Exercise # 3

Q3a) For this question, we will be using our VG11 NN trained for the last assignment. The test accuracy is 98.99% and the model summary is:

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Model: "sequential"
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 Layer (type)                Output Shape              Param #   
=================================================================
 conv2d (Conv2D)             (None, 32, 32, 64)        640       
 batch_normalization         (None, 32, 32, 64)        256       
 (BatchNormalization)                                            
 max_pooling2d               (None, 16, 16, 64)        0         
 (MaxPooling2D)                                                  
 conv2d_1 (Conv2D)           (None, 16, 16, 128)       73856     
 batch_normalization_1       (None, 16, 16, 128)       512       
 (BatchNormalization)                                            
 max_pooling2d_1             (None, 8, 8, 128)         0         
 (MaxPooling2D)                                                  
 conv2d_2 (Conv2D)           (None, 8, 8, 256)         295168    
 batch_normalization_2       (None, 8, 8, 256)         1024      
 (BatchNormalization)                                            
 conv2d_3 (Conv2D)           (None, 8, 8, 256)         590080    
 batch_normalization_3       (None, 8, 8, 256)         1024      
 (BatchNormalization)                                            
 max_pooling2d_2             (None, 4, 4, 256)         0         
 (MaxPooling2D)                                                  
 conv2d_4 (Conv2D)           (None, 4, 4, 512)         1180160   
 batch_normalization_4       (None, 4, 4, 512)         2048      
 (BatchNormalization)                                            
 conv2d_5 (Conv2D)           (None, 4, 4, 512)         2359808   
 batch_normalization_5       (None, 4, 4, 512)         2048      
 (BatchNormalization)                                            
 max_pooling2d_3             (None, 2, 2, 512)         0         
 (MaxPooling2D)                                                  
 conv2d_6 (Conv2D)           (None, 2, 2, 512)         2359808   
 batch_normalization_6       (None, 2, 2, 512)         2048      
 (BatchNormalization)                                            
 conv2d_7 (Conv2D)           (None, 2, 2, 512)         2359808   
 batch_normalization_7       (None, 2, 2, 512)         2048      
 (BatchNormalization)                                            
 max_pooling2d_4             (None, 1, 1, 512)         0         
 (MaxPooling2D)                                                  
 flatten (Flatten)           (None, 512)               0         
 dense (Dense)               (None, 4096)              2101248   
 dropout (Dropout)           (None, 4096)              0         
 dense_1 (Dense)             (None, 4096)              16781312  
 dropout_1 (Dropout)         (None, 4096)              0         
 dense_2 (Dense)             (None, 10)                40970     
                                                                 
=================================================================
Total params: 28153866 (107.40 MB)
Trainable params: 28148362 (107.38 MB)
Non-trainable params: 5504 (21.50 KB)
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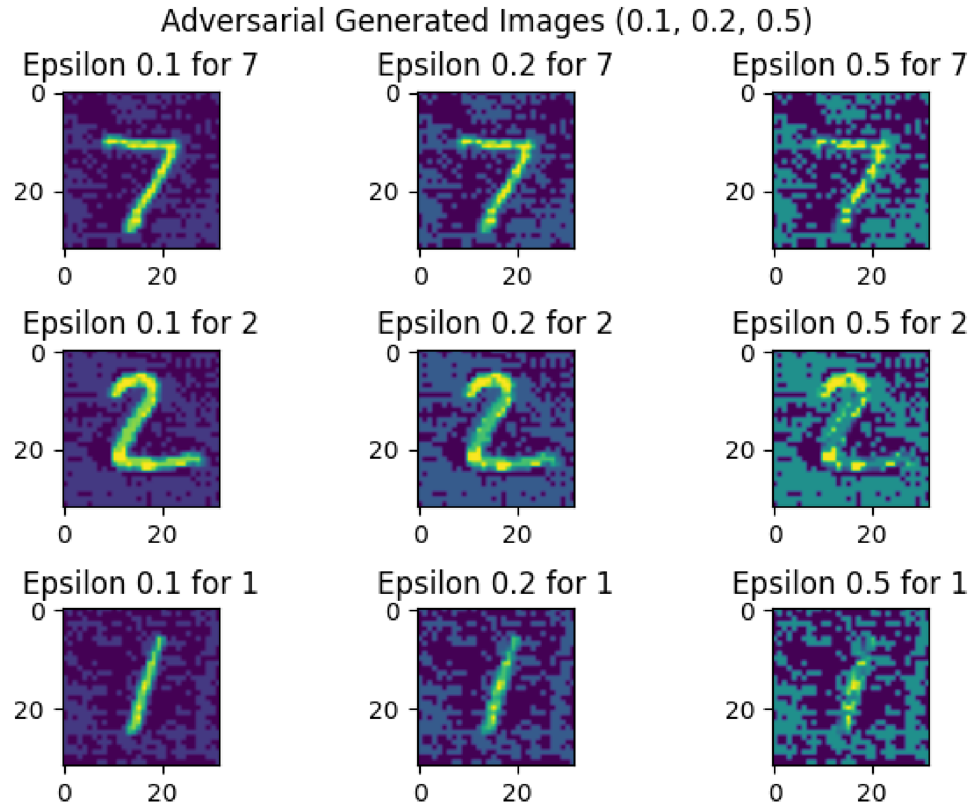
Q3b) Below are 9 samples of test images for the 3 degrees of epsilon in adversary training. The left column denotes $\epsilon = 0.1$, the middle column denotes $\epsilon = 0.2$ and finally the last column denotes $\epsilon = 0.5$:



With our base model we receive the following test accuracies for the perturbed test set:

Test Accuracy on $\epsilon = 0.1$	Test Accuracy on $\epsilon = 0.2$	Test Accuracy on $\epsilon = 0.5$
76.82%	42.63%	33.88%