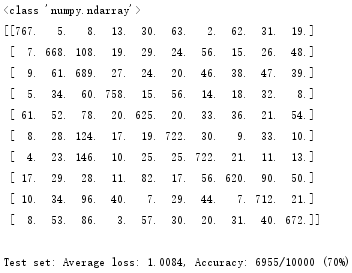
**Part 1: Japanese Character Recognition**

1. This is the final confusion matrix and final accuracy of the model *NetLin*.



<class 'numpy.ndarray'>

[[767. 5. 8. 13. 30. 63. 2. 62. 31. 19.]

[ 7. 668. 108. 19. 29. 24. 56. 15. 26. 48.]

[ 9. 61. 689. 27. 24. 20. 46. 38. 47. 39.]

[ 5. 34. 60. 758. 15. 56. 14. 18. 32. 8.]

[ 61. 52. 78. 20. 625. 20. 33. 36. 21. 54.]

[ 8. 28. 124. 17. 19. 722. 30. 9. 33. 10.]

[ 4. 23. 146. 10. 25. 25. 722. 21. 11. 13.]

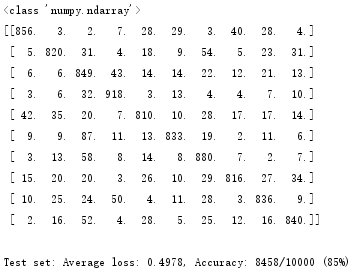
[ 17. 29. 28. 11. 82. 17. 56. 620. 90. 50.]

[ 10. 34. 96. 40. 7. 29. 44. 7. 712. 21.]

[ 8. 53. 86. 3. 57. 30. 20. 31. 40. 672.]]

Test set: Average loss: 1.0084, Accuracy: 6955/10000 (70%)

1. I tried different values for the number of hidden nodes and got corresponding accuracy as follows.[20(75%), 50(82%), 80(83%), 100(84%), 130(84%), 150(84%), 180(85%), 200(84%), 230(85%), 250(85%), 300(85%), 350(85%), 400(85%), 500(85%),800(85%)]. We could see that the accuracy is stable at around when the number of hidden nodes is larger than 180. This is the final confusion matrix and final accuracy of the model *NetLin* when the number of hidden nodes is 180.



[[856. 3. 2. 7. 28. 29. 3. 40. 28. 4.]

[ 5. 820. 31. 4. 18. 9. 54. 5. 23. 31.]

[ 6. 6. 849. 43. 14. 14. 22. 12. 21. 13.]

[ 3. 6. 32. 918. 3. 13. 4. 4. 7. 10.]

[ 42. 35. 20. 7. 810. 10. 28. 17. 17. 14.]

[ 9. 9. 87. 11. 13. 833. 19. 2. 11. 6.]

[ 3. 13. 58. 8. 14. 8. 880. 7. 2. 7.]

[ 15. 20. 20. 3. 26. 10. 29. 816. 27. 34.]

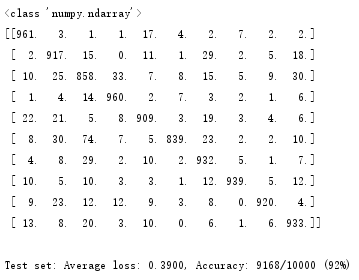
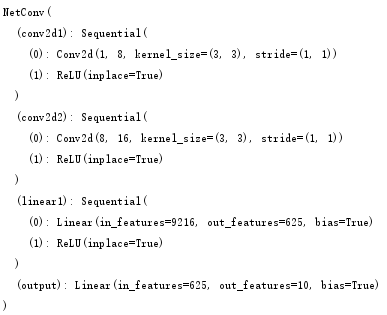
[ 10. 25. 24. 50. 4. 11. 28. 3. 836. 9.]

[ 2. 16. 52. 4. 28. 5. 25. 12. 16. 840.]]

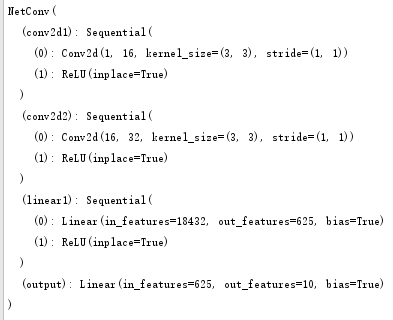
Test set: Average loss: 0.4978, Accuracy: 8458/10000 (85%)

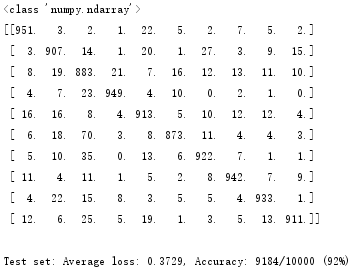
3.

(1)

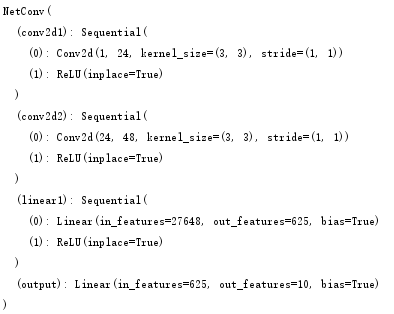


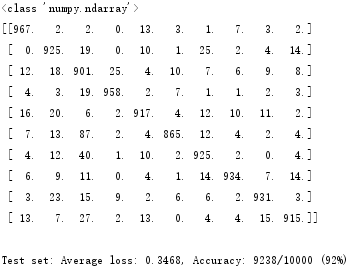
(2)



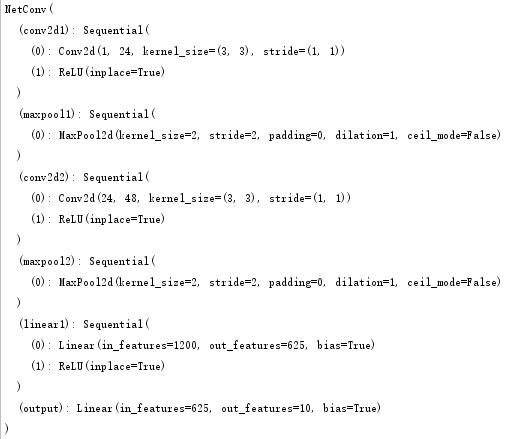
****

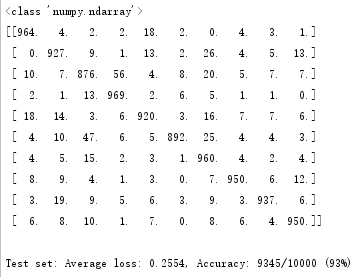
(3)



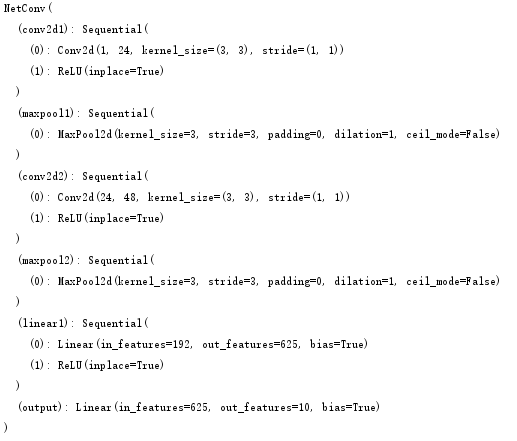


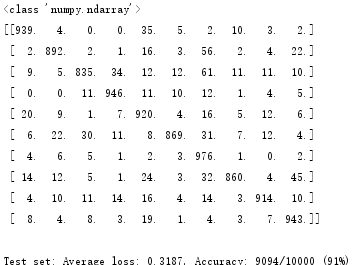
(4)



