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Training System Artificial Neural Networks for Recognition Numbers

منظومة التدريب للشبكة العصبية الاصطناعية في تمييز الارقام

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Abstract

This research present a multiply connected neural network designed to recognize input images to it which are the numbers (0……9) by using neucontron network with for layers (U1, U2, U3, U4) in addition to input layer (U0) to after training network and produce database related to its which can use to check the performance rate of network , also we will mention in this research to the way that normalize image before inter it to the network and then the research will appear the way to display the output to the network by designing program using Matlab for simulation Artificial Neural Network. These results show that the improved learning algorithm is effective for letting neural networks learn all trained patterns, which cannot be learned by conventional methods.

الخلاصة:

يقوم هذا البحث بدراسة شبكة عصبية متعددة الارتباطات صممت لتقوم بتمييز الصور الداخلة إليها وهي الأرقام من (0…..9) وباستخدام شبكة النيوكونترون بطبقاتها الأربعة (U1, U2, U3, U4) إضافة إلى طبقة الإدخال (U0) بعد تدريب الشبكة وتكوين قاعدة البيانات الخاصة بها والتي تستخدم في فحص نسبة انجاز الشبكة بالاضافة الى طريقة تمثيل الصورة قبل إدخالها على الشبكة (Normalization of Image) ومن ثم يعرض هذا البحث الكيفية التي تم بها عرض مخرجات الشبكة وذلك من خلال تصميم برنامج (Matlab) في محكاة الشبكة العصبية الاصطناعية. اظهرت النتائج اهمية لخوارزمية التعلم في فعالية الشبكة العصبية لتدريب جميع الانماط والتي لايمكن تعلمها في الطرق التقليدية .

1- Introduction

Studies on models of neural networks are in progress. Neural networks are recently being applied on various kinds of pattern recognition processing, such as character recognition[l], speech recognition, and object recognition [2]. The neural networks used in the pediments are a globally-connected neural network, a locally-connected neural network, and a neural network into which a feature vector is input. In these experiments, improved learning algorithm performance is estimated, too. We can divide training ways to artificial neural networks to supervised and unsupervised training and we can follow the style to train (neucontron) networks calls(Wasserman) so that it had followed the supervised training to recognize an image which represents the numbers(0… 9) that achieved in this research to (neucontron network) (Wasserman) . The style that followed in recognize image is to choose some image specifications which are very important from all specifications that. This choosing way will refer to the success or failure to recognition way , so that , choosing network way training will reflex the competition of work because not good training will Figure bad coding and the result will recognize general specifications similar to two images and related to two different classification. But the good training will generate general specifications to image related to fixed classification not similar to generate general specifications to another classify, so that, the recognition will be succeed [3].

2- Training to (neucontron) network

We can train neucontron network by using supervised training , the training will follow the form (Layer After Layer) where the next weighs to the layer S can be modified , while the weighs that come from the layer S to the layer C will have fixed values , really the layer C don't learn , just only the layer S and observe that the space to field seeing which represents input space has weighs these weighs will be the same to all once matrix sample units from S , so that , to disclose form in any location will be in the corner or the middle . In general weighs will be trained in S either came from input layer or from the last C layer and then fixed these weighs and training weighs in the next layer [4] .

3- Design neucontron network

During design term will inter the image that need to recognize to input layer (U0) and before normalize image. The image file that has interred to the network be from type (BITMAP) because this type of file is used extensively and represents standard Figure to windows, always image has represented in computer as two dimensional array from the digital values which each of them represents pixel for image. To arrive image point and then display it depends on used technique to represent image point which depends on the used binary cells number , there are two ways to represent , the first by using 24 binary cells (24 bits) each (8 bits) from it represent pixel to one of three main color(RGB)and by mixing the three pixel will form the need color and observe that we can use this type of representation by (256) different color levels to each colors[5]. The second type will be represented (256) a color from the gray scale which represent by (8) binary cells The third type is the representation of one image (pixel) by one cell takes either the value 0 or 1, binary representation. This last representation is the used form to represent input image to the network so that the origin image (digital image) will transmit to (binary image) and this transmission will do by using the value of threshold operation [6] ,shown in the Figure (1) .

This operation is complement to normalize image operation and the used commend to this purpose is:

Syntax:

BW= im2bw (image name, level)…….. (1)

This commend will turn input image (image name) to (binary image) by threshold direction which fixed in the value (level) from the recommend where the once image point value (pixel) takes the value (0) to represent the color black to the value that less threshold and (pixel) takes the value(1) to represent the color white to the value that large(0) threshold. The binary image will save always in two dimension matrix [7]. The artificial neural network training is the adaptive operation so that we can't estimate network activity till training completed so that it will use trying style and false to get good result in training and the network will train on many images till we get best results and then keep this results (weighs) to become the idealistic weighs to trained image, show in the Figure (2)

4- Cells Numbers and Neucontron Network Connections

The cells number will account by account cells number to each layer and the layer contains simple sub layer , complex sub layer , so that , will account cells number to each sub layer by multiply plan cells number to sub layer levels [8] :

Cells number to simple sub layer (SS) =NSC ×NPS ……... (2)
Cells number to complex sub layer (CC) =NCC×NPC . ……..…… (3)
Cells number to one layer (NL) =SS+CC ……..…… (4)
NL (U1) = (19 × 19 × 12) + (11 ×11 ×8)

= 4332 + 968 = 5300
NL (U2) = (11 × 11 × 38) + (7 × 7 × 22)
= 4598 + 1078 = 5676
NL (U3) = (7 × 7 × 32) + (7 × 7 × 30)
= 1568 + 1470 = 3038
NL (U4) = (3 × 3 × 16) + (1 × 10)
= 144 + 10 = 154 cell

Total network cells number = NI + NL (u1) + NL (u2) + NL (u3) + NL (u4)…… …..… (5)
= 361+ (5300 + 5676 + 3038 + 154
= (14529) cell

NSC: plan cells number in simple sub layer
NPS :Levels number in simple sub layer
SS : cells number to simple sub layer
NCC: Plan cells number in complex sub layer
NPC: Levels number in complex sub layer
CC: cells number in complex sub layer
NL: Cells number in one layer
NI : Cells number to input layer .

Network connections number will account by sum the connections to each layer where the connections to each layer have Figure by accounting connections number to simple sub layer after multiply its levels to weighs direction. The complex sub layer will account after multiply its levels to weighs direction to it:

Connections number U1) = 9 ×12) + (25 × (8
= 108 + 200 = 308
Connections number U2 = 9 × 38) + (25 × (22
= 342 + 550 = 892
Connections number U3) = 9 × 32) + (9× (30
= 288 + 270 = 558
Connections number U4) = 25 × 16) + (9 ×(10
= 400 + 90 = 490
Total connections number = 308 + 892 + 558 + 490 = 2248

5-Documents base

The operation of recognize image may bear man difficulties where the image that represent number has some defect if this image has rotation or different number location n image so that will lead to wrong recognition by giving wrong coding about image [9].To leave these problems it is important to normalize image to fix number size and its location to image. But using neucotron network made work so easy because the ability of this network in recognizing without affected by image situation. Using (ANN) to recognition needs to Figure large documentations base takes to account the Figure for each number and the way can show this number that's means take to account many images to one number which represent small different size and large to it by that the documents base will be very large and it needs large save space and active , good administration . But using neucotron network made many things easy so that documents base to be less compared to another recognition network [10]. Samples to documents base had collected which represent images that the network training on it by Figure in image bear numbers Figures from (0….9) and then make samples to these hand writing numbers by light survey to input number to the network by that this number will be in image file type bit map file (BMP) . This image will read inside designed recognition system and by it will fix image size n (19 * 19) image point to be fit with designed network size in this system.

6- Image Recognition

The images represent numbers (0…..9) be inputs to network and limit training trying numbers which is the value (Interaction). when the used training way in this research is the supervised training so that will limit target output value advanced to match with it and one of the requirements to image recognition is to make image normalization before inter it to the network[11] .

7- Research procedure

1-Image normalization is an important size (19*19) before interring to the network and transmits to origin image to binary image.

2- training operation layers cells layer after layer, first layer (S1) be in size (3*3) then training samples will be as in Figure (3) .As we see that the training samples numbers to first layer are (12) with the same matrixes number which represented in the first layer that has the simple cells (S1), where each matrix training on sample different from another matrix. As we see training to matrix (1) S1 respond to part of liner while the matrixes (2) S1, (3) S1 respond to part liner with angle (22) with the horizontal axes , so that , each matrix respond to different Figure of parts between vertical and horizontal diameter . About the training samples to simple second layer (S2) will be (38) samples according to its matrixes and each matrix will represent once sample which represent the possibility that this sample comes from the number interred to the network with observing that sample here (once matrix from the layer S2) will be in size (11*11) for seeing field to the first layer (S1) was (3*3) and the layer (C1) was (5*5) , the sum to them be (8) . When starts training seeing field to its simple layer will be (3*3) by that the summation with (8) has the value (11*11) training sample size to this layer , on other word when we are going close to output layer the space that seeing field inter in it to recognition will be large layer after layer till covered all image by that the image will be ready to disclose and the result appear in the fourth layer (U4) and in the Figure (4) some of these samples that may appear in it input number to the network in this layer[12] .out the training samples to third simple layer (S3) will be (32) samples according to its matrixes and to the same description of second layer one sample size to thus layer be (11+5+3=19) , the number (11) from layer second , the number (5) seeing field size from second complex layer (C2) , the number (3) seeing field size to third simple layer (S3) . In Figure (5) some of these samples from this layer .The reality that in the third layer there some numbers appearance in full structure or small part from it not completes but in fourth layers the training sample represents all number.

