

1. Image Processing

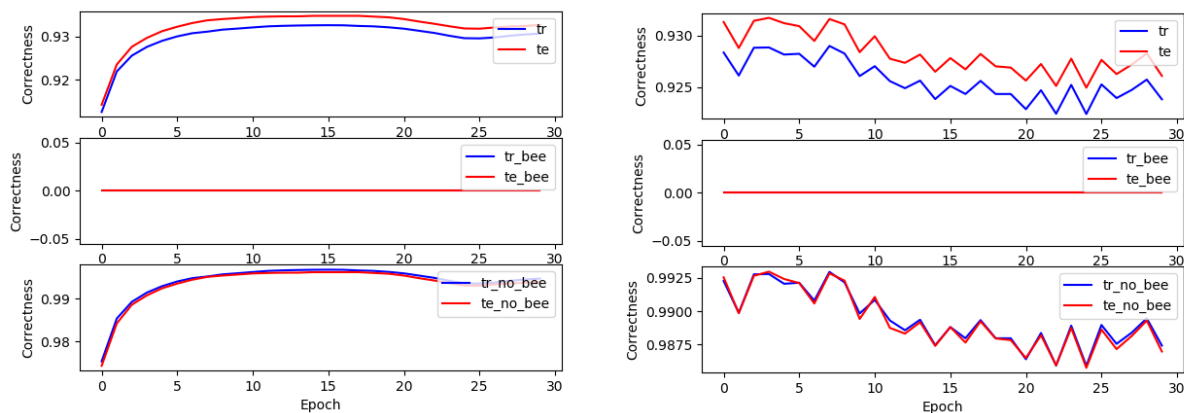
To get the one dimensional vector, I convert the color image to gray image by OpenCv's function. And normalized it from [0...255] to [0...1].



2. Compared 1024-30-1 with 1024-100-1

Both I use Quadratic cost function as the cost function, train 30 epochs, the learning rate is 0.01. The training set here is 2629-38177. The error rate is 0.2

It seems that the final results of both network are almost the same.

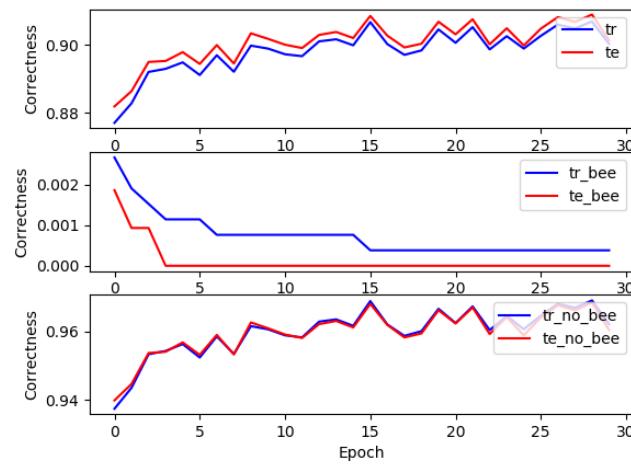


3. Compared Cross Entropy with Quadratic

I use 1024-100-1 network and Cross Entropy as the cost function, train 30 epochs, the learning rate is 0.001

The training set here is 2629-38177. The error rate is 0.2

With Cross Entropy, the ANN may recognize a few pictures of bee, but the correctness of recognize pictures of no bee decrease.



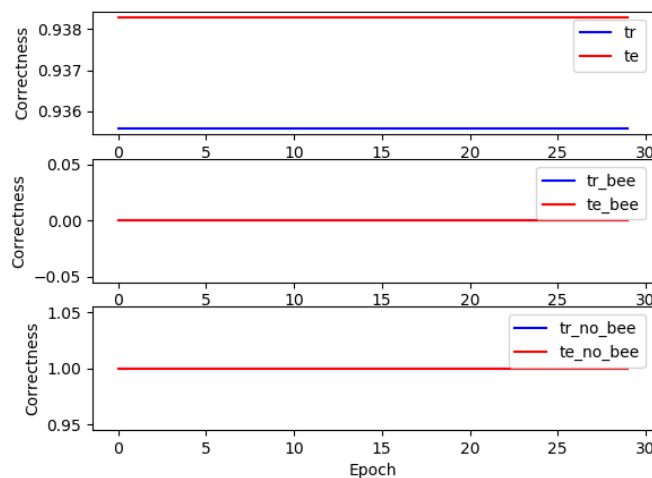
4. Weight Initialization

As before, I use (0,1) distribution to random the weights and biases. Base on this technique, we divide the weights by \sqrt{n} , n is the number of inputs of the neurons.

