Name: Nontawat Janpongsri

Student ID: 301311427

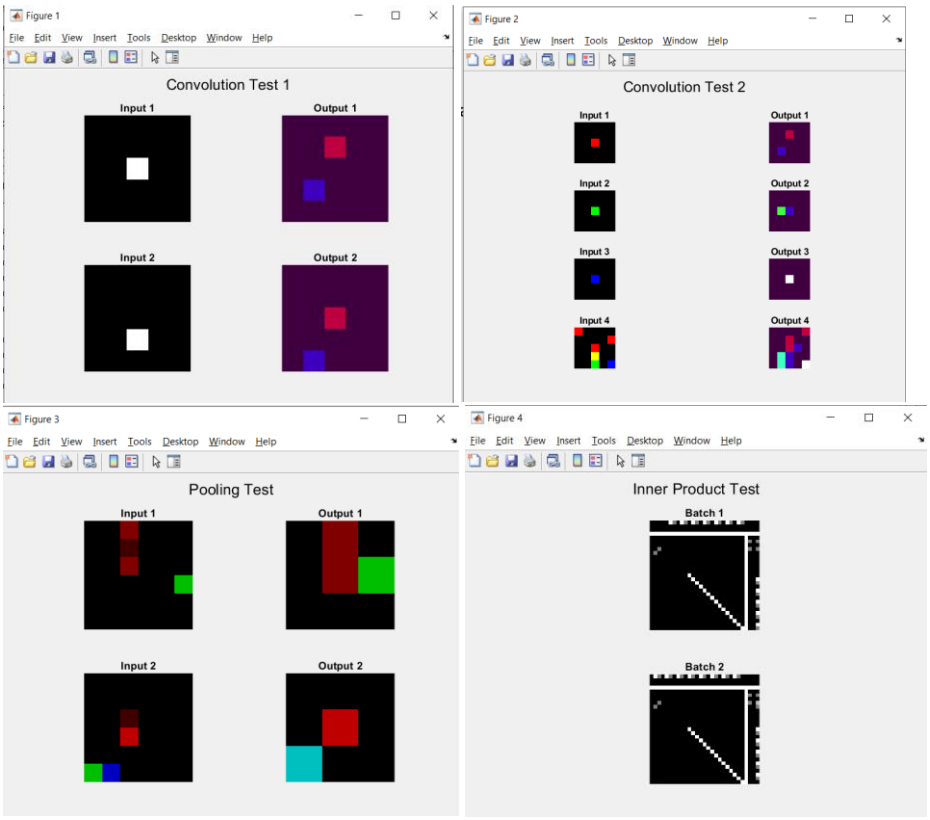
CMPT412 – assignment 1

Got some of the inspiration from Jiangpei chen

I did not include the mnist_all.m file as my package is over 30mb

Ans 1-2:

The results got from implementing the forward and backward are:



Ans 3.1:

```
cost = 0.083081 training_percent = 0.970000
cost = 0.026531 training_percent = 1.000000
cost = 0.044653 training_percent = 0.980000
cost = 0.056298 training_percent = 0.980000
cost = 0.049833 training_percent = 0.990000
test accuracy: 0.970000
```

After the training for 3000 more iterations the test accuracy is 97%.

Ans 3.2:

```
test_network
 56     0     1     0     0     0     0     0     0     1
  0    57     0     0     0     0     0     0     1     1
  1     0    48     0     0     0     0     0     0     0
  0     0     0    51     0     0     0     0     0     1
  0     0     0     1    42     0     0     0     1     0
  1     0     0     1     0    43     0     0     0     0
  1     0     0     0     1     0    56     0     0     0
  3     0     0     1     0     1     0    49     1     2
  0     2     0     0     0     1     0     0    25     0
  1     0     0     0     0     0     0     0     0    49
```

The largest mismatch is in the 8th row and 1st column (8, 1). The second largest mismatch are in the 9th row and 2nd column (9, 2) and the 8th row and 10th column (8, 10).

Ans 3.3:

The 10 original real-world images done by using paint are:

The confusion matrix generate by using the real-world images is:

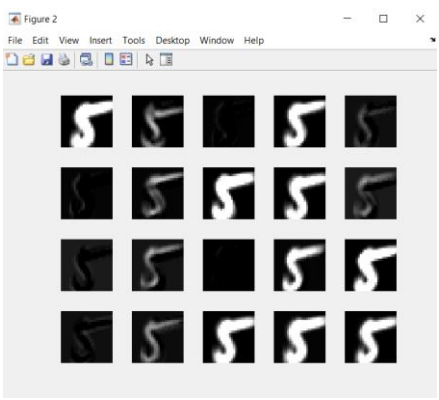
```
test_real_world
  1     0     0     0     0     0     0     0     0     0
  0     1     0     0     0     0     0     0     0     0
  0     0     1     0     0     0     0     0     0     0
  0     0     0     1     0     0     0     0     0     0
  0     0     0     0     1     0     0     0     0     0
  0     0     0     0     1     0     0     0     0     0
  0     0     0     0     0     0     1     0     0     0
  0     0     0     0     0     0     0     1     0     0
  0     0     0     0     0     0     1     0     0     0
  0     0     0     0     0     0     0     0     1     0
```

As you can see the mismatch occur for number 6, 9, 0. The program have predicted the number 6 as 5, number 9 as 7 and number 0 as 9.