7-2 Network Output

During observing network design we can see that output be from the complex fourth layer (C4) which contains (10) cells each one represents one of the numbers from (0….9) . If the output represents (0) value then output to the network in output layer will represent that value (1000000000) see the Figure (7). Output represents the value "8" for example then network output in output layer will represent output in value (000000010), shown in the Figure (8).

7-3 Test Network recognition

The operation to get image recognition results will do after complete network raining where ding test to this image by interring to the network. Because the network trained on this image the idealistic weighs be saved in side documents base so that and easy way we can get result after interring this image and its idealistic weighs to the network with its four layers (U1,U2,U3,U4) to get recognition code from complex part of fourth layer which represents output layer

8- Discussion

8-1 Recognition Rate to Neucotron Network

The network recognition rate account during images numbers not classify in right way to the total images number and according the following equation:

Recognition Rate = (1- Images number not classy/Total images number) * 100 %.....(6)

If the recognition rate during training 97% and don't show object image when the image be outside input field may in one corner of image or under it. When continue in training mistake rate will be reduced gradually between typical output and your aim , by that the network be able to get recognition let it to separate between different classification , see the Figure (9).

8-2 Learning Rate Effect on Network Steps to Recognize Numbers

The steps that network need will increase when learning rate little and steps be little when learning rate large, for example if it is (0.9) then network speed work increase and arrive to solution in less steps while it needs to more steps in the vale (0.1) Table (1) describe the relationship between learning rate value with neucontron network steps in recognize numbers and figure (10) shown the relation between learning rate values and Frequent lies number.

Table (1) Learning Rate Effect on Network Steps

learning rate value	recognize numbers
0.1	3311
0.2	3280
0.3	3207
0.4	3081
0.5	2771
0.6	2562
0.7	2351
0.8	2100
0.9	1820

8-3 Network Ability on Recognition and Training Time

Choosing frequent lies (iteration) which represent training time to train network should be fit to practice all samples that we want train them , increase in frequently don be useful just consumption time at the same time choose little frequently may be lead to little training and then network not able to recognition . The table (2) will show that.

Table (2) relationship between recognition rates with frequent lies

Frequent lies number	2000	2500	3000
Recognition rate	%85	%87.5	%90

9- Conclusions

From discussing the results we conclude the following :

1- Multiply connected neural network (neucontron) designed to recognition an image which represents the numbers (0…… 9).
2- Recognition rates achieved by using them are 85%, 87.5%, and 90%, respectively. These results show that the improved learning algorithm is effective for letting neural networks learn all trained patterns, which cannot be learned by plain back propagation.
3- The results indicate that for complex problems, the neural network performs comparably to the nearest neighbor classifier while being significantly more cost effective. After training the neural network the weights were fixed and the network was tested.
4- The neural network is more efficient than some conventional classifiers for complex and difficult Problem.
5- The feature input neural network correctly recognized about 97% of handwritten numerals.

10-Refrenses

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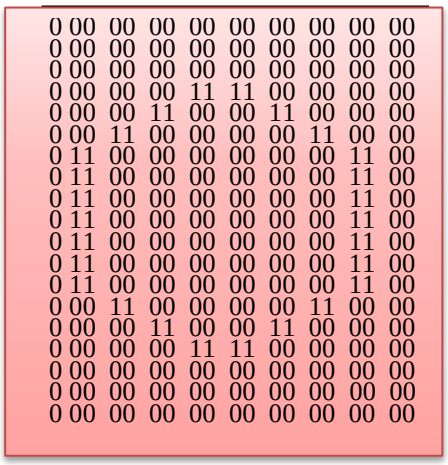