I use 1024-100-1 network and Cross Entropy as the cost function, train 30 epochs, the learning rate is 0.001

The training set here is 2629-38177. The error rate is 0.2

It seems that it speeds up ANN learning and increase the correctness.

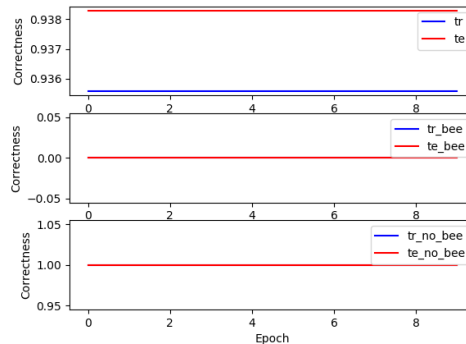


5. Compared Multiple Hidden Layers and Single Hidden Layer

I use 1024-100-100-1 network and Cross Entropy as the cost function, train 30 epochs, the learning rate is 0.001. The latest weight initialization method is used.

The training set here is 2629-38177. The error rate is 0.2

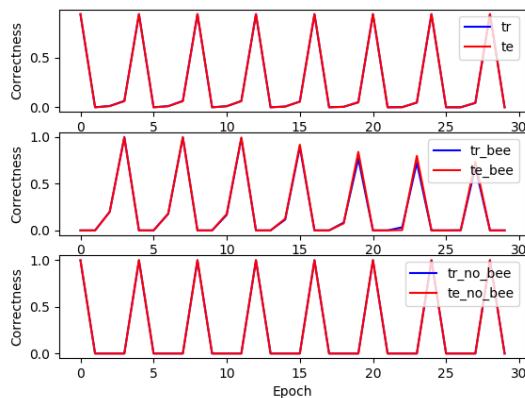
It seems that nothing improved even if I add one more layer.



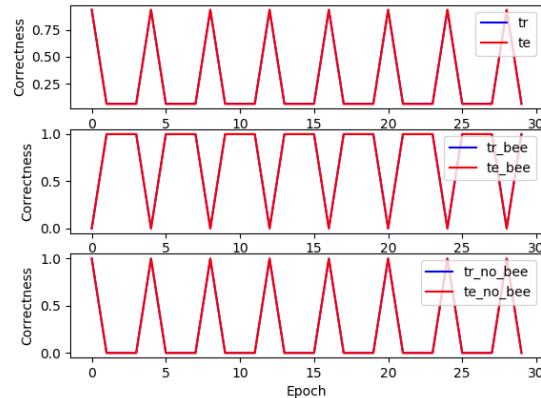
6. Alternative way.

I try to improve the correctness of the pictures with bee. In the training cycle, one epoch for the training data with both, the other 3 epochs with training dataset of bee.

I use 1024-100-1 network and 1024-100-100-1, Cross Entropy as the cost function, train 30 epochs, the learning rate is 0.001. The error rate is 0.2



1024-100-1

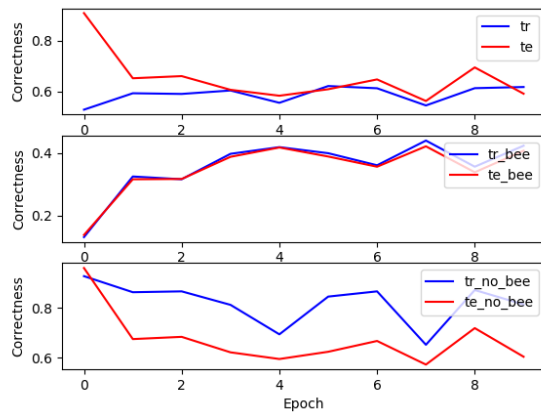


1024-100-100-1

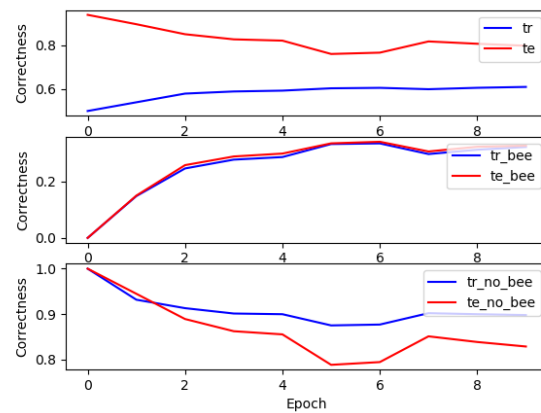
7. Balance the Training Set

Here we reduce the training set of pictures of no bee. So bee and no bee training set is 2629-2629.

