Name Yunhao Ge(葛云皓)

Student number 116020910017

**Problem one**

One variation of the perceptron learning rule is

whereis called the learning rate. Prove convergence of this algorithm. Does the proof require a limit on the learning rate? Explain.

**Resolution**

Asume the transfor function of single neuron perceptron is , provided training dataset are ｛p1,t1｝, ｛p2,t2｝,…, ｛pQ,tQ｝,the value of teacher singnal tq  are 1 or 0.

Set X=]; z=]

So the learning rule of perceptron can be (1)

The the value of error e can be 0,-1,1 when the p added to the fixed weight w. If we only consider the time when the vector w changed, the learning rule can be

(2)

is the member of assemble ｛z1, z2,…,zQ, -z1, -z2,…,-zQ｝,assume the perfect can separate the whole Q input vector

If

If

Asume that the original X(0)=0,we can get the equition via(2) after k times iteration.

（3）

Make scalar product with

(4)

If (5)

If (6)

From Cauchy inequition:

(7)

From the equition (6),(7),we can see that the **minimum** of

Then gain the **maximum** of k times iteration by getting the maximum of vector of wight

Asuming the tq=0,and the ,

So

So  (7)

K<

So k have the maximum and the times of iteration is limited