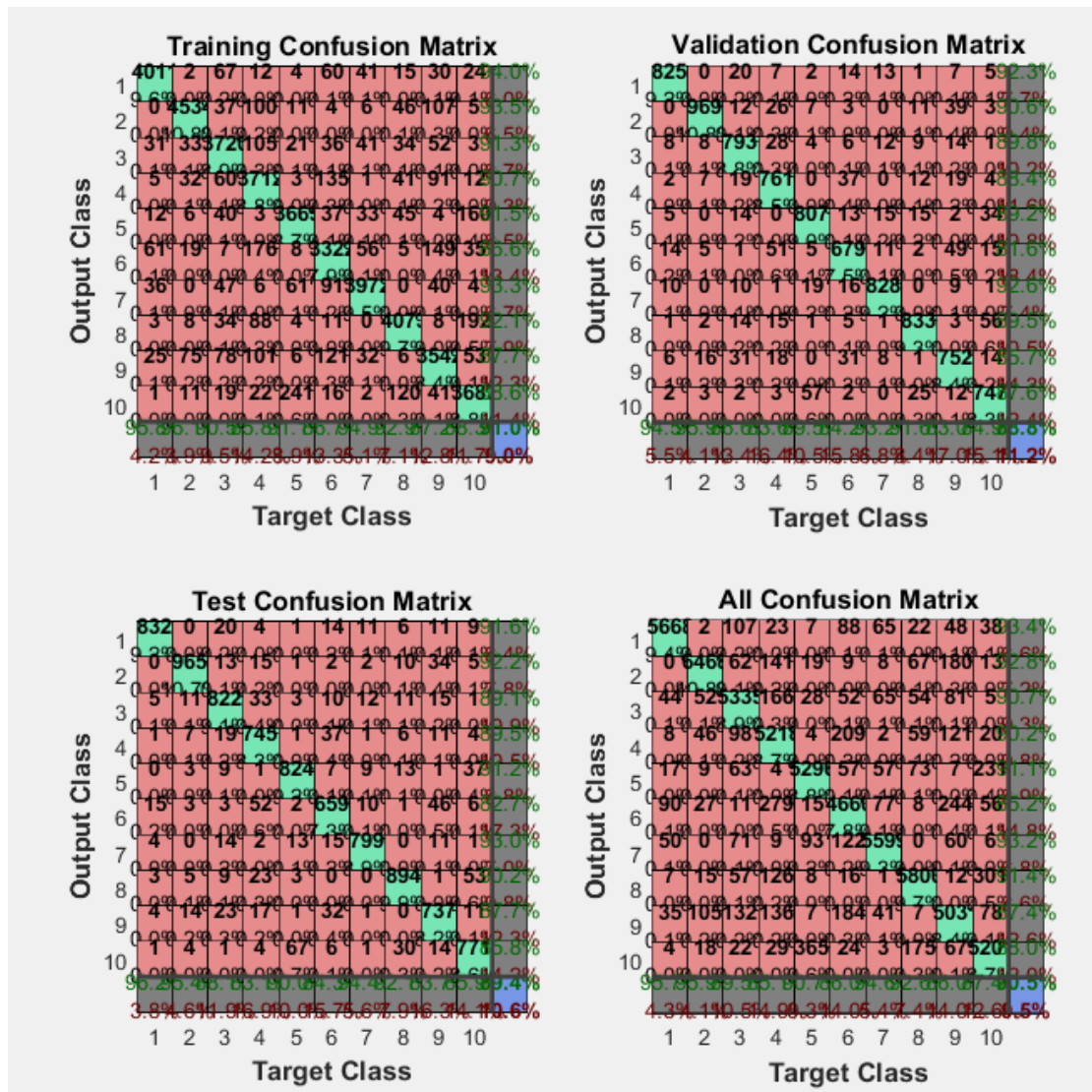


(b) — (c) 见代码

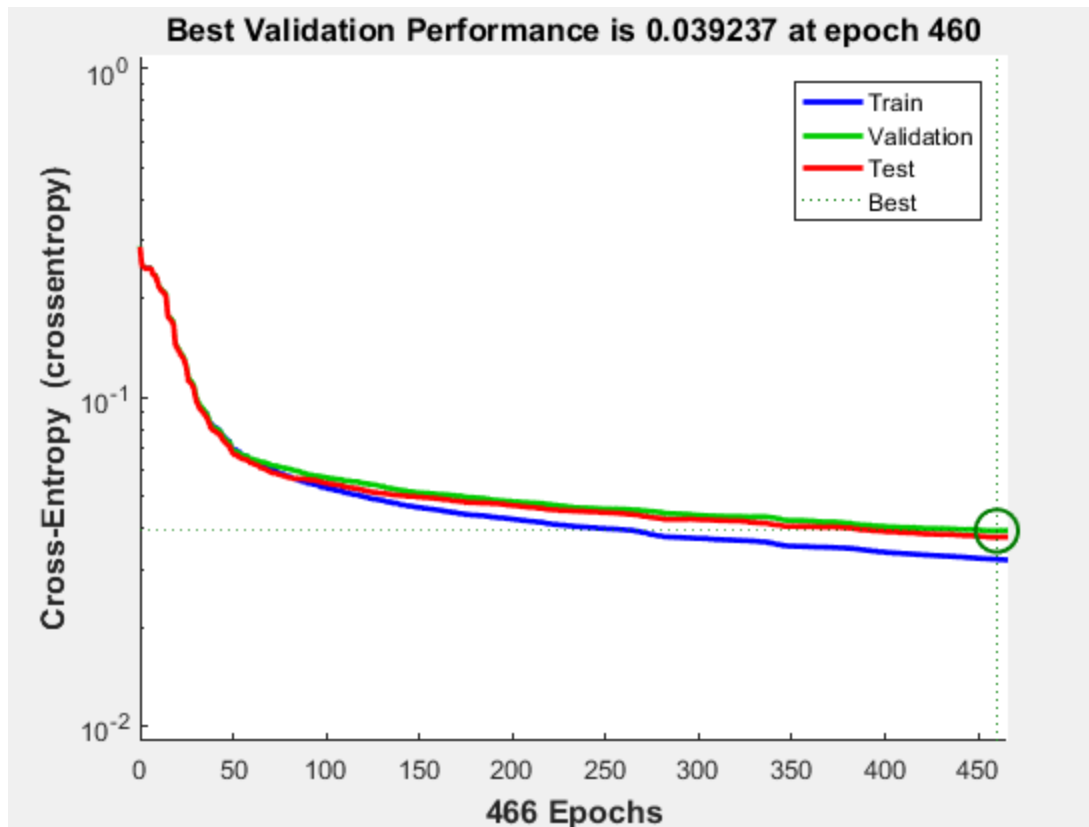
(d) 设隐藏节点个数为 N

N=5 时:

训练得到的混淆矩阵为:



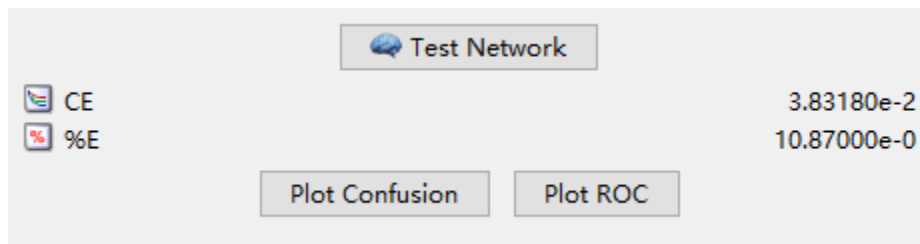
训练误差曲线:



测试得到混淆矩阵:

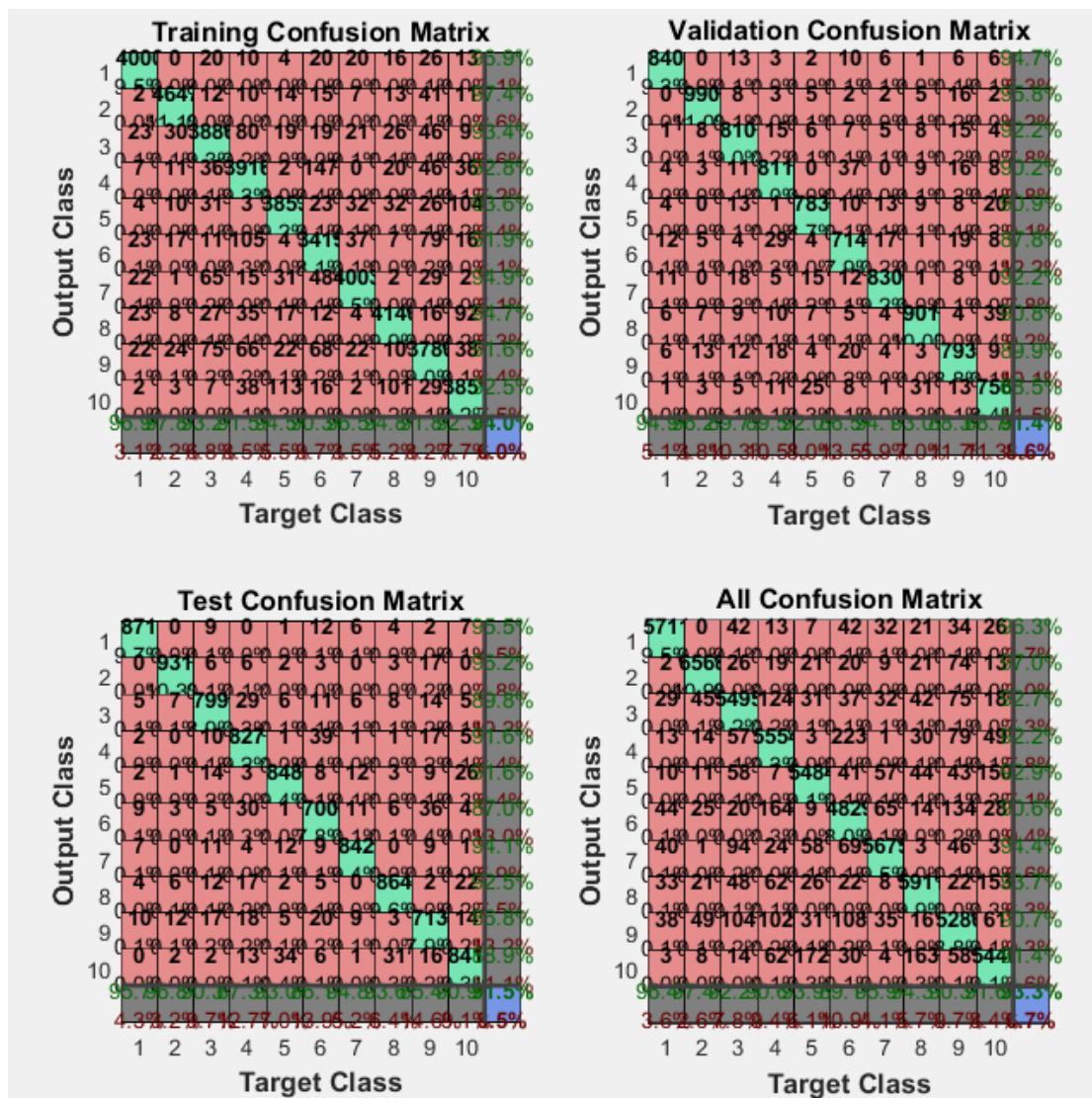
Confusion Matrix											
Output Class	1	2	3	4	5	6	7	8	9	10	
	943 9.4%	0 0.0%	20 0.2%	4 0.0%	0 0.0%	18 0.2%	23 0.2%	4 0.0%	7 0.1%	6 0.1%	92.0% 8.0%
	0 0.0%	1097 11.0%	11 0.1%	21 0.2%	6 0.1%	2 0.0%	1 0.0%	14 0.1%	33 0.3%	3 0.0%	92.3% 7.7%
	3 0.0%	6 0.1%	911 9.1%	29 0.3%	7 0.1%	6 0.1%	9 0.1%	19 0.2%	4 0.0%	2 0.0%	91.5% 8.5%
	3 0.0%	2 0.0%	24 0.2%	840 8.4%	1 0.0%	48 0.5%	0 0.0%	14 0.1%	18 0.2%	2 0.0%	88.2% 11.8%
	2 0.0%	0 0.0%	7 0.1%	0 0.0%	881 8.8%	11 0.1%	12 0.1%	9 0.1%	5 0.1%	42 0.4%	90.9% 9.1%
	14 0.1%	2 0.0%	5 0.1%	49 0.5%	3 0.0%	724 7.2%	18 0.2%	0 0.0%	53 0.5%	16 0.2%	81.9% 18.1%
	9 0.1%	3 0.0%	12 0.1%	3 0.0%	19 0.2%	27 0.3%	888 8.9%	0 0.0%	17 0.2%	1 0.0%	90.7% 9.3%
	4 0.0%	2 0.0%	7 0.1%	30 0.3%	6 0.1%	8 0.1%	0 0.0%	938 9.4%	5 0.1%	47 0.5%	89.6% 10.4%
	2 0.0%	22 0.2%	33 0.3%	30 0.3%	3 0.0%	41 0.4%	6 0.1%	0 0.0%	817 8.2%	16 0.2%	84.2% 15.8%
	0 0.0%	1 0.0%	2 0.0%	4 0.0%	56 0.6%	7 0.1%	1 0.0%	30 0.3%	15 0.1%	874 8.7%	88.3% 11.7%
Target Class	96.2% 3.8%	96.7% 3.3%	88.3% 11.7%	83.2% 16.8%	89.7% 10.3%	81.2% 18.8%	92.7% 7.3%	91.2% 8.8%	83.9% 16.1%	86.6% 13.4%	89.1% 10.9%