Figure (1) binary image represent number “0” , size 19*19

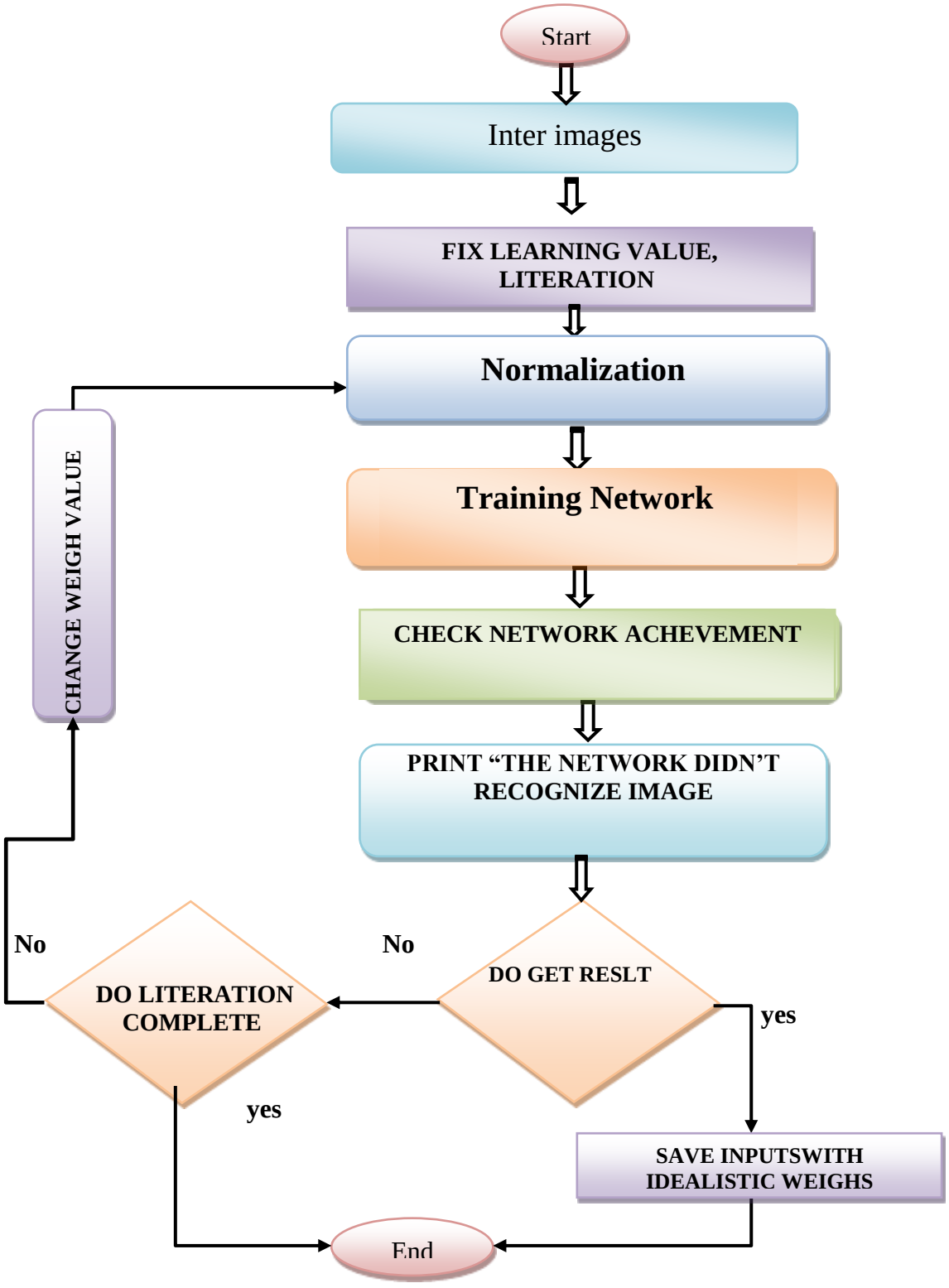

Figure (2) planning to neucontron training network

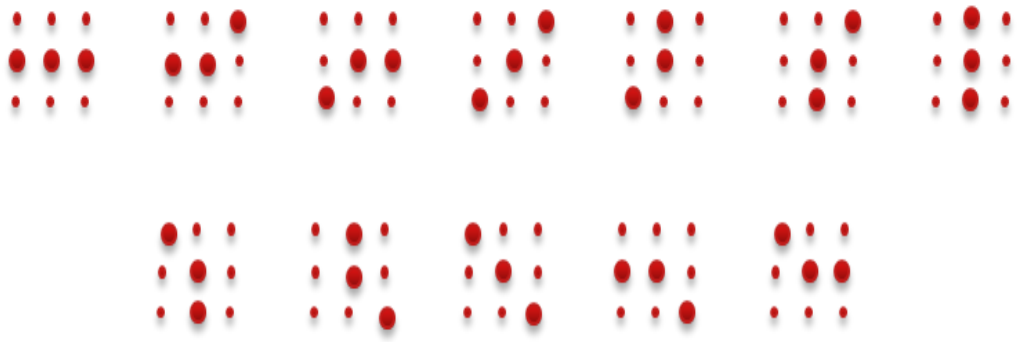

Figure (3) some training samples to first layer

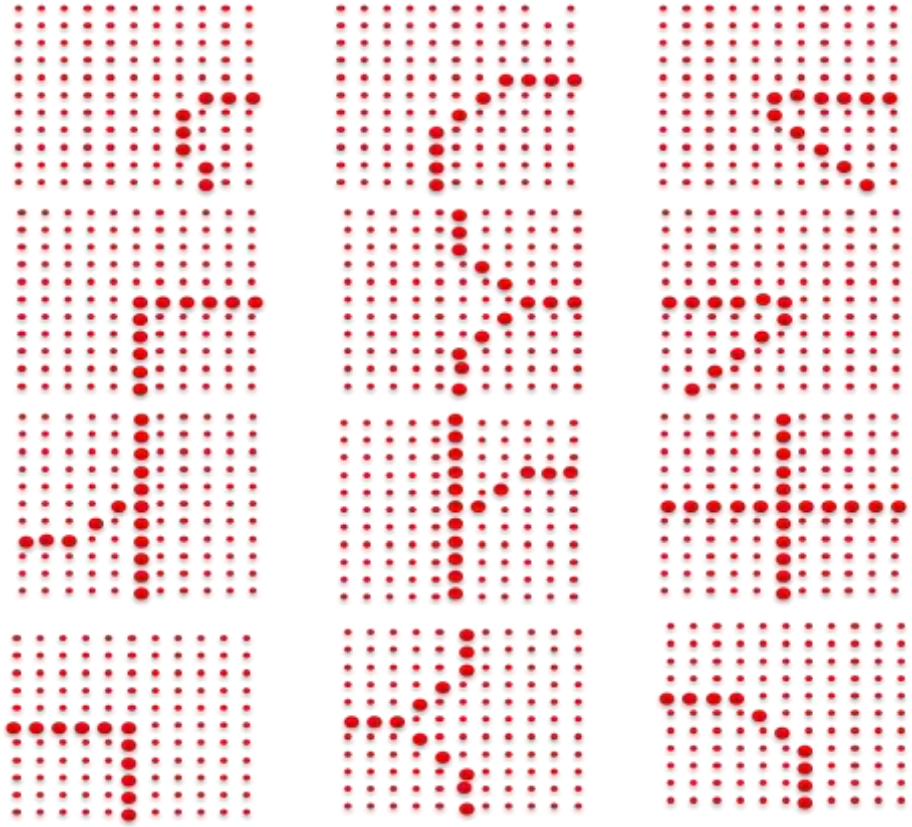

Figure (4) some training samples to second layer

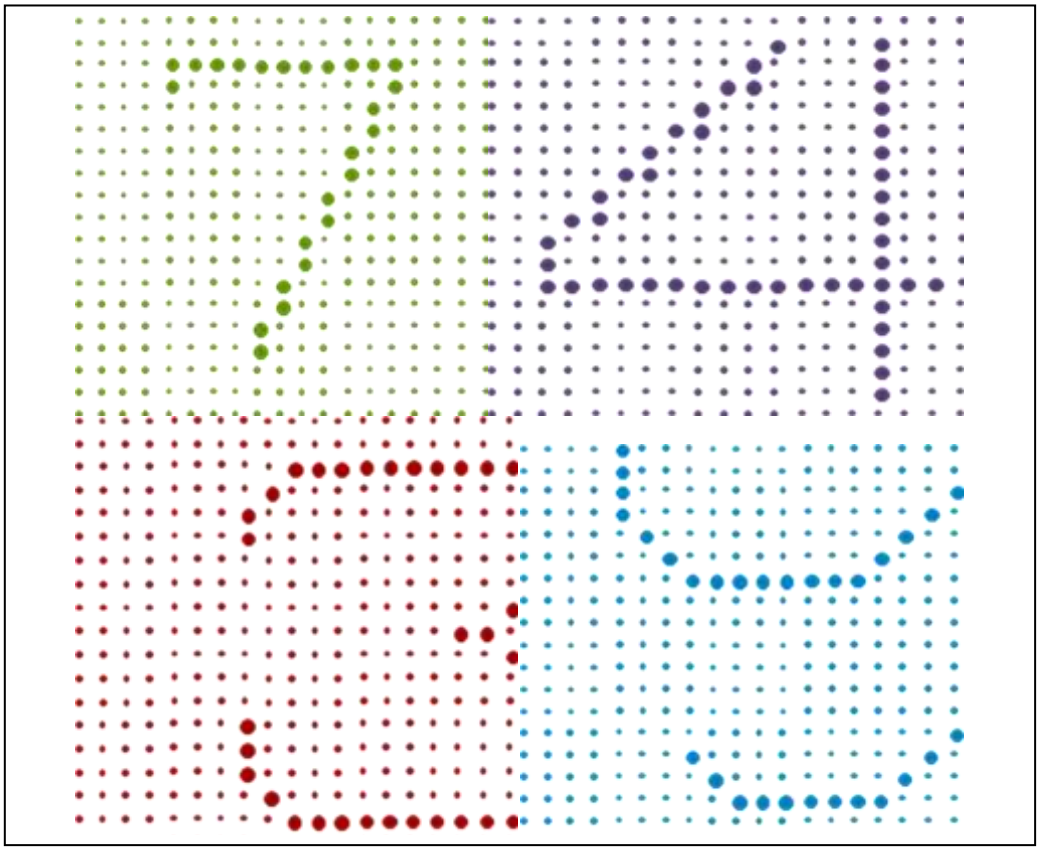

Figure (5) Some training samples to third layer

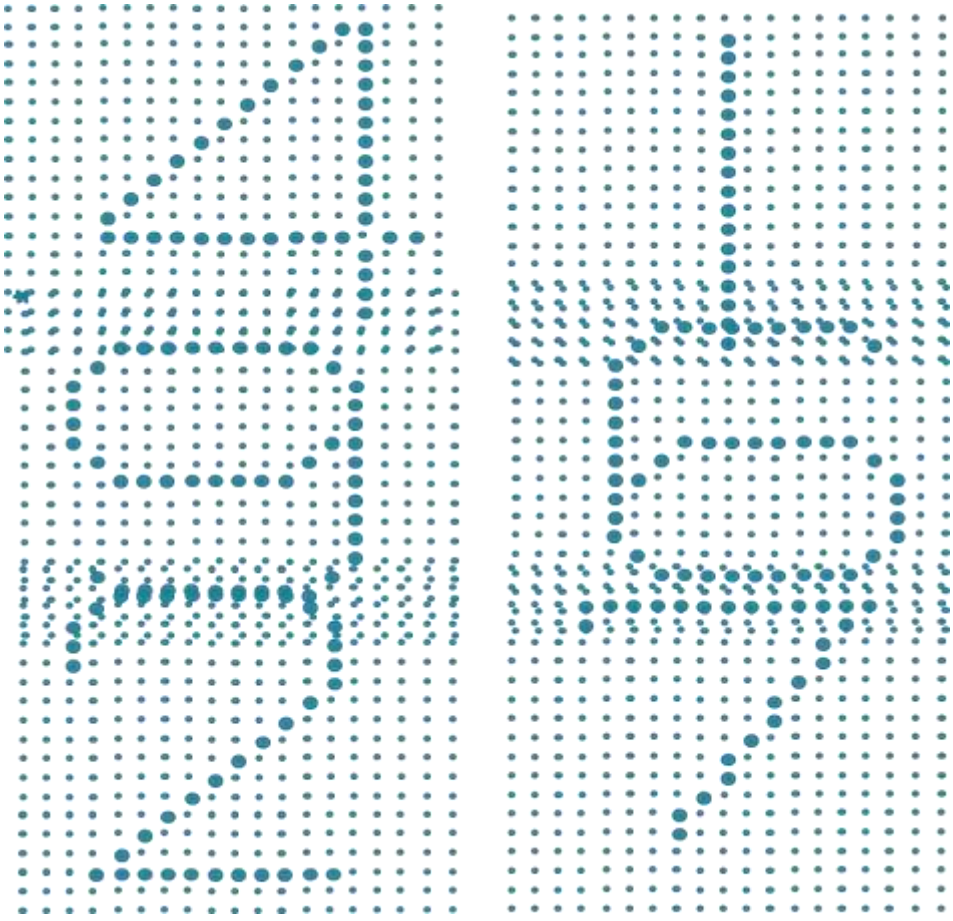

Figure (6) some training samples to forth layer

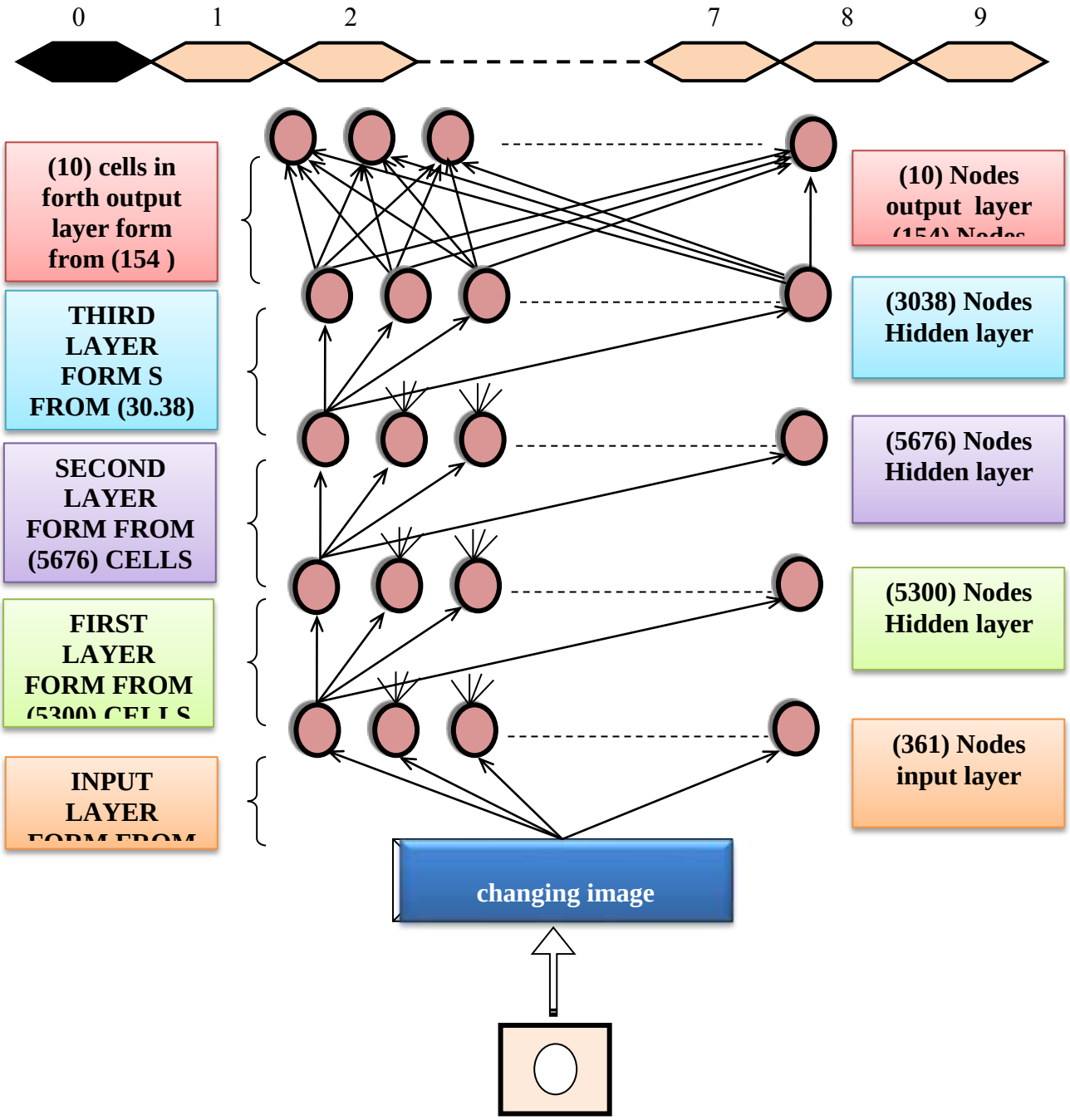

Figure (7) Network Architecture to recognize the number “0”

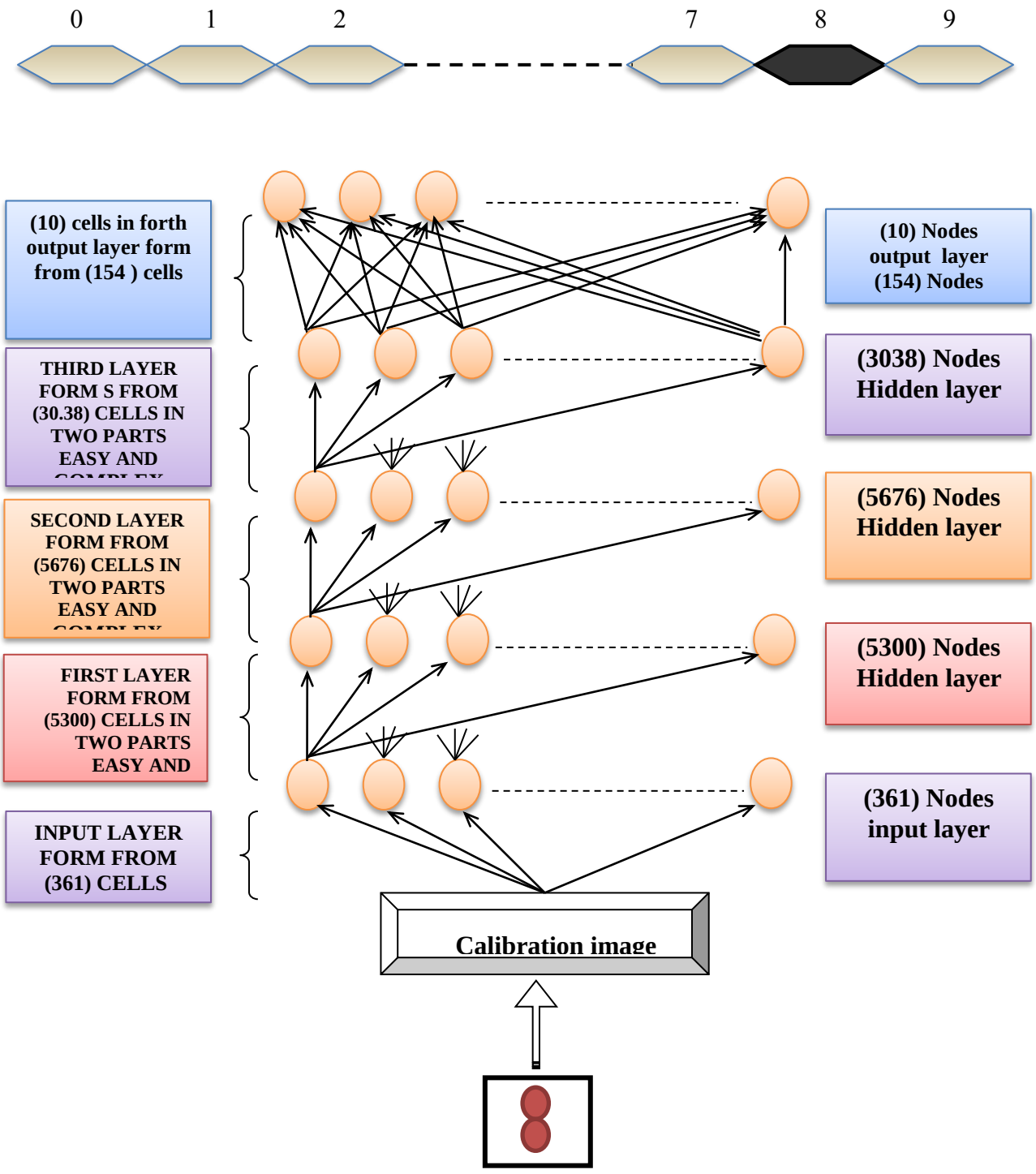

Figure (8) Network Architecture to recognize the number “8”

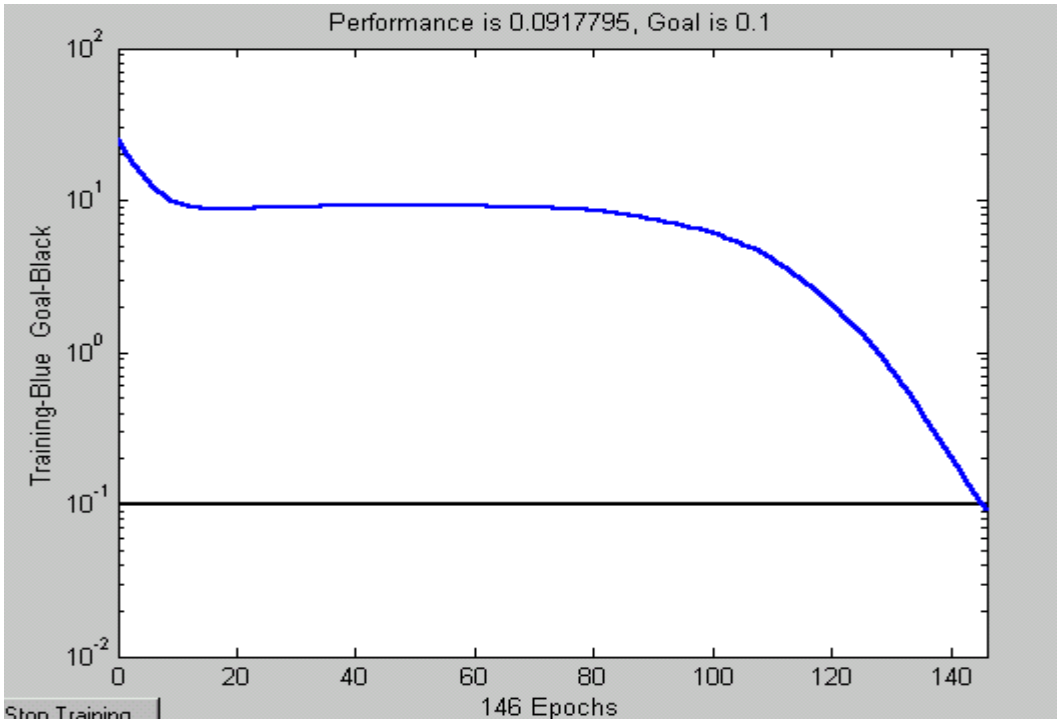

Figure (9) reduce mistake gradually during training

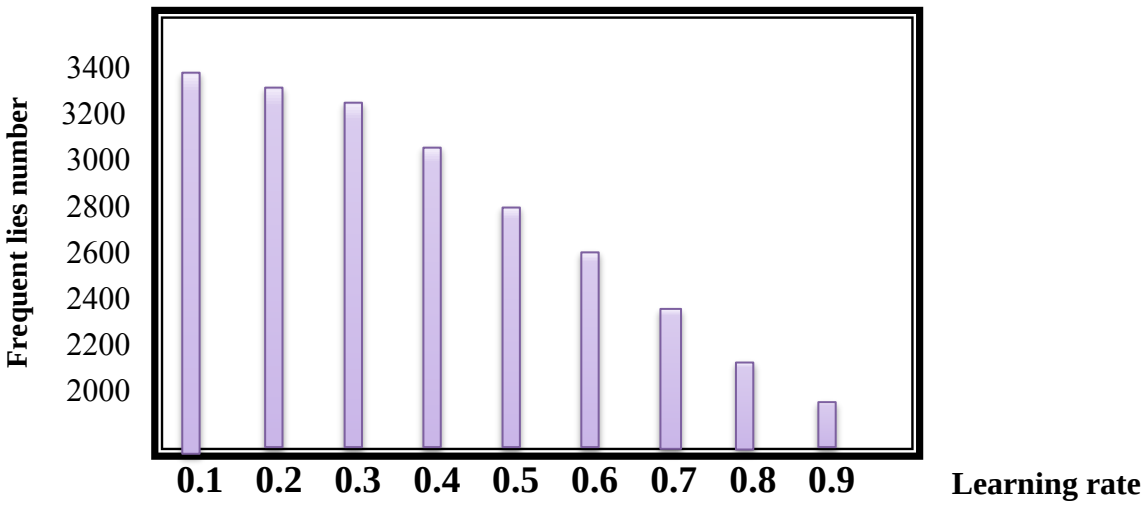

Figure (10) the learning rate values and Frequent lies number