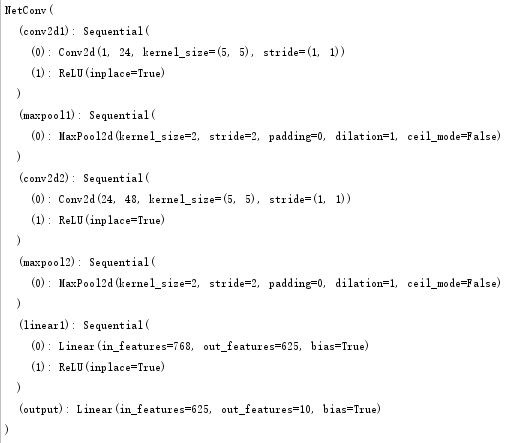


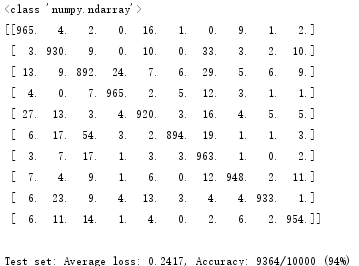
(5)



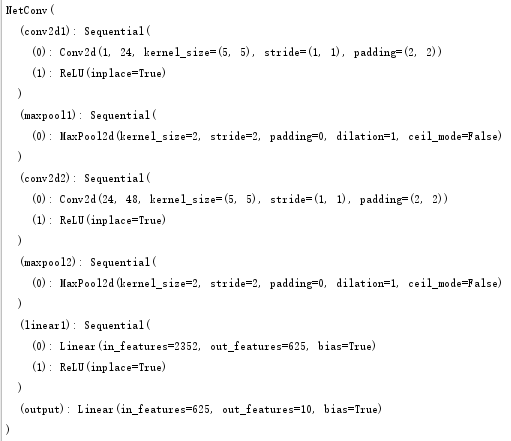


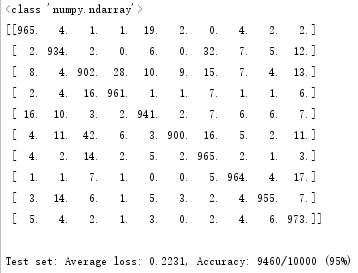
(6)





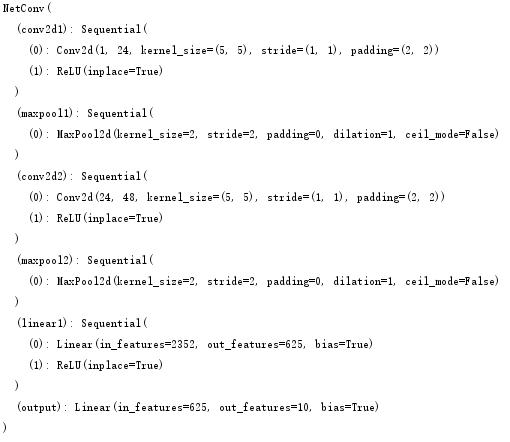
(7)

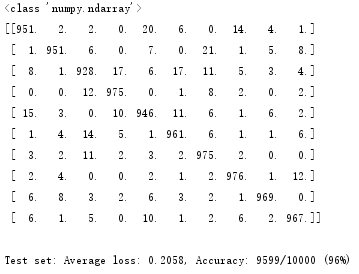




(8) increase the lr from 0.01 to 0.1

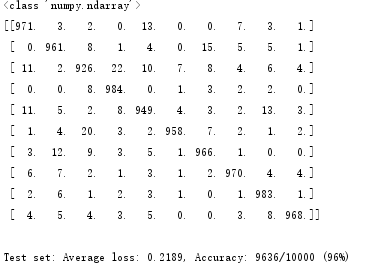
python kuzu\_main.py --net conv --lr 0.1





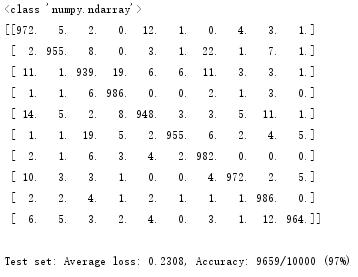
(9)increase the mom from 0.5 to 0.6

python kuzu\_main.py --net conv --lr 0.1 --mom 0.6



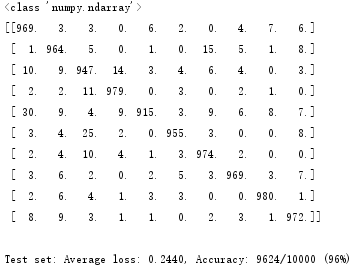
(10) increase the mom to 0.7

python kuzu\_main.py --net conv --lr 0.1 --mom 0.7



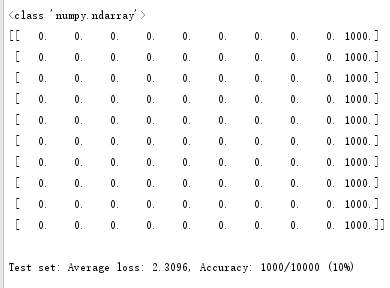
(11)increase the mom to 0.8

python kuzu\_main.py --net conv --lr 0.1 --mom 0.8



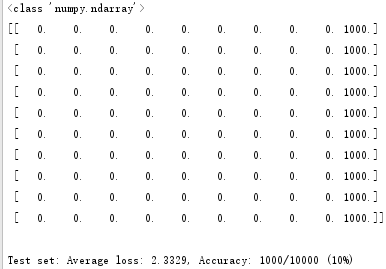
(12) increase the mom to 0.9

python kuzu\_main.py --net conv --lr 0.1 --mom 0.9



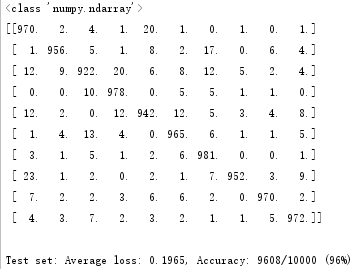
(13)increase the mom to 0.99

python3 kuzu\_main.py --net conv --lr 0.1 --mom 0.99



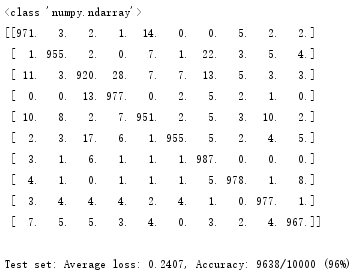
(13)decrease the mom to 0.4

python3 kuzu\_main.py --net conv --lr 0.1 --mom 0.4



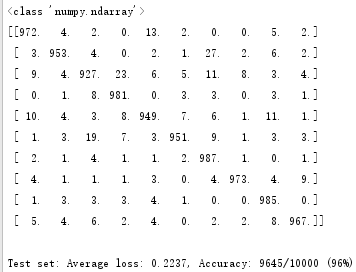
(14)decrease the mom to 0.4

python3 kuzu\_main.py --net conv --lr 0.1 --mom 0.4



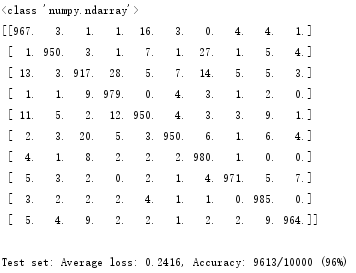
(15)decrease the mom to 0.3

python3 kuzu\_main.py --net conv --lr 0.1 --mom 0.3



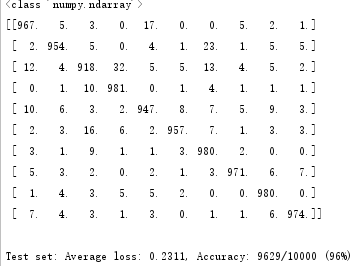
(16)decrease the mom to 0.2

python3 kuzu\_main.py --net conv --lr 0.1 --mom 0.2



(16)decrease the mom to 0.1

python3 kuzu\_main.py --net conv --lr 0.1 --mom 0.1



### Part 2: Twin Spirals Task

1.

2. the minimum number of hidden nodes is 7

3.

4.

python spiral\_main.py --net raw --hid 10 --init 0.1

ep:17500 loss: 0.0136 acc: 100.00

python spiral\_main.py --net raw --hid 10 --init 0.11

ep:18500 loss: 0.0213 acc: 100.00

python spiral\_main.py --net raw --hid 10 --init 0.12

ep: 5100 loss: 0.0386 acc: 100.00

5.