错误率:

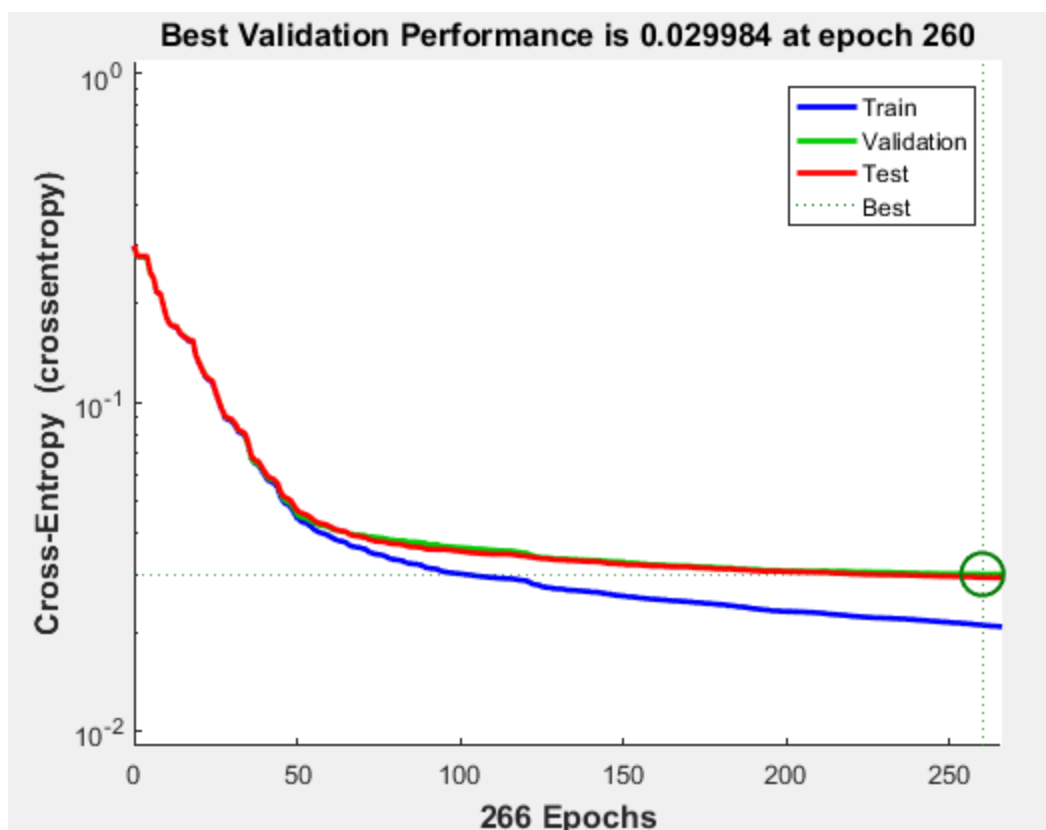


N=10 时:

训练得到的混淆矩阵:



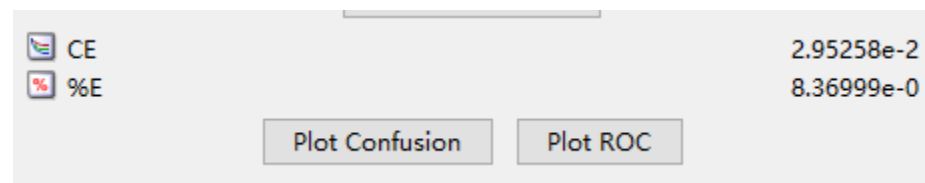
训练误差曲线:



测试得到混淆矩阵:

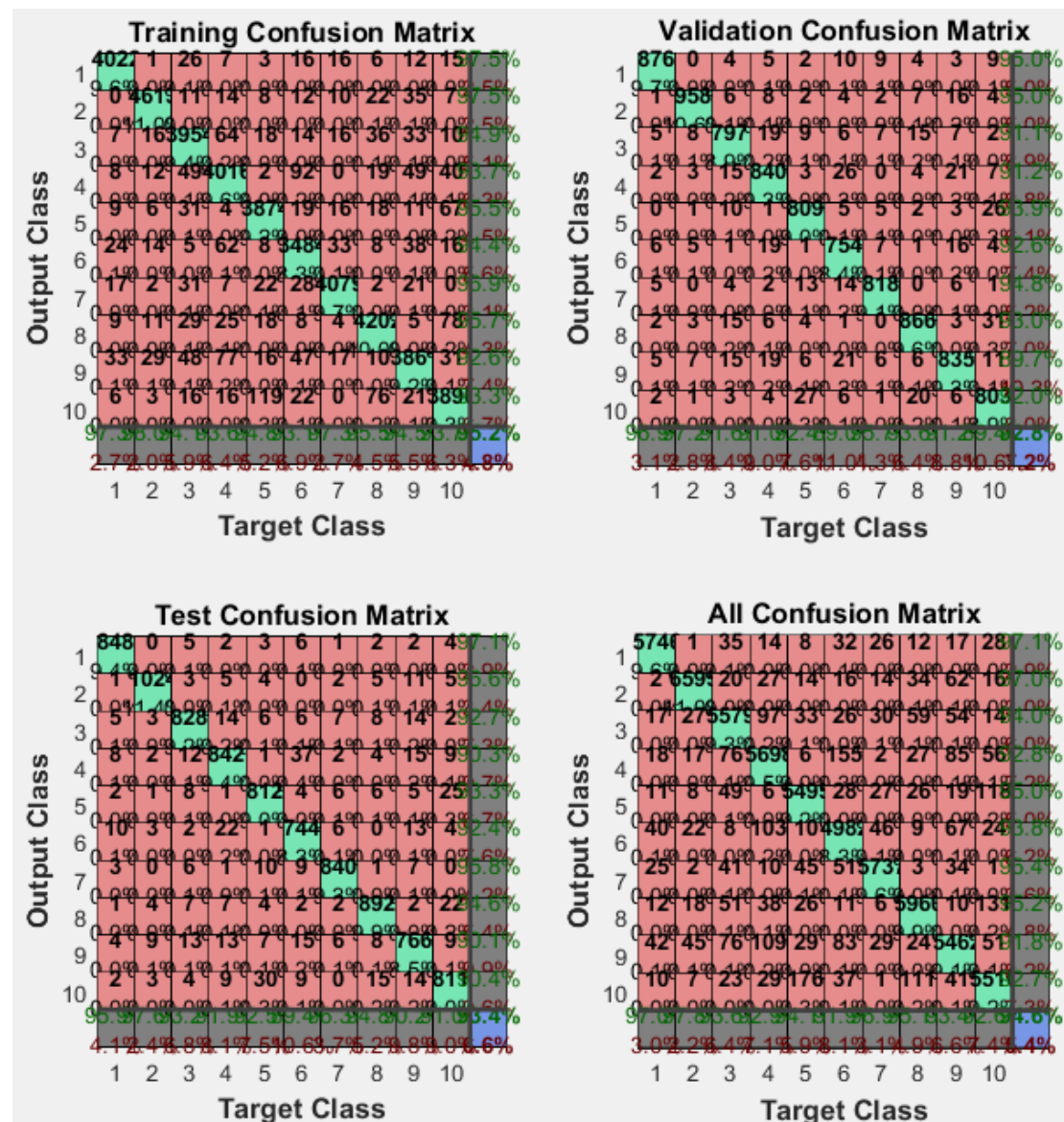
Output Class	1	2	3	4	5	6	7	8	9	10	
	944 9.4%	0 0.0%	11 0.1%	3 0.0%	2 0.0%	7 0.1%	14 0.1%	3 0.0%	9 0.1%	7 0.1%	94.4% 5.6%
	0 0.0%	1107 11.1%	1 0.0%	2 0.0%	2 0.0%	6 0.1%	1 0.0%	9 0.1%	10 0.1%	4 0.0%	96.9% 3.1%
	2 0.0%	6 0.1%	934 9.3%	16 0.2%	6 0.1%	6 0.1%	6 0.1%	22 0.2%	12 0.1%	3 0.0%	92.2% 7.8%
	2 0.0%	2 0.0%	18 0.2%	904 9.0%	0 0.0%	40 0.4%	0 0.0%	10 0.1%	19 0.2%	9 0.1%	90.0% 10.0%
	3 0.0%	1 0.0%	9 0.1%	1 0.0%	911 9.1%	12 0.1%	10 0.1%	5 0.1%	15 0.1%	29 0.3%	91.5% 8.5%
	5 0.1%	2 0.0%	5 0.1%	30 0.3%	0 0.0%	756 7.6%	19 0.2%	0 0.0%	21 0.2%	6 0.1%	89.6% 10.4%
	12 0.1%	2 0.0%	15 0.1%	3 0.0%	17 0.2%	18 0.2%	899 9.0%	0 0.0%	12 0.1%	0 0.0%	91.9% 8.1%
	7 0.1%	3 0.0%	11 0.1%	19 0.2%	3 0.0%	9 0.1%	6 0.1%	942 9.4%	12 0.1%	28 0.3%	90.6% 9.4%
	5 0.1%	11 0.1%	23 0.2%	25 0.3%	5 0.1%	25 0.3%	2 0.0%	4 0.0%	850 8.5%	7 0.1%	88.8% 11.2%
	0 0.0%	1 0.0%	5 0.1%	7 0.1%	36 0.4%	13 0.1%	1 0.0%	33 0.3%	14 0.1%	916 9.2%	89.3% 10.7%
Target Class	96.3% 3.7%	97.5% 2.5%	90.5% 9.5%	89.5% 10.5%	92.8% 7.2%	84.8% 15.2%	93.8% 6.2%	91.6% 8.4%	87.3% 12.7%	90.8% 9.2%	91.6% 8.4%

错误率:



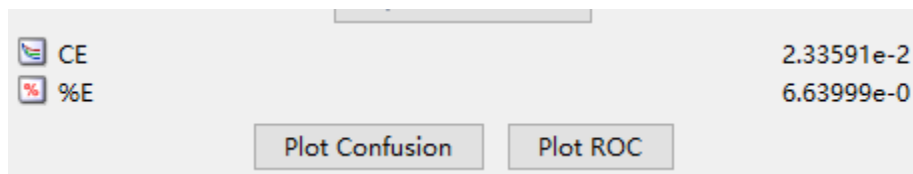
N=20:

训练得到混淆矩阵:



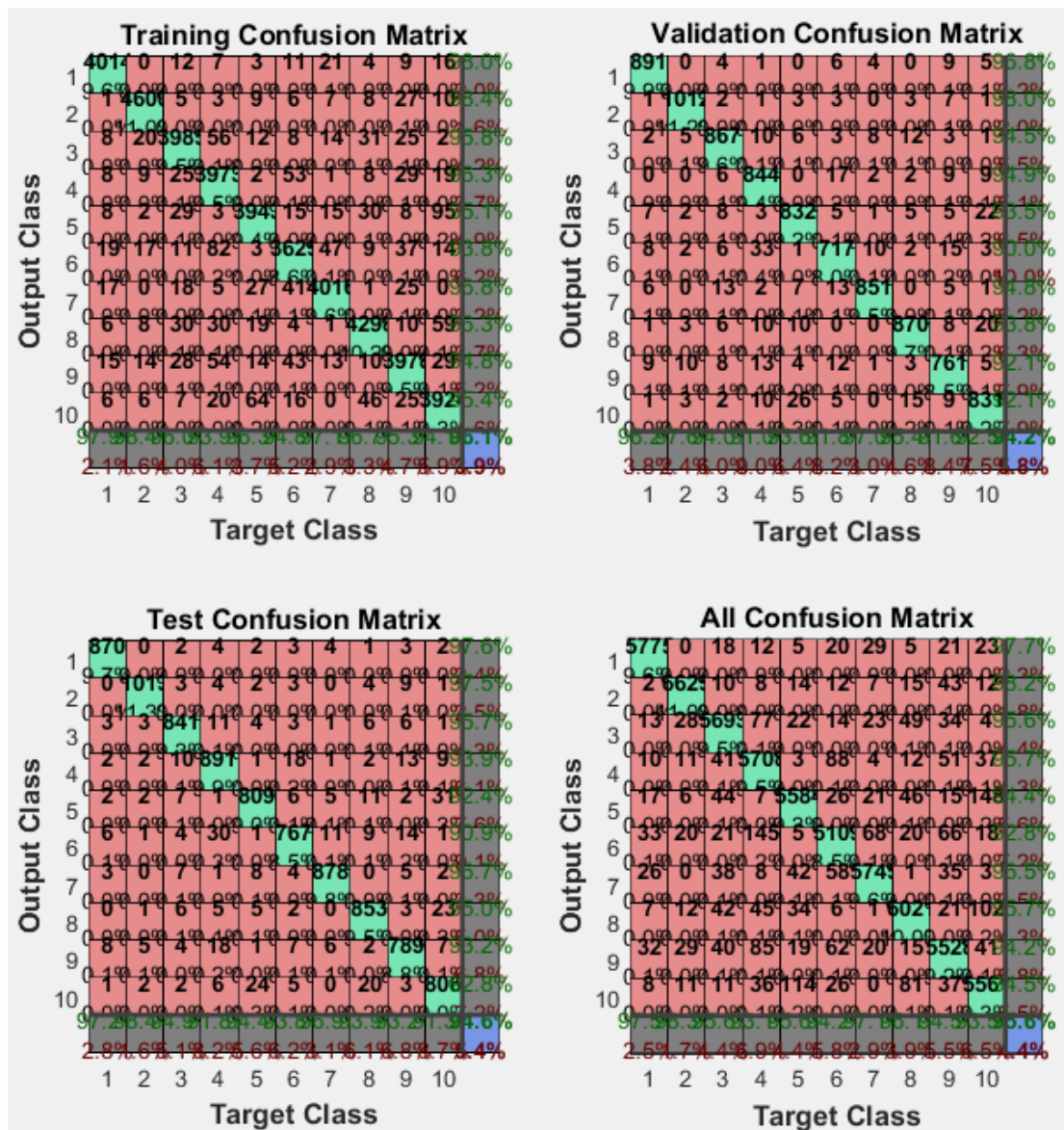
训练误差曲线:

错误率:

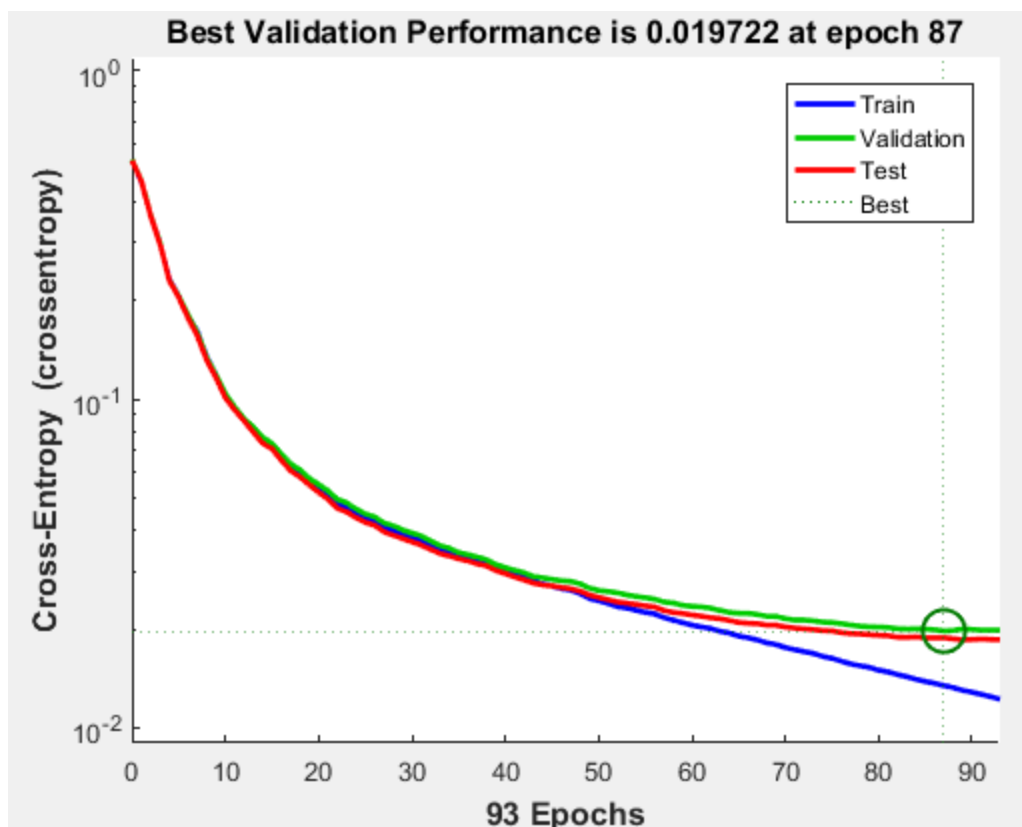


N=40:

训练混淆矩阵:



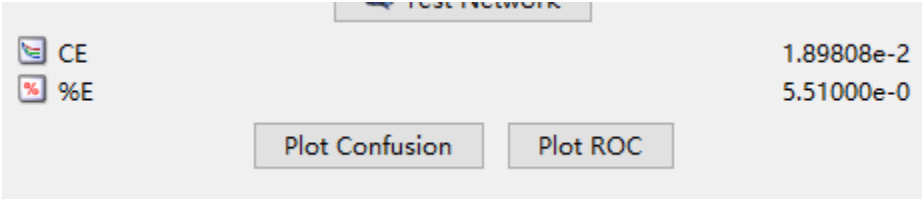
训练误差曲线:



测试混淆矩阵:

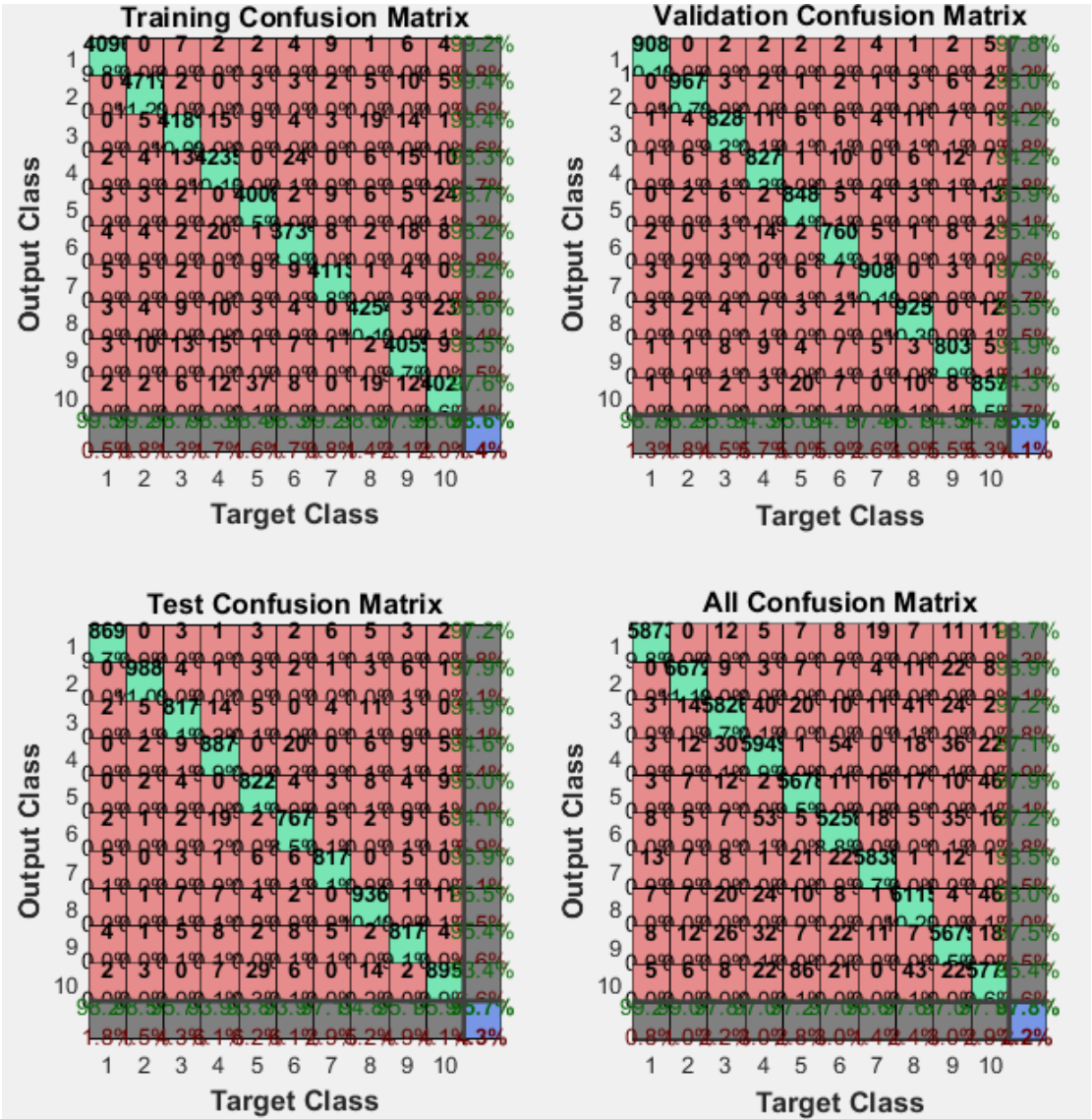
Confusion Matrix										
Output Class	1	2	3	4	5	6	7	8	9	10
	956 9.6%	0 0.0%	10 0.1%	0 0.0%	1 0.0%	5 0.1%	8 0.1%	1 0.0%	2 0.0%	6 0.1%
	0 0.0%	1119 11.2%	1 0.0%	0 0.0%	1 0.0%	5 0.1%	2 0.0%	5 0.1%	3 0.0%	6 0.1%
	2 0.0%	5 0.1%	968 9.7%	15 0.1%	3 0.0%	2 0.0%	2 0.0%	19 0.2%	7 0.1%	1 0.0%
	1 0.0%	0 0.0%	8 0.1%	936 9.4%	1 0.0%	19 0.2%	1 0.0%	6 0.1%	16 0.2%	12 0.1%
	2 0.0%	0 0.0%	11 0.1%	1 0.0%	933 9.3%	8 0.1%	4 0.0%	6 0.1%	5 0.1%	22 0.2%
	8 0.1%	1 0.0%	2 0.0%	28 0.3%	3 0.0%	826 8.3%	12 0.1%	3 0.0%	13 0.1%	10 0.1%
	8 0.1%	3 0.0%	9 0.1%	0 0.0%	7 0.1%	8 0.1%	922 9.2%	0 0.0%	7 0.1%	1 0.0%
	2 0.0%	2 0.0%	8 0.1%	8 0.1%	4 0.0%	1 0.0%	3 0.0%	958 9.6%	12 0.1%	13 0.1%
	1 0.0%	5 0.1%	14 0.1%	10 0.1%	5 0.1%	13 0.1%	4 0.0%	4 0.0%	905 9.0%	12 0.1%
	0 0.0%	0 0.0%	1 0.0%	12 0.1%	24 0.2%	5 0.1%	0 0.0%	26 0.3%	4 0.0%	926 9.3%
Target Class										
	97.6% 2.4%	98.6% 1.4%	93.8% 6.2%	92.7% 7.3%	95.0% 5.0%	92.6% 7.4%	96.2% 3.8%	93.2% 6.8%	92.9% 7.1%	91.8% 8.2%
	3.3%	2.0%	5.5%	6.4%	5.9%	8.8%	4.5%	5.2%	7.0%	5.5%

错误率:

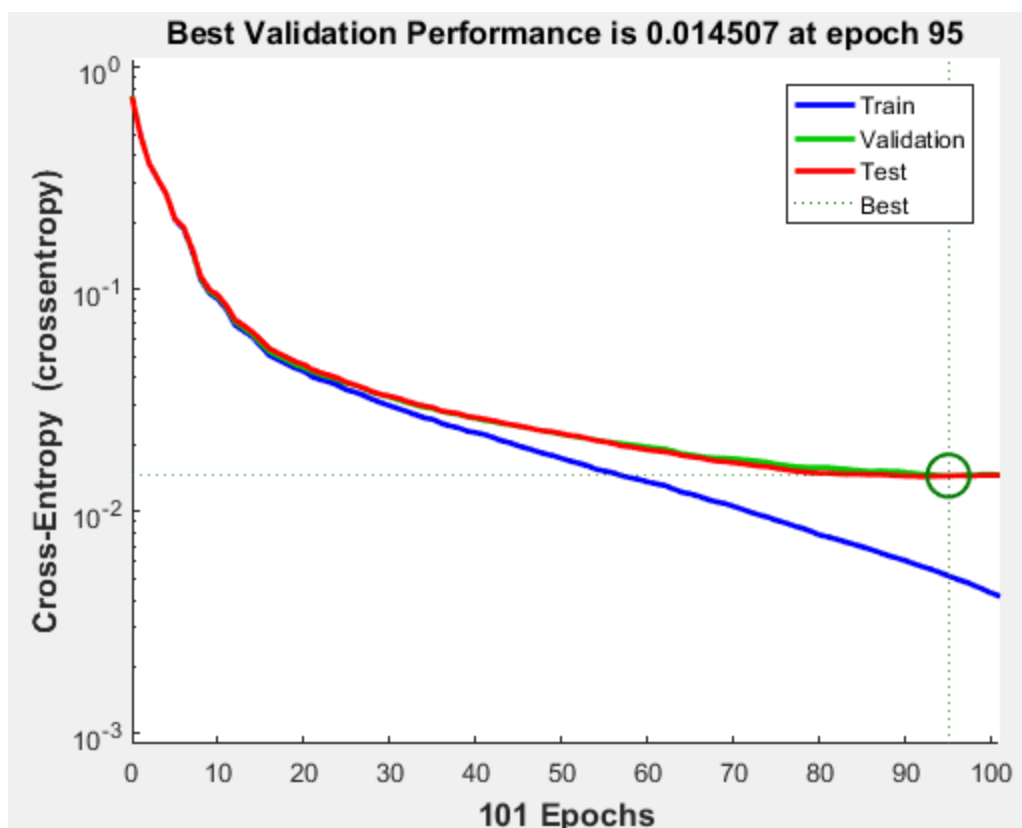


N=100:

训练混淆矩阵:



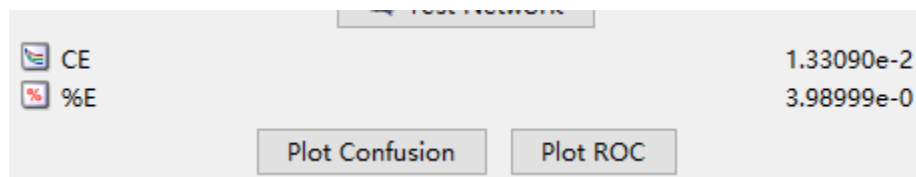
训练误差曲线:



测试混淆矩阵:

Confusion Matrix											
Output Class	1	2	3	4	5	6	7	8	9	10	
	961 9.6%	0 0.0%	2 0.0%	0 0.0%	3 0.0%	5 0.1%	10 0.1%	2 0.0%	9 0.1%	4 0.0%	96.5% 3.5%
	0 0.0%	1122 11.2%	3 0.0%	1 0.0%	0 0.0%	2 0.0%	2 0.0%	4 0.0%	1 0.0%	3 0.0%	98.6% 1.4%
	3 0.0%	4 0.0%	985 9.8%	10 0.1%	8 0.1%	2 0.0%	5 0.1%	16 0.2%	2 0.0%	0 0.0%	95.2% 4.8%
	1 0.0%	1 0.0%	9 0.1%	967 9.7%	0 0.0%	8 0.1%	0 0.0%	6 0.1%	12 0.1%	7 0.1%	95.6% 4.4%
	2 0.0%	0 0.0%	4 0.0%	0 0.0%	929 9.3%	2 0.0%	8 0.1%	5 0.1%	4 0.0%	14 0.1%	96.0% 4.0%
	3 0.0%	1 0.0%	4 0.0%	13 0.1%	2 0.0%	851 8.5%	5 0.1%	0 0.0%	8 0.1%	7 0.1%	95.2% 4.8%
	7 0.1%	2 0.0%	8 0.1%	0 0.0%	9 0.1%	7 0.1%	926 9.3%	0 0.0%	6 0.1%	1 0.0%	95.9% 4.1%
	1 0.0%	3 0.0%	7 0.1%	7 0.1%	2 0.0%	1 0.0%	1 0.0%	985 9.8%	6 0.1%	10 0.1%	96.3% 3.7%
	2 0.0%	1 0.0%	9 0.1%	10 0.1%	4 0.0%	9 0.1%	1 0.0%	2 0.0%	921 9.2%	9 0.1%	95.1% 4.9%
	0 0.0%	1 0.0%	1 0.0%	2 0.0%	25 0.3%	5 0.1%	0 0.0%	8 0.1%	5 0.1%	954 9.5%	95.3% 4.7%
Target Class	98.1% 1.9%	98.9% 1.1%	95.4% 4.6%	95.7% 4.3%	94.6% 5.4%	95.4% 4.6%	96.7% 3.3%	95.8% 4.2%	94.6% 5.4%	94.5% 5.5%	96.0% 4.0%

错误率：



注：所有截图的源图均已打包

分析错误率和收敛速度与节点数目的关系：

可以发现，当隐藏节点增多时，错误率减小并且神经网络收敛速度减小。可以总结为：若隐层节点数太少，网络可能根本不能训练或网络性能很差；若隐层节点数太多，虽然可使网络的系统误差减小，但一方面使网络训练时间延长，另一方面，训练容易陷入局部极小点而得不到最优点，也是训练时出现“过拟合”的内在原因。

（2）观察测试混淆矩阵可知 4 和 9 混淆最严重

利用 Logistic 回归的错误率为 0.2963

利用 fisher 投影到一维再结合 parzen 窗法用最小错误率贝叶斯决策分类的错误率为：0.0362

分析：logistic 回归与 fisher+贝叶斯决策判别的准确性在此题中大致与有 100 个隐层节点的神经网络相当。Logistic 回归与 fisher+贝叶斯决策判别法原理较简单，但可能处理更复杂的问题时不如功能强大的神经网络分类。而神经网络又因为它强大的拟合功能，容易造成过拟合现象。所以这几种分类方法各有优劣，应用的时候应当对问题有基本判断再选择分类方法。