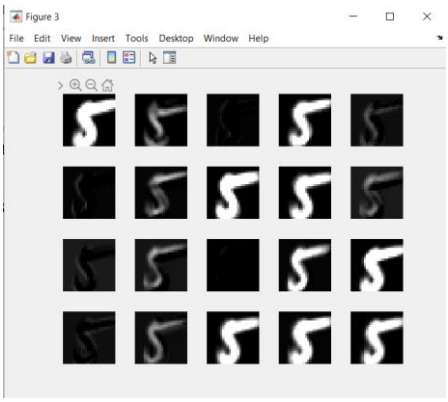
Ans 4.1:

the outputs for layer 2 (CONV layer) and layer 3 (ReLU layer) are the same because in layer 3 (ReLU), the negative values are interpreted as 0 in the imshow function since it cannot visualise negative pixel values.

Outputs for layer 2 (CONV)



outputs for layer 3 (ReLU)



Ans 4.2:

The original image is:

The differences between the original image and feature maps are:

1) some of the feature maps have a darker color on the number (grey, dark grey and black) compare to the original image (white)

2) some of the feature maps have difference background color (grey and dark grey) compare to the original image (black)

3) feature maps have fatter number compare to the original image

Ans 5:

I did not manage to finish this question. However, I did manage to proceed to step 2 (find connected components and place a bounding box around each character). Below are the images showing the results in step 2 for the 4 images:

Image 1:

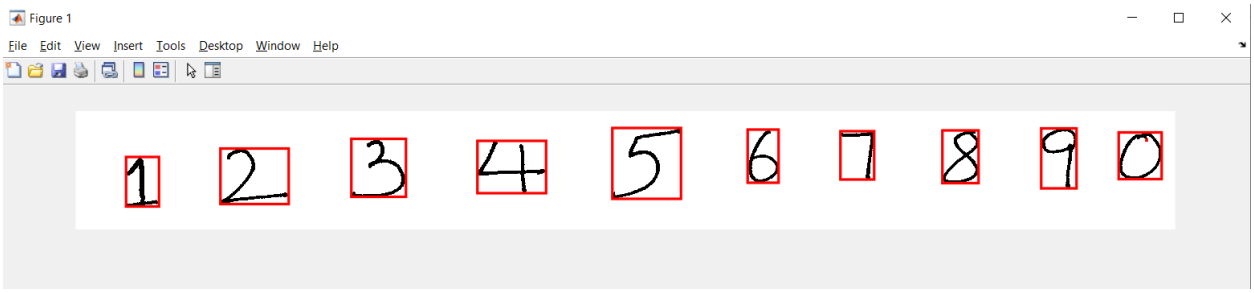


Image 2:

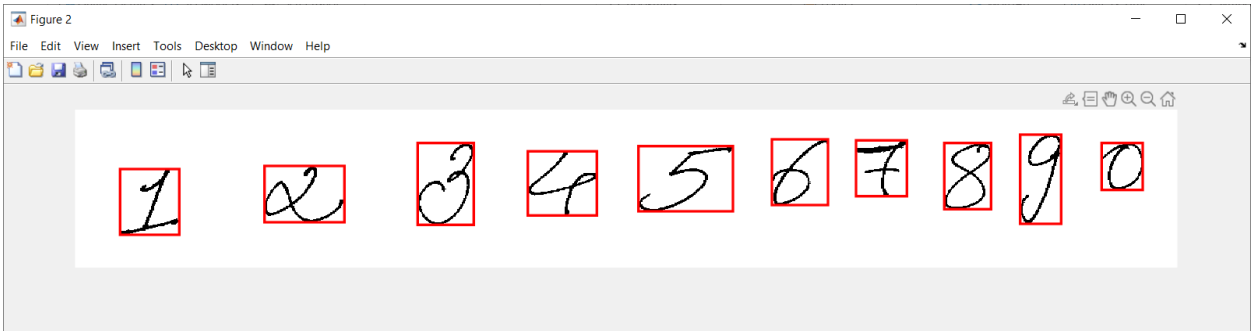


Image 3:

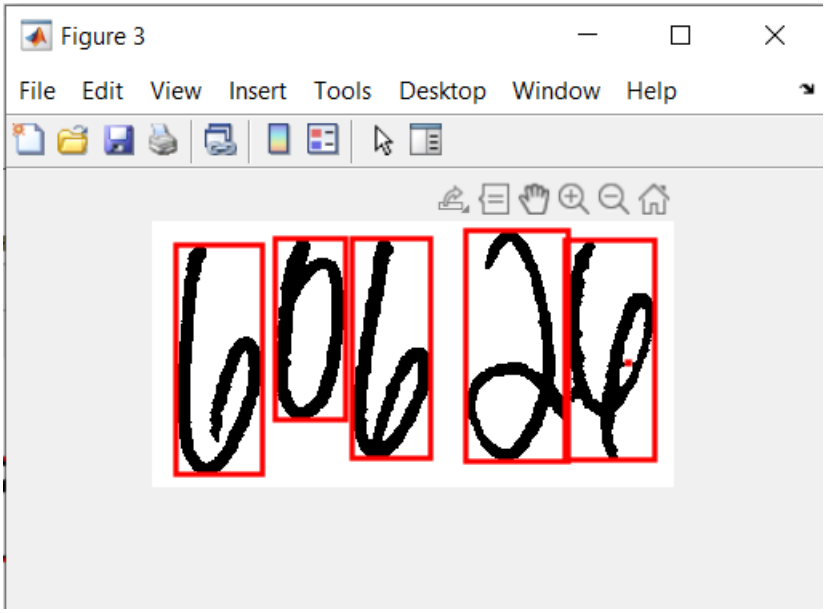


Image 4: