Fundamental Of Image Processing
SCSV 3213
Handwritten Arabic Number Recognition Using Neural Network

Group Members :

1) Lim Bao Jing (A17CS0076)
2) Tan See Jou (A17CS0218)
3) Low Chia Jing (A17CS0083)

The Data

10 classes of pattern indicating ‘0’ to ‘9’.

The data:

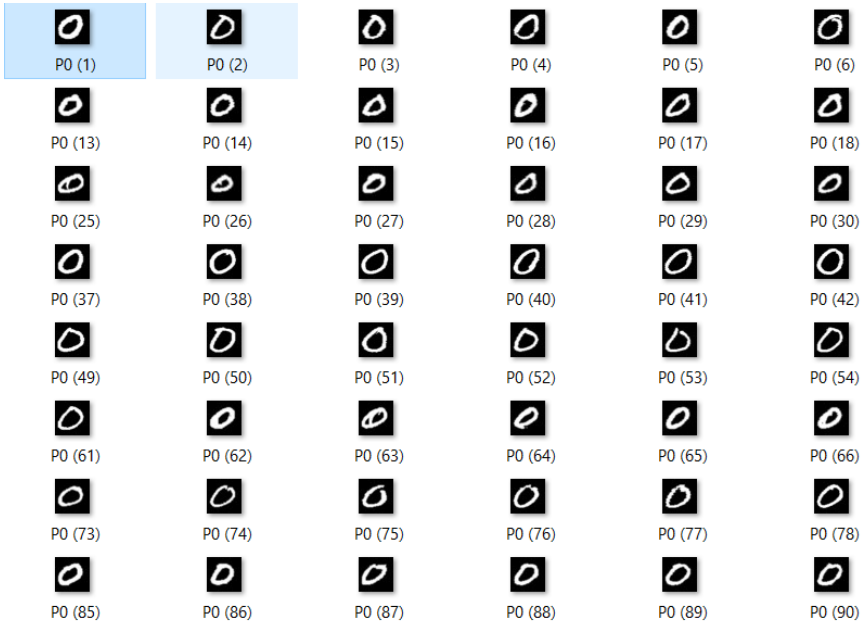
Training patterns 10000 patterns

- Each class has 1000 patterns

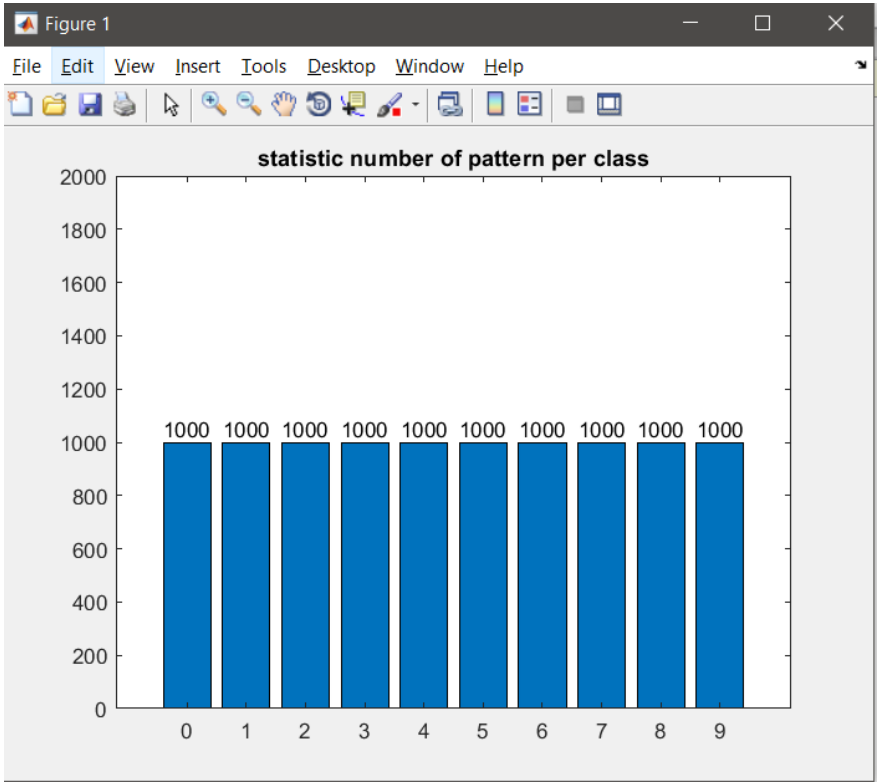
Testing patterns 5000 patterns

- Each class has 5000 patterns

We use large number of data to increase the accuracy.