I use 1024-100-1 network and Cross Entropy as the cost function, train 10 epochs, the learning rate is 0.001 and 0.0005. The error rate is 0.5.

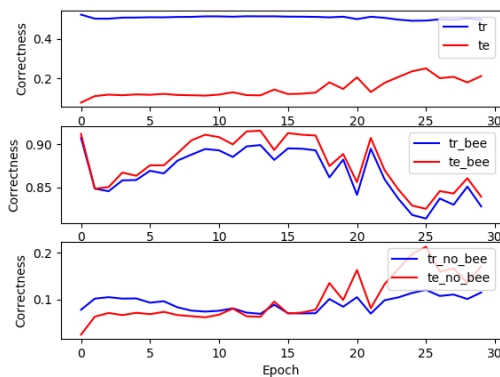


$\eta=0.001$

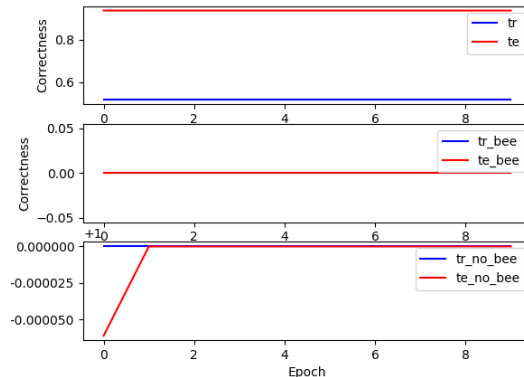


$\eta=0.0005$

I also try to use 2629-2300-0.5, learning rate is 0.001. and 2629-2800-0.5, learning rate is 0.001



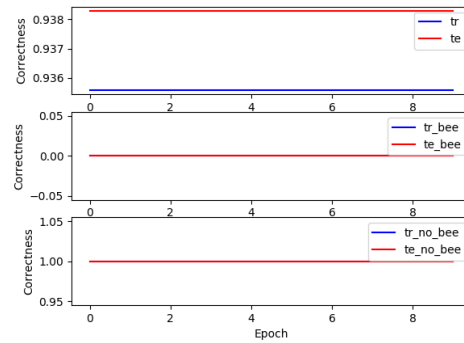
2629-2300-0.5



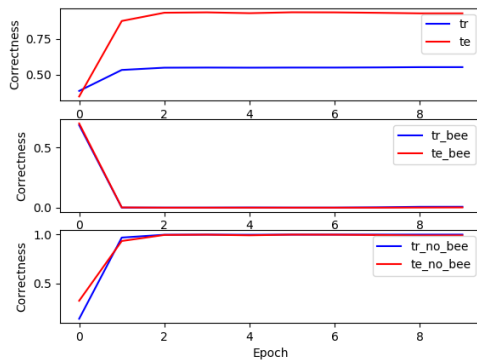
2629-2800-0.5

8. Two outputs Strategy.

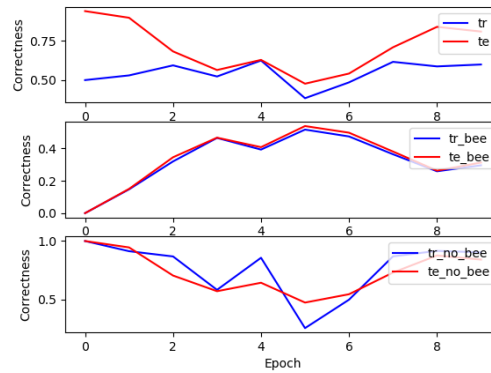
I use 1024-30-2 network. Cross Entropy as the cost function, train 10 epochs, the learning rate is 0.001.



2629-38177



2629-3200



2629-2629