Select the Patterns



Equal size of patterns:

Ease the training

```
29      %find the distribution of file being extracted
30 -    if (x == '0')
31 -        cnt(1)=cnt(1)+1;
32 -    elseif (x=='1')
33 -        cnt(2)=cnt(2)+1;
34 -    elseif (x=='2')
35 -        cnt(3)=cnt(3)+1;
36 -    elseif (x=='3')
37 -        cnt(4)=cnt(4)+1;
38 -    elseif (x=='4')
39 -        cnt(5)=cnt(5)+1;
40 -    elseif (x=='5')
41 -        cnt(6)=cnt(6)+1;
42 -    elseif (x=='6')
43 -        cnt(7)=cnt(7)+1;
44 -    elseif (x=='7')
45 -        cnt(8)=cnt(8)+1;
46 -    elseif (x=='8')
47 -        cnt(9)=cnt(9)+1;
48 -    elseif (x=='9')
49 -        cnt(10)=cnt(10)+1;
50 -    end
51 -  end
52 -  cnt
53 -  bar([0 1 2 3 4 5 6 7 8 9],cnt);
54 -  ylim([0 2000]);
55 -  title('statistic number of pattern per class');
```

Pre-Processing

Step 1: Read the file

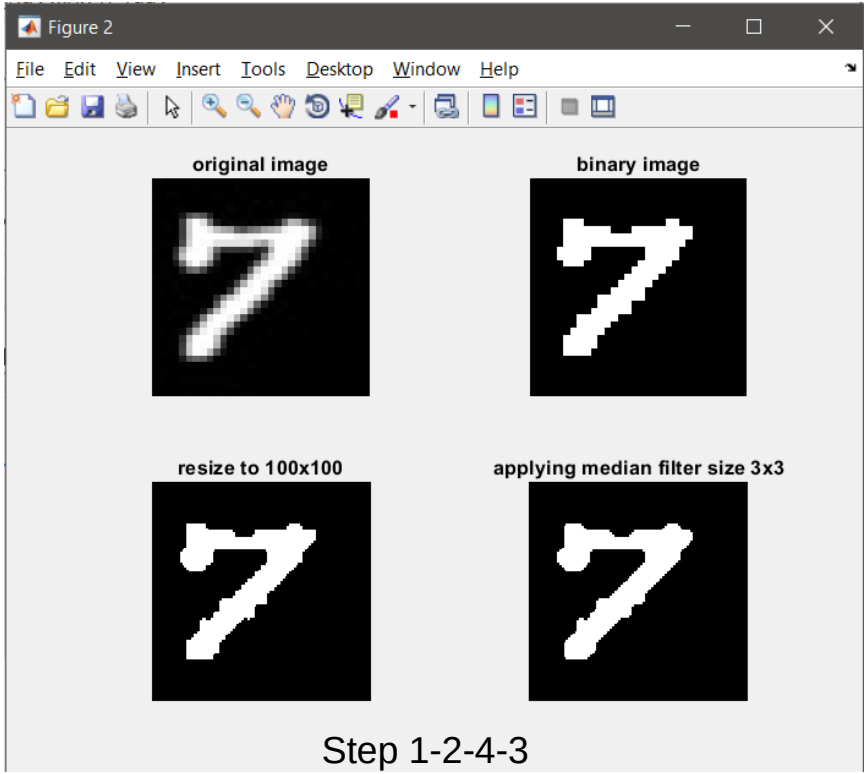
Step 2: Do thresholding and convert to binary

Step 3: Apply median filter size 3x3

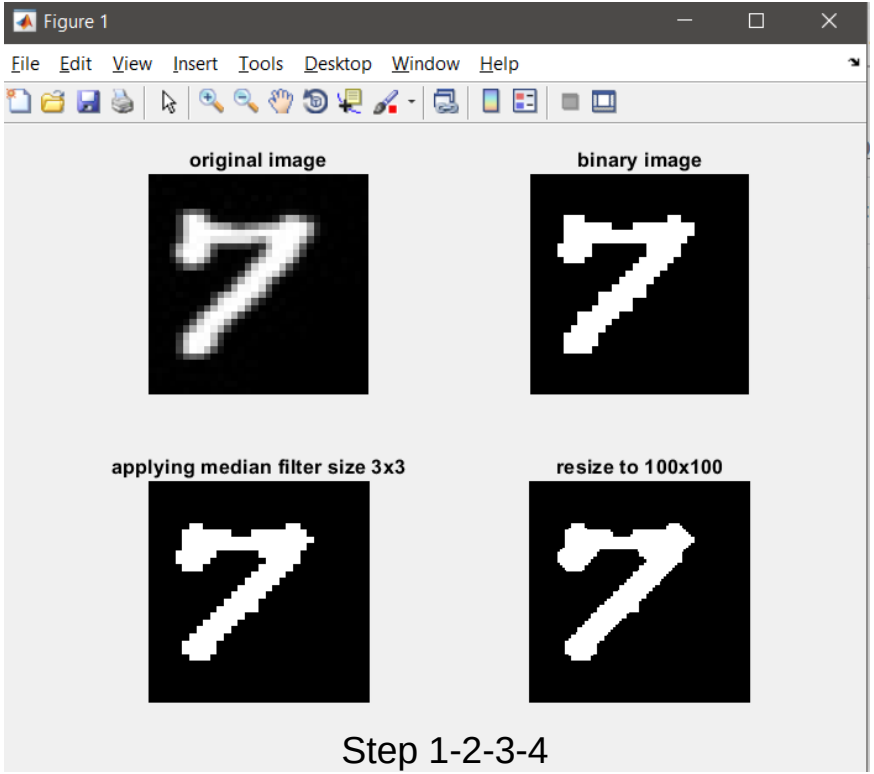
Step 4: Resize to 100x100

Pre-Processing

WHY Step 1-2-3-4



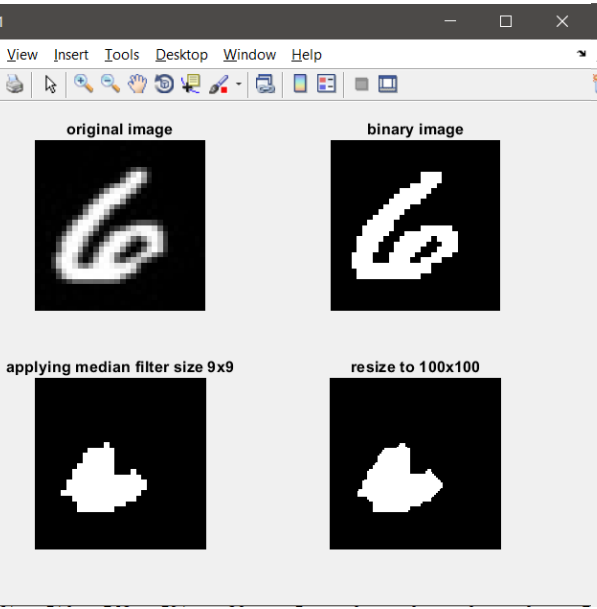
Step 1-2-4-3

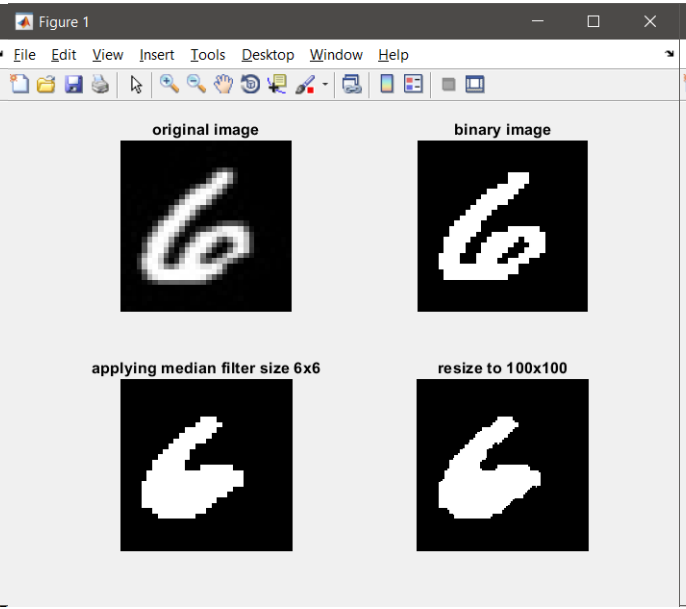


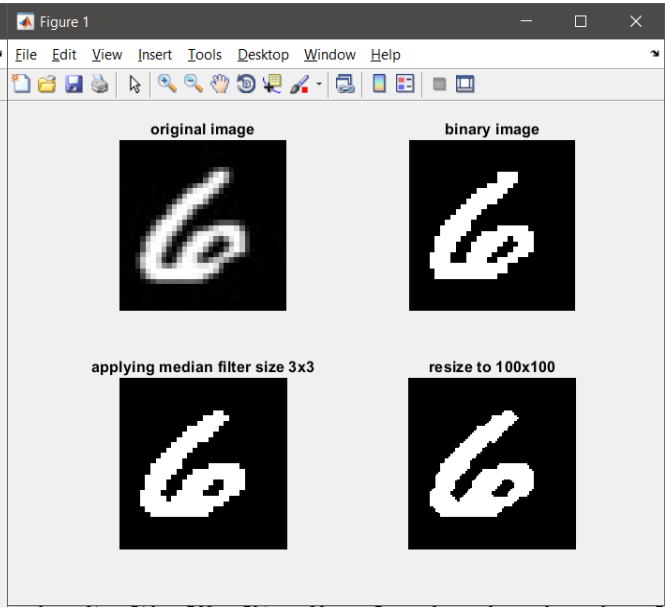
Step 1-2-3-4

Pre-Processing

WHY Median Filter size 3x3

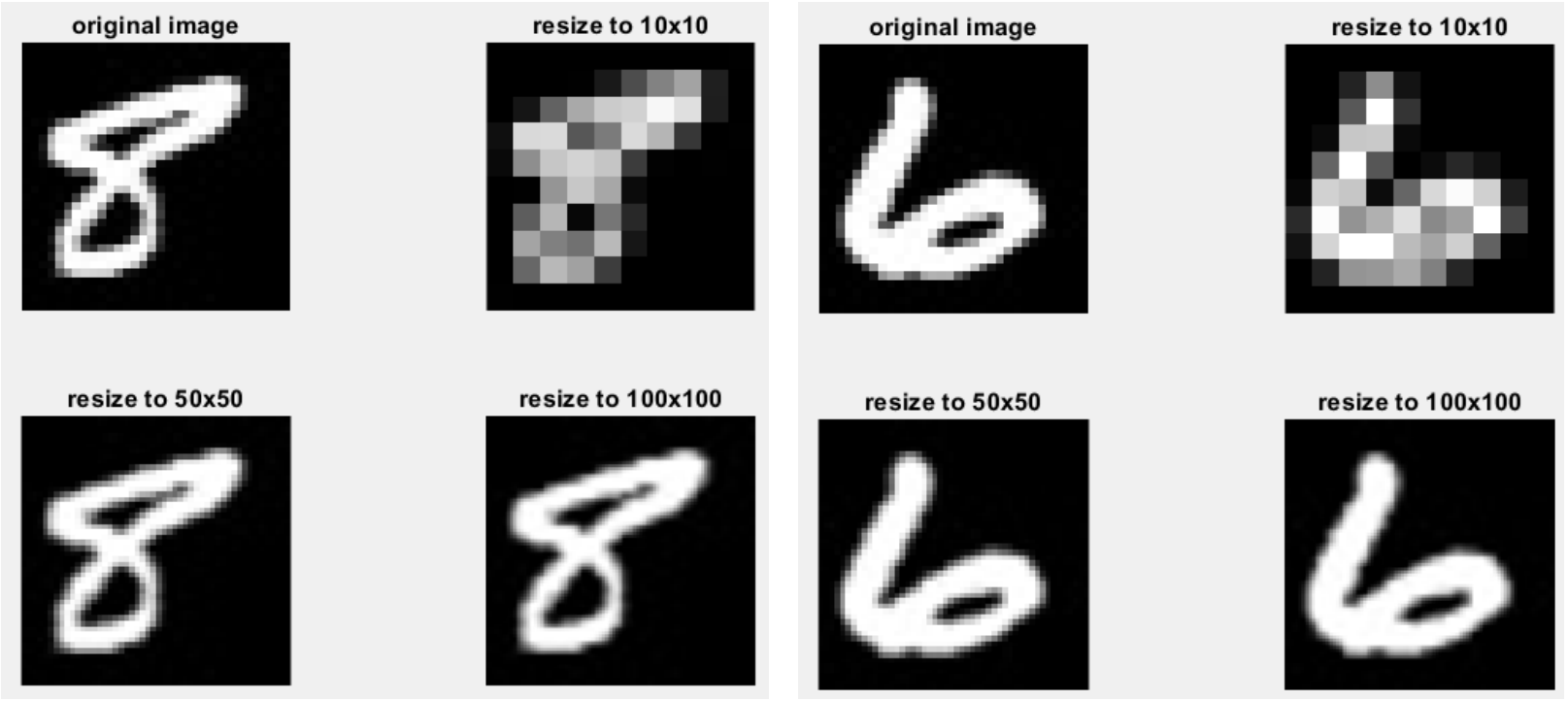






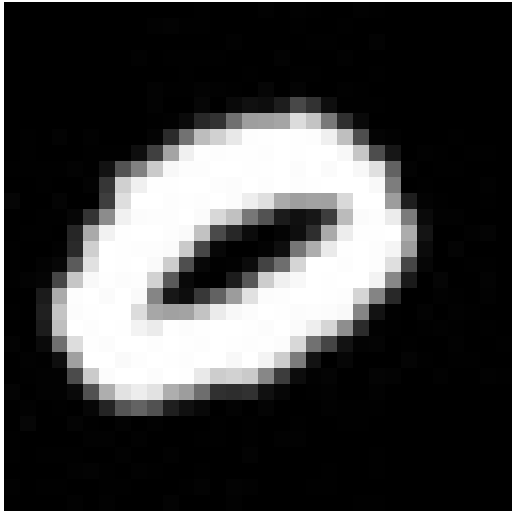
Features Extraction

Why resize [100 x 100] -> Faster and clearer



Grid Feature Function

```
6   function out = gridfeatures(k)
7   [x,y]= size(k);
8   N=10;
9
10  z = zeros(N);
11  ind=1;
12  for i=1:N-1
13      for j=1:N
14           r =sum(sum(k(((j*N)-N)+1:(j*N),((i*N)-N)+1:(i*N))));
15          if((r/100)> 0.4)
16              z(j,i)=1;
17          else
18              z(j,i)=0;
19          end
20      end
21  end
22  out = reshape(z,[],N*N);
23  end
```



Very thick outline -
Easy to detect

Recognition

Number of Train Data: 10000
Number of Test Data: 5000
Features Used: Binary Grid Scale (100 features)
Topology: 100: 200: 10

Demo

Experimental Setup

Find the Best Learning Rate

Learning Rate β	Momentum Rate	Error Convergence (take the lower)	Epoch	Recognition Rate (take the higher)
0.3	0.9	0.0561	1600	69.5200
0.5		0.0564	1600	70.86
0.9		0.0562	1600	70.32

Find the Best Momentum Rate

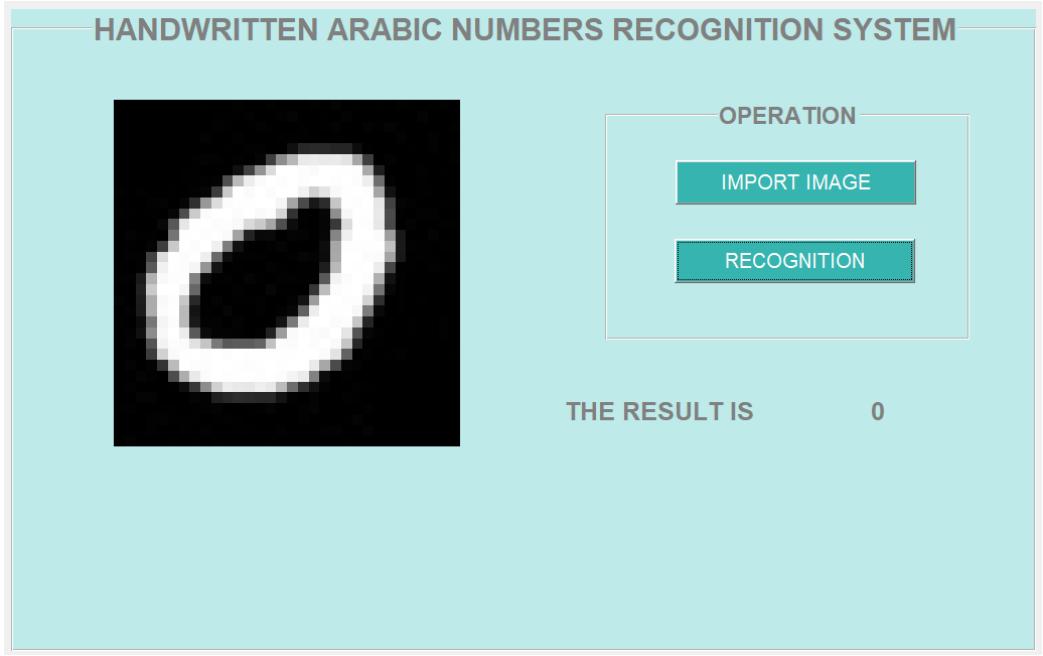
Learning Rate β	Momentum Rate	Error Convergence	Epoch	Recognition Rate
0.5 (Previous best)	0.3	0.0564	1600	70.8600
	0.5	0.0564	1600	70.8600
	0.9	0.0564	1600	70.8600

Find the best hidden nodes

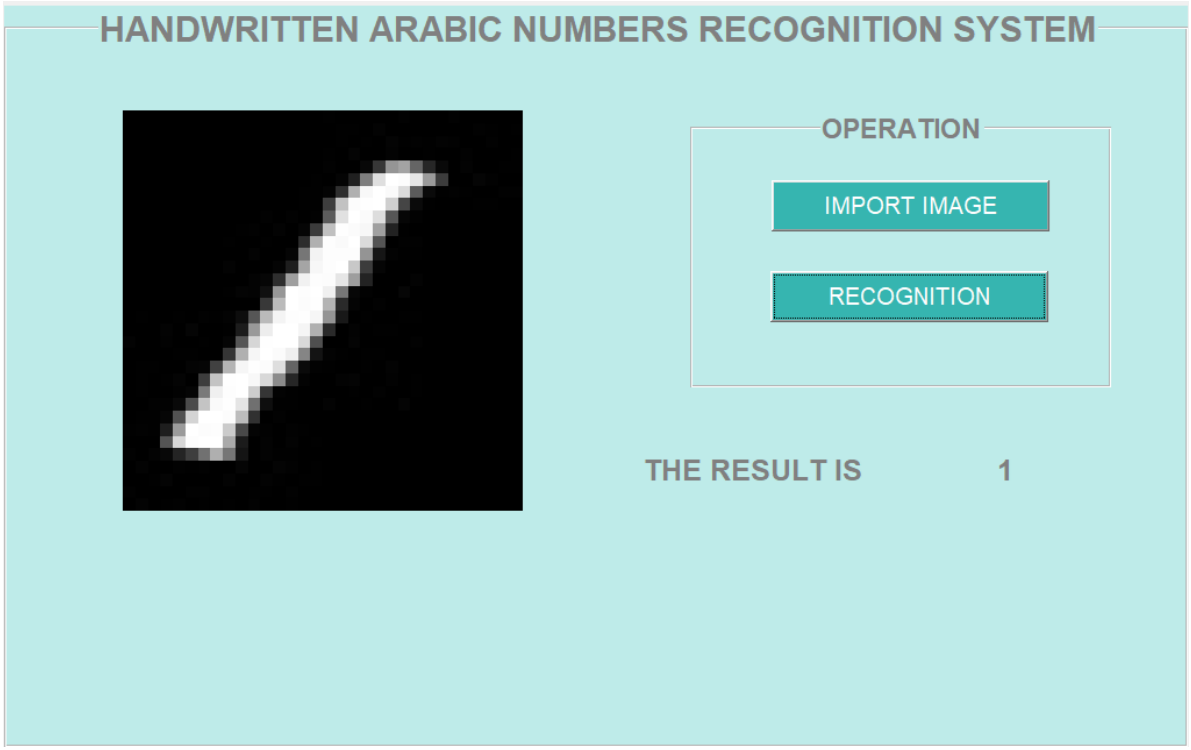
Number of Hidden Node	Learning Rate β	Momentum Rate	Error Convergence	Epoch	Recognition Rate
h=n	Choose the best from above ---0.5	Choose the best from above ---0.5	0.0715	1600	67.52
h=2n			0.221	1600	49.7200
h=$\sqrt{n \times m}$			0.0564	1600	70.8600

Results Example

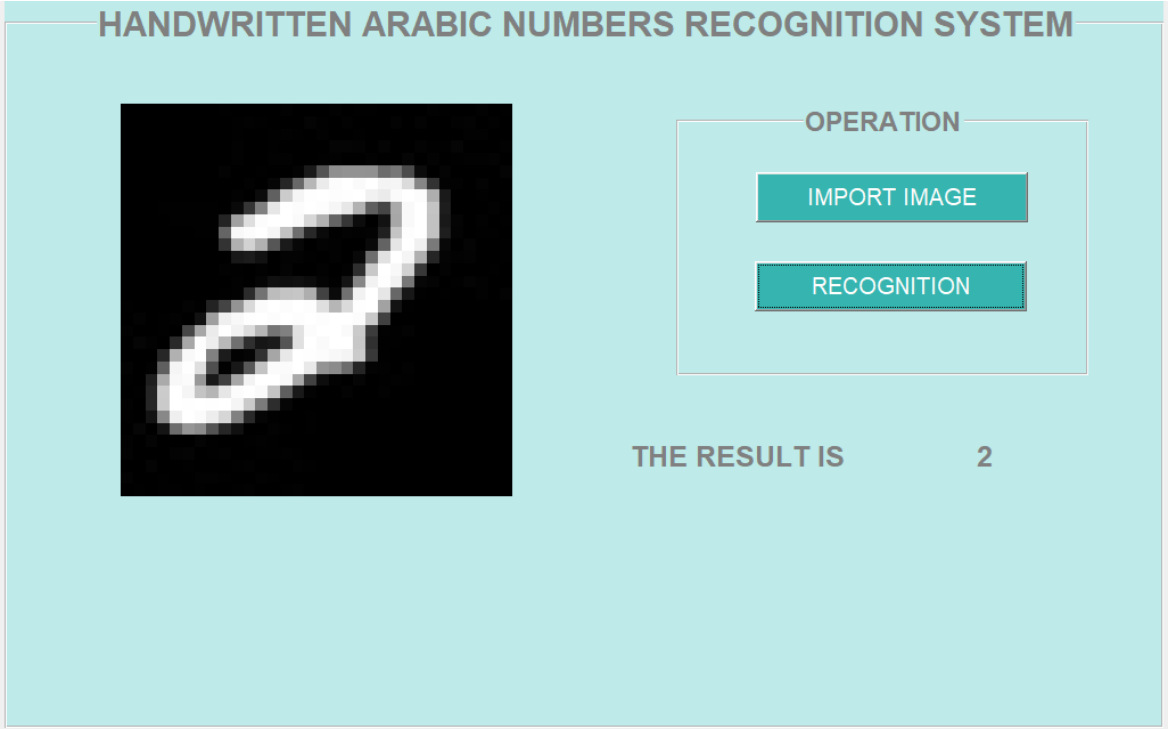
Number 0



Number 1


HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM
OPERATION
IMPORT IMAGE
RECOGNITION
THE RESULT IS
1

Number 2


HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM
OPERATION
IMPORT IMAGE
RECOGNITION
THE RESULT IS
2

Number 3

HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM

OPERATION

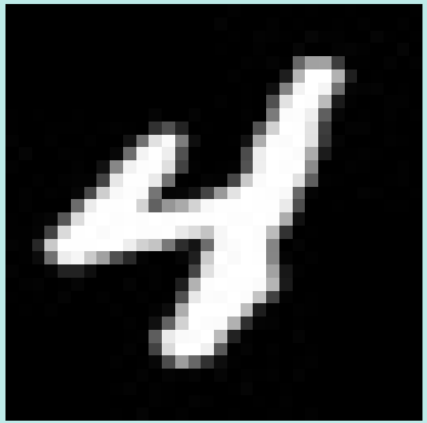
IMPORT IMAGE

RECOGNITION

THE RESULT IS 3

Number 4

HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM



OPERATION

IMPORT IMAGE

RECOGNITION

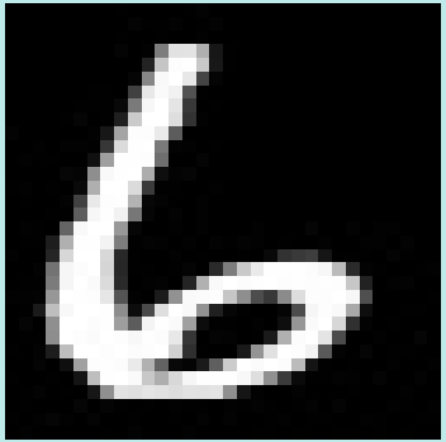
THE RESULT IS 4

Number 5


HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM
OPERATION
IMPORT IMAGE
RECOGNITION
THE RESULT IS
5

Number 6

HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM



OPERATION

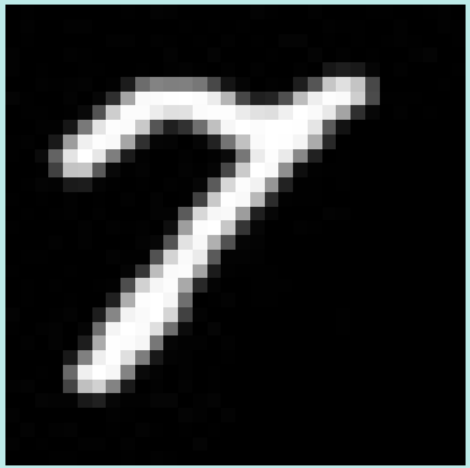
IMPORT IMAGE

RECOGNITION

THE RESULT IS 6

Number 7

HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM



OPERATION

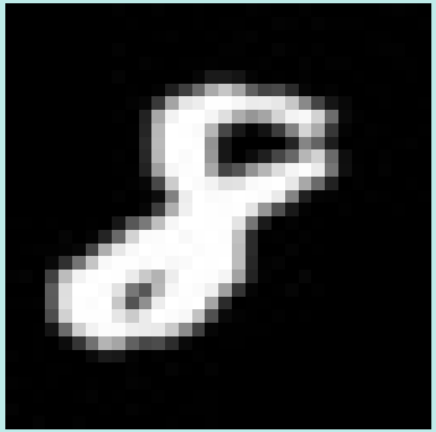
IMPORT IMAGE

RECOGNITION

THE RESULT IS 7

Number 8

HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM



OPERATION

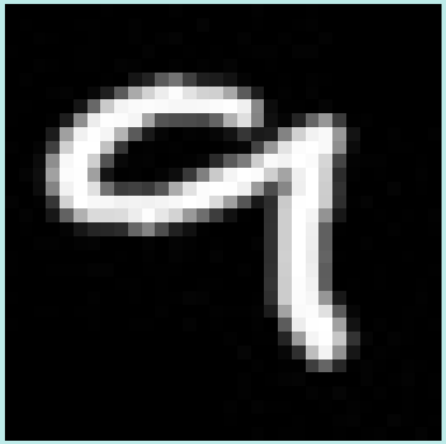
IMPORT IMAGE

RECOGNITION

THE RESULT IS 8

Number 9

HANDWRITTEN ARABIC NUMBERS RECOGNITION SYSTEM



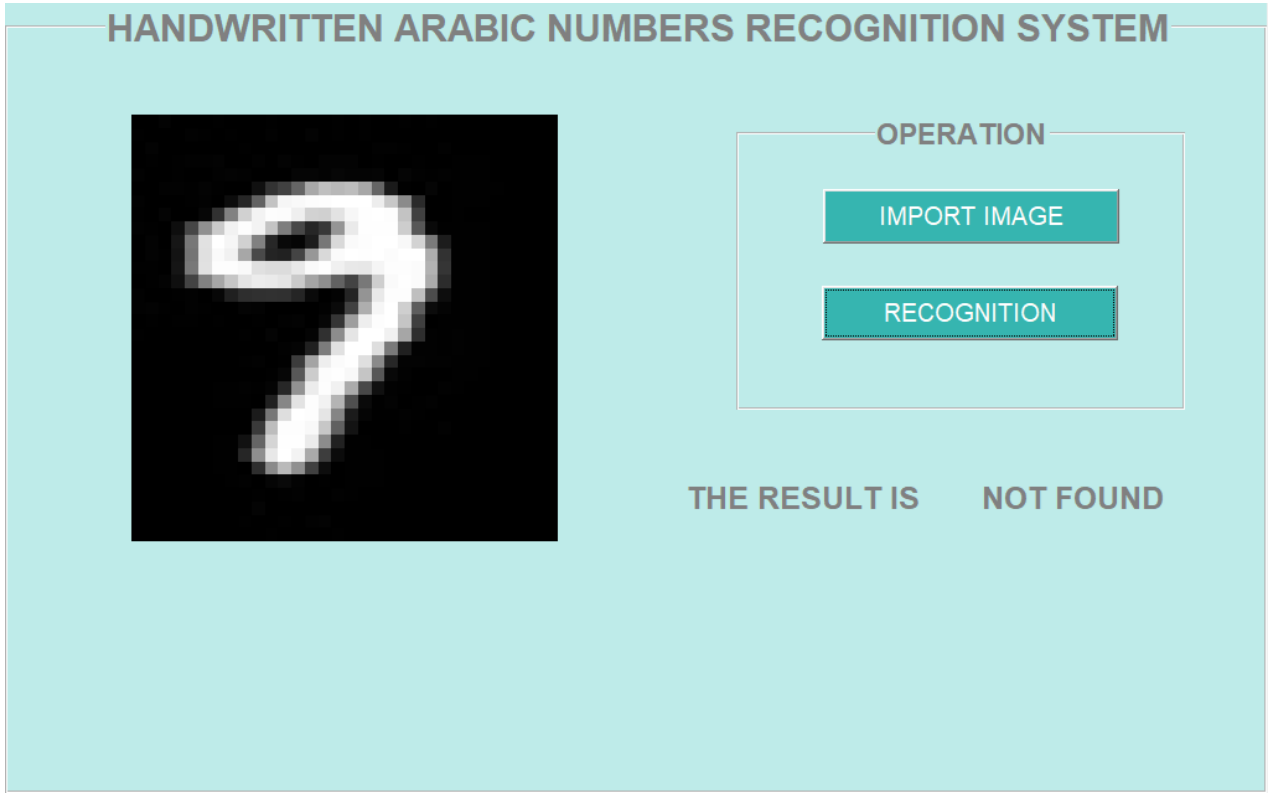
OPERATION

IMPORT IMAGE

RECOGNITION

THE RESULT IS 9

Result Not Found Example



Result Not Found Example

THANK YOU

_____The End_____