For Project 2, I worked on all of the tasks by myself.

Task 1

In task 1.1, I was given CodeP2.1 from the class that contains data array for the project. Implementation of the remaining equations for weights and biases were completed via the backpropagation method using Newton-Raphson finite difference approximation and the learning rate parameter. The total batch squared error cutout limit was changed to 0.00035. The parameters were adjusted to converge to a batch squared error less than 0.00035.

In task 1.2, I was given CodeP2.2 from class that contains the Keras neural network model. First, I ran the program to get a loss value below 0.03, and then I changed the epoch to be 400. In the end, I was able to get a last epoch with loss less than 0.025, I ended up getting 0.0239. As indicated in the instructions, I also tried training the network with starting values that are all 50% different from the values in the original program. To reach a loss value below 0.03 with the changed initial values, I had to double the number of epochs compared to the starting values in the original program.

The resulting values for weights and biases from both methods were collected. Based on the results, I would say that the results of the two models agree. If the two models were given the same starting values for the weights and bias values, I would expect that they would yield a similar answer—not necessarily exactly the same, but close enough to each other. It was seen in the resulting values that the weights and biases were pretty close to each other, and the discrepancy might be a result of the loss values that we were able to get down to. The tables comparing the weights and biases (Table 1) for First Principles and Keras method as well as the measured vs predicted values (Table 2) using the two methods are shown below. Figure 1 show the log-log plots of predicted y3 vs the data y3 values for both First Principles and Keras models.

Table 1. Weights and Bias	es of the two models using	ng First Principles	and Keras methods.

	First Principles	Keras
w01	1.2317446777456715	0.93278986
w02	0.39071987719447326	-0.099556476
w03	0.6908682132924195	0.90238297
b1	-0.15913730444025148	-0.24067132
w12	0.717440495245393	-0.5746556
b2	-0.12656640856995455	0.5076427
w23	0.6472143707613583	-1.4124379
b3	0.07574054459128032	0.5199998
	rms = 0.006458164948	mae = loss = 0.0239

Table 2. Measured data and two predicted y3 values based on the two models using First Principles and Keras methods.

x01	x02	x03	Y3data	First Principles Predicted y3	Keras Predicted y3
20	13.0	310.8	30.97	31.49863838103	32.515316
20	14.5	308	32.3	32.0120270208347	32.08422
20	15.3	306	31.5	32.268743338089	31.818192
20.2	13.0	310.8	30.91	31.682038191219	32.729336
20	14.5	308	32.5	32.0120270208347	32.08422
20	15.3	306	31.4	32.268743338089	32.034702
24	13.0	310.8	35.59	35.166634584733	36.638195
36	14.5	308	46.4	46.68401183563	46.472282

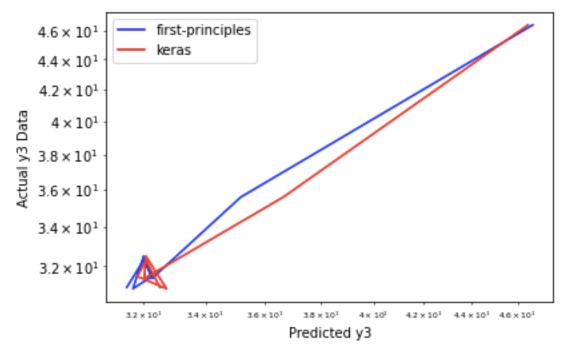


Figure 1. Log-log plot of the predicted y3 values vs the data y3 values based on the two models—First Principles and Keras methods. The two predicted values are fairly similar to each other and to the actual y3 data.

Task 2

In task 2.1, I was given CodeP2.3 from the class that contains the two arrays xdata and ydata that contain the input and output parameters for the system of interest. I was also given CodeP2.4 from the class that contains the general architecture of the neural network we will use for our subsequent tasks. The CodeP2.4 was edited to extend the data points of xdata and ydata to include the datapoints from CodeP2.3. These data were normalized with the median value of each of the parameters from our data given. The normalized data were printed to confirm that the data has been normalized as expected.

In task 2.2, I used the given CodeP2.4 to create a sequential neural network. In the first hidden dense layer, I have three input variables, 16 neurons, and relu activation function. In the second hidden dense layer, I put 32 neurons with relu activation function. In the third hidden dense layer, I put 16 neurons with relu activation function. Finally, there is an output dense layer with 2 neurons. The learning parameter for this model was changed to 0.001, and the epoch was changed to 600. This network was trained by successive forward passes for each point in the dataset, and the backpropagation pass was used to update the weights and biases at the end of each epoch. I set the threshold for mean absolute error to be less than 0.05. The lowest loss I was able to get was 0.049724594006935754.

Then the trained model was used to predict α values for 268 < T_1 < 318 K and 500 < \dot{Q}_s < 2500 kW with γ = 0.25. The resulting α values variation was plotted using surface plot (Figure 2) as a function of T_1 and \dot{Q}_s over these ranges.

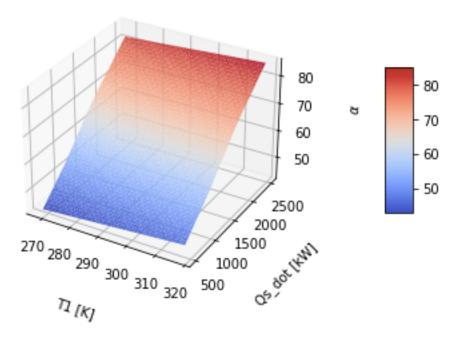


Figure 2. A surface plot for predicted α values for 268 < T_1 < 318 K and 500 < \dot{Q}_s < 2500 kW with $\gamma = 0.25$. It seems that the T_1 variation does not affect the predicted α values as much, but the \dot{Q}_s variation affects the predicted α values.

In task 2.3 part a, I was given test data to test the trained model. I took the given test data and normalized with the respective parameter median values used to normalize the training data set. The resulting normalized test data were inputted to the trained model using model.predict() function. The α values from the test data were log-log plotted against the predicted α values to evaluate the agreement (Figure 3). The rms deviation between the predictions and the collection of the test data were 0.161 for α values and 0.959 for η_{sys} .

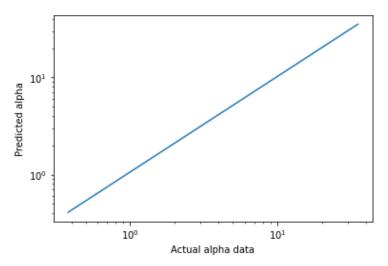


Figure 3. A log-log plot to evaluate the agreement of α in the test data vs predicted α values using the trained model. The rms for α is 0.161, which is fairly good.

In task 2.3 part b, I was given a table that indicates the anticipated combination of air inlet temperature and solar heat input along with the information that the air to fuel ratio will vary ($\gamma = 0$ and 0.5). I normalized the values in each of the parameters with the respective median value used to normalize the train data. The normalized values were inputted with the model.predict() to predict the α values over the course of the day. The resulting predicted α values were plotted against time over the course of the day (Figure 4).

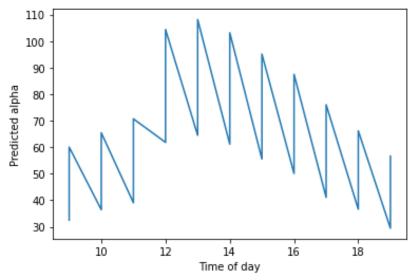


Figure 4. Plot of the predicted α values over the time of day (24 hour clock) given the operating conditions provided. The fluctuation of the predicted α values within the same time period is due to the variation in air to fuel ratio ($\gamma = 0$ and 0.5). It is clear that the predicted α values increase around 12PM and decrease as we progress through the afternoon into evening.

In task 2.4, I created more versions of neural network model trained in Task 2.2. The original model created in task 2.2 were compared with the other four models trained—described

below. Model version 1 had the same number of neurons and layers with activation function changed to ELU from the original Relu. Model version 2 included an additional layer with number of neurons in the layers set to 16, 32, 16, 16, 2 with relu activation functions for all layers. Model version 3 had the same number of layers as the original model with number of neurons decreased to 8, 16, 8, 2 with relu activation functions for all layers. Model version 4 had the same number of layers as the original model with number of neurons increased to 20, 40, 20, 2 with relu activation functions for all layers. The summary of minimum loss values obtained, and the number of epochs needed to obtain the min loss for each of the model (min loss value threshold ~ 0.5) are in Table 3.

Table 3. Result summary of different models and their minimum loss values, number of epochs to get to the min loss, and comparison to the original model. Based on the result, best to worst models are: 1) using elu activation functions, 2) relu with more layers, 3) relu with same number of layers but more neurons each, and 4) relu with same number of layers with less neurons each.

Model Name	minimum loss value	# of epoch	compared to baseline
Original Model	0.0543997	598	baseline
Model v1	0.0559068	-	smaller
Model v2	0.0530908		smaller
Model v3	0.0558974	588	similar
Model v4	0.0423302	433	smaller

Based on the result, best to worst models are: 1) using elu activation functions, 2) relu with more layers, 3) relu with same number of layers but more neurons each, and 4) relu with same number of layers with less neurons each. Therefore, I conclude that the best design features for the network for the application in Part 2 is to use elu activation function with more neurons in each of the dense hidden layers.

Appendix

```
In [1]:
         '''#Intro to Neural Network Modeling
         # Python Neural Network Model of Spray Cooling Test System
         >>>> start CodeP2.1
             V.P. Carey ME249, Spring 2021'''
         #import math and numpy packages
         import math
         import numpy
         #assembling data array
         #store array where rows are data vectors [x01, x02, x03, y3]
         xydata = []
         xydata = [[20./20.2, 13.0/14.5, 310.8/308.0, 30.97/32.4], [20./20.2, 14.5/14.]
         xydata.append([20./20.2, 15.3/14.5, 306.0/308.0, 31.5/32.4])
         xydata.append([20.2/20.2, 13.0/14.5, 310.8/308.0, 30.91/32.4])
         xydata.append([20./20.2, 14.5/14.5, 308.0/308.0, 32.5/32.4])
         xydata.append([20./20.2, 15.3/14.5, 306.0/308.0, 31.4/32.4])
         xydata.append([24./20.2, 13.0/14.5, 310.8/308.0, 35.59/32.4])
         xydata.append([36./20.2, 14.5/14.5, 308.0/308.0, 46.4/32.4])
         print (xydata)
         #set starting values
         w01n = 1.24
         w02n = 0.40
         w03n = 0.70
         b1n = -0.15
         w12n = 0.72
         b2n = -0.12
         w23n = 0.65
         b3n = 0.08
         #start of batch loop
         for k in range (0,40):
             icount = 0
             #initialize error and derivative parameters
             E3ti = 0.
             dE3da3 = 0.
             dE3dw01ti = 0.
             dE3dw02ti = 0.
             dE3dw03ti = 0.
             dE3db1ti = 0.
             dE3dw12ti = 0.
             dE3db2ti = 0.
             dE3dw23ti = 0.
             dE3db3ti = 0.
             w01 = w01n
             w02 = w02n
             w03 = w03n
```

```
b1 = b1n
w12 = w12n
b2 = b2n
w23 = w23n
b3 = b3n
#doing calcuations for each data point
for i in range(0,8):
    #compute activation functions and their derivatives
    z1 = w01*xydata[i][0]+w02*xydata[i][1]+w03*xydata[i][2]+b1
    sig1 = z1
    sigp1 = 1.0
    if z1 < 0.0:
        sig1 = math.exp(z1) - 1.0
        sigp1 = math.exp(z1)
    a1 = sig1
    z2 = w12*a1+b2
    sig2 = z2
    sigp2 = 1.0
    if z2 < 0.0:
        sig2 = math.exp(z2) - 1.0
        sigp2 = math.exp(z2)
    a2 = sig2
    z3 = w23*a2+b3
    siq3 = z3
    sigp3 = 1.0
    if z3 < 0.0:
        sig3 = math.exp(z3) - 1.0
        sigp3 = math.exp(z3)
    a3 = sig3
    #compute derivatives for backpropagation
    #add to sum for batch average calculation
    E3ti = E3ti + (a3 - xydata[i][3])*(a3 - xydata[i][3])
    dE3da3 = 2.*(a3 - xydata[i][3])
    dE3dw01ti = dE3dw01ti + dE3da3*sigp3*w23*sigp2*w12*sigp1*xydata[i][0]
    dE3dw02ti = dE3dw02ti + dE3da3*sigp3*w23*sigp2*w12*sigp1*xydata[i][1]
    dE3dw03ti = dE3dw03ti + dE3da3*sigp3*w23*sigp2*w12*sigp1*xydata[i][2]
    dE3db1ti = dE3db1ti + dE3da3*sigp3*w23*sigp2*w12*sigp1
    dE3dw12ti = dE3dw12ti + dE3da3*sigp3*w23*sigp2*a1
    dE3db2ti = dE3db2ti + dE3da3*sigp3*w23*sigp2
    dE3dw23ti = dE3dw23ti + dE3da3*sigp3*a2
    dE3db3ti = dE3db3ti + dE3da3*sigp3
    icount = i + 1
    # end calculations for each data point in batch
```

```
#compute batch averaged values
    E3 = E3ti/icount
    dE3dw01 = dE3dw01ti/icount
    dE3dw02 = dE3dw02ti/icount
    dE3dw03 = dE3dw03ti/icount
    dE3db1 = dE3db1ti/icount
    dE3dw12 = dE3dw12ti/icount
    dE3db2 = dE3db2ti/icount
    dE3dw23 = dE3dw23ti/icount
    dE3db3 = dE3db3ti/icount
    #set gam = learning rate
    qam = 0.03
    if E3 < 0.07:
       qam = 0.009
   w01n = w01 + gam*(-E3)/dE3dw01
   w02n = w02 + gam*(-E3)/dE3dw02
   w03n = w03 + gam*(-E3)/dE3dw03
   b1n = b1 + gam*(-E3)/dE3db1
   w12n = w12 + gam*(-E3)/dE3dw12
   b2n = b2 + gam*(-E3)/dE3db2
   w23n = w23 + gam*(-E3)/dE3dw23
   b3n = b3 + gam*(-E3)/dE3db3
    #printing for each iteration
    print ('======')
    print ('last w01, w02, w03, w12, w23:')
   print ('last b1, b2, b3:')
   print (w01, w02, w03, w12, w23)
   print (b1, b2, b3)
   print ('E3 = ', E3, 'icount =', icount)
    print ('next ws:', w01n, w02n, w03n, w12n, w23n)
   print ('next bs:', b1n, b2n, b3n)
   print ('
               ')
    #quit if squared error is below target
    if E3 < 0.00035:
       break
print ('======')
print ('last w01, w02, w03, w12, w23:')
print ('last b1, b2, b3:')
print (w01, w02, w03, w12, w23)
print (b1, b2, b3)
print ('
#decomment print statements below if you want to print neuron outputs
#print ('z1 =', z1)
#print ('a1 =', a1)
#print ('z2 = ', z2)
#print ('a2 =', a2)
#print ('z3 = ', z3)
```

```
#print ('a3 =', a3)
#print comparison of data and trained network predictions
# restore raw data values
xydatar = [[20., 13.0, 310.8, 30.97], [20., 14.5, 308.0, 32.3]]
xydatar.append([20., 15.3, 306.0, 31.5])
xydatar.append([20.2, 13.0, 310.8, 30.91])
xydatar.append([20., 14.5, 308.0, 32.5])
xydatar.append([20., 15.3, 306.0, 31.4])
xydatar.append([24., 13.0, 310.8, 35.59])
xydatar.append([36., 14.5, 308.0, 46.4])
print ('Tdbin, Twbin, qdot, Tdbout, ypredicted:')
for i in range(0,8):
    z1 = w01*xydata[i][0]+w02*xydata[i][1]+w03*xydata[i][2]+b1
    sig1 = z1
    sigp1 = 1.0
    if z1 < 0.0:
        sig1 = math.exp(z1) - 1.0
        sigp1 = math.exp(z1)
    a1 = sig1
    z2 = w12*a1+b2
    sig2 = z2
    sigp2 = 1.0
    if z2 < 0.0:
        sig2 = math.exp(z2) - 1.0
        sigp2 = math.exp(z2)
    a2 = sig2
    z3 = w23*a2+b3
    sig3 = z3
    sigp3 = 1.0
    if z3 < 0.0:
        sig3 = math.exp(z3) - 1.0
        sigp3 = math.exp(z3)
    a3 = sig3
    print (xydatar[i][0], xydatar[i][1], xydatar[i][2], xydatar[i][3], a3*32.
[[0.990099009900901, 0.896551724137931, 1.0090909090909, 0.9558641975308642
], [0.990099009901, 1.0, 1.0, 0.9969135802469136], [0.9900990099009901, 1.
0551724137931036, 0.9935064935064936, 0.972222222222222], [1.0, 0.89655172413
7931, 1.00909090909090, 0.9540123456790124], [0.9900990099009901, 1.0, 1.0, 1
.0030864197530864], [0.9900990099009901, 1.0551724137931036, 0.993506493506493
6, 0.9691358024691358], [1.188118811881188, 0.896551724137931, 1.0090909090909
```

next bs: -0.15046548493782352 -0.12033514915523294 0.0797821530490986

_____ last w01, w02, w03, w12, w23: last b1, b2, b3: 1.2395842004849886 0.3995251230041434 0.6995350552723261 0.7198562254547948 0.6995350552723261649860208771567 -0.15046548493782352 -0.12033514915523294 0.0797821530490986E3 = 0.0018852257532186052 icount = 8next ws: 1.239180605627035 0.399064501023702 0.6990839671244636 0.719716618546 577 0.6497244293405798 next bs: -0.15091708613217156 -0.1206602370864072 0.07957089133827658 _____ last w01, w02, w03, w12, w23: last b1, b2, b3: 7244293405798 $-0.15091708613217156 \ -0.1206602370864072 \ 0.07957089133827658$ E3 = 0.001752381308227137 icount = 8next ws: 1.2387886417033136 0.3986174779186808 0.6986460935787717 0.7195809879 720887 0.6495924788329756 next bs: -0.15135544635031273 -0.1209757322203131 0.07936590644243985 _____ last w01, w02, w03, w12, w23: last b1, b2, b3: 6495924788329756 -0.15135544635031273 -0.1209757322203131 0.07936590644243985E3 = 0.0016289317351831172 icount = 8next ws: 1.238407741934573 0.3981834068215117 0.6982208013186909 0.71944914431 57252 0.6494641759186996 next bs: -0.15178119964193323 -0.12128209619452976 0.07916689470900333 _____ last w01, w02, w03, w12, w23: last b1, b2, b3: 494641759186996 -0.15178119964193323 -0.12128209619452976 0.07916689470900333E3 = 0.001514213675001606 icount = 8 next ws: 1.2380373444440234 0.3977616479762124 0.6978074635218237 0.7193208993 968568 0.6493393401897525 next bs: -0.15219497350282402 -0.12157978544468785 0.07897355620546954 _____ last w01, w02, w03, w12, w23: last b1, b2, b3: 1.2380373444440234 0.3977616479762124 0.6978074635218237 0.7193208993968568 0. 6493393401897525 -0.15219497350282402 -0.12157978544468785 0.07897355620546954E3 = 0.001407610713939203 icount = 8next ws: 1.2376768899291055 0.39735156628986235 0.6974054573992086 0.719196065

next bs: -0.15259739133135208 -0.121869252999038 0.07878559353472148

5175778 0.6492177914392265

last w01, w02, w03, w12, w23: last b1, b2, b3: 1.2376768899291055 0.39735156628986235 0.6974054573992086 0.7191960655175778 0.6974054573992086.6492177914392265 -0.15259739133135208 -0.121869252999038 0.07878559353472148E3 = 0.0013085500811198642 icount = 8 next ws: 1.2373258189676108 0.3969525285178638 0.6970141613605588 0.7190744545 846743 0.6490993488156311 next bs: -0.1529890752576638 -0.12215095053776788 0.0786027104807734 ______ last w01, w02, w03, w12, w23: last b1, b2, b3: 1.2373258189676108 0.3969525285178638 0.6970141613605588 0.7190744545846743 0. 6490993488156311 -0.1529890752576638 -0.12215095053776788 0.0786027104807734E3 = 0.0012164995823033403 icount = 8 next ws: 1.236983568855 0.3965638999801277 0.6966329517002857 0.71895587707135 4 0.6489838298186811 next bs: -0.15337064945041765 -0.12242533079230593 0.07842461043622488 _____ last w01, w02, w03, w12, w23: last b1, b2, b3: 1.236983568855 0.3965638999801277 0.6966329517002857 0.718955877071354 0.6489838298186811 -0.15337064945041765 -0.12242533079230593 0.07842461043622488E3 = 0.0011309647541177205 icount = 8 next ws: 1.2366495698357824 0.39618504067186416 0.696261198664777 0.7188401407 728999 0.6488710490915331 next bs: -0.15374274404005647 -0.12269285038435322 0.0782509945468265 ______ last w01, w02, w03, w12, w23: last b1, b2, b3: 1.2366495698357824 0.39618504067186416 0.696261198664777 0.7188401407728999 0. 6488710490915331 $-0.15374274404005647 \ -0.12269285038435322 \ 0.0782509945468265$ E3 = 0.0010514862244056788 icount = 8 next ws: 1.2363232405442695 0.39581530058598136 0.6958982617134323 0.718727049 2945207 0.6487608169488154 next bs: -0.1541059998453953 -0.12295397323859956 0.0780815594864499 _____ last w01, w02, w03, w12, w23: last b1, b2, b3: 1.2363232405442695 0.39581530058598136 0.6958982617134323 0.7187270492945207 0.6958982617134323.6487608169488154 -0.1541059998453953 -0.12295397323859956 0.0780815594864499E3 = 0.000977637265794909 icount = 8next ws: 1.236003982402412 0.39545401399800223 0.6955434837179588 0.7186164001 871046 0.6486529375575923 next bs: -0.15446107415800872 -0.12320917475158448 0.07791599474439924 _____ last w01, w02, w03, w12, w23:

```
last b1, b2, b3:
1.236003982402412 0.39545401399800223 0.6955434837179588 0.7186164001871046 0.
6486529375575923
-0.15446107415800872 -0.12320917475158448 0.07791599474439924
E3 = 0.000909021531163883 icount = 8
next ws: 1.2356911726247397 0.39510049236923767 0.6951961837463942 0.718507982
6140226 0.6485472066563629
next bs: -0.15480864793650176 -0.12345894696908456 0.07775397926179753
last w01, w02, w03, w12, w23:
last b1, b2, b3:
.6485472066563629
-0.15480864793650176 -0.12345894696908456 0.07775397926179753
E3 = 0.0008452709614332549 icount = 8
next ws: 1.2353841553365126 0.39475401538438953 0.6948556479343685 0.718401574
3842336 0.6484434086500519
next bs: -0.15514943490604463 -0.12370380512707196 0.07759517718740779
______
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2353841553365126 0.39475401538438953 0.6948556479343685 0.7184015743842336 0.6948556479343685
.6484434086500519
-0.15514943490604463 -0.12370380512707196 0.07759517718740779
E3 = 0.0007860438582345493 icount = 8
next ws: 1.23508223009484 0.394413819430888 0.6945211177303616 0.7182969381150
562 0.648341312848191
next bs: -0.15548419327328072 -0.12394429606513267 0.07743923242378224
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.23508223009484 0.394413819430888 0.6945211177303616 0.7182969381150562 0.648
341312848191
-0.15548419327328072 -0.12394429606513267 0.07743923242378224
E3 = 0.0007310231167565462 icount = 8
next ws: 1.2347846367696247 0.3940790825075416 0.6941917744709254 0.7181938161
775541 0.6482406685047739
next bs: -0.15581374109588056 -0.12418100925706863 0.077285761482154
_____
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2347846367696247 0.3940790825075416 0.6941917744709254 0.7181938161775541 0.6941917744709254 0.7181938161775541 0.7181938161775541
6482406685047739
-0.15581374109588056 -0.12418100925706863 0.077285761482154
E3 = 0.0006799146179094892 icount = 8
next ws: 1.234490535215556 0.39374890404809504 0.6938667187215655 0.7180919239
034601 0.6481411981469138
next bs: -0.1561389768636207 -0.12441459157425934 0.0771343439247074
```

last w01, w02, w03, w12, w23:

last b1, b2, b3:

1.234490535215556 0.39374890404809504 0.6938667187215655 0.7180919239034601 0.

```
6481411981469138
-0.1561389768636207 -0.12441459157425934 0.0771343439247074
E3 = 0.0006324457846912208 icount = 8
next ws: 1.2341989773118012 0.3934222773342937 0.6935449419767978 0.7179909402
502455 0.6480425884013634
next bs: -0.1564609076855579 -0.12464576749754805 0.07698450928480434
_____
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2341989773118012 0.3934222773342937 0.6935449419767978 0.7179909402502455 0.
6480425884013634
-0.1564609076855579 -0.12464576749754805 0.07698450928480434
E3 = 0.0005883643168007826 icount = 8
next ws: 1.2339088675095673 0.3930980508194523 0.6932252869041592 0.7178904946
474869 0.6479444770615411
next bs: -0.15678068887874655 -0.12487536749711993 0.07683571870678484
_____
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2339088675095673 0.3930980508194523 0.6932252869041592 0.7178904946474869 0.
6479444770615411
-0.15678068887874655 -0.12487536749711993 0.07683571870678484
E3 = 0.0005474371330248956 icount = 8
next ws: 1.2336189055187174 0.39277487233814395 0.6929063898699888 0.717790147
9229485 0.6478464343249896
next bs: -0.15709968118658524 -0.125104369042783 0.07668733842003389
______
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2336189055187174 0.39277487233814395 0.6929063898699888 0.7177901479229485 0.6929063898699888
.6478464343249896
-0.15709968118658524 -0.125104369042783 0.07668733842003389
E3 = 0.0005094495785741164 icount = 8
next ws: 1.2333275001822752 0.39245110593317656 0.6925865950439918 0.717689363
7050957 0.6477479346509275
next bs: -0.15741953626830535 -0.12533339578692048 0.07653860011747567
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2333275001822752 0.39245110593317656 0.6925865950439918 0.7176893637050957 0.7176893637050957
.6477479346509275
-0.15741953626830535 -0.12533339578692048 0.07653860011747567
E3 = 0.0004742050068173452 icount = 8
next ws: 1.233032634765999 0.39212470294630913 0.6922638208931235 0.7175874638
180038 0.6476483128468841
next bs: -0.1577423295321621 -0.12556562316135045 0.07638853940295802
_____
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.233032634765999 0.39212470294630913 0.6922638208931235 0.7175874638180038 0.
6476483128468841
-0.1577423295321621 -0.12556562316135045 0.07638853940295802
```

```
E3 = 0.00044152494994462464 icount = 8
next ws: 1.2327316458003326 0.3917929926469378 0.6919353426232621 0.7174835553
019213 0.647546692190067
next bs: -0.15807077651691392 -0.12580131260013716 0.07623589553557197
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2327316458003326 0.3917929926469378 0.6919353426232621 0.7174835553019213 0.
647546692190067
-0.15807077651691392 -0.12580131260013716 0.07623589553557197
E3 = 0.0004112503197786423 icount = 8
next ws: 1.2324208375366001 0.3914523219457121 0.6915974163055622 0.7173764037
260559 0.6474418595907473
next bs: -0.15840860656513536 -0.12604370010422292 0.07607893830907304
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2324208375366001 0.3914523219457121 0.6915974163055622 0.7173764037260559 0.
6474418595907473
-0.15840860656513536 -0.12604370010422292 0.07607893830907304
E3 = 0.00038324461210528863 icount = 8
next ws: 1.2320947562527569 0.391097388139053 0.6912445792881466 0.71726419600
49825 0.647332031738242
next bs: -0.15876125792937293 -0.12629668387166876 0.07591514602823164
_____
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2320947562527569 0.391097388139053 0.6912445792881466 0.7172641960049825 0.6
47332031738242
-0.15876125792937293 -0.12629668387166876 0.07591514602823164
E3 = 0.00035740147568798426 icount = 8
next ws: 1.2317446777456715 0.39071987719447326 0.6908682132924195 0.717144049
5245393 0.6472143707613583
next bs: -0.15913730444025148 -0.12656640856995455 0.07574054459128032
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2317446777456715 0.39071987719447326 0.6908682132924195 0.7171440495245393 0
.6472143707613583
-0.15913730444025148 -0.12656640856995455 0.07574054459128032
E3 = 0.00033366315594520607 icount = 8
next ws: 1.2313549702288527 0.39030528310865487 0.6904531584302075 0.717010843
2593911 0.6470838297434378
next bs: -0.15955181403702529 -0.1268636716607517 0.07554815164701947
last w01, w02, w03, w12, w23:
last b1, b2, b3:
1.2317446777456715 0.39071987719447326 0.6908682132924195 0.7171440495245393 0.6908682132924195 0.7171440495245393
.6472143707613583
-0.15913730444025148 -0.12656640856995455 0.07574054459128032
```

Tdbin, Twbin, qdot, Tdbout, ypredicted:

20.0 13.0 310.8 30.97 31.498638381033796 20.0 14.5 308.0 32.3 32.012027020834694 20.0 15.3 306.0 31.5 32.268743338089074 20.2 13.0 310.8 30.91 31.682038191218748 20.0 14.5 308.0 32.5 32.012027020834694 20.0 15.3 306.0 31.4 32.268743338089074 24.0 13.0 310.8 35.59 35.16663458473277 36.0 14.5 308.0 46.4 46.6840118356306

```
In [2]:
        '''>>>> start CodeP2.2
            V.P. Carey ME249, Spring 2021
         Intro to Neural Network Modeling
         Keras model for comparison with first principles model'''
         #import useful packages
         import keras
         import pandas as pd
         from keras.models import Sequential
         import numpy as np
         import keras.backend as kb
         import tensorflow as tf
         #the follwoing 2 lines are only needed for Mac OS machines
         import os
         os.environ['KMP_DUPLICATE LIB OK']='True'
         #raw data in dictionary form x01, x02, x03, y3
         my_dict = {
             x01': [20., 20., 20., 20.2, 20., 20.2, 24.0, 36.],
             x02': [13., 14.5, 15.3, 13., 14.5, 15.3, 13., 14.5],
             'x03' : [310.8, 308.0, 306.0, 310.8, 308.0, 306.0, 310.8, 308.0],
             'y3' : [30.97, 32.3, 31.5, 30.91, 32.5, 31.4, 35.59, 46.4]
         #normalized inputs in array
         xdata = []
         xdata = [[20./20.2, 13.0/14.5, 310.8/308.0], [20./20.2, 14.5/14.5, 308.0/308.]]
         xdata.append([20./20.2, 15.3/14.5, 306.0/308.0])
         xdata.append([20.2/20.2, 13.0/14.5, 310.8/308.0])
         xdata.append([20./20.2, 14.5/14.5, 308.0/308.0])
         xdata.append([20.2/20.2, 15.3/14.5, 306.0/308.0])
         xdata.append([24./20.2, 13.0/14.5, 310.8/308.0])
         xdata.append([36./20.2, 14.5/14.5, 308.0/308.0])
         #data frame
         df = pd.DataFrame(my_dict)
         #devide by the median to normalize
         df.x01 = df.x01/20.2 #div by 2 for Task1.2.b
         df.x02 = df.x02/14.5
         df.x03 = df.x03/308.0
         #normalize output array
         df.y3 = df.y3/32.401
         df.head
         print (df.x01, df.x02, df.x03, df.y3)
         xarray= np.array(xdata)
         print (xdata)
         print (xarray)
```

```
Using TensorFlow backend.
     0.990099
1
     0.990099
2
     0.990099
3
     1.000000
4
     0.990099
5
     1.000000
6
     1.188119
7
     1.782178
Name: x01, dtype: float64 0
                             0.896552
1
     1.000000
2
     1.055172
3
     0.896552
4
     1.000000
5
     1.055172
     0.896552
6
7
     1.000000
Name: x02, dtype: float64 0 1.009091
     1.000000
2
     0.993506
3
     1.009091
4
     1.000000
5
     0.993506
     1.009091
7
     1.000000
Name: x03, dtype: float64 0
                                0.955835
     0.996883
1
2
     0.972192
3
     0.953983
4
     1.003055
5
     0.969106
     1.098423
6
7
     1.432055
Name: y3, dtype: float64
[[0.990099009901, 0.896551724137931, 1.0090909090909], [0.99009900990099
01, 1.0, 1.0], [0.9900990099009901, 1.0551724137931036, 0.9935064935064936], [
1.0, 0.896551724137931, 1.009090909090909], [0.9900990099009901, 1.0, 1.0], [1
.0, 1.0551724137931036, 0.9935064935064936], [1.188118811881188, 0.89655172413
7931, 1.00909090909090909, [1.7821782178217822, 1.0, 1.0]]
[[0.99009901 0.89655172 1.00909091]
 [0.99009901 1.
                         1.
 [0.99009901 1.05517241 0.99350649]
             0.89655172 1.009090911
 [1.
 [0.99009901 1.
                         1.
 [1.
             1.05517241 0.993506491
 [1.18811881 0.89655172 1.00909091]
 [1.78217822 1.
                         1.
                                   ]]
```

```
In [3]:
         # define model
         #As seen below, we have created three dense layers each with just one neuron.
         #A dense layer is a layer in neural network that's fully connected.
         #In other words, all the neurons in one layer are connected to all other neur
         #In the first layer, we need to provide the input shape, which is 3 in this c
         #The activation function we have chosen is ReLU, which stands for rectified 1
         from keras import backend as K
         #initialize weights with values between -0.2 and 1.2
         initializer = tf.keras.initializers.RandomUniform(minval= -0.2, maxval=1.2)
         # define three layer model with one neuron in each layer
         model = keras.Sequential([
             keras.layers.Dense(1, activation=K.relu, input shape=[3]),
             keras.layers.Dense(1, activation=K.tanh),
             keras.layers.Dense(1)
           1)
```

#We're using RMSprop as our optimizer here. RMSprop stands for Root Mean Squa #It's one of the most popular gradient descent optimization algorithms for de #RMSprop is an optimizer that's reliable and fast.

#We're compiling the mode using the model.compile function. The loss function #is mean absolute error. After the compilation of the model, we'll use the fi #Running model.fit successive times extends the calculation to additional epoc sgd = tf.keras.optimizers.RMSprop(0.0035) model.compile(loss='mean absolute error',optimizer='sgd')

In [7]:

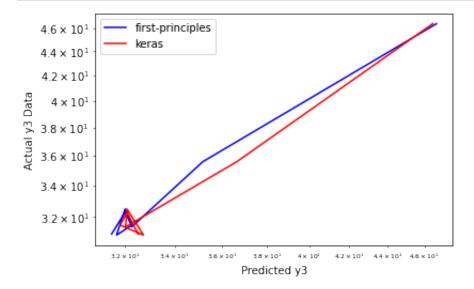
#After the compilation of the model, we'll use the fit method with 500 epochs #I started with epochs value of 100 and then tested the model after training. #The prediction was not that good. Then I modified the number of epochs to 20 #Accuracy had improved slightly, but figured I'd give it one more try. Finall #I found acceptable prediction accuracy. #The fit method takes three parameters; namely, x, y, and number of epochs. #During model training, if all the batches of data are seen by the model once #we say that one epoch has been completed. # Add an early stopping callback es = keras.callbacks.EarlyStopping(monitor='loss', mode='min', patience = 20, restore_best_weights = True, verbose=1) # Add a checkpoint where loss is minimum, and save that model mc = keras.callbacks.ModelCheckpoint('best model.SB', monitor='loss', mode='min', verbose=1, save_best_only=True) historyData = model.fit(xarray,df.y3,epochs=400,callbacks=[es]) #changed to 1 loss hist = historyData.history['loss'] #The above line will return a dictionary, access it's info like this: best epoch = np.argmin(historyData.history['loss']) + 1 print ('best epoch = ', best epoch) print('smallest loss =', np.min(loss hist))

```
Epoch 1/400
Epoch 2/400
Epoch 3/400
8/8 [=========== ] - 0s 687us/step - loss: 0.0289
Epoch 4/400
Epoch 5/400
Epoch 6/400
Epoch 7/400
Epoch 8/400
8/8 [============== ] - 0s 540us/step - loss: 0.0137
Epoch 9/400
8/8 [=========== ] - 0s 622us/step - loss: 0.0155
Epoch 10/400
8/8 [============= ] - 0s 759us/step - loss: 0.0199
Epoch 11/400
8/8 [============== ] - 0s 780us/step - loss: 0.0283
Epoch 12/400
8/8 [============= ] - 0s 866us/step - loss: 0.0136
Epoch 13/400
Epoch 14/400
8/8 [=========== ] - 0s 841us/step - loss: 0.0193
Epoch 15/400
Epoch 16/400
Epoch 17/400
8/8 [============ ] - 0s 808us/step - loss: 0.0150
Epoch 18/400
Epoch 19/400
8/8 [============ ] - 0s 1ms/step - loss: 0.0276
Epoch 20/400
8/8 [============= ] - 0s 945us/step - loss: 0.0141
Epoch 21/400
8/8 [============ ] - 0s 1ms/step - loss: 0.0153
Epoch 22/400
8/8 [============== ] - 0s 759us/step - loss: 0.0200
Epoch 23/400
8/8 [============ ] - 0s 678us/step - loss: 0.0280
Epoch 24/400
8/8 [============= ] - 0s 955us/step - loss: 0.0139
Restoring model weights from the end of the best epoch
Epoch 00024: early stopping
best epoch = 4
smallest loss = 0.01327359676361084
```

```
In [8]:
         from __future__ import print_function
         #For results of training network:
         #keras.layer.get weights() function retrieves weight values
         first_layer_weights = model.layers[0].get_weights()[0]
         w01 = first layer weights[0][0]
         w02 = first layer weights[1][0]
         w03 = first layer weights[2][0]
         first layer bias = model.layers[0].get weights()[1]
         b1 = first layer bias
         second layer weights = model.layers[1].get weights()[0]
         w12 = second_layer_weights[0][0]
         second layer bias = model.layers[1].get weights()[1]
         b2 = second_layer_bias
         third layer weights = model.layers[2].get weights()[0]
         w23 = third_layer_weights[0][0]
         third_layer_bias = model.layers[2].get_weights()[1]
         b3 = third layer bias
         #print weights and biases
         print (first layer weights)
         print ('w01 = ', w01, 'w02 = ', w02, 'w03 = ', w03)
         print (first_layer_bias)
         print ('b1 = ', b1)
         print (second layer weights)
         print ('w12 = ', w12)
         print (second layer bias)
         print ('b2 = ', b2)
         print (third_layer_weights)
         print ('w23 = ', w23)
         print (third_layer_bias)
         print ('b3 = ', b3)
         #use model.predict() function to print model predictions for data conditions
         xarray= np.array(xdata)
         print ('x01/20.2, x02/14.5, x03/308.0, y3/32.4, a3:')
         test = []
         for i in range(0,8):
             test = [[xarray[i][0], xarray[i][1], xarray[i][2]]]
             testarray = np.array(test)
             a3 = model.predict(testarray)
             print (xarray[i][0], xarray[i][1], xarray[i][2], df.y3[i], a3)
         print(' ')
         print ('x01, x02, x03, y3, a3*32.4:')
         for i in range(0,8):
             test = [[xarray[i][0], xarray[i][1], xarray[i][2]]]
             testarray = np.array(test)
             a3 = model.predict(testarray)
             print (xarray[i][0]*20.2, xarray[i][1]*14.5, xarray[i][2]*308.0, df.y3[i]
```

```
[[ 1.047099 ]
[ 0.01080906]
 [-1.0649904]
w01 = 1.047099 \ w02 = 0.010809059 \ w03 = -1.0649904
[0.0358692]
b1 = [0.0358692]
[[-0.42079762]]
w12 = -0.42079762
[-0.38960966]
b2 = [-0.38960966]
[[-1.8120942]]
w23 = -1.8120942
[0.2925]
b3 = [0.2925]
x01/20.2, x02/14.5, x03/308.0, y3/32.4, a3:
0.990099009901 \ 0.896551724137931 \ 1.0090909090909 \ 0.9558346964599856 \ [[0.89658346964599856]]
9698342]]
0.990099009901 1.0 1.0 0.9968828122588808 [[0.9769068]]
0.9900990099009901 1.0551724137931036 0.9935064935064936 0.9721922162896206
0.981811911
1.0 0.896551724137931 1.0090909090909 0.9539829017622912 [[0.976624]]
0.9900990099009901 1.0 1.0 1.003055461251196 [[0.9769068]]
1.0\ 1.0551724137931036\ 0.9935064935064936\ 0.9691058917934631\ [[0.988562]]
1.18811881188 0.896551724137931 1.0090909090909 1.0984228881824636 [[1.1
01232411
1.7821782178217822 1.0 1.0 1.4320545662170918 [[1.4395097]]
x01, x02, x03, y3, a3*32.4:
20.0 13.0 310.8 30.969044165303533 [[31.42263]]
20.0 14.5 308.0 32.29900311718774 [[31.651781]]
20.0 15.3 306.0 31.499027807783705 [[31.810707]]
20.2 13.0 310.8 30.909046017098234 [[31.64262]]
20.0 14.5 308.0 32.498996944538746 [[31.651781]]
20.2 15.3 306.0 31.3990308941082 [[32.02941]]
23.999999999999 13.0 310.8 35.58890157711182 [[35.67993]]
36.0 14.5 308.0 46.398567945433776 [[46.640118]]
```

```
In [100...
          #Task 1.2.c
          #Make log-log plots of predicted y3 vs data
          import matplotlib.pyplot as plt
          pfp = [31.49, 32.01, 32.27, 31.68, 32.01, 32.27, 35.17, 46.68] #predicted y3
          pkm = [32.52, 32.08, 31.82, 32.73, 32.08, 32.03, 36.65, 46.47] #predicted y3
          y3a = [0,0,0,0,0,0,0,0] #actual y3 data
          for i in range(8):
              y3a[i] = xydatar[i][3]
          plt.figure()
          plt.loglog(pfp, y3a, label ="first-principles", c='b')
          plt.loglog(pkm, y3a, label ="keras", c='r')
          plt.rc('xtick', labelsize=6)
          plt.xlabel("Predicted y3")
          plt.ylabel("Actual y3 Data")
          plt.legend()
          plt.show()
```



```
In [8]:
    '''>>>> start CodeP2.3
        V.P. Carey ME249, Spring 2021

Intro to Neural Network Modeling
    Data arrays for hybrid solar/fossil-fuel gas turbine power system'''

#create input data array, normalizing input temp
    #T1(K), gamma, , qsol(kW):
    ''' #DATA ADDED TO CODEP2.4
    xdata = []
    xdata = [[ 318.0 , 0.0 , 500.0 ], [ 318.0 , 0.0 , 1000.0 ]]
    xdata.append([ 318.0 , 0.0 , 1500.0 ])
```

```
xdata.append([ 318.0 , 0.0 , 2000.0 ])
xdata.append([ 318.0 , 0.0 , 2500.0 ])
xdata.append([ 318.0 , 0.25 , 500.0 ])
xdata.append([ 318.0 , 0.25 , 1000.0 ])
xdata.append([ 318.0 , 0.25 , 1500.0 ])
xdata.append([ 318.0 , 0.25 , 2000.0 ])
xdata.append([ 318.0 , 0.25 , 2500.0 ])
xdata.append([ 318.0 , 0.5 , 500.0 ])
xdata.append([ 318.0 , 0.5 , 1000.0 ])
xdata.append([ 318.0 , 0.5 , 1500.0 ])
xdata.append([ 318.0 , 0.5 , 2000.0 ])
xdata.append([ 318.0 , 0.5 , 2500.0 ])
xdata.append([ 303.0 , 0.0 , 500.0 ])
xdata.append([ 303.0 , 0.0 , 1000.0 ])
xdata.append([ 303.0 , 0.0 , 1500.0 ])
xdata.append([ 303.0 , 0.0 , 2000.0 ])
xdata.append([ 303.0 , 0.0 , 2500.0 ])
xdata.append([ 303.0 , 0.25 , 500.0 ])
xdata.append([ 303.0 , 0.25 , 1000.0 ])
xdata.append([ 303.0 , 0.25 , 1500.0 ])
xdata.append([ 303.0 , 0.25 , 2000.0 ])
xdata.append([ 303.0 , 0.25 , 2500.0 ])
xdata.append([ 303.0 , 0.5 , 500.0 ])
xdata.append([ 303.0 , 0.5 , 1000.0 ])
xdata.append([ 303.0 , 0.5 , 1500.0 ])
xdata.append([ 303.0 , 0.5 , 2000.0 ])
xdata.append([ 303.0 , 0.5 , 2500.0 ])
xdata.append([ 288.0 , 0.0 , 500.0 ])
xdata.append([ 288.0 , 0.0 , 1000.0 ])
xdata.append([ 288.0 , 0.0 , 1500.0 ])
xdata.append([ 288.0 , 0.0 , 2000.0 ])
xdata.append([ 288.0 , 0.0 , 2500.0 ])
xdata.append([ 288.0 , 0.25 , 500.0 ])
xdata.append([ 288.0 , 0.25 , 1000.0 ])
xdata.append([ 288.0 , 0.25 , 1500.0 ])
xdata.append([ 288.0 , 0.25 , 2000.0 ])
xdata.append([ 288.0 , 0.25 , 2500.0 ])
xdata.append([ 288.0 , 0.5 , 500.0 ])
xdata.append([ 288.0 , 0.5 , 1000.0 ])
xdata.append([ 288.0 , 0.5 , 1500.0 ])
xdata.append([ 288.0 , 0.5 , 2000.0 ])
xdata.append([ 288.0 , 0.5 , 2500.0 ])
xdata.append([ 268.0 , 0.0 , 500.0 ])
xdata.append([ 268.0 , 0.0 , 1000.0 ])
xdata.append([ 268.0 , 0.0 , 1500.0 ])
xdata.append([ 268.0 , 0.0 , 2000.0 ])
xdata.append([ 268.0 , 0.0 , 2500.0 ])
xdata.append([ 268.0 , 0.25 , 500.0 ])
xdata.append([ 268.0 , 0.25 , 1000.0 ])
xdata.append([ 268.0 , 0.25 , 1500.0 ])
```

```
xdata.append([ 268.0 , 0.25 , 2000.0 ])
xdata.append([ 268.0 , 0.25 , 2500.0 ])
xdata.append([ 268.0 , 0.5 , 500.0 ])
xdata.append([ 268.0 , 0.5 , 1000.0 ])
xdata.append([ 268.0 , 0.5 , 1500.0 ])
xdata.append([ 268.0 , 0.5 , 2000.0 ])
xdata.append([ 268.0 , 0.5 , 2500.0 ])
ydata = [[ 35.1316 , 0.3808 ],[ 40.3764 , 0.38686 ]]
ydata.append([ 47.4620 , 0.3930 ])
ydata.append([ 57.5639 , 0.39949 ])
ydata.append([ 73.1286 , 0.40612 ])
ydata.append([ 49.1110 , 0.4023 ])
ydata.append([ 56.4428 , 0.40605 ])
ydata.append([ 66.3479 , 0.4098 ])
ydata.append([ 80.4695 , 0.413 ])
ydata.append([ 102.2276 , 0.4175 ])
ydata.append([ 63.0904 , 0.41540 ])
ydata.append([ 72.5092 , 0.4175 ])
ydata.append([ 85.2338, 0.4197 ])
ydata.append([ 103.3750 , 0.42192 ])
ydata.append([ 131.3266 , 0.4242 ])
ydata.append([ 34.273 , 0.3952 ])
ydata.append([ 38.99026 , 0.4012 ])
ydata.append([ 45.2133, 0.4073 ])
ydata.append([ 53.8000 , 0.4136 ])
ydata.append([ 66.4130 , 0.4201 ])
ydata.append([ 47.922 , 0.4178 ])
ydata.append([ 54.518 , 0.4215 ])
ydata.append([ 63.220 , 0.4252 ])
ydata.append([ 75.226 , 0.4290 ])
ydata.append([ 92.862 , 0.4329 ])
ydata.append([ 61.572 , 0.4315 ])
ydata.append([ 70.0468 , 0.43373 ])
ydata.append([ 81.226 , 0.43597 ])
ydata.append([ 96.653 , 0.4382 ])
ydata.append([ 119.3124 , 0.44045 ])
ydata.append([ 33.4521 , 0.40913 ])
ydata.append([ 37.6911, 0.4150 ])
ydata.append([ 43.1602 , 0.4209 ])
ydata.append([ 50.4858 , 0.4271 ])
ydata.append([ 60.8067 , 0.4334 ])
ydata.append([ 46.7865 , 0.4328 ])
ydata.append([ 52.7151 , 0.43646 ])
ydata.append([ 60.36425 , 0.44016 ])
ydata.append([ 70.6099 , 0.443926 ])
ydata.append([ 85.0447 , 0.4477 ])
ydata.append([ 60.1208 , 0.44721 ])
ydata.append([ 67.7391 , 0.44940 ])
ydata.append([ 77.56830 , 0.4516 ])
ydata.append([ 90.73410 , 0.4538 ])
```

```
ydata.append([ 109.2828 , 0.4560 ])
ydata.append([ 32.4123 , 0.42694 ])
ydata.append([ 36.0807 , 0.4325 ])
ydata.append([ 40.6854 , 0.4383 ])
ydata.append([ 46.6374 , 0.4442 ])
ydata.append([ 54.6293 , 0.4503 ])
ydata.append([ 45.3472 , 0.4519 ])
ydata.append([ 50.4796 , 0.4555 ])
ydata.append([ 56.9219 , 0.4591 ])
ydata.append([ 65.2492 , 0.4628 ])
ydata.append([ 76.4304 , 0.4665 ])
ydata.append([ 58.2822 , 0.4672 ])
ydata.append([ 64.8785 , 0.4693 ])
ydata.append([ 73.1584 , 0.4715 ])
ydata.append([ 83.8610 , 0.4738 ])
ydata.append([ 98.2316 , 0.4760 ])
print(xdata)
print(ydata)
```

Out[8]:

' #DATA ADDED TO CODEP2.4\nxdata = []\nxdata = [[318.0 , 0.0 , 500.0], [31 8.0 , 0.0 , 1000.0]]\nxdata.append([318.0 , 0.0 , 1500.0])\nxdata.append([318.0 , 0.0 , 2000.0])\nxdata.append([318.0 , 0.0 , 2500.0])\nxdata.append([318.0 , 0.25 , 500.0])\nxdata.append([318.0 , 0.25 , 1000.0])\nxdata.appe nd([318.0 , 0.25 , 1500.0])\nxdata.append([318.0 , 0.25 , 2000.0])\nxdata. append([318.0 , 0.25 , 2500.0])\nxdata.append([318.0 , 0.5 , 500.0])\nxdat a.append([318.0 , 0.5 , 1000.0])\nxdata.append([318.0 , 0.5 , 1500.0])\nxd ata.append([318.0 , 0.5 , 2000.0])\nxdata.append([318.0 , 0.5 , 2500.0])\n \nxdata.append([303.0 , 0.0 , 500.0])\nxdata.append([303.0 , 0.0 , 1000.0])\nxdata.append([303.0 , 0.0 , 1500.0])\nxdata.append([303.0 , 0.0 , 2000.0])\nxdata.append([303.0 , 0.0 , 2500.0])\nxdata.append([303.0 , 0.25 , 500. 0])\nxdata.append([303.0 , 0.25 , 1000.0])\nxdata.append([303.0 , 0.25 , 1 500.0])\nxdata.append([303.0 , 0.25 , 2000.0])\nxdata.append([303.0 , 0.25 , 2500.0])\nxdata.append([303.0 , 0.5 , 500.0])\nxdata.append([303.0 , 0.5 , 1000.0])\nxdata.append([303.0 , 0.5 , 1500.0])\nxdata.append([303.0 , 0. 5 , 2000.0])\nxdata.append([303.0 , 0.5 , 2500.0])\n \nxdata.append([288. 0 , 0.0 , 500.0])\nxdata.append([288.0 , 0.0 , 1000.0])\nxdata.append([288 .0 , 0.0 , 1500.0])\nxdata.append([288.0 , 0.0 , 2000.0])\nxdata.append([2 88.0 , 0.0 , 2500.0])\nxdata.append([288.0 , 0.25 , 500.0])\nxdata.append([288.0 , 0.25 , 1000.0])\nxdata.append([288.0 , 0.25 , 1500.0])\nxdata.appen d([288.0 , 0.25 , 2000.0])\nxdata.append([288.0 , 0.25 , 2500.0])\nxdata.a ppend([288.0 , 0.5 , 500.0])\nxdata.append([288.0 , 0.5 , 1000.0])\nxdata. append([288.0 , 0.5 , 1500.0])\nxdata.append([288.0 , 0.5 , 2000.0])\nxdat a.append([288.0 , 0.5 , 2500.0])\n \nxdata.append([268.0 , 0.0 , 500.0])\ nxdata.append([268.0 , 0.0 , 1000.0])\nxdata.append([268.0 , 0.0 , 1500.0])\nxdata.append([268.0 , 0.0 , 2000.0])\nxdata.append([268.0 , 0.0 , 2500.0])\nxdata.append([268.0 , 0.25 , 500.0])\nxdata.append([268.0 , 0.25 , 1000 .0])\nxdata.append([268.0 , 0.25 , 1500.0])\nxdata.append([268.0 , 0.25 , 2000.0])\nxdata.append([268.0 , 0.25 , 2500.0])\nxdata.append([268.0 , 0.5 , 500.0])\nxdata.append([268.0 , 0.5 , 1000.0])\nxdata.append([268.0 , 0.5 , 1500.0])\nxdata.append([268.0 , 0.5 , 2000.0])\nxdata.append([268.0 , 0. 5 , 2500.0])\n\nydata = [[35.1316 , 0.3808],[40.3764 , 0.38686]]\nydata. append([47.4620 , 0.3930])\nydata.append([57.5639 , 0.39949])\nydata.appen

> d([73.1286 , 0.40612])\nydata.append([49.1110 , 0.4023])\nydata.append([5 6.4428 , 0.40605])\nydata.append([66.3479 , 0.4098])\nydata.append([80.469 5 , 0.413])\nydata.append([102.2276 , 0.4175])\nydata.append([63.0904 , 0. 41540])\nydata.append([72.5092 , 0.4175])\nydata.append([85.2338, 0.4197])\nydata.append([103.3750 , 0.42192])\nydata.append([131.3266 , 0.4242])\n \nydata.append([34.273 , 0.3952])\nydata.append([38.99026 , 0.4012])\nydat a.append([45.2133, 0.4073])\nydata.append([53.8000 , 0.4136])\nydata.appen d([66.4130 , 0.4201])\nydata.append([47.922 , 0.4178])\nydata.append([54. 518 , 0.4215])\nydata.append([63.220 , 0.4252])\nydata.append([75.226 , 0. 4290])\nydata.append([92.862 , 0.4329])\nydata.append([61.572 , 0.4315])\ nydata.append([70.0468 , 0.43373])\nydata.append([81.226 , 0.43597])\nydat a.append([96.653 , 0.4382])\nydata.append([119.3124 , 0.44045])\n \nydata .append([33.4521 , 0.40913])\nydata.append([37.6911, 0.4150])\nydata.appen d([43.1602 , 0.4209])\nydata.append([50.4858 , 0.4271])\nydata.append([60 .8067 , 0.4334])\nydata.append([46.7865 , 0.4328])\nydata.append([52.7151 , 0.43646])\nydata.append([60.36425 , 0.44016])\nydata.append([70.6099 , 0 .443926])\nydata.append([85.0447 , 0.4477])\nydata.append([60.1208 , 0.447 21])\nydata.append([67.7391 , 0.44940])\nydata.append([77.56830 , 0.4516] \nydata.append([90.73410 , 0.4538])\nydata.append([109.2828 , 0.4560])\n \nydata.append([32.4123 , 0.42694])\nydata.append([36.0807 , 0.4325])\nyda ta.append([40.6854 , 0.4383])\nydata.append([46.6374 , 0.4442])\nydata.app end([54.6293 , 0.4503])\nydata.append([45.3472 , 0.4519])\nydata.append([50.4796 , 0.4555])\nydata.append([56.9219 , 0.4591])\nydata.append([65.249 2 , 0.4628])\nydata.append([76.4304 , 0.4665])\nydata.append([58.2822 , 0. 4672])\nydata.append([64.8785 , 0.4693])\nydata.append([73.1584 , 0.4715])\nydata.append([83.8610 , 0.4738])\nydata.append([98.2316 , 0.4760])\n\np rint(xdata)\nprint(ydata)\n'

```
In [79]:
```

```
'''>>>> start CodeP2.4
    V.P. Carey ME249, Spring 2021
Intro to Neural Network Modeling
Keras model for hybrid solar/fossil-fuel gas turbine power system'''
#import useful packages
import keras
import pandas as pd
from keras.models import Sequential
import numpy as np
import keras.backend as kb
import tensorflow as tf
import copy as cp
#the follwoing 2 lines are only needed for Mac OS machines
os.environ['KMP DUPLICATE LIB OK']='True'
#Task 2.1 Normalize Data
#initialize
xdatan=[]
ydatan=[]
T=[]
ga=[]
```

```
qs=[]
al=[]
ef=[]
def median(sample):
                     #function to calculate median
    n = len(sample)
    i = n//2
    if n%2:
        return sorted (sample [i])
    return sum(sorted(sample)[i-1:i+1])/2
#create input data array
\#T1(K), gamma, , qsol(kW):
xdata = []
xdata = [[ 318.0 , 0.0 , 500.0 ], [ 318.0 , 0.0 , 1000.0 ]]
xdata.append([ 318.0 , 0.0 , 1500.0 ])
xdata.append([ 318.0 , 0.0 , 2000.0 ])
xdata.append([ 318.0 , 0.0 , 2500.0 ])
xdata.append([ 318.0 , 0.25 , 500.0 ])
xdata.append([ 318.0 , 0.25 , 1000.0 ])
xdata.append([ 318.0 , 0.25 , 1500.0 ])
xdata.append([ 318.0 , 0.25 , 2000.0 ])
xdata.append([ 318.0 , 0.25 , 2500.0 ])
xdata.append([ 318.0 , 0.5 , 500.0 ])
xdata.append([ 318.0 , 0.5 , 1000.0 ])
xdata.append([ 318.0 , 0.5 , 1500.0 ])
xdata.append([ 318.0 , 0.5 , 2000.0 ])
xdata.append([ 318.0 , 0.5 , 2500.0 ])
xdata.append([ 303.0 , 0.0 , 500.0 ])
xdata.append([ 303.0 , 0.0 , 1000.0 ])
xdata.append([ 303.0 , 0.0 , 1500.0 ])
xdata.append([ 303.0 , 0.0 , 2000.0 ])
xdata.append([ 303.0 , 0.0 , 2500.0 ])
xdata.append([ 303.0 , 0.25 , 500.0 ])
xdata.append([ 303.0 , 0.25 , 1000.0 ])
xdata.append([ 303.0 , 0.25 , 1500.0 ])
xdata.append([ 303.0 , 0.25 , 2000.0 ])
xdata.append([ 303.0 , 0.25 , 2500.0 ])
xdata.append([ 303.0 , 0.5 , 500.0 ])
xdata.append([ 303.0 , 0.5 , 1000.0 ])
xdata.append([ 303.0 , 0.5 , 1500.0 ])
xdata.append([ 303.0 , 0.5 , 2000.0 ])
xdata.append([ 303.0 , 0.5 , 2500.0 ])
xdata.append([ 288.0 , 0.0 , 500.0 ])
xdata.append([ 288.0 , 0.0 , 1000.0 ])
xdata.append([ 288.0 , 0.0 , 1500.0 ])
xdata.append([ 288.0 , 0.0 , 2000.0 ])
xdata.append([ 288.0 , 0.0 , 2500.0 ])
xdata.append([ 288.0 , 0.25 , 500.0 ])
xdata.append([ 288.0 , 0.25 , 1000.0 ])
xdata.append([ 288.0 , 0.25 , 1500.0 ])
```

```
xdata.append([ 288.0 , 0.25 , 2000.0 ])
xdata.append([ 288.0 , 0.25 , 2500.0 ])
xdata.append([ 288.0 , 0.5 , 500.0 ])
xdata.append([ 288.0 , 0.5 , 1000.0 ])
xdata.append([ 288.0 , 0.5 , 1500.0 ])
xdata.append([ 288.0 , 0.5 , 2000.0 ])
xdata.append([ 288.0 , 0.5 , 2500.0 ])
xdata.append([ 268.0 , 0.0 , 500.0 ])
xdata.append([ 268.0 , 0.0 , 1000.0 ])
xdata.append([ 268.0 , 0.0 , 1500.0 ])
xdata.append([ 268.0 , 0.0 , 2000.0 ])
xdata.append([ 268.0 , 0.0 , 2500.0 ])
xdata.append([ 268.0 , 0.25 , 500.0 ])
xdata.append([ 268.0 , 0.25 , 1000.0 ])
xdata.append([ 268.0 , 0.25 , 1500.0 ])
xdata.append([ 268.0 , 0.25 , 2000.0 ])
xdata.append([ 268.0 , 0.25 , 2500.0 ])
xdata.append([ 268.0 , 0.5 , 500.0 ])
xdata.append([ 268.0 , 0.5 , 1000.0 ])
xdata.append([ 268.0 , 0.5 , 1500.0 ])
xdata.append([ 268.0 , 0.5 , 2000.0 ])
xdata.append([ 268.0 , 0.5 , 2500.0 ])
# alpha, effsys
ydata = []
ydata = [[ 35.1316 , 0.3808 ],[ 40.3764 , 0.38686 ]]
ydata.append([ 47.4620 , 0.3930 ])
ydata.append([ 57.5639 , 0.39949 ])
ydata.append([ 73.1286 , 0.40612 ])
ydata.append([ 49.1110 , 0.4023 ])
ydata.append([ 56.4428 , 0.40605 ])
ydata.append([ 66.3479 , 0.4098 ])
ydata.append([ 80.4695 , 0.413 ])
ydata.append([ 102.2276 , 0.4175 ])
ydata.append([ 63.0904 , 0.41540 ])
ydata.append([ 72.5092 , 0.4175 ])
ydata.append([ 85.2338, 0.4197 ])
ydata.append([ 103.3750 , 0.42192 ])
ydata.append([ 131.3266 , 0.4242 ])
ydata.append([ 34.273 , 0.3952 ])
ydata.append([ 38.99026 , 0.4012 ])
ydata.append([ 45.2133, 0.4073 ])
ydata.append([ 53.8000 , 0.4136 ])
ydata.append([ 66.4130 , 0.4201 ])
ydata.append([ 47.922 , 0.4178 ])
ydata.append([ 54.518 , 0.4215 ])
ydata.append([ 63.220 , 0.4252 ])
ydata.append([ 75.226 , 0.4290 ])
ydata.append([ 92.862 , 0.4329 ])
ydata.append([ 61.572 , 0.4315 ])
ydata.append([ 70.0468 , 0.43373 ])
```

```
ydata.append([ 81.226 , 0.43597 ])
ydata.append([ 96.653 , 0.4382 ])
ydata.append([ 119.3124 , 0.44045 ])
ydata.append([ 33.4521 , 0.40913 ])
ydata.append([ 37.6911, 0.4150 ])
ydata.append([ 43.1602 , 0.4209 ])
ydata.append([ 50.4858 , 0.4271 ])
ydata.append([ 60.8067 , 0.4334 ])
ydata.append([ 46.7865 , 0.4328 ])
ydata.append([ 52.7151 , 0.43646 ])
ydata.append([ 60.36425 , 0.44016 ])
ydata.append([ 70.6099 , 0.443926 ])
ydata.append([ 85.0447 , 0.4477 ])
ydata.append([ 60.1208 , 0.44721 ])
ydata.append([ 67.7391 , 0.44940 ])
ydata.append([ 77.56830 , 0.4516 ])
ydata.append([ 90.73410 , 0.4538 ])
ydata.append([ 109.2828 , 0.4560 ])
ydata.append([ 32.4123 , 0.42694 ])
ydata.append([ 36.0807 , 0.4325 ])
ydata.append([ 40.6854 , 0.4383 ])
ydata.append([ 46.6374 , 0.4442 ])
ydata.append([ 54.6293 , 0.4503 ])
ydata.append([ 45.3472 , 0.4519 ])
ydata.append([ 50.4796 , 0.4555 ])
ydata.append([ 56.9219 , 0.4591 ])
ydata.append([ 65.2492 , 0.4628 ])
ydata.append([ 76.4304 , 0.4665 ])
ydata.append([ 58.2822 , 0.4672 ])
ydata.append([ 64.8785 , 0.4693 ])
ydata.append([ 73.1584 , 0.4715 ])
ydata.append([ 83.8610 , 0.4738 ])
ydata.append([ 98.2316 , 0.4760 ])
xdatar = np.array(cp.deepcopy(xdata)) #xdata copy
ydatar = np.array(cp.deepcopy(ydata)) #ydata copy
for x in range(len(xdatar)):
    T.append(xdatar[x][0])
    ga.append(xdatar[x][1])
    qs.append(xdatar[x][2])
for y in range(len(ydatar)):
    al.append(ydatar[y][0])
    ef.append(ydatar[y][1])
Tmed = median (T) #find median of the parameters
gamed = median(ga)
qsmed = median(qs)
almed = median(al)
efmed = median(ef)
```

```
for x in range(len(xdatar)):
    xdatan.append([xdatar[x][0]/Tmed, xdatar[x][1]/gamed, xdatar[x][2]/qsmed]

for y in range(len(ydatar)):
    ydatan.append([ydatar[y][0]/almed, ydatar[y][1]/efmed])

xarray= np.array(xdatan)
#print (xdata)
print('normalized xdata = ')
print (xarray)

yarray= np.array(ydatan)
#print (ydata)
print('normalized ydata = ')
print (yarray)
normalized xdata =
```

```
[[1.07614213 0.
                         0.33333333
[1.07614213 0.
                         0.666666671
 [1.07614213 0.
                         1.333333331
[1.07614213 0.
 [1.07614213 0.
                         1.66666667]
 [1.07614213 1.
                         0.333333331
 [1.07614213 1.
                         0.66666671
 [1.07614213 1.
 [1.07614213 1.
                         1.333333331
 [1.07614213 1.
                         1.66666667]
                         0.333333331
 [1.07614213 2.
[1.07614213 2.
                         0.66666667]
 [1.07614213 2.
 [1.07614213 2.
                         1.333333331
 [1.07614213 2.
                         1.66666667]
 [1.02538071 0.
                         0.33333333
 [1.02538071 0.
                         0.66666671
 [1.02538071 0.
                         1.333333331
[1.02538071 0.
 [1.02538071 0.
                         1.66666671
 [1.02538071 1.
                         0.33333333
 [1.02538071 1.
                         0.66666671
[1.02538071 1.
 [1.02538071 1.
                         1.333333331
 [1.02538071 1.
                         1.66666667]
                         0.333333331
[1.02538071 2.
 [1.02538071 2.
                         0.66666671
 [1.02538071 2.
 [1.02538071 2.
                         1.333333331
[1.02538071 2.
                         1.66666667]
[0.97461929 0.
                         0.33333331
 [0.97461929 0.
                         0.66666671
 [0.97461929 0.
 [0.97461929 0.
                         1.33333333
 [0.97461929 0.
                         1.66666667]
 [0.97461929 1.
                         0.333333331
 [0.97461929 1.
                         0.66666667]
```

```
[0.97461929 1.
 [0.97461929 1.
                         1.33333333]
 [0.97461929 1.
                         1.666666671
 [0.97461929 2.
                         0.333333331
 [0.97461929 2.
                         0.66666671
 [0.97461929 2.
 [0.97461929 2.
                         1.333333331
 [0.97461929 2.
                         1.666666671
 [0.90693739 0.
                         0.333333331
 [0.90693739 0.
                         0.666666671
 [0.90693739 0.
                         1.
 [0.90693739 0.
                         1.33333333
 [0.90693739 0.
                         1.66666667]
 [0.90693739 1.
                         0.333333331
                         0.666666671
 [0.90693739 1.
 [0.90693739 1.
 [0.90693739 1.
                         1.33333333]
 [0.90693739 1.
                         1.666666671
 [0.90693739 2.
                         0.333333331
 [0.90693739 2.
                         0.666666671
 [0.90693739 2.
 [0.90693739 2.
                         1.333333331
 [0.90693739 2.
                         1.66666667]]
normalized ydata =
[[0.57414566 0.88148148]
 [0.65985993 0.89550926]
 [0.77565786 0.90972222]
 [0.94075031 0.92474537]
 [1.19511974 0.94009259]
 [0.80260699 0.93125
 [0.92242849 0.93993056]
 [1.0843047 0.94861111]
 [1.31508996 0.95601852]
 [1.67067635 0.96643519]
 [1.03106831 0.96157407]
 [1.18499706 0.96643519]
 [1.39295155 0.97152778]
 [1.68942798 0.97666667]
 [2.14623296 0.98194444]
 [0.56011381 0.91481481]
 [0.63720664 0.9287037 ]
 [0.738908
             0.942824071
 [0.87923797 0.95740741]
 [1.08536861 0.9724537 ]
 [0.7831755 0.96712963]
 [0.89097204 0.97569444]
 [1.03318633 0.98425926]
 [1.22939695 0.99305556]
 [1.51761704 1.00208333]
 [1.00625354 0.99884259]
 [1.14475477 1.00400463]
 [1.32745323 1.00918981]
 [1.57957226 1.01435185]
 [1.94988834 1.01956019]
 [0.54669808 0.94706019]
 [0.61597484 0.96064815]
 [0.70535477 0.97430556]
```

```
[0.82507495 0.98865741]
[0.99374646 1.00324074]
[0.76461835 1.00185185]
[0.86150776 1.01032407]
[0.98651563 1.01888889]
[1.15395735 1.02760648]
[1.38986114 1.03634259]
[0.98253699 1.03520833]
[1.10704069 1.04027778]
[1.26767648 1.04537037]
[1.48284138 1.05046296]
[1.78597746 1.05555556]
[0.52970492 0.98828704]
[0.58965653 1.00115741]
[0.66490982 1.01458333]
[0.76218165 1.02824074]
[0.89279098 1.04236111]
[0.74109629 1.04606481]
[0.82497363 1.05439815]
[0.93025829 1.06273148]
[1.06634896 1.0712963 ]
[1.24908011 1.07986111]
[0.95248928 1.08148148]
[1.06029072 1.08634259]
[1.19560675 1.09143519]
[1.37051627 1.09675926]
[1.60537087 1.10185185]]
# define neural network model
#As seen below, we have created four dense layers.
#A dense layer is a layer in neural network that's fully connected.
#In other words, all the neurons in one layer are connected to all other neur
#In the first layer, we need to provide the input shape, which is 1 in our ca
#The activation function we have chosen is elu, which stands for exponential
from keras import backend as K
#initialize weights with values between -0.2 and 1.2
initializer = tf.keras.initializers.RandomUniform(minval= -0.2, maxval=1.2)
model = keras.Sequential([
    keras.layers.Dense(16, activation=K.relu, input shape=[3]),
    keras.layers.Dense(32, activation=K.relu),
```

keras.layers.Dense(2)

])

keras.layers.Dense(16, activation=K.relu),

In [80]:

```
#We're using RMSprop as our optimizer here. RMSprop stands for Root Mean Squa #It's one of the most popular gradient descent optimization algorithms for de #RMSprop is an optimizer that's reliable and fast.

#We're compiling the mode using the model.compile function. The loss function #is mean squared error. After the compilation of the model, we'll use the fit #Number of epochs can be varied.

#from tf.keras import optimizers

sgd = tf.keras.optimizers.RMSprop(0.001) #original value 0.050
model.compile(loss='mean_absolute_error',optimizer='sgd')
```

In [82]: #After the compilation of the model, we'll use the fit method with 500 epochs #I started with epochs value of 100 and then tested the model after training. #The prediction was not that good. Then I modified the number of epochs to 20 #Accuracy had improved slightly, but figured I'd give it one more try. Finall #I found acceptable prediction accuracy. #The fit method takes three parameters; namely, x, y, and number of epochs. #During model training, if all the batches of data are seen by the model once #we say that one epoch has been completed. # Add an early stopping callback es = keras.callbacks.EarlyStopping(monitor='loss', mode='min', patience = 20, restore_best_weights = True, verbose=1) # Add a checkpoint where loss is minimum, and save that model mc = keras.callbacks.ModelCheckpoint('best model.SB', monitor='loss', mode='min', verbose=1, save best only=True) historyData = model.fit(xarray,yarray,epochs=600,callbacks=[es]) #epoch origi loss hist = historyData.history['loss'] #The above line will return a dictionary, access it's info like this: best_epoch = np.argmin(historyData.history['loss']) + 1 print ('best epoch = ', best_epoch) print('smallest loss =', np.min(loss_hist))

Epoch	6/600			
	[=======]	_	0s	318us/step - loss: 0.5672
Epoch	7/600			
	[======]	-	0s	225us/step - loss: 0.4815
Epoch				
	[========]	-	0s	210us/step - loss: 0.3893
Epoch	9/600 [========]		Λc	359us/sten loss 0 3002
	10/600	_	US	339us/scep - 10ss: 0.3002
	[=======]	_	0s	427us/step - loss: 0.2413
Epoch	11/600			_
	[======]	-	0s	246us/step - loss: 0.2138
	12/600		•	0.000 / 1 0.000
	[======] 13/600	-	0s	3/3us/step - loss: 0.1975
	[==========]	_	۸e	373ug/sten _ loss• 0 1888
	14/600		V.S	3/3us/scep - 10ss. 0:1000
	[========]	_	0s	180us/step - loss: 0.1835
	15/600			
	[=====]	-	0s	136us/step - loss: 0.1756
	16/600 [======]		0	152/
	17/600	_	US	152us/step - 10ss: 0.1/04
	[========]	_	0s	124us/step - loss: 0.1648
Epoch	18/600			_
	[======]	-	0s	156us/step - loss: 0.1604
	19/600			
	[=======]	-	0s	334us/step - loss: 0.1552
	20/600 [======]	_	۸e	263ug/sten _ loss
	21/600	_	V.S	203us/scep - 10ss. 0:1313
	[========]	_	0s	286us/step - loss: 0.1483
	22/600			
	[=====]	-	0s	352us/step - loss: 0.1425
	23/600		٥٠	256::g/ghom logg: 0 1202
	24/600	_	US	356us/step - 10ss: 0.1393
	[=======]	_	0s	487us/step - loss: 0.1371
Epoch	25/600			
	[======]	-	0s	268us/step - loss: 0.1351
	26/600		•	266 / 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
	[======] 27/600	-	0s	366us/step - loss: 0.1300
	[========]	_	Λs	186us/sten = loss: 0.1269
	28/600		OB	10000, 5000 1055. 0:1209
	[=======]	_	0s	229us/step - loss: 0.1244
	29/600			
	[=======]	-	0s	280us/step - loss: 0.1237
	30/600		٥٥	105ug/gton logg. 0 1216
	31/600	_	US	195us/step - 10ss: 0.1216
	[=======]	_	0s	178us/step - loss: 0.1181
Epoch	32/600			
	[======]	-	0s	156us/step - loss: 0.1161
	33/600		^	104/
	[======] 34/600	-	US	124us/step - 10ss: 0.1145
просп	J=/ UUU			

60/60	[======]	_	0s	134us/step - loss: 0	.1123
Epoch	35/600				
	[======]	-	0s	156us/step - loss: 0	.1113
	36/600		•	100 / 1	1004
	[======] 37/600	-	0s	128us/step - loss: 0	.1094
	[=========]	_	٥٩	142115/sten = loss. 0	1078
	38/600		V.S	142us/scep - 10ss. 0	7.1070
	[=========]	_	0s	191us/step - loss: 0	.1067
	39/600				
	[=====]	-	0s	164us/step - loss: 0	.1063
	40/600 [=======]		0 -	167/	1042
	41/600	_	US	16/us/step = loss: 0	0.1043
	[=======]	_	0s	145us/step - loss: 0	.1025
	42/600				
	[======]	-	0s	135us/step - loss: 0	.1015
	43/600				
	[======]	-	0s	167us/step - loss: 0	.1003
	44/600 [=======]	_	۸e	29311g/g+on - logg. 0	1007
	45/600	_	US	293us/scep - 10ss. 0	7.1007
	[========]	_	0s	185us/step - loss: 0	0.0987
Epoch	46/600				
	[=====]	-	0s	117us/step - loss: 0	0.0972
	47/600 [=======]		0 ~	102	0071
	48/600	-	US	193us/step - 10ss: 0	0.09/1
	[=======]	_	0s	163us/step - loss: 0	0.0965
Epoch	49/600				
	[======]	-	0s	166us/step - loss: 0	.0959
	50/600		•		
	[======] 51/600	-	US	214us/step - loss: 0	0.0949
	[========]	_	0s	153us/step - loss: 0	0.0943
	52/600				
	[======]	-	0s	231us/step - loss: 0	0.0943
	53/600		•	100 / 1	
	[======] 54/600	-	0s	139us/step - loss: 0	0.0940
	[========]	_	0s	152us/step = loss: 0	0.0933
	55/600		Ů.	10245,5005 1055.0	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
60/60	[======]	_	0s	130us/step - loss: 0	.0919
	56/600				
	[=========]	-	0s	133us/step - loss: 0	0.0924
	57/600 [=======]	_	۸e	15911g/gton - logg. 0	0 0924
	58/600		V.S	137d3/Scep - 1055. 0	0.0024
	[=========]	_	0s	144us/step - loss: 0	0.0902
	59/600				
	[======]	-	0s	241us/step - loss: 0	0.0920
	60/600 [=======]		٥٥	192ug/g+on logg: 0	0000
	61/600	_	UB	17202/20Eb - 1022: 0	0.0000
	[=======]	_	0s	135us/step - loss: 0	0.0882
Epoch	62/600				
60/60	[=====]	-	0s	154us/step - loss: 0	0.0882

Enoch	63/600				
	[========]	_	0s	169us/step - loss:	0.0880
	64/600		٥٥	103 db, 500p 1055	
60/60	[======]	_	0s	150us/step - loss:	0.0873
	65/600				
	[=====]	-	0s	221us/step - loss:	0.0875
	66/600		0	104 / 1 3	0 0065
	[=========]	-	0s	194us/step - loss:	0.0865
	67/600 [======]	_	Λe	18711g/gton - logg.	0 0877
	68/600	_	V.S	10/us/scep - 10ss.	0.0077
	[========]	_	0s	168us/step - loss:	0.0871
Epoch	69/600				
	[======]	-	0s	201us/step - loss:	0.0860
	70/600		_		
	[=========]	-	0s	142us/step - loss:	0.0884
	71/600 [=========]	_	۸e	16111g/gton - logg.	0 0857
	72/600		V.S	101us/scep - 10ss.	0.0037
	[========]	_	0s	170us/step - loss:	0.0865
	73/600				
	[=====]	-	0s	237us/step - loss:	0.0844
	74/600 [======]		0~	254/5+5	0 0000
	75/600	_	US	254us/step - loss:	0.0838
	[=======]	_	0s	238us/step - loss:	0.0839
Epoch	76/600			_	
	[======]	-	0s	236us/step - loss:	0.0834
	77/600		_		
	[======] 78/600	-	0s	219us/step - loss:	0.0833
	[=========]	_	Λs	26311s/sten - loss:	0.0826
	79/600		٥٥	200 db / b cop	0.0020
60/60	[======]	_	0s	269us/step - loss:	0.0825
	80/600				
	[======================================	-	0s	531us/step - loss:	0.0839
_	81/600 [======]		Λc	37/11g/gton logg.	0 0010
	82/600	_	V.S	3/4us/scep - 10ss.	0.0010
	[========]	_	0s	369us/step - loss:	0.0813
Epoch	83/600				
	[======]	-	0s	258us/step - loss:	0.0811
-	84/600		0	700/	0 0006
	[=======] 85/600	-	US	/88us/step - loss:	0.0806
	[=======]	_	0s	559us/step - loss:	0.0809
	86/600				
	[======]	_	0s	235us/step - loss:	0.0802
	87/600				
	[========]	-	0s	185us/step - loss:	0.0804
	88/600 [======]	_	۸e	23511g/gton - logg.	0 0795
	89/600	_	va	20000/pceh - 10pp:	0.0193
	[=======]	_	0s	162us/step - loss:	0.0794
	90/600				
	[========]	-	0s	262us/step - loss:	0.0800
Epoch	91/600				

```
60/60 [=============== ] - 0s 370us/step - loss: 0.0791
Epoch 92/600
60/60 [============ ] - 0s 481us/step - loss: 0.0789
Epoch 93/600
Epoch 94/600
60/60 [================ ] - 0s 271us/step - loss: 0.0785
Epoch 95/600
Epoch 96/600
Epoch 97/600
- loss: 0.0777
Epoch 98/600
60/60 [=============== ] - 0s 296us/step - loss: 0.0783
Epoch 99/600
60/60 [============= ] - 0s 333us/step - loss: 0.0777
Epoch 100/600
Epoch 101/600
Epoch 102/600
60/60 [============== ] - 0s 191us/step - loss: 0.0792
Epoch 103/600
60/60 [============= ] - 0s 457us/step - loss: 0.0771
Epoch 104/600
60/60 [=========== ] - 0s 348us/step - loss: 0.0770
Epoch 105/600
60/60 [============ ] - 0s 216us/step - loss: 0.0767
Epoch 106/600
60/60 [============= ] - 0s 267us/step - loss: 0.0763
Epoch 107/600
60/60 [============== ] - 0s 155us/step - loss: 0.0764
Epoch 108/600
60/60 [============= ] - 0s 204us/step - loss: 0.0763
Epoch 109/600
Epoch 110/600
60/60 [============= ] - 0s 211us/step - loss: 0.0758
Epoch 111/600
Epoch 112/600
60/60 [================ ] - 0s 240us/step - loss: 0.0766
Epoch 113/600
60/60 [============== ] - 0s 195us/step - loss: 0.0762
Epoch 114/600
60/60 [============= ] - 0s 233us/step - loss: 0.0755
Epoch 115/600
60/60 [============== ] - 0s 276us/step - loss: 0.0760
Epoch 116/600
60/60 [============ ] - 0s 214us/step - loss: 0.0785
Epoch 117/600
60/60 [============= ] - 0s 416us/step - loss: 0.0755
Epoch 118/600
60/60 [============= ] - 0s 183us/step - loss: 0.0768
Epoch 119/600
```

60/60	[======]	_	0s	221us/step - loss: 0.0	748
	120/600 [========]		0 ~	242	744
	121/600	_	US	342us/step - 10ss: 0.0) / 4 4
60/60	[======]	_	0s	258us/step - loss: 0.0	739
	122/600		•		
	[======] 123/600	-	0s	228us/step - loss: 0.0)/35
60/60	[======]	_	0s	214us/step - loss: 0.0	742
	124/600		•	050 / 1 3 0 6	7.45
	[======] 125/600	_	US	259us/step - 10ss: 0.0)/45
60/60	[======]	_	0s	227us/step - loss: 0.0	767
	126/600		0 -	240/	750
	[======] 127/600	_	US	248us/step - 10ss: 0.0)/50
60/60	[======]	_	0s	237us/step - loss: 0.0	0731
	128/600		0 ~	210	716
	129/600	_	US	218us/step - 10ss: 0.0)/46
60/60	[======]	_	0s	178us/step - loss: 0.0	727
	130/600 [=========]		٥٩	20Eug/gton logg. 0 (777
	131/600	-	US	205us/step - 10ss: 0.0) / 2 /
60/60	[======]	_	0s	189us/step - loss: 0.0	739
	132/600 [========]		٥٩	170ug/gton logg. 0 (776
	133/600	_	US	1/0us/step - 10ss: 0.0	1/26
60/60	[======]	_	0s	143us/step - loss: 0.0	738
	134/600 [=========]		٥٩	170ug/gton logg. 0 (776
	135/600	_	05	1/ous/scep - 10ss: 0.0	7/20
60/60	[======]	-	0s	168us/step - loss: 0.0	727
	136/600 [=========]		٥٥	169ug/gton logg. 0 (774
	137/600	_	US	100us/scep - 10ss: 0.0	1124
	[=======]	-	0s	150us/step - loss: 0.0	735
	138/600 [==========]	_	Λe	173ug/gton - logg. 0 (715
	139/600		V.S	1/3us/scep - 10ss. 0.0	3713
	[======]	-	0s	203us/step - loss: 0.0	725
	140/600 [=========]	_	0 s	198us/sten = loss: 0.0	1720
Epoch	141/600				
	[=======]	-	0s	256us/step - loss: 0.0	0714
	142/600 [=========]	_	0s	129us/step - loss: 0.0	718
Epoch	143/600				
	[=========]	-	0s	178us/step - loss: 0.0	719
	144/600	_	0s	205us/step - loss: 0.0	0710
Epoch	145/600				
	[========]	-	0s	211us/step - loss: 0.0	0720
	146/600	_	0s	196us/step - loss: 0.0	0719
Epoch	147/600				
60/60	[=====]	-	0s	220us/step - loss: 0.0	0717

Epoch	148/600				
	[=========]	_	0s	209us/step - loss: 0.070	9
Epoch	149/600				
	[]	-	0s	174us/step - loss: 0.070	1
	150/600		^	242 / 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
	[======] 151/600	_	US	242us/step - loss: 0.0/0) 2
	[==========]	_	0s	206us/step = loss: 0.070	1
	152/600		٥٥	Total, roop Total (10)	_
60/60	[======]	_	0s	187us/step - loss: 0.069	9
	153/600				
	[======] 154/600	-	0s	163us/step - loss: 0.069	9
	[==========]	_	Λs	194us/sten = loss: 0.069	8 (
	155/600		0 D	19148/1009 1000. 0.009	, 0
60/60	[======]	_	0s	163us/step - loss: 0.070)6
	156/600				
	[======] 157/600	-	0s	213us/step - loss: 0.069	9
	[==========]	_	0s	312us/step - loss: 0.069	96
Epoch	158/600			-	
	[======]	_	0s	177us/step - loss: 0.071	8
	159/600		•	170 / 1 2 0 000	
	[======] 160/600	_	US	1/0us/step - loss: 0.069	15
	[========]	_	0s	173us/step - loss: 0.069	3
Epoch	161/600				
	[======]	_	0s	179us/step - loss: 0.069	0
	162/600 [=======]		٥٥	162ug/gton logg. 0 071	2
	163/600	_	US	103us/scep - 10ss: 0.0/1	
	[========]	_	0s	158us/step - loss: 0.070	9
	164/600				
	[======================================	-	0s	181us/step - loss: 0.070)3
	165/600 [=======]	_	0s	173us/step = loss: 0.069	3
	166/600		• •	1,045, 200p	
	[]	_	0s	177us/step - loss: 0.069	94
	167/600		0 -	151/	
	[======] 168/600	_	US	151us/step - 10ss: 0.068	39
	[========]	_	0s	149us/step - loss: 0.069	0
Epoch	169/600				
	[=======]	_	0s	161us/step - loss: 0.069	8
	170/600 [=======]		٥٥	182ug/g+on logg: 0.069	20
	171/600	_	US	102us/scep - 10ss: 0.000	כס
	[========]	_	0s	134us/step - loss: 0.068	37
	172/600				
	[======================================	-	0s	167us/step - loss: 0.068	37
	173/600 [=======]	_	Λς	178us/sten = loss: 0.069	8 (
	174/600		0.0		
	[========]	-	0s	201us/step - loss: 0.070	4
	175/600		^	102/	
	[======] 176/600	-	US	182us/step - loss: 0.069	16
просп	1,0,000				

60/60	[======]	_	0s	305us/step - loss:	0.0683
	177/600 [========]		0 a	145,19/9+09 1099	0 0605
	178/600	_	US	145us/step - 10ss:	0.0085
60/60	[======]	_	0s	158us/step - loss:	0.0692
	179/600 [=========]		0 ~	105	0 0605
	180/600	_	US	185us/step - loss:	0.0685
	[======]	_	0s	168us/step - loss:	0.0682
	181/600		0	152/	0 0710
	[======] 182/600	_	US	153us/step - loss:	0.0/18
60/60	[======]	_	0s	163us/step - loss:	0.0682
	183/600 [======]		0 -	210/	0 0600
	184/600	_	US	210us/step - loss:	0.0682
60/60	[======]	_	0s	244us/step - loss:	0.0680
	185/600		0 -	201/	0 0600
	[======] 186/600	_	US	201us/step - loss:	0.0688
60/60	[======]	_	0s	250us/step - loss:	0.0679
	187/600		0 -	220/	0 0603
	[======] 188/600	_	US	239us/step - loss:	0.0693
60/60	[======]	_	0s	290us/step - loss:	0.0680
	189/600		0 -	262/	0 0604
	[======] 190/600	-	0s	263us/step - loss:	0.0684
60/60	[======]	_	0s	224us/step - loss:	0.0683
	191/600		0 -	100/	0 0670
	[======] 192/600	_	US	198us/step - loss:	0.06/9
60/60	[======]	_	0s	330us/step - loss:	0.0680
	193/600		0 ~	106	0 0602
	194/600	_	US	196us/step - loss:	0.0083
	[======]	_	0s	180us/step - loss:	0.0687
	195/600 [=======]		٥٥	216ug/gton logg.	0 0690
	196/600	_	US	210us/scep - 10ss:	0.0009
	[=======]	-	0s	282us/step - loss:	0.0702
	197/600 [==========]		Λσ	586ug/gton logg.	0 0678
	198/600		05	300ds/scep - 10ss.	0.0070
	[=====]	-	0s	310us/step - loss:	0.0675
	199/600	_	Λe	210ug/gten _ logg.	0 0676
	200/600		05	210d5/5cep - 1055.	0.0070
	[======]	-	0s	292us/step - loss:	0.0672
	201/600 [=========]	_	Λς	20111g/gten - logg.	0 0676
	202/600		05	201db/bccp - 1055.	0.0070
	[======]	-	0s	220us/step - loss:	0.0689
	203/600 [==========]	_	0 <	173us/sten = loss.	0.0673
Epoch	204/600				
60/60	[=====]	-	0s	208us/step - loss:	0.0674

Epoch	205/600				
	[=======]	_	0s	283us/step - loss:	0.0670
Epoch	206/600				
	[=======]	-	0s	238us/step - loss:	0.0694
-	207/600		^	044 / 1 3	0 0607
	[=======] 208/600	_	US	244us/step - loss:	0.0697
	[=========]	_	0s	363us/step = loss:	0.0672
	209/600		٥٥		0000,=
60/60	[======]	_	0s	503us/step - loss:	0.0671
	210/600				
	[======] 211/600	-	0s	544us/step - loss:	0.0689
	[=========]	_	Λs	50311s/sten - loss:	0.0670
	212/600		0 D	303db/bccp 10bb.	0.0070
	[======]	_	0s	287us/step - loss:	0.0676
	213/600				
	[=========]	-	0s	183us/step - loss:	0.0691
	214/600 [=======]	_	Λs	23111g/sten - loss:	0.0670
	215/600		O D	20105/2009 1055	0.0070
	[======]	-	0s	268us/step - loss:	0.0667
	216/600		•	001 / 1	0.0650
	[======] 217/600	-	0s	201us/step - loss:	0.0670
	[========]	_	0s	207us/step - loss:	0.0670
Epoch	218/600			_	
	[======]	-	0s	363us/step - loss:	0.0664
	219/600 [======]		٥~	101/5+5	0 0664
	220/600	-	US	191us/step - 10ss:	0.0664
	[=======]	_	0s	178us/step - loss:	0.0664
	221/600				
	[=========]	-	0s	153us/step - loss:	0.0663
	222/600 [======]	_	۸e	214ug/gton - logg.	0 0669
	223/600		0.5	21405/500p - 1055.	0.0003
_	[======]	_	0s	203us/step - loss:	0.0665
	224/600				
	[=======] 225/600	-	0s	197us/step - loss:	0.0668
	[========]	_	0s	236us/step - loss:	0.0664
	226/600		• •		
	[======]	-	0s	333us/step - loss:	0.0677
	227/600		•	060 / 1	0.0660
	[=======] 228/600	-	US	268us/step - loss:	0.0669
	[=======]	_	0s	184us/step - loss:	0.0659
Epoch	229/600				
	[========]	-	0s	182us/step - loss:	0.0667
	230/600 [======]		٥٥	100ug/gton logg.	0 0656
	231/600	-	US	iguus/step - ioss:	0.0000
	[========]	_	0s	160us/step - loss:	0.0663
Epoch	232/600				
	[=========]	-	0s	246us/step - loss:	0.0672
Броси	233/600				

60/60	[=====]	_	0s	195us/step - loss:	0.0670
	234/600			_	
	[========]	-	0s	202us/step - loss:	0.0659
	235/600 [=========]	_	۸c	21611g/gten - logg.	0 0654
	236/600		UB	210d5/5ccp - 1055.	0.0034
	[=======]	_	0s	167us/step - loss:	0.0661
	237/600				
	[=======]	-	0s	241us/step - loss:	0.0656
	238/600 [=========]	_	۸e	31911g/gten - logg.	0 0663
	239/600		05	51745/500p - 1055.	0.0005
	[======]	_	0s	183us/step - loss:	0.0660
	240/600				
	[======] 241/600	-	0s	188us/step - loss:	0.0659
	[=========]	_	0s	209us/step - loss:	0.0656
Epoch	242/600				
	[======]	-	0s	205us/step - loss:	0.0652
	243/600		0	200/	0.0653
	[======] 244/600	-	US	200us/step - loss:	0.0653
	[========]	_	0s	259us/step - loss:	0.0659
Epoch	245/600				
	[======]	-	0s	161us/step - loss:	0.0656
	246/600 [=======]		٥٥	147ug/g+on logg.	0 0661
	247/600	_	05	14/us/scep - 10ss:	0.0001
	[========]	_	0s	173us/step - loss:	0.0670
	248/600				
	[=======]	-	0s	240us/step - loss:	0.0652
	249/600 [=======]	_	0 s	20511s/sten - loss:	0.0650
	250/600		Ů.	2034B/ BCCP 1055	0.0000
	[======]	-	0s	222us/step - loss:	0.0656
	251/600		0	201 / 1 7	0.0655
	[======] 252/600	-	US	291us/step - loss:	0.0655
	[========]	_	0s	250us/step - loss:	0.0649
Epoch	253/600				
	[======]	-	0s	188us/step - loss:	0.0656
	254/600 [=======]		۸c	27/11g/gton logg.	0 0664
	255/600		V S	2/4us/scep - 10ss.	0.0004
	[======]	_	0s	204us/step - loss:	0.0675
	256/600				
	[======] 257/600	-	0s	217us/step - loss:	0.0651
	[=========]	_	0s	200us/step - loss:	0.0655
	258/600			20045, 200P 2025	
	[======]	-	0s	190us/step - loss:	0.0644
	259/600		0 =	20209/5455	0 0642
	[======] 260/600	-	US	ZUJUS/STEP - loss:	0.0643
	[=======]	_	0s	212us/step - loss:	0.0653
Epoch	261/600				
60/60	[=====]	-	0s	245us/step - loss:	0.0645

Epoch	262/600				
	[========]	_	0s	200us/step - loss: 0.	0657
Epoch	263/600				
	[======]	_	0s	167us/step - loss: 0.	0650
	264/600				
	[======================================	-	0s	166us/step - loss: 0.	.0644
	265/600 [======]		٥٥	157ug/gtop logg. 0	0654
	266/600	_	US	13/us/scep - 10ss: 0.	.0034
	[=======]	_	0s	171us/step - loss: 0.	0669
Epoch	267/600			_	
	[======]	_	0s	152us/step - loss: 0.	0654
	268/600		•	160 / 1	0651
	[======] 269/600	_	0s	168us/step - loss: 0.	.0651
	[=========]	_	۸e	167us/sten _ loss. 0	0645
	270/600		V.S	10/ds/scep - 10ss. 0.	.0045
	[========]	_	0s	208us/step - loss: 0.	0641
Epoch	271/600				
	[======]	-	0s	234us/step - loss: 0.	0640
	272/600		•		0.600
	[======] 273/600	_	0s	211us/step - loss: 0.	.0638
	[========]	_	0s	184us/step = loss: 0.	0648
	274/600		OB	10145/5002 1055. 0.	.0010
	[=======]	_	0s	202us/step - loss: 0.	0641
	275/600				
	[======]	-	0s	228us/step - loss: 0.	.0638
	276/600 [======]		٥٠	27/112/2405 102210	0647
	277/600	_	US	2/4us/step - 10ss: 0.	.0647
	[=======]	_	0s	374us/step - loss: 0.	0669
Epoch	278/600				
	[======]	_	0s	189us/step - loss: 0.	0650
	279/600				
	[======] 280/600	-	0s	271us/step - loss: 0.	.0637
	[=========]	_	۸q	186us/sten = loss. 0	0652
	281/600		0.5	100ds/5ccp = 1055. 0.	.0032
	[=========]	_	0s	189us/step - loss: 0.	0642
	282/600				
	[=======]	-	0s	247us/step - loss: 0.	0642
	283/600		0~	171	0653
	[======] 284/600	_	US	1/lus/step - loss: 0.	.0653
	[========]	_	0s	194us/step - loss: 0.	0636
	285/600				
60/60	[======]	_	0s	427us/step - loss: 0.	0638
	286/600				
	[======================================	-	0s	217us/step - loss: 0.	.0635
	287/600 [======]		٥٥	208us/stop loss. 0	0633
	288/600	-	US	200us/scep - 1055: 0.	.0033
	[========]	_	0s	208us/step - loss: 0.	0636
Epoch	289/600				
	[========]	-	0s	194us/step - loss: 0.	0647
Epoch	290/600				

60/60	[======]	_	0s	187us/step - loss:	0.0648
	291/600		•		0 0641
	[======] 292/600	-	0s	213us/step - loss:	0.0641
	[========]	_	0s	226us/step - loss:	0.0633
	293/600				
	[======] 294/600	-	0s	366us/step - loss:	0.0634
	[========]	_	0s	210us/step - loss:	0.0630
	295/600			-	
	[======] 296/600	-	0s	172us/step - loss:	0.0631
	[========]	_	0s	259us/step - loss:	0.0632
	297/600				
	[======] 298/600	-	0s	210us/step - loss:	0.0632
	[========]	_	0s	217us/step - loss:	0.0633
	299/600				
	[======] 300/600	-	0s	190us/step - loss:	0.0638
	[=======]	_	0s	273us/step - loss:	0.0630
	301/600				
	[======] 302/600	-	0s	232us/step - loss:	0.0638
	[=======]	_	0s	170us/step - loss:	0.0640
	303/600				
	[======] 304/600	-	0s	188us/step - loss:	0.0643
	[=======]	_	0s	212us/step - loss:	0.0642
	305/600		0	200 / 1	0 0625
	[======] 306/600	-	0s	329us/step - loss:	0.0635
	[=======]	_	0s	262us/step - loss:	0.0629
	307/600 [========]		0 -	210/5+0	0 0635
	308/600	_	US	319us/step - loss:	0.0635
	[======]	_	0s	278us/step - loss:	0.0649
	309/600		٥٥	305ug/g+on logg.	0 0639
	310/600	_	05	303us/step - 10ss:	0.0036
	[=======]	-	0s	249us/step - loss:	0.0631
-	311/600 [=========]		۸c	353ug/g+on logg.	0 0631
	312/600		V S	333da/acep - 10aa.	0.0031
	[======]	-	0s	317us/step - loss:	0.0626
	313/600 [==========]	_	۸e	15411g/gten - logg.	0 0629
	314/600		V.S	134d3/3cep - 1033.	0.0023
	[======]	-	0s	202us/step - loss:	0.0625
	315/600 [==========]	_	0 =	194118/sten - loss.	0.0640
Epoch	316/600				
	[=======]	-	0s	190us/step - loss:	0.0642
	317/600 [==========]	_	0s	164us/step - loss:	0.0645
Epoch	318/600				
60/60	[=====]	-	0s	247us/step - loss:	0.0628

Epoch	319/600				
	[========]	_	0s	186us/step - loss: (0.0631
	320/600				
	[=======]	-	0s	270us/step - loss: (0.0634
	321/600 [=======]		Λc	193ug/g+on logg. (0 0628
	322/600	_	US	103us/scep - 10ss. (0.0020
	[=========]	_	0s	156us/step - loss: (0.0633
	323/600				
	[========]	-	0s	386us/step - loss: (0.0627
	324/600 [=======]		٥٥	206ug/g+op logg. (0.624
	325/600	_	US	2000s/scep - 10ss. (0.0024
	[========]	_	0s	206us/step - loss: (0.0626
	326/600				
	[=======]	-	0s	246us/step - loss: (0.0623
	327/600 [======]	_	۸e	495ug/sten - loss. (n 0619
	328/600		V.S	473da/acep - 10aa. (0.0017
	[=======]	-	0s	300us/step - loss: 0	0.0622
	329/600				
	[========]	-	0s	265us/step - loss: (0.0623
	330/600 [======]	_	Λς	406us/sten - loss: (0.0627
	331/600		0 D	TOOUS, BEEP TOOS.	0.0027
	[======]	_	0s	181us/step - loss: 0	0.0618
	332/600				
	[======] 333/600	-	0s	237us/step - loss: (0.0624
	[=========]	_	0s	845us/step = loss: (0.0632
	334/600		O D	01345,500p 1055.	0.0002
	[======]	-	0s	475us/step - loss: 0	0.0622
	335/600		•		
	[======] 336/600	-	US	360us/step - loss: (0.0624
	[=======]	_	0s	229us/step - loss: (0.0619
	337/600				
	[=======]	-	0s	391us/step - loss: (0.0622
_	338/600 [======]		٥٩	205ug/gton logg. (0.610
	339/600	_	US	Judus/step - loss: (0.0019
	[========]	_	0s	383us/step - loss: (0.0619
	340/600				
	[========]	-	0s	406us/step - loss: (0.0637
	341/600 [=======]		Λc	303ug/g+on logg. (0.653
	342/600	_	US	393us/scep - 10ss. (0.0055
	[========]	_	0s	261us/step - loss: (0.0624
	343/600				
	[=========]	-	0s	211us/step - loss: (0.0627
	344/600 [=======]	_	۸e	227us/sten = loss. (0626
	345/600	-	0.5	22/db/bccp - 10bb. (
60/60	[======]	_	0s	197us/step - loss: (0.0617
	346/600		_	241 / : -	0 0 5 5 =
	[======] 347/600	-	0s	341us/step - loss: (0.0615
тЬоси	34//000				

```
60/60 [============== ] - 0s 285us/step - loss: 0.0622
Epoch 348/600
60/60 [============ ] - 0s 226us/step - loss: 0.0616
Epoch 349/600
Epoch 350/600
Epoch 351/600
60/60 [=============== ] - 0s 246us/step - loss: 0.0614
Epoch 352/600
60/60 [============== ] - 0s 212us/step - loss: 0.0629
Epoch 353/600
60/60 [============== ] - 0s 358us/step - loss: 0.0629
Epoch 354/600
60/60 [============== ] - 0s 257us/step - loss: 0.0617
Epoch 355/600
60/60 [============== ] - 0s 154us/step - loss: 0.0621
Epoch 356/600
60/60 [============= ] - 0s 236us/step - loss: 0.0614
Epoch 357/600
Epoch 358/600
60/60 [============== ] - 0s 513us/step - loss: 0.0617
Epoch 359/600
60/60 [============ ] - 0s 308us/step - loss: 0.0609
Epoch 360/600
60/60 [============== ] - 0s 153us/step - loss: 0.0624
Epoch 361/600
- loss: 0.0629
Epoch 362/600
60/60 [============= ] - 0s 227us/step - loss: 0.0607
Epoch 363/600
60/60 [============== ] - 0s 185us/step - loss: 0.0610
Epoch 364/600
Epoch 365/600
Epoch 366/600
60/60 [============== ] - 0s 288us/step - loss: 0.0612
Epoch 367/600
60/60 [=============== ] - 0s 217us/step - loss: 0.0624
Epoch 368/600
60/60 [=============== ] - 0s 250us/step - loss: 0.0604
Epoch 369/600
60/60 [============== ] - 0s 195us/step - loss: 0.0603
Epoch 370/600
60/60 [========== ] - 0s 487us/step - loss: 0.0627
Epoch 371/600
60/60 [============== ] - 0s 589us/step - loss: 0.0611
Epoch 372/600
- loss: 0.0637
Epoch 373/600
Epoch 374/600
60/60 [============== ] - 0s 240us/step - loss: 0.0606
```

Epoch	375/600				
	[========]	_	0s	200us/step - loss: 0	.0617
Epoch	376/600				
	[======]	-	0s	176us/step - loss: 0	.0624
	377/600				
	[======================================	-	0s	172us/step - loss: 0	.0610
	378/600 [======]		٥٥	219ug/gton logg. 0	0600
	379/600	_	US	210us/scep - 10ss: 0	.0009
	[=======]	_	0s	210us/step - loss: 0	.0607
Epoch	380/600			_	
	[======]	-	0s	337us/step - loss: 0	.0605
	381/600				
	[======] 382/600	_	0s	285us/step - loss: 0	.0619
	[=========]	_	۸e	456us/stan _ loss. 0	0600
	383/600		V S	430us/scep - 10ss. 0	.0000
	[========]	_	0s	280us/step - loss: 0	.0601
Epoch	384/600				
	[=======]	_	0s	278us/step - loss: 0	.0619
	385/600		•		0.001
	[======] 386/600	_	0s	636us/step - loss: 0	.0601
	[=========]	_	۸q	299118/sten = loss. 0	0618
	387/600		0.D	277d3/36CP = 1033. 0	.0010
	[=========]	_	0s	237us/step - loss: 0	.0609
	388/600				
	[=====]	-	0s	239us/step - loss: 0	.0620
	389/600		٥-	245/	0.602
	[======] 390/600	-	US	245us/step - 10ss: 0	0.0603
	[========]	_	0s	278us/step - loss: 0	.0606
	391/600				
	[======]	_	0s	355us/step - loss: 0	.0599
	392/600				
	[======================================	-	0s	597us/step - loss: 0	.0615
-	393/600 [======]		Λc	182us/stan loss. 0	0602
	394/600	_	US	102us/scep = 10ss. 0	.0002
	[========]	_	0s	273us/step - loss: 0	.0602
Epoch	395/600				
	[======]	-	0s	274us/step - loss: 0	.0600
	396/600		^	252 / 1 2	0606
	[======] 397/600	-	US	253us/step - loss: 0	0.0606
	[========]	_	0s	251us/step = loss: 0	.0604
	398/600		0.5	20102, 200F 2022 C	
	[=======]	_	0s	300us/step - loss: 0	.0609
	399/600				
	[========]	-	0s	240us/step - loss: 0	.0610
	400/600		٥٠	27000 / 0400 1000 1	0604
	[======] 401/600	-	υS	5/0us/step - 10SS: 0	.0004
	[========]	_	0s	345us/step - loss: 0	.0608
Epoch	402/600				
	[======]	-	0s	390us/step - loss: 0	.0599
Epoch	403/600				

60/60	[=====]	_	0s	490us/step	_	loss:	0.0596
	404/600		•	202 / 1		-	0.0004
	[======] 405/600	-	0s	383us/step	-	loss:	0.0604
	[=======]	_	0s	794us/step	_	loss:	0.0599
	406/600						
	[=========]	-	0s	381us/step	-	loss:	0.0599
	407/600	_	0s	220us/step	_	loss:	0.0603
Epoch	408/600			_			
	[======]	-	0s	223us/step	-	loss:	0.0601
	409/600 [=======]		۸c	155ug/g+en		1055.	0 0508
	410/600		V S	433087 8 Cep		1055.	0.0370
	[======]	-	0s	219us/step	-	loss:	0.0610
	411/600 [=======]		٥٠	22222/2402		1000.	0 0602
	412/600	_	US	233us/step	_	loss:	0.0603
60/60	[======]	_	0s	205us/step	_	loss:	0.0619
	413/600		•	155 / .		-	
	[======] 414/600	-	0s	1/5us/step	-	loss:	0.0597
	[========]	_	0s	172us/step	_	loss:	0.0605
	415/600			_		_	
	[======] 416/600	-	0s	282us/step	-	loss:	0.0593
	[=========]	_	0s	334us/step	_	loss:	0.0594
Epoch	417/600			_			
	[=======]	-	0s	208us/step	-	loss:	0.0590
	418/600 [=======]	_	0s	263us/sten	_	loss:	0.0593
Epoch	419/600						
	[======]	-	0s	227us/step	-	loss:	0.0613
	420/600 [======]	_	0 s	232115/sten	_	1055:	0.0590
Epoch	421/600						
	[======]	-	0s	198us/step	-	loss:	0.0607
	422/600 [=======]	_	0 s	424115/sten	_	1055:	0.0596
	423/600		O.D	12 145/ 5 669		1000.	0.0330
	[======]	-	0s	250us/step	-	loss:	0.0600
	424/600 [=======]	_	۸e	19311g/gten	_	1099.	0 0624
	425/600		O.D	173457 5 6 6 5		1000.	0.0021
	[======]	-	0s	237us/step	-	loss:	0.0593
	426/600 [=======]		۸e	222115/sten		1000	0 0587
	427/600		V S	222d5/5cep		1055.	0.0307
	[=====]	-	0s	200us/step	-	loss:	0.0592
	428/600 [=======]		٥٥	120ug/g+op		logg•	0 0500
	429/600	_	UB	429us/scep	_	1022:	0.0000
60/60	[======]	_	0s	256us/step	-	loss:	0.0597
	430/600 [==========]		0~	240119/250		1000	0 0506
	431/600	_	US	240us/step	_	TOSS:	0.0596
	[======]	_	0s	168us/step	-	loss:	0.0588

```
Epoch 432/600
60/60 [=============== ] - 0s 176us/step - loss: 0.0591
Epoch 433/600
60/60 [============ ] - 0s 235us/step - loss: 0.0594
Epoch 434/600
60/60 [============== ] - 0s 184us/step - loss: 0.0591
Epoch 435/600
60/60 [============= ] - 0s 263us/step - loss: 0.0601
Epoch 436/600
60/60 [============= ] - 0s 283us/step - loss: 0.0587
Epoch 437/600
60/60 [============= ] - 0s 267us/step - loss: 0.0595
Epoch 438/600
Epoch 439/600
Epoch 440/600
60/60 [=========== ] - 0s 211us/step - loss: 0.0600
Epoch 441/600
60/60 [=============== ] - 0s 270us/step - loss: 0.0600
Epoch 442/600
60/60 [================ ] - 0s 418us/step - loss: 0.0598
Epoch 443/600
60/60 [============== ] - 0s 205us/step - loss: 0.0586
Epoch 444/600
Epoch 445/600
60/60 [========== ] - 0s 192us/step - loss: 0.0596
Epoch 446/600
60/60 [============ ] - 0s 223us/step - loss: 0.0617
Epoch 447/600
60/60 [============= ] - 0s 220us/step - loss: 0.0581
Epoch 448/600
60/60 [============== ] - 0s 497us/step - loss: 0.0591
Epoch 449/600
Epoch 450/600
Epoch 451/600
60/60 [============= ] - 0s 189us/step - loss: 0.0594
Epoch 452/600
Epoch 453/600
60/60 [=============== ] - 0s 233us/step - loss: 0.0585
Epoch 454/600
60/60 [============== ] - 0s 472us/step - loss: 0.0586
Epoch 455/600
60/60 [=========== ] - 0s 265us/step - loss: 0.0581
Epoch 456/600
60/60 [============== ] - 0s 213us/step - loss: 0.0582
Epoch 457/600
- loss: 0.0580
Epoch 458/600
60/60 [================ ] - 0s 266us/step - loss: 0.0614
Epoch 459/600
60/60 [============== ] - 0s 344us/step - loss: 0.0618
```

Epoch	460/600				
	[========]	_	0s	316us/step - loss: (0.0581
	461/600				
	[=========]	-	0s	358us/step - loss: (0.0585
	462/600 [=======]	_	۸e	284us/sten - loss. (0620
	463/600		V.S	20405/500p - 1055. (0.0020
	[======]	_	0s	321us/step - loss: 0	0.0603
	464/600				
	[======] 465/600	-	0s	226us/step - loss: (0.0578
	[========]	_	0s	187us/step - loss: (0.0588
Epoch	466/600				
	[=====]	-	0s	202us/step - loss: 0	0.0583
	467/600 [=======]		٥٥	172ug/g+on logg. (0 0577
	468/600	_	US	1/2us/step - 10ss: (0.0377
	[========]	_	0s	182us/step - loss: (0.0588
	469/600				
	[======] 470/600	-	0s	211us/step - loss: (0.0615
	[========]	_	0s	243us/step - loss: (0.0611
	471/600				
	[======] 472/600	-	0s	513us/step - loss: (0.0587
	[=========]	_	0s	383us/step - loss: (0.0577
Epoch	473/600			_	
	[=========]	-	0s	815us/step - loss: (0.0589
	474/600 [=======]	_	0s	353us/step - loss: (0.0579
Epoch	475/600				
	[=======]	-	0s	229us/step - loss: (0.0622
	476/600 [=======]	_	Λq	336119/sten - loss: (0.0583
	477/600		0 D	JJours Beep Lobb.	
	[======]	-	0s	230us/step - loss: 0	0.0575
-	478/600 [======]		٥٥	326ug/g+op logg. (0.0576
	479/600	_	US	32003/Step - 1055. (0.0370
	[======]	-	0s	330us/step - loss: 0	0.0583
	480/600 [=======]		0~	1000-7	0.0570
	481/600	_	US	100us/step - 10ss: (0.0372
60/60	[======]	_	0s	194us/step - loss: (0.0579
	482/600		•	260 / 1 1	0.570
	[======] 483/600	_	US	260us/step - loss: (0.05/9
	[========]	_	0s	259us/step - loss: (0.0600
	484/600				
	[======] 485/600	-	0s	274us/step - loss: (0.0574
	[========]	_	0s	468us/step - loss: (0.0579
Epoch	486/600				
	[=========]	-	0s	200us/step - loss: (0.0581
	487/600 [=======]	_	0s	205us/step - loss: (0.0576
	488/600				- • •

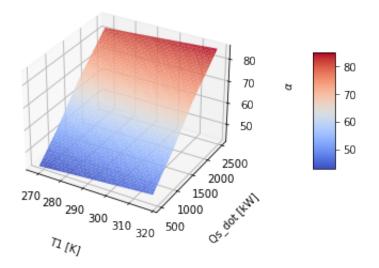
	[======] 489/600	-	0s	236us/step - loss: 0.056	9
60/60	[======]	_	0s	202us/step - loss: 0.058	3
	490/600 [=======]	_	0s	247us/step = loss: 0.060	1
Epoch	491/600 [=======]			_	
Epoch	492/600				
	[======] 493/600	-	0s	198us/step - loss: 0.058	3
	[=========]	_	0s	353us/step - loss: 0.057	1
	494/600 [=========]		0 ~	221,127/5409 1055	0
Epoch	495/600				
	[=======]	-	0s	223us/step - loss: 0.056	8
	496/600 [=======]	_	0s	248us/step - loss: 0.057	7
Epoch	497/600				
	[======] 498/600	-	0s	180us/step - loss: 0.058	6
60/60	[======]	_	0s	206us/step - loss: 0.056	8
	499/600 [=======]		۸c	177us/s+on loss. 0 056	Q
Epoch	500/600			_	
	[========]	-	0s	167us/step - loss: 0.057	8
	501/600 [=========]	_	0s	215us/step - loss: 0.057	8
Epoch	502/600			_	
	[======] 503/600	-	0s	1/8us/step - loss: 0.05/	0
60/60	[======]	_	0s	208us/step - loss: 0.057	9
	504/600	_	0 s	483us/sten = loss: 0.056	8
Epoch	505/600			_	
	[======] 506/600	-	0s	354us/step - loss: 0.057	6
	[========]	_	0s	206us/step - loss: 0.056	7
-	507/600 [=========]		٥٥	106ug/gton logg. 0 057	Λ
	508/600	_	US	100us/step - 10ss: 0.05/	U
	[=========]	-	0s	204us/step - loss: 0.057	1
_	509/600	_	0s	188us/step - loss: 0.057	0
Epoch	510/600			_	
	[=======] 511/600	-	0s	339us/step - loss: 0.058	5
60/60	[======]	_	0s	390us/step - loss: 0.059	0
	512/600 [=========]	_	0 s	311us/sten = loss: 0.056	4
Epoch	513/600				
	[======] 514/600	-	0s	443us/step - loss: 0.059	6
	[========]	_	0s	323us/step - loss: 0.059	0
Epoch	515/600				
	[=======] 516/600	-	US	251us/step - 10SS: 0.056	1
	[=====]	-	0s	195us/step - loss: 0.058	3

Enoch	517/600			
	[=======]	_	0s	169us/step - loss: 0.0578
Epoch	518/600			_
	[======]	-	0s	198us/step - loss: 0.0577
	519/600			
	[========]	-	0s	217us/step - loss: 0.0599
	520/600 [======]		٥٥	199ug/g+on logg: 0 0621
	521/600	_	US	190us/scep - 10ss: 0.0021
	[========]	_	0s	188us/step - loss: 0.0579
Epoch	522/600			
	[======]	-	0s	165us/step - loss: 0.0579
	523/600			
	[======] 524/600	_	0s	322us/step - loss: 0.0578
	[==========]	_	۸e	273115/sten _ loss. 0 0571
	525/600		V.S	2/3us/scep - 10ss. 0.03/1
	[=========]	_	0s	183us/step - loss: 0.0568
Epoch	526/600			
	[======]	-	0s	199us/step - loss: 0.0586
	527/600		0	100/
	[======] 528/600	_	0s	198us/step - loss: 0.0566
	[=========]	_	0s	230us/step = loss: 0.0570
	529/600		٥٥	200 db, 500p 10bb; 0103, 0
	[======]	_	0s	226us/step - loss: 0.0587
	530/600			
	[======]	-	0s	183us/step - loss: 0.0583
	531/600 [======]		٥٥	371ug/gton logg: 0.0570
	532/600	_	US	3/1us/scep - 10ss: 0.03/0
	[========]	_	0s	350us/step - loss: 0.0561
Epoch	533/600			
	[]	-	0s	160us/step - loss: 0.0558
	534/600		^	100 / 1 0 0574
	[======] 535/600	_	0s	190us/step - loss: 0.05/4
-	[=========]	_	0s	320us/step - loss: 0.0556
	536/600		٥٥	olumb, book loss of the second
60/60	[======]	_	0s	537us/step - loss: 0.0596
	537/600			
	[======================================	-	0s	481us/step - loss: 0.0571
	538/600 [======]		Λc	199us/sten loss: 0 0578
	539/600	_	US	199us/scep - 10ss. 0.03/0
	[========]	_	0s	221us/step - loss: 0.0566
Epoch	540/600			
	[=======]	-	0s	211us/step - loss: 0.0559
	541/600		^	250 / 1 2 0 0500
	[======] 542/600	_	0s	358us/step - loss: 0.0582
	[=========]	_	0s	157us/step = loss: 0.0557
	543/600			
60/60	[======]	-	0s	161us/step - loss: 0.0561
	544/600		_	
	[=========]	-	0s	168us/step - loss: 0.0568
гроси	545/600			

60/60	[======]	_	0s	210us/step - los	s: 0.05	62
	546/600					
	[======] 547/600	-	0s	156us/step - los	3: 0.055	56
	[=======]	_	0s	144us/step - los	s: 0.056	65
Epoch	548/600					
	[========]	-	0s	146us/step - los	s: 0.056	62
	549/600 [=======]	_	0s	258us/step = los	s: 0.05	77
Epoch	550/600					
	[=====]	-	0s	211us/step - los	s: 0.05	64
	551/600 [=======]		٥٥	201ug/gton log	a. 0 05'	7.0
	552/600	_	US	201us/step - 10s	5. 0.05	70
60/60	[======]	_	0s	227us/step - los	s: 0.058	86
	553/600		0	200 / 1	0.05	7.0
	[======] 554/600	-	0s	200us/step - los	3: 0.05	/9
	[========]	_	0s	236us/step - los	s: 0.05	73
	555/600					
	[======] 556/600	-	0s	244us/step - los	s: 0.055	55
	[=========]	_	0s	147us/step - los	s: 0.058	83
Epoch	557/600					
	[======]	-	0s	146us/step - los	s: 0.056	67
	558/600 [=======]	_	Λe	171ug/gten _ log	e• 0 059	Q 1
	559/600		05	1/105/5cep - 105	3. 0.03.	71
	[=====]	-	0s	258us/step - los	s: 0.055	55
	560/600 [=======]		0 ~	242/=+=== 1	0 OFI	F 0
	561/600	_	US	243us/step - 10s	5: 0.05	56
60/60	[======]	_	0s	258us/step - los	s: 0.05	56
	562/600		•	150 /	0.051	
	[======] 563/600	-	0s	170us/step - los	s: 0.055	53
	[=======]	_	0s	222us/step - los	s: 0.05	54
	564/600					
	[======] 565/600	-	0s	213us/step - los	s: 0.056	63
	[========]	_	0s	268us/step - los	s: 0.050	68
Epoch	566/600					
	[========]	-	0s	294us/step - los	s: 0.056	64
	567/600 [=========]	_	0s	351us/step - los	s: 0.05!	52
Epoch	568/600					
	[=======]	-	0s	315us/step - los	s: 0.055	58
	569/600 [=======]	_	۸e	29211s/sten = los	s• 0 05′	71
	570/600		05	27245/500p - 105	3. 0.03	, 1
	[======]	-	0s	370us/step - los	s: 0.056	64
	571/600 [=======]		0~	506ug/g+on 1	g. A AFI	<u>5</u> 1
	572/600	_	US	Judus/Steb - 108	5. U.US	JΙ
60/60	[======]	_	0s	384us/step - los	s: 0.05	52
	573/600		•	227 / 1	0 0=:	- ^
60/60	[=====]	-	υs	33/us/step - los	s: 0.055	52

```
Epoch 574/600
60/60 [============= ] - 0s 353us/step - loss: 0.0596
Epoch 575/600
60/60 [============= ] - 0s 419us/step - loss: 0.0553
Epoch 576/600
60/60 [============== ] - 0s 374us/step - loss: 0.0559
Epoch 577/600
60/60 [============= ] - 0s 327us/step - loss: 0.0552
Epoch 578/600
60/60 [============ ] - 0s 503us/step - loss: 0.0549
Epoch 579/600
60/60 [============== ] - 0s 409us/step - loss: 0.0549
Epoch 580/600
Epoch 581/600
Epoch 582/600
60/60 [=========== ] - 0s 189us/step - loss: 0.0553
Epoch 583/600
60/60 [=============== ] - 0s 185us/step - loss: 0.0556
Epoch 584/600
Epoch 585/600
60/60 [============== ] - 0s 228us/step - loss: 0.0548
Epoch 586/600
Epoch 587/600
60/60 [=========== ] - 0s 178us/step - loss: 0.0560
Epoch 588/600
60/60 [============ ] - 0s 179us/step - loss: 0.0546
Epoch 589/600
60/60 [============= ] - 0s 177us/step - loss: 0.0556
Epoch 590/600
60/60 [============== ] - 0s 212us/step - loss: 0.0556
Epoch 591/600
60/60 [=============== ] - 0s 225us/step - loss: 0.0549
Epoch 592/600
Epoch 593/600
60/60 [============== ] - 0s 179us/step - loss: 0.0553
Epoch 594/600
Epoch 595/600
Epoch 596/600
60/60 [============== ] - 0s 185us/step - loss: 0.0566
Epoch 597/600
60/60 [============== ] - 0s 176us/step - loss: 0.0554
Epoch 598/600
60/60 [============== ] - 0s 260us/step - loss: 0.0544
Epoch 599/600
60/60 [============ ] - 0s 174us/step - loss: 0.0544
Epoch 600/600
60/60 [=========== ] - 0s 209us/step - loss: 0.0553
best epoch = 598
smallest loss = 0.054399729271729785
```

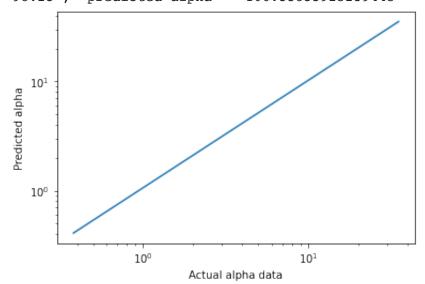
```
In [42]:
          #Task2.2
          import matplotlib.pyplot as plt
          import numpy as np
          #from mpl toolkits.mplot3d import Axes3D
          #from matplotlib import cm # to colormap 3D surfaces from blue to red
          #from matplotlib.ticker import LinearLocator, FormatStrFormatter
          fig = plt.figure()
          ax = plt.axes(projection='3d')
          X = np.linspace(268, 318)
          Y = np.linspace(500, 2500)
          Zp = []
          Xp = []
          [] = qY
          gamma = 0.25
          testdata = []
          Xn = X/Tmed
          gn = gamma/gamed
          Yn = Y/qsmed
          for x in range(len(Xn)):
              for y in range(len(Yn)):
                  testdata.append([Xn[x], gn, Yn[y]])
                  Xp.append(Xn[x]*Tmed)
                  Yp.append(Yn[y]*qsmed)
          for x in range(len(testdata)):
              test = [[testdata[x][0], testdata[x][1], testdata[x][2]]]
              testarray = np.array(test)
              outptn = model.predict(testarray)
              Zp.append(outptn[0][0]*almed)
          surf = ax.plot_trisurf(Xp, Yp, Zp, cmap=cm.coolwarm)
          fig.colorbar(surf, shrink=0.5, aspect=5, pad=0.2)
          ax.set zlabel(r'$\alpha$', rotation=60)
          ax.set ylabel('Qs dot [kW]')
          ax.set xlabel('T1 [K]', rotation=150)
          ax.xaxis.labelpad=15
          ax.yaxis.labelpad=15
          ax.zaxis.labelpad=15
          plt.show()
```



```
In [45]:
          #Task 2.3
          from sklearn import metrics
          test = []
          outpt=[]
          outptdata=[]
          testn = []
          outptn = []
          test.append([318.0, 0.0, 500.0])
          test.append([318.0, 0.0, 1500.0])
          test.append([318.0, 0.0, 2500.0])
          test.append([318.0, 0.25, 1500.0])
          test.append([318.0, 0.5, 500.0])
          test.append([318.0, 0.5, 1500.0])
          test.append([318.0, 0.5, 2500.0])
          test.append([318.0, 0.0, 1000.0])
          test.append([318.0, 0.0, 2000.0])
          test.append([318.0, 0.25, 1000.0])
          test.append([318.0, 0.25, 2000.0])
          test.append([318.0, 0.5, 1000.0])
          test.append([318.0, 0.5, 2000.0])
          test.append([318.0, 0.0, 500.0])
          test.append([318.0, 0.0, 2500.0])
          test.append([318.0, 0.25, 2500.0])
          test.append([318.0, 0.5, 1500.0])
          test.append([318.0, 0.0, 1500.0])
          test.append([318.0, 0.25, 2000.0])
          test.append([318.0, 0.5, 2500.0])
          outptdata.append([35.13, 0.3808])
          outptdata.append([47.46, 0.3930])
          outptdata.append([73.12, 0.4061])
          outptdata.append([66.34, 0.4098])
          outptdata.append([63.09, 0.4154])
```

```
outptdata.append([85.23, 0.4197])
outptdata.append([131.32, 0.4242])
outptdata.append([38.99, 0.4012])
outptdata.append([53.80, 0.4136])
outptdata.append([54.51, 0.4215])
outptdata.append([75.22, 0.4290])
outptdata.append([70.04, 0.4337])
outptdata.append([96.65, 0.4382])
outptdata.append([33.45, 0.4091])
outptdata.append([60.80, 0.4334])
outptdata.append([85.044, 0.4477])
outptdata.append([77.56, 0.4516])
outptdata.append([40.68, 0.4383])
outptdata.append([65.24, 0.4628])
outptdata.append([98.23, 0.4760])
for x in range(len(test)):
    testn.append([test[x][0]/Tmed, test[x][1]/gamed, test[x][2]/qsmed])
#first point (row [0])comparison of data and prediction
# put in a loop to print comparion for all data points
for x in range(len(testn)):
    test = [[testn[x][0], testn[x][1], testn[x][2]]]
    testarray = np.array(test)
    outptn = model.predict(testarray)
    outpt.append([outptn[0][0]*almed, outptn[0][1]*efmed])
    print ('row[',x,'] data: T1 = ', testn[x][0]*Tmed, ', gam= ', testn[x][1]
         ', qsol= ', testn[x][2]*qsmed,', alpha= ', outptdata[x][0],\
         ', predicted alpha = ', outpt[x][0])
plt.figure()
plt.loglog(outptdata[:][0], outpt[:][0])
plt.xlabel("Actual alpha data")
plt.ylabel("Predicted alpha")
plt.show()
#RMS of predicted vs test data
rms_alpha = np.sqrt(metrics.mean_squared_error(outptdata[:][0],outpt[:][0]))
rms ef = np.sqrt(metrics.mean squared error(outptdata[:][1],outpt[:][1]))
print('rms deviation between predictions and the collection of test data: alp
row[ 0 ] data: T1 = 317.999999999999 , gam=
                                              0.0 , qsol= 500.0 , alpha= 3
5.13 , predicted alpha = 35.35579579508007
                                              0.0 , qsol= 1500.0 , alpha=
47.46 , predicted alpha = 46.10397140096426
row[ 2 ] data: T1 = 317.999999999999 , gam=
                                              0.0 , gsol= 2500.0 , alpha=
73.12 , predicted alpha = 63.713636228460075
row[ 3 ] data: T1 = 317.999999999999 , gam=
                                              0.25 , qsol= 1500.0 , alpha=
66.34 , predicted alpha = 66.66348148511052
                                             0.5 , qsol = 500.0 , alpha = 6
row[ 4 ] data: T1 = 317.999999999999 , gam=
3.09 , predicted alpha = 62.261566764038804
row[ 5 ] data: T1 = 317.999999999999 , gam= 0.5 , qsol= 1500.0 , alpha=
85.23 , predicted alpha = 81.56974759143591
row[ 6 ] data: T1 = 317.999999999999999 , gam= 0.5 , qsol= 2500.0 , alpha=
```

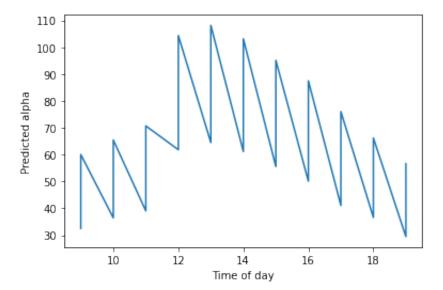
131.32 , predicted alpha = 106.33833925239445 row[7] data: T1 = 317.999999999999 , gam= 0.0 , qsol= 1000.0 , alpha= 38.99 , predicted alpha = 40.894876074126365 row[8] data: T1 = 317.999999999999 , gam= 0.0 , qsol= 2000.0 , alpha= 53.8 , predicted alpha = 54.58968013318778 row[9] data: T1 = 317.999999999999 , gam= 0.25 , qsol= 1000.0 , alpha= 54.51 , predicted alpha = 55.812112866219884 0.25 , qsol= 2000.0 , alpha= 75.22 , predicted alpha = 76.62401072491409 row[11] data: T1 = 317.9999999999999 , gam= 0.5 , qsol= 1000.0 , alpha= 70.04 , predicted alpha = 71.94912725197078 row[12] data: T1 = 317.999999999999 , gam= 0.5 , qsol= 2000.0 , alpha= 96.65 , predicted alpha = 93.23908514338733 row[13] data: T1 = 317.9999999999999 , gam= 0.0 , qsol= 500.0 , alpha= 33.45 , predicted alpha = 35.35579579508007 row[14] data: T1 = 317.9999999999999 , gam= 0.0 , qsol = 2500.0 , alpha =60.8 , predicted alpha = 63.713636228460075 row[15] data: T1 = 317.999999999999 , gam= 0.25 , qsol= 2500.0 , alpha= 85.044 , predicted alpha = 85.31592312467694 row[16] data: T1 = 317.9999999999999 , gam= 0.5 , qsol= 1500.0 , alpha= 77.56 , predicted alpha = 81.56974759143591 row[17] data: T1 = 317.999999999999 , gam= 0.0 , qsol= 1500.0 , alpha= 40.68 , predicted alpha = 46.10397140096426 row[18] data: T1 = 317.999999999999 , gam= 0.25 , qsol= 2000.0 , alpha= 65.24 , predicted alpha = 76.62401072491409 row[19] data: T1 = 317.9999999999999999 , gam= 0.5 , qsol= 2500.0 , alpha= 98.23 , predicted alpha = 106.33833925239445



rms deviation between predictions and the collection of test data: alpha = 0.1 6097612804647565 ef = 0.958976451567033

```
In [46]:
          #Task 2.3 Part b
          test = []
          outpt=[]
          testn = []
          outptn = []
          time = []
          pred alpha = []
          test.append([287.0, 0.0, 500.0, 9])
          test.append([287.0, 0.5, 500.0, 9])
          test.append([295.0, 0.0, 750.0, 10])
          test.append([295.0, 0.5, 750.0, 10])
          test.append([301.0, 0.0, 1000.0, 11])
          test.append([301.0, 0.5, 1000.0, 11])
          test.append([305.0, 0.0, 2450.0, 12])
          test.append([305.0, 0.5, 2450.0, 12])
          test.append([307.0, 0.0, 2600.0, 13])
          test.append([307.0, 0.5, 2600.0, 13])
          test.append([308.0, 0.0, 2400.0, 14])
          test.append([308.0, 0.5, 2400.0, 14])
          test.append([308.0, 0.0, 2100.0, 15])
          test.append([308.0, 0.5, 2100.0, 15])
          test.append([305.0, 0.0, 1800.0, 16])
          test.append([305.0, 0.5, 1800.0, 16])
          test.append([295.0, 0.0, 1300.0, 17])
          test.append([295.0, 0.5, 1300.0, 17])
          test.append([292.0, 0.0, 800.0, 18])
          test.append([292.0, 0.5, 800.0, 18])
          test.append([295.0, 0.0, 250.0, 19])
          test.append([295.0, 0.5, 250.0, 19])
          for x in range(len(test)):
              testn.append([test[x][0]/Tmed, test[x][1]/gamed, test[x][2]/qsmed])
              time.append(test[x][3])
          #first point (row [0])comparison of data and prediction
          # put in a loop to print comparion for all data points
          for x in range(len(testn)):
              test = [[testn[x][0], testn[x][1], testn[x][2]]]
              testarray = np.array(test)
              outptn = model.predict(testarray)
              outpt.append([outptn[0][0]*almed, outptn[0][1]*efmed])
              pred alpha.append(outpt[x][0])
              print ('row[',x,'] data: T1 = ', testn[x][0]*Tmed, ', gam= ', testn[x][1]
                  ', qsol= ', testn[x][2]*qsmed, ', predicted alpha = ', outpt[x][0])
          plt.figure()
          plt.plot(time, pred alpha)
          plt.xlabel("Time of day")
          plt.ylabel("Predicted alpha")
          plt.show()
```

```
0.0 , qsol=500.0 , predicted alpha=32
                    287.0 , qam =
row[ 0 ] data: T1 =
.51046017961502
row[ 1 ] data: T1 =
                    287.0 , gam=
                                  0.5 , qsol=
                                               500.0 , predicted alpha =
                                                                           60
.03040354594589
row[ 2 ] data: T1 =
                    295.0 , gam=
                                  0.0 , qsol=
                                               750.0 , predicted alpha =
                                                                           36
.42781925913692
                    295.0 , gam=
row[ 3 ] data: T1 =
                                  0.5 , qsol=
                                               750.0 , predicted alpha =
.44025002196432
                                  0.0 , qsol=
                                               1000.0 , predicted alpha = 3
row[ 4 ] data: T1 =
                    301.0 , gam=
9.04131890002191
                                  0.5 , qsol=
                                               1000.0 , predicted alpha = 7
row[ 5 ] data: T1 =
                    301.0 , gam=
0.69393928992153
row[ 6 ] data: T1 =
                    305.0 , gam=
                                  0.0 , qsol=
                                               2450.0 , predicted alpha = 6
1.81680174141527
                                  0.5 , qsol=
                                               2450.0 , predicted alpha =
                    305.0 , gam=
row[ 7 ] data: T1 =
04.37455732254386
                                               2600.0 , predicted alpha = 6
row[ 8 ] data: T1 =
                    307.0 , gam=
                                  0.0 , qsol=
4.48669026948811
row[ 9 ] data: T1 =
                                  0.5 , qsol=
                                               2600.0 , predicted alpha = 1
                    307.0 , gam=
08.1642800592661
                                   0.0 , qsol=
                                                2400.0 , predicted alpha =
row[ 10 ] data: T1 =
                     308.0 , gam=
61.15114225262404
                                   0.5 , qsol=
                                                2400.0 , predicted alpha =
row[11] data: T1 = 308.0 , gam =
103.17117375565768
                                   0.0 , qsol=
                                                2100.0 , predicted alpha =
row[12] data: T1 = 308.0, gam=
55.55622380897999
row[ 13 ] data: T1 =
                     308.0 , gam=
                                   0.5 , qsol=
                                                2100.0 , predicted alpha =
95.1197553753376
row[ 14 ] data: T1 =
                                   0.0 , qsol=
                                                1800.0 , predicted alpha =
                     305.0 , gam=
50.10198033899367
                                   0.5 , qsol=
                                                1800.0 , predicted alpha =
row[ 15 ] data: T1 =
                     305.0 , gam=
87.49366260436177
row[ 16 ] data: T1 =
                     295.0 , gam=
                                   0.0 , qsol=
                                                1300.0 , predicted alpha =
41.0626166924268
row[ 17 ] data: T1 =
                     295.0 , gam=
                                   0.5 , qsol=
                                                1300.0 , predicted alpha =
76.02330003005862
                                   0.0 , qsol=
                                                800.0 , predicted alpha = 3
row[ 18 ] data: T1 = 292.0 , gam=
6.591588109883666
                                                800.0 , predicted alpha = 6
row[ 19 ] data: T1 = 292.0 , gam=
                                   0.5 , qsol=
6.18117979429364
                                   0.0 , qsol=
                                                250.0 , predicted alpha = 2
row[ 20 ] data: T1 =
                    295.0 , gam=
9.443648374451698
row[ 21 ] data: T1 = 295.0 , gam= 0.5 , gsol= 250.0 , predicted alpha =
6.60733440329135
```



```
In [59]:
          #Task 2.4
          #import useful packages
          import keras
          import pandas as pd
          from keras.models import Sequential
          import numpy as np
          import keras.backend as kb
          import tensorflow as tf
          import copy as cp
          #the follwoing 2 lines are only needed for Mac OS machines
          import os
          os.environ['KMP DUPLICATE LIB OK']='True'
          #Task 2.1 Normalize Data
          #initialize
          xdatan=[]
          ydatan=[]
          T=[]
          ga=[]
          qs=[]
          al=[]
          ef=[]
          def median(sample):
                                    #function to calculate median
              n = len(sample)
              i = n//2
              if n%2:
                  return sorted (sample [i])
              return sum(sorted(sample)[i-1:i+1])/2
          #create input data array
          \#T1(K), gamma, , qsol(kW):
```

```
xdata = []
xdata = [[ 318.0 , 0.0 , 500.0 ], [ 318.0 , 0.0 , 1000.0 ]]
xdata.append([ 318.0 , 0.0 , 1500.0 ])
xdata.append([ 318.0 , 0.0 , 2000.0 ])
xdata.append([ 318.0 , 0.0 , 2500.0 ])
xdata.append([ 318.0 , 0.25 , 500.0 ])
xdata.append([ 318.0 , 0.25 , 1000.0 ])
xdata.append([ 318.0 , 0.25 , 1500.0 ])
xdata.append([ 318.0 , 0.25 , 2000.0 ])
xdata.append([ 318.0 , 0.25 , 2500.0 ])
xdata.append([ 318.0 , 0.5 , 500.0 ])
xdata.append([ 318.0 , 0.5 , 1000.0 ])
xdata.append([ 318.0 , 0.5 , 1500.0 ])
xdata.append([ 318.0 , 0.5 , 2000.0 ])
xdata.append([ 318.0 , 0.5 , 2500.0 ])
xdata.append([ 303.0 , 0.0 , 500.0 ])
xdata.append([ 303.0 , 0.0 , 1000.0 ])
xdata.append([ 303.0 , 0.0 , 1500.0 ])
xdata.append([ 303.0 , 0.0 , 2000.0 ])
xdata.append([ 303.0 , 0.0 , 2500.0 ])
xdata.append([ 303.0 , 0.25 , 500.0 ])
xdata.append([ 303.0 , 0.25 , 1000.0 ])
xdata.append([ 303.0 , 0.25 , 1500.0 ])
xdata.append([ 303.0 , 0.25 , 2000.0 ])
xdata.append([ 303.0 , 0.25 , 2500.0 ])
xdata.append([ 303.0 , 0.5 , 500.0 ])
xdata.append([ 303.0 , 0.5 , 1000.0 ])
xdata.append([ 303.0 , 0.5 , 1500.0 ])
xdata.append([ 303.0 , 0.5 , 2000.0 ])
xdata.append([ 303.0 , 0.5 , 2500.0 ])
xdata.append([ 288.0 , 0.0 , 500.0 ])
xdata.append([ 288.0 , 0.0 , 1000.0 ])
xdata.append([ 288.0 , 0.0 , 1500.0 ])
xdata.append([ 288.0 , 0.0 , 2000.0 ])
xdata.append([ 288.0 , 0.0 , 2500.0 ])
xdata.append([ 288.0 , 0.25 , 500.0 ])
xdata.append([ 288.0 , 0.25 , 1000.0 ])
xdata.append([ 288.0 , 0.25 , 1500.0 ])
xdata.append([ 288.0 , 0.25 , 2000.0 ])
xdata.append([ 288.0 , 0.25 , 2500.0 ])
xdata.append([ 288.0 , 0.5 , 500.0 ])
xdata.append([ 288.0 , 0.5 , 1000.0 ])
xdata.append([ 288.0 , 0.5 , 1500.0 ])
xdata.append([ 288.0 , 0.5 , 2000.0 ])
xdata.append([ 288.0 , 0.5 , 2500.0 ])
xdata.append([ 268.0 , 0.0 , 500.0 ])
xdata.append([ 268.0 , 0.0 , 1000.0 ])
xdata.append([ 268.0 , 0.0 , 1500.0 ])
xdata.append([ 268.0 , 0.0 , 2000.0 ])
xdata.append([ 268.0 , 0.0 , 2500.0 ])
```

```
xdata.append([ 268.0 , 0.25 , 500.0 ])
xdata.append([ 268.0 , 0.25 , 1000.0 ])
xdata.append([ 268.0 , 0.25 , 1500.0 ])
xdata.append([ 268.0 , 0.25 , 2000.0 ])
xdata.append([ 268.0 , 0.25 , 2500.0 ])
xdata.append([ 268.0 , 0.5 , 500.0 ])
xdata.append([ 268.0 , 0.5 , 1000.0 ])
xdata.append([ 268.0 , 0.5 , 1500.0 ])
xdata.append([ 268.0 , 0.5 , 2000.0 ])
xdata.append([ 268.0 , 0.5 , 2500.0 ])
# alpha, effsys
ydata = []
ydata = [[ 35.1316 , 0.3808 ],[ 40.3764 , 0.38686 ]]
ydata.append([ 47.4620 , 0.3930 ])
ydata.append([ 57.5639 , 0.39949 ])
ydata.append([ 73.1286 , 0.40612 ])
ydata.append([ 49.1110 , 0.4023 ])
ydata.append([ 56.4428 , 0.40605 ])
ydata.append([ 66.3479 , 0.4098 ])
ydata.append([ 80.4695 , 0.413 ])
ydata.append([ 102.2276 , 0.4175 ])
ydata.append([ 63.0904 , 0.41540 ])
ydata.append([ 72.5092 , 0.4175 ])
ydata.append([ 85.2338, 0.4197 ])
ydata.append([ 103.3750 , 0.42192 ])
ydata.append([ 131.3266 , 0.4242 ])
ydata.append([ 34.273 , 0.3952 ])
ydata.append([ 38.99026 , 0.4012 ])
ydata.append([ 45.2133, 0.4073 ])
ydata.append([ 53.8000 , 0.4136 ])
ydata.append([ 66.4130 , 0.4201 ])
ydata.append([ 47.922 , 0.4178 ])
ydata.append([ 54.518 , 0.4215 ])
ydata.append([ 63.220 , 0.4252 ])
ydata.append([ 75.226 , 0.4290 ])
ydata.append([ 92.862 , 0.4329 ])
ydata.append([ 61.572 , 0.4315 ])
ydata.append([ 70.0468 , 0.43373 ])
ydata.append([ 81.226 , 0.43597 ])
ydata.append([ 96.653 , 0.4382 ])
ydata.append([ 119.3124 , 0.44045 ])
ydata.append([ 33.4521 , 0.40913 ])
ydata.append([ 37.6911, 0.4150 ])
ydata.append([ 43.1602 , 0.4209 ])
ydata.append([ 50.4858 , 0.4271 ])
ydata.append([ 60.8067 , 0.4334 ])
ydata.append([ 46.7865 , 0.4328 ])
ydata.append([ 52.7151 , 0.43646 ])
ydata.append([ 60.36425 , 0.44016 ])
ydata.append([ 70.6099 , 0.443926 ])
```

```
ydata.append([ 85.0447 , 0.4477 ])
ydata.append([ 60.1208 , 0.44721 ])
ydata.append([ 67.7391 , 0.44940 ])
ydata.append([ 77.56830 , 0.4516 ])
ydata.append([ 90.73410 , 0.4538 ])
ydata.append([ 109.2828 , 0.4560 ])
ydata.append([ 32.4123 , 0.42694 ])
ydata.append([ 36.0807 , 0.4325 ])
ydata.append([ 40.6854 , 0.4383 ])
ydata.append([ 46.6374 , 0.4442 ])
ydata.append([ 54.6293 , 0.4503 ])
ydata.append([ 45.3472 , 0.4519 ])
ydata.append([ 50.4796 , 0.4555 ])
ydata.append([ 56.9219 , 0.4591 ])
ydata.append([ 65.2492 , 0.4628 ])
ydata.append([ 76.4304 , 0.4665 ])
ydata.append([ 58.2822 , 0.4672 ])
ydata.append([ 64.8785 , 0.4693 ])
ydata.append([ 73.1584 , 0.4715 ])
ydata.append([ 83.8610 , 0.4738 ])
ydata.append([ 98.2316 , 0.4760 ])
xdatar = np.array(cp.deepcopy(xdata)) #xdata copy
ydatar = np.array(cp.deepcopy(ydata)) #ydata copy
for x in range(len(xdatar)):
    T.append(xdatar[x][0])
    ga.append(xdatar[x][1])
    qs.append(xdatar[x][2])
for y in range(len(ydatar)):
    al.append(ydatar[y][0])
    ef.append(ydatar[y][1])
Tmed = median (T) #find median of the parameters
gamed = median(ga)
qsmed = median(qs)
almed = median(al)
efmed = median(ef)
for x in range(len(xdatar)):
    xdatan.append([xdatar[x][0]/Tmed, xdatar[x][1]/gamed, xdatar[x][2]/qsmed]
for y in range(len(ydatar)):
    ydatan.append([ydatar[y][0]/almed, ydatar[y][1]/efmed])
```

```
In [67]:
          from keras import backend as K
          #initialize weights with values between -0.2 and 1.2
          initializer = tf.keras.initializers.RandomUniform(minval= -0.2, maxval=1.2)
          modelv1 = keras.Sequential([
              keras.layers.Dense(16, activation=K.elu, input shape=[3]),
              keras.layers.Dense(32, activation=K.elu),
              keras.layers.Dense(16, activation=K.elu),
              keras.layers.Dense(2)
            ])
          modelv2 = keras.Sequential([
              keras.layers.Dense(16, activation=K.relu, input shape=[3]),
              keras.layers.Dense(32, activation=K.relu),
              keras.layers.Dense(16, activation=K.relu),
              keras.layers.Dense(16, activation=K.relu),
              keras.layers.Dense(2)
            1)
          modelv3 = keras.Sequential([
              keras.layers.Dense(8, activation=K.relu, input shape=[3]),
              keras.layers.Dense(16, activation=K.relu),
              keras.layers.Dense(8, activation=K.relu),
              keras.layers.Dense(2)
            1)
          modelv4 = keras.Sequential([
              keras.layers.Dense(20, activation=K.relu, input shape=[3]),
              keras.layers.Dense(40, activation=K.relu),
              keras.layers.Dense(20, activation=K.relu),
              keras.layers.Dense(2)
            1)
```

```
sgd = tf.keras.optimizers.RMSprop(0.001) #Original value 0.05
modelv1.compile(loss='mean_absolute_error',optimizer='sgd')
modelv2.compile(loss='mean_absolute_error',optimizer='sgd')
modelv3.compile(loss='mean_absolute_error',optimizer='sgd')
modelv4.compile(loss='mean_absolute_error',optimizer='sgd')
```

```
In [69]:
          # Add an early stopping callback
          es = keras.callbacks.EarlyStopping(
              monitor='loss',
              mode='min',
              patience = 20,
              restore best weights = True,
              verbose=1)
          # Add a checkpoint where loss is minimum, and save that model
          mc = keras.callbacks.ModelCheckpoint('best model.SB', monitor='loss',
                               mode='min', verbose=1, save best only=True)
          historyDatav1 = modelv1.fit(xarray,yarray,epochs=600,callbacks=[es]) #epoch o
          loss histv1 = historyDatav1.history['loss']
          #The above line will return a dictionary, access it's info like this:
          best_epochv1 = np.argmin(historyDatav1.history['loss']) + 1
          print ('best epoch v1 = ', best_epochv1)
          print('smallest loss v1 =', np.min(loss_histv1))
         Epoch 1/600
```

```
60/60 [============== ] - 1s 16ms/step - loss: 0.9624
Epoch 2/600
60/60 [============== ] - 0s 354us/step - loss: 0.8003
Epoch 3/600
60/60 [============ ] - 0s 284us/step - loss: 0.6341
Epoch 4/600
Epoch 5/600
60/60 [============== ] - 0s 389us/step - loss: 0.3649
Epoch 6/600
60/60 [============ ] - 0s 370us/step - loss: 0.2614
Epoch 7/600
Epoch 8/600
Epoch 9/600
Epoch 10/600
60/60 [============= ] - 0s 411us/step - loss: 0.1106
Epoch 11/600
60/60 [============== ] - 0s 232us/step - loss: 0.1060
Epoch 12/600
60/60 [================ ] - 0s 231us/step - loss: 0.1009
Epoch 13/600
60/60 [============== ] - 0s 198us/step - loss: 0.0982
Epoch 14/600
60/60 [=============== ] - 0s 250us/step - loss: 0.0973
Epoch 15/600
Epoch 16/600
60/60 [============== ] - 0s 227us/step - loss: 0.0952
Epoch 17/600
Epoch 18/600
```

```
60/60 [============== ] - 0s 173us/step - loss: 0.0964
Epoch 19/600
60/60 [=========== ] - 0s 143us/step - loss: 0.0930
Epoch 20/600
60/60 [=============== ] - 0s 140us/step - loss: 0.0926
Epoch 21/600
60/60 [============== ] - 0s 175us/step - loss: 0.0944
Epoch 22/600
Epoch 23/600
60/60 [=============== ] - 0s 251us/step - loss: 0.0917
Epoch 24/600
60/60 [============== ] - 0s 334us/step - loss: 0.0932
Epoch 25/600
60/60 [============== ] - 0s 258us/step - loss: 0.0943
Epoch 26/600
60/60 [============== ] - 0s 367us/step - loss: 0.0937
Epoch 27/600
60/60 [============ ] - 0s 297us/step - loss: 0.0909
Epoch 28/600
Epoch 29/600
60/60 [============== ] - 0s 228us/step - loss: 0.0912
Epoch 30/600
60/60 [============= ] - 0s 145us/step - loss: 0.0907
Epoch 31/600
Epoch 32/600
60/60 [============= ] - 0s 156us/step - loss: 0.0902
Epoch 33/600
60/60 [============= ] - 0s 137us/step - loss: 0.0897
Epoch 34/600
Epoch 35/600
60/60 [============= ] - 0s 159us/step - loss: 0.0955
Epoch 36/600
60/60 [============== ] - 0s 158us/step - loss: 0.0914
Epoch 37/600
60/60 [============== ] - 0s 185us/step - loss: 0.0905
Epoch 38/600
- loss: 0.0893
Epoch 39/600
Epoch 40/600
60/60 [============== ] - 0s 161us/step - loss: 0.0885
Epoch 41/600
60/60 [============== ] - 0s 160us/step - loss: 0.0888
Epoch 42/600
60/60 [=========== ] - 0s 225us/step - loss: 0.0890
Epoch 43/600
60/60 [============ ] - 0s 188us/step - loss: 0.0880
Epoch 44/600
60/60 [============= ] - 0s 287us/step - loss: 0.0880
Epoch 45/600
60/60 [============== ] - 0s 276us/step - loss: 0.0880
Epoch 46/600
```

60/60	[======]	_	0s	540us/step - lo	ss:	0.0880
	47/600			_		
	[=======]	-	0s	368us/step - lo	SS:	0.0881
	48/600 [=======]	_	۸c	28611g/gten = 10		0 0880
	49/600		UB	20003/SCCP - 10	55.	0.0000
	[=======]	_	0s	313us/step - lo	ss:	0.0872
	50/600					
	[=======]	-	0s	565us/step - lo	SS:	0.0872
	51/600 [========]	_	Λc	27611g/gten _ 10		0 0861
	52/600	_	V.S	2700375cep - 10	55.	0.0001
	[======]	_	0s	227us/step - lo	ss:	0.0858
	53/600					
	[======] 54/600	-	0s	155us/step - lo	ss:	0.0864
	[==========]	_	0s	196us/step = lo	ss:	0.0861
	55/600		Ů.	13045/5000	55.	0.0001
	[======]	_	0s	192us/step - lo	ss:	0.0859
	56/600					
	[=======] 57/600	-	0s	177us/step - lo	ss:	0.0859
	[=========]	_	0s	167us/step - lo	ss:	0.0881
Epoch	58/600					
	[======]	-	0s	198us/step - lo	ss:	0.0867
	59/600		0	140 / 1		0 0050
	[======] 60/600	-	0s	148us/step - 10	SS:	0.0852
	[========]	_	0s	167us/step - lo	ss:	0.0897
Epoch	61/600					
	[=====]	-	0s	173us/step - lo	ss:	0.0857
	62/600 [======]		٥٩	101,12 / 2+02 10		0 0050
	63/600	_	US	181us/step - 10	55:	0.0859
	[========]	_	0s	175us/step - lo	ss:	0.0866
	64/600					
	[=======]	-	0s	239us/step - lo	ss:	0.0839
	65/600 [=======]	_	۸c	310us/sten = 10		0 0844
	66/600		05	310d3/3ccp - 10	55.	0.0011
	[======]	_	0s	637us/step - lo	ss:	0.0860
	67/600					
	[======] 68/600	-	0s	384us/step - 10	SS:	0.0859
	[========]	_	0s	316us/step - lo	ss:	0.0859
	69/600					
	[======]	-	0s	200us/step - lo	ss:	0.0860
	70/600		0	176/		0 0050
	[======] 71/600	-	US	1/6us/step - 10	ss:	0.0859
	[========]	_	0s	234us/step - lo	ss:	0.0847
Epoch	72/600					
	[======]	-	0s	341us/step - lo	ss:	0.0834
	73/600		0~	170ug/g+on 15		0 0027
	74/600	_	US	1/0us/scep - 10	35:	0.003/
	[========]	_	0s	173us/step - lo	ss:	0.0868
	•			-		

Enoch	75/600				
	[========]	_	0s	462us/step - loss: 0.0830	б
	76/600				
60/60	[======]	_	0s	441us/step - loss: 0.083	5
	77/600				
	[=======]	-	0s	304us/step - loss: 0.0833	3
	78/600 [======]		٥٥	419ug/gton logg. 0 0020	0
	79/600	_	US	410us/scep - 10ss: 0.002	,
	[=======]	_	0s	209us/step - loss: 0.0829	9
Epoch	80/600			_	
	[======]	-	0s	162us/step - loss: 0.0819	9
	81/600 [======]		0~	156.00/0+00 3000 0 0010	^
	82/600	_	US	156us/step - 10ss: 0.081	1
	[========]	_	0s	216us/step - loss: 0.0820	0
Epoch	83/600			_	
	[======]	-	0s	209us/step - loss: 0.084	1
	84/600		_		_
	[======] 85/600	-	0s	185us/step - loss: 0.0819	9
	[=========]	_	Λs	186us/sten = loss: 0.082	1
	86/600		OB	10005/2002	-
60/60	[======]	_	0s	231us/step - loss: 0.0830	Э
	87/600				
	[======] 88/600	-	0s	214us/step - loss: 0.083	1
	[=========]	_	0s	250us/step - loss: 0.083	2.
Epoch	89/600			_	
	[======]	-	0s	273us/step - loss: 0.085	1
	90/600		^	202 / 1 2 2 2 2 2 2	4
	[======] 91/600	-	US	202us/step - loss: 0.0814	ł
	[========]	_	0s	418us/step - loss: 0.0812	2
Epoch	92/600				
	[=====]	-	0s	295us/step - loss: 0.0829	9
	93/600		٥٠	20299/9409 1099 0 0000	0
	94/600	_	US	202us/step = 10ss: 0.080)
	[========]	_	0s	161us/step - loss: 0.0803	1
Epoch	95/600				
	[=======]	-	0s	176us/step - loss: 0.081	7
	96/600 [=======]		٥٠	20000/9400 1099 0 0011	=
	97/600	_	US	209us/step = 10ss: 0.081:)
	[========]	_	0s	194us/step - loss: 0.0800	0
Epoch	98/600				
	[=======]	-	0s	243us/step - loss: 0.0800)
	99/600		0~	240/5+5	^
	[======] 100/600	_	US	340us/step - 10ss: 0.0800	J
	[========]	_	0s	139us/step - loss: 0.079	7
Epoch	101/600				
	[========]	-	0s	163us/step - loss: 0.0800)
	102/600 [======]		0 ~	1/9ug/gtop logg. 0 000	7
	103/600	_	US	140us/scep - 10ss: 0.080	′
	,				

60/60	[======]	_	0s	224us/step - loss: 0.	.0811
	104/600		•	100 / 1	0.500
	[======] 105/600	-	0s	198us/step - loss: 0.	.0792
	[=======]	_	0s	190us/step - loss: 0.	.0802
Epoch	106/600				
	[========]	-	0s	189us/step - loss: 0.	.0796
	107/600 [=========]	_	0s	347us/step = loss: 0.	.0795
Epoch	108/600				
	[=====]	-	0s	178us/step - loss: 0.	.0808
	109/600		٥٥	207ug/g+on logg. 0	0002
	110/600	_	US	20/us/step - 10ss: 0.	.0002
60/60	[======]	_	0s	162us/step - loss: 0.	.0801
	111/600		0	0.40 / 1 7 0	0000
	[======] 112/600	-	0s	242us/step - loss: 0.	.0803
	[========]	_	0s	230us/step - loss: 0.	.0787
	113/600				
	[======] 114/600	-	0s	232us/step - loss: 0.	.0792
	[=========]	_	0s	179us/step - loss: 0.	.0813
Epoch	115/600				
	[=======]	-	0s	224us/step - loss: 0.	.0788
	116/600 [=========]	_	0 s	192115/sten - loss: 0.	. 0785
Epoch	117/600				
	[=======]	-	0s	191us/step - loss: 0.	.0787
	118/600 [=========]		٥٥	165yg/g+on logg. 0	0700
	119/600	_	US	103us/step - 10ss: 0.	.0790
60/60	[======]	_	0s	174us/step - loss: 0.	.0777
	120/600		0	150/	0702
	[======] 121/600	-	US	159us/step - 10ss: 0.	.0/83
	[=======]	_	0s	187us/step - loss: 0.	.0772
	122/600				
	[=======] 123/600	-	0s	134us/step - loss: 0.	.0773
	[========]	_	0s	174us/step - loss: 0.	.0804
Epoch	124/600				
	[======] 125/600	-	0s	165us/step - loss: 0.	.0775
	[=========]	_	0s	161us/step - loss: 0.	.0819
Epoch	126/600				
	[=========]	-	0s	174us/step - loss: 0.	.0788
	127/600 [========]	_	0s	181us/step = loss: 0.	.0772
	128/600		Ů.	10145/500p 1055. 0.	.0772
	[======]	-	0s	137us/step - loss: 0.	.0772
	129/600 [=========]	_	۸e	168115/sten = loss. 0	0776
	130/600	_	VB	100db/bccp - 10bb. 0	
60/60	[======]	-	0s	199us/step - loss: 0.	.0759
	131/600		0	170119/9409	0760
00/60	[=====]	-	υS	i/ous/step - loss: 0	.0/08

Enoch	132/600			
	[========]	_	0s	160us/step - loss: 0.0773
Epoch	133/600			
	[=======]	-	0s	271us/step - loss: 0.0781
	134/600		٥٥	226ug/gton logg. 0 0795
	135/600	_	US	220us/step - 10ss: 0.0763
	[=========]	_	0s	162us/step - loss: 0.0763
Epoch	136/600			
	[=======]	-	0s	174us/step - loss: 0.0765
	137/600 [======]		Λc	171us/sten loss. 0 0755
	138/600		V.S	1/1us/scep - 10ss. 0.0/55
	[========]	_	0s	192us/step - loss: 0.0750
	139/600			
	[======] 140/600	-	0s	519us/step - loss: 0.0755
	[===========]	_	0s	258us/step = loss: 0.0753
Epoch	141/600			_
	[======]	_	0s	205us/step - loss: 0.0752
	142/600		0 -	107/
	[======] 143/600	_	US	19/us/step - loss: 0.0/50
	[=========]	_	0s	182us/step - loss: 0.0749
Epoch	144/600			
	[======]	-	0s	168us/step - loss: 0.0743
	145/600 [=======]		٥٥	150ug/gton logg: 0 0764
	146/600	_	US	139us/scep - 10ss: 0.0/04
	[========]	_	0s	160us/step - loss: 0.0798
	147/600			
	[======] 148/600	-	0s	178us/step - loss: 0.0765
	[===========]	_	0s	250us/step - loss: 0.0745
Epoch	149/600			
	[======]	_	0s	182us/step - loss: 0.0742
	150/600 [=======]		٥٥	22019/9+09 1099 0 0746
	151/600	_	US	230us/scep - 10ss: 0.0/40
	[=========]	_	0s	193us/step - loss: 0.0739
	152/600			
	[======] 153/600	-	0s	166us/step - loss: 0.0742
	[==========]	_	0s	147us/step - loss: 0.0742
Epoch	154/600			
	[======]	_	0s	172us/step - loss: 0.0748
	155/600 [=======]		٥٥	154ug/gton logg. 0 0744
	156/600	_	US	134us/scep - 10ss: 0.0/44
	[========]	_	0s	216us/step - loss: 0.0741
	157/600			
	[======] 158/600	-	0s	223us/step - loss: 0.0747
	[===========]	_	0s	242us/step - loss: 0.0747
Epoch	159/600			
	[=======]	-	0s	290us/step - loss: 0.0756
Epoch	160/600			

60/60	[=====]	_	0s	488us/step - loss: 0.0731
	161/600		0	204 / 1 2 2 2756
	[======] 162/600	-	0s	204us/step - loss: 0.0756
	[=======]	_	0s	190us/step - loss: 0.0740
Epoch	163/600			
	[=========]	-	0s	168us/step - loss: 0.0728
	164/600	_	0s	170us/step - loss: 0.0728
Epoch	165/600			
	[======]	-	0s	145us/step - loss: 0.0738
	166/600 [=======]		Λσ	16/us/step loss: 0 07/6
	167/600		05	104d5/5cep - 1055. 0.0/40
	[=======]	-	0s	216us/step - loss: 0.0744
	168/600 [=======]		٥٩	10000/0400 10000 0 0742
	169/600	_	US	189us/step = 10ss: 0.0/43
60/60	[======]	_	0s	216us/step - loss: 0.0727
	170/600		•	225 / 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
	[======] 171/600	-	0s	336us/step - loss: 0.0/20
	[========]	_	0s	211us/step - loss: 0.0724
	172/600			
	[======] 173/600	-	0s	260us/step - loss: 0.0717
	[=========]	_	0s	209us/step - loss: 0.0715
Epoch	174/600			
	[======] 175/600	-	0s	242us/step - loss: 0.0741
	[=========]	_	0s	227us/step - loss: 0.0715
Epoch	176/600			
	[======] 177/600	-	0s	202us/step - loss: 0.0719
	[========]	_	0s	201us/step - loss: 0.0713
Epoch	178/600			
	[======] 179/600	-	0s	226us/step - loss: 0.0714
	[=========]	_	0s	314us/step - loss: 0.0715
Epoch	180/600			
	[======] 181/600	-	0s	199us/step - loss: 0.0706
	[========]	_	0s	174us/step - loss: 0.0706
	182/600			
	[======] 183/600	-	0s	236us/step - loss: 0.0709
	[========]	_	0s	184us/step - loss: 0.0711
	184/600			
	[======] 185/600	-	0s	209us/step - loss: 0.0736
	[=========]	_	0s	248us/step - loss: 0.0726
Epoch	186/600			
	[=========]	-	0s	442us/step - loss: 0.0703
	187/600 [=======]	_	0s	228us/step - loss: 0.0708
Epoch	188/600			
60/60	[=====]	-	0s	260us/step - loss: 0.0713

Epoch	189/600				
	[========]	_	0s	232us/step - loss: 0.0	0698
Epoch	190/600				
	[=======]	_	0s	181us/step - loss: 0.0	704
	191/600				
	[=========]	-	0s	230us/step - loss: 0.0	706
	192/600 [======]		٥٥	222115/5+05 loss. 0.0	1600
	193/600	_	US	223us/scep - 10ss: 0.0	1030
	[=======]	_	0s	234us/step - loss: 0.0	0699
Epoch	194/600			_	
	[========]	_	0s	243us/step - loss: 0.0	708
	195/600		•	150 /	
	[======] 196/600	_	0s	170us/step - loss: 0.0)693
	[===========]	_	۸e	194us/step _ loss. 0 0	1693
	197/600		US	19403/SCEP - 1035. 0.0	,0,5
	[=======]	_	0s	200us/step - loss: 0.0	0689
	198/600				
	[=======]	-	0s	191us/step - loss: 0.0	0697
	199/600		•		
	[======] 200/600	-	0s	214us/step - loss: 0.0)693
	[==========]	_	0s	197us/step = loss: 0.0)691
	201/600		O.D.	1374575000	,0,1
	[=======]	_	0s	235us/step - loss: 0.0	695
	202/600				
	[======]	-	0s	185us/step - loss: 0.0)695
	203/600 [======]		٥٠	16009/9409 1099 0 0	710
	204/600	_	US	169us/step - loss: 0.0	7/10
	[=========]	_	0s	208us/step - loss: 0.0	702
Epoch	205/600				
	[=======]	_	0s	201us/step - loss: 0.0	0688
	206/600				
	[======] 207/600	-	0s	252us/step - loss: 0.0)678
	[==========]	_	۸c	172us/sten = loss. 0 0	705
	208/600		0.5	17245/5000 - 1055. 0.0	,,05
	[===========]	_	0s	169us/step - loss: 0.0	0695
	209/600				
	[=======]	-	0s	177us/step - loss: 0.0	715
	210/600		0 ~	1600-7-1 1 0.0	701
	[======] 211/600	_	US	160us/step - loss: 0.0	7701
	[=========]	_	0s	167us/step - loss: 0.0	678
	212/600			111111111111111111111111111111111111111	
60/60	[======]	_	0s	199us/step - loss: 0.0	0683
	213/600				
	[======================================	-	0s	173us/step - loss: 0.0	0681
	214/600 [=======]		۸c	188us/sten loss. 0.0	1674
	215/600	_	UB	10008/8cep - 1088: 0.0	,0,4
	[========]	_	0s	184us/step - loss: 0.0	0685
Epoch	216/600				
	[=======]	-	0s	167us/step - loss: 0.0	678
Epoch	217/600				

60/60	[======]	_	0s	206us/step - loss: 0	.0672
Epoch	218/600				
	[======]	-	0s	180us/step - loss: 0	.0714
	219/600				
	[======]	-	0s	187us/step - loss: 0	.0675
	220/600		0 -	100/	0.670
	[======] 221/600	_	US	198us/step - 10ss: 0	0.06/8
	[========]	_	Λe	187us/sten - loss. 0	0689
	222/600		05	1074575CCP = 1055. 0	.000
	[========]	_	0s	178us/step - loss: 0	.0669
Epoch	223/600				
	[======]	-	0s	201us/step - loss: 0	.0675
	224/600		_		
	[========]	-	0s	165us/step - loss: 0	.0719
	225/600 [=======]		0 a	175ug/gton logg. 0	0674
	226/600	-	US	1/3us/scep - 10ss: 0	0.0074
	[========]	_	0s	184us/step - loss: 0	.0662
	227/600			1 11 11 11 11	
60/60	[======]	_	0s	146us/step - loss: 0	.0663
	228/600				
	[======]	-	0s	168us/step - loss: 0	.0710
	229/600 [=======]		0 a	17799/9409 1099 0	0600
	230/600	_	US	1//us/scep - loss: 0	.0080
	[=======]	_	0s	174us/step - loss: 0	.0668
	231/600		0.5	1,145,566p 1655 6	
	[======]	_	0s	162us/step - loss: 0	.0656
	232/600				
	[======]	-	0s	136us/step - loss: 0	.0664
	233/600 [=======]		0 a	1/200/04-05 1000 0	0671
	234/600	_	US	143us/scep - 10ss: 0	0.00/1
	[========]	_	0s	175us/step - loss: 0	.0678
	235/600				
	[======]	-	0s	144us/step - loss: 0	.0658
-	236/600				
	[=======]	-	0s	173us/step - loss: 0	.0670
	237/600 [=======]	_	۸e	181us/sten _ loss. 0	0676
	238/600		V.S	101us/scep - 10ss. 0	.0070
	[========]	_	0s	172us/step - loss: 0	.0666
Epoch	239/600				
	[=====]	-	0s	189us/step - loss: 0	.0665
	240/600		^	150 / 1 0	0.650
	[======] 241/600	-	0s	153us/step - 10ss: 0	0.0652
	[=======]	_	0s	172us/step = loss: 0	0.0668
	242/600		Ů.	1,245,5665 1655,6	
	[=======]	_	0s	324us/step - loss: 0	.0679
Epoch	243/600				
	[======]	-	0s	175us/step - loss: 0	.0671
	244/600		^	240/	0.650
	[======] 245/600	-	US	249us/step - loss: 0	.0652
	[======================================	_	0 =	205us/sten = loss. 0	0.0647
00/00	ij	_	V D	20000/BCCP - 1088. 0	

Enoch	246/600				
	[=======]	_	0s	536us/step - loss: 0	.0650
Epoch	247/600				
	[======]	_	0s	293us/step - loss: 0	.0647
	248/600				
	[========]	-	0s	384us/step - loss: 0	.0669
	249/600 [======]		Λc	391us/sten loss. 0	0677
	250/600	_	US	391us/scep - 10ss: 0	.0077
	[=======]	_	0s	399us/step - loss: 0	.0644
Epoch	251/600			_	
	[======]	-	0s	285us/step - loss: 0	.0648
	252/600		•	055 / 1	0645
	[======] 253/600	_	0s	255us/step - loss: 0	.0645
	[==========]		۸e	21111g/g+en _ logg. 0	0641
	254/600		0.D	21145/5005 - 1055. 0	.0041
	[=========]	_	0s	226us/step - loss: 0	.0649
	255/600				
	[=====]	-	0s	175us/step - loss: 0	.0653
	256/600		٥-	120/	0700
	[======] 257/600	_	US	139us/step - 10ss: 0	.0708
	[========]	_	0s	199us/step - loss: 0	.0668
	258/600				
	[======]	_	0s	259us/step - loss: 0	.0678
	259/600				
	[=======]	-	0s	352us/step - loss: 0	.0673
	260/600 [======]		۸e	30211g/gton _ logg. 0	0642
	261/600		V S	302us/scep - 10ss. 0	.0042
	[=========]	_	0s	390us/step - loss: 0	.0668
	262/600				
	[======]	-	0s	335us/step - loss: 0	.0643
	263/600 [======]		٥٠	20000 / 0 + 0 > 1 0 0 0	0624
	[] 264/600	_	US	309us/step - loss: 0	.0634
-	[=======]	_	0s	273us/step - loss: 0	.0640
Epoch	265/600				
	[=======]	_	0s	301us/step - loss: 0	.0647
	266/600		•	150 / 1	0.505
	[======] 267/600	-	0s	150us/step - loss: 0	.0626
	[========]	_	0s	152us/step = loss: 0	.0654
	268/600		OB	13245/5005 1055. 0	•0031
	[========]	_	0s	196us/step - loss: 0	.0664
	269/600				
	[=======]	-	0s	200us/step - loss: 0	.0644
	270/600 [======]		٥٥	1/11/2/2+02 1022 0	0626
	271/600	_	US	141us/step - loss: 0	.0626
	[=======]	_	0s	166us/step - loss: 0	.0625
Epoch	272/600				
	[======]	-	0s	164us/step - loss: 0	.0631
	273/600		•	100 / 1 3 0	0.605
	[======] 274/600	-	US	190us/step - loss: 0	.0635
проси	2/1/000				

	[=====]	-	0s	233us/step	_	loss:	0.0675
	275/600 [=======]	_	0s	192us/step	_	loss:	0.0628
	276/600 [=======]	_	۸e	199112/sten	_	10991	0 0619
Epoch	277/600			_			
	[======] 278/600	-	0s	215us/step	-	loss:	0.0625
60/60	[======]	_	0s	249us/step	_	loss:	0.0621
	279/600 [======]	_	0s	282us/step	_	loss:	0.0616
Epoch	280/600			_			
	[======] 281/600	-	0s	183us/step	-	loss:	0.0625
	[========]	-	0s	175us/step	-	loss:	0.0625
	282/600 [=======]	_	0s	168us/step	_	loss:	0.0633
	283/600 [======]		Λα	163ug/g+on		logg•	0 0634
Epoch	284/600			_			
	[======] 285/600	-	0s	172us/step	-	loss:	0.0653
60/60	[======]	_	0s	197us/step	_	loss:	0.0618
	286/600 [=======]	_	05	156115/sten	_	1099:	0.0665
Epoch	287/600						
	[======] 288/600	-	0s	158us/step	-	loss:	0.0622
60/60	[======]	_	0s	282us/step	_	loss:	0.0611
	289/600 [=======]	_	0s	205us/step	_	loss:	0.0628
Epoch	290/600			_			
	[======] 291/600	-	0s	316us/step	-	loss:	0.0624
60/60	[======]	-	0s	343us/step	-	loss:	0.0626
	292/600 [=======]	_	0s	284us/step	_	loss:	0.0622
Epoch	293/600			_			
	[=======] 294/600	_	US	232us/step	_	loss:	0.0634
	[==========]	-	0s	262us/step	-	loss:	0.0609
	295/600 [=======]	_	0s	225us/step	_	loss:	0.0602
	296/600 [======]		0.4	172,50 / 5+00		1000.	0 0605
Epoch	297/600						
	[======] 298/600	-	0s	234us/step	-	loss:	0.0603
	[========]	_	0s	226us/step	_	loss:	0.0610
	299/600 [======]		٥٥	260ug/g+on		1000.	0 0605
Epoch	300/600						
	[======] 301/600	-	0s	304us/step	-	loss:	0.0652
60/60	[======]	_	0s	286us/step	_	loss:	0.0632
	302/600 [======]		0.5	196115/5+05		1055	0 0505
00/00	[==]	_	US	-oous/step	_	TOSS:	0.0095

Epoch	303/600				
	[========]	_	0s	397us/step - loss: 0.059	9
	304/600				
	[======================================	-	0s	288us/step - loss: 0.060	2
	305/600 [======]	_	۸e	270us/sten = loss: 0 061	6
	306/600		05	270d3/3ccp = 1033. 0.001	. 0
	[=======]	-	0s	227us/step - loss: 0.060	8
	307/600				
	[======] 308/600	-	0s	207us/step - loss: 0.059	0
	[=========]	_	0s	231us/step = loss: 0.060	1
Epoch	309/600			_	
	[=======]	-	0s	251us/step - loss: 0.059	7
	310/600		0 -	401/	
	[======] 311/600	-	US	491us/step - 10ss: 0.059	0
	[=======]	_	0s	401us/step - loss: 0.059	3
Epoch	312/600			_	
	[======]	-	0s	297us/step - loss: 0.059	4
	313/600 [======]		۸c	318us/stan loss: 0.050	1
	314/600	_	VS	310us/scep - 10ss. 0.039	
60/60	[======]	_	0s	328us/step - loss: 0.059	0
	315/600				_
	[======] 316/600	-	0s	205us/step - loss: 0.059	8
	[=========]	_	0s	255us/step - loss: 0.059	6
Epoch	317/600				
	[=====]	-	0s	276us/step - loss: 0.060	3
	318/600 [======]		۸c	276us/sten loss: 0.059	2
	319/600		V.S	270us/scep - 10ss. 0.030	, ,
	[======]	-	0s	209us/step - loss: 0.058	9
	320/600 [======]		0 ~	205/5	
	321/600	-	US	205us/step - 10ss: 0.058	9
-	[=======]	_	0s	271us/step - loss: 0.060	4
	322/600		•		
	[======] 323/600	-	US	340us/step - 10ss: 0.060	12
	[========]	_	0s	440us/step - loss: 0.063	6
	324/600				
	[======================================	-	0s	275us/step - loss: 0.060	5
	325/600 [======]	_	٥q	423us/step = loss: 0.060	1
	326/600		0 D	12345, 5005	_
	[======]	-	0s	354us/step - loss: 0.058	3
	327/600		•	200 / 1 2 2 2 2 2	
	[======] 328/600	-	US	290us/step - loss: 0.060	0
	[========]	_	0s	339us/step - loss: 0.059	5
Epoch	329/600				
	[=========]	-	0s	434us/step - loss: 0.059	6
	330/600 [======]	_	0,5	291us/step = loss: 0.060	6
	331/600		7.5		-
-					

60/60	[=====]	_	0s	340us/step -	- loss:	0.0578
	332/600 [=======]		0 ~	250/	1	0 0500
	333/600	_	US	350us/step -	- loss:	0.0589
60/60	[======]	_	0s	287us/step -	- loss:	0.0582
	334/600		0	107 / 1	1	0 0501
	[======] 335/600	-	0s	19/us/step -	- loss:	0.0591
	[=======]	_	0s	190us/step -	- loss:	0.0571
	336/600			a=	-	
	[======] 337/600	-	0s	356us/step -	- loss:	0.0602
	[=======]	_	0s	305us/step -	- loss:	0.0596
	338/600				-	
	[======] 339/600	-	0s	303us/step -	- loss:	0.0612
	[=======]	_	0s	388us/step -	- loss:	0.0588
	340/600				_	
	[======] 341/600	-	0s	388us/step -	- loss:	0.0626
	[=======]	_	0s	327us/step -	- loss:	0.0578
	342/600				_	
	[======] 343/600	-	0s	288us/step -	- loss:	0.0566
	[=======]	_	0s	417us/step -	- loss:	0.0567
Epoch	344/600					
	[======] 345/600	-	0s	202us/step -	- loss:	0.0597
	[=======]	_	0s	168us/step -	- loss:	0.0589
Epoch	346/600					
	[======] 347/600	-	0s	201us/step -	- loss:	0.0610
	[=======]	_	0s	161us/step -	- loss:	0.0561
	348/600				_	
	[======] 349/600	-	0s	193us/step -	- loss:	0.0638
	[=======]	_	0s	238us/step -	- loss:	0.0597
	350/600		•	014		
	[=======] 351/600	-	0s	214us/step -	- loss:	0.0559
	[=======]	_	0s	218us/step -	- loss:	0.0569
	352/600		•	100 / 1		0.000
	[======] 353/600	-	0s	190us/step -	- loss:	0.0628
	[=======]	_	0s	155us/step -	- loss:	0.0564
	354/600		•	105 / .		0 0615
	[======] 355/600	-	0s	185us/step -	- loss:	0.0615
	[=======]	_	0s	308us/step -	- loss:	0.0570
	356/600				-	
	[======] 357/600	-	0s	225us/step -	- loss:	0.0578
	[========]	_	0s	258us/step -	- loss:	0.0569
	358/600		•	010 /		0.0=05
	[======] 359/600	-	0s	212us/step -	- loss:	0.0588
	[========]	_	0s	253us/step -	- loss:	0.0573

```
Epoch 360/600
       60/60 [=============== ] - 0s 243us/step - loss: 0.0567
       Epoch 361/600
       60/60 [============= ] - 0s 215us/step - loss: 0.0610
       Epoch 362/600
       60/60 [============== ] - 0s 219us/step - loss: 0.0638
       Epoch 363/600
       60/60 [============ ] - 0s 206us/step - loss: 0.0584
       Epoch 364/600
       60/60 [============ ] - 0s 307us/step - loss: 0.0595
       Epoch 365/600
       60/60 [============= ] - 0s 302us/step - loss: 0.0579
       Epoch 366/600
       Epoch 367/600
       60/60 [============== ] - 0s 224us/step - loss: 0.0620
       Epoch 368/600
       60/60 [=========== ] - 0s 191us/step - loss: 0.0574
       Epoch 369/600
       60/60 [=============== ] - 0s 207us/step - loss: 0.0580
       Epoch 370/600
       60/60 [================ ] - 0s 168us/step - loss: 0.0573
       Restoring model weights from the end of the best epoch
       Epoch 00370: early stopping
       best epoch v1 = 350
       smallest loss v1 = 0.05590683569510778
In [70]:
        historyDatav2 = modelv2.fit(xarray,yarray,epochs=600,callbacks=[es])
        loss histv2 = historyDatav2.history['loss']
        best epochv2 = np.argmin(historyDatav2.history['loss']) + 1
        print ('best epoch v2 = ', best_epochv2)
        print('smallest loss v2 =', np.min(loss histv2))
       Epoch 1/600
       60/60 [============= ] - 1s 15ms/step - loss: 1.0445
       Epoch 2/600
       60/60 [=============== ] - 0s 220us/step - loss: 1.0140
       Epoch 3/600
       60/60 [============== ] - 0s 298us/step - loss: 0.9843
       Epoch 4/600
       60/60 [============= ] - 0s 294us/step - loss: 0.9547
       Epoch 5/600
       60/60 [=========== ] - 0s 404us/step - loss: 0.9250
       Epoch 6/600
       60/60 [============= ] - 0s 234us/step - loss: 0.8950
       Epoch 7/600
       60/60 [============== ] - 0s 371us/step - loss: 0.8643
       Epoch 8/600
       60/60 [============= ] - 0s 339us/step - loss: 0.8327
       Epoch 9/600
       60/60 [===========] - 0s 446us/step - loss: 0.7998
       Epoch 10/600
       60/60 [============== ] - 0s 348us/step - loss: 0.7652
       Epoch 11/600
```

60/60	[======]	_	0s	519us/step - loss: 0.72	97
	12/600				
	[=======]	-	0s	218us/step - loss: 0.69	32
	13/600 [=========]	_	۸c	170us/sten = loss. 0 65	48
	14/600		V.S	170us/scep - 10ss. 0.05	40
	[=======]	_	0s	168us/step - loss: 0.61	39
	15/600				
	[=======]	-	0s	289us/step - loss: 0.57	02
	16/600 [=======]		۸c	150us/sten loss. 0.52	28
	17/600	_	V.S	130us/scep - 10ss. 0.32	20
	[=======]	_	0s	160us/step - loss: 0.47	80
	18/600				
	[=======]	-	0s	183us/step - loss: 0.41	28
	19/600 [======]	_	۸c	385us/sten = loss. 0 34	76
	20/600		US	303us/scep - 10ss. 0.34	70
	[======]	_	0s	175us/step - loss: 0.27	44
	21/600				
	[======] 22/600	-	0s	281us/step - loss: 0.20	22
	[=========]	_	0s	153us/step = loss: 0.15	2.0
	23/600		Ů.	13045, 5005 1055 0113	
	[======]	-	0s	201us/step - loss: 0.13	89
	24/600				
	[======] 25/600	-	0s	29/us/step - loss: 0.13	30
	[========]	_	0s	185us/step - loss: 0.13	10
Epoch	26/600				
	[=====]	-	0s	186us/step - loss: 0.12	91
	27/600 [======]		٥٠	225,127,24.00 10.22.0.12	0.0
	28/600	_	US	235us/step - 10ss: 0.12	80
	[=========]	_	0s	283us/step - loss: 0.12	65
	29/600				
	[========]	-	0s	180us/step - loss: 0.12	50
	30/600	_	0 s	368us/sten = loss: 0.12	39
	31/600		05	300d3/BCCP = 1055: 0:12	3,
	[======]	_	0s	589us/step - loss: 0.12	29
	32/600		•	500 / 1 3 0 10	0.0
	[======] 33/600	-	0s	580us/step - loss: 0.12	23
	[=========]	_	0s	212us/step - loss: 0.12	11
Epoch	34/600				
	[======]	-	0s	239us/step - loss: 0.11	98
	35/600		0 ~	167	0.7
	[======] 36/600	_	US	16/us/step - 10ss: 0.12	0 /
	[========]	_	0s	248us/step - loss: 0.11	80
Epoch	37/600				
	[=======]	-	0s	472us/step - loss: 0.11	69
	38/600 [=======]		٥٥	222115/5+00 1005 0 11	50
	39/600	_	US	222us/step - 10ss: 0.11	20
	[========]	_	0s	257us/step - loss: 0.11	55
	•			_	

Enoch	40/600			
	[========]	_	0s	572us/step - loss: 0.1143
	41/600		0.2	5,145,566p
	[======]	_	0s	286us/step - loss: 0.1135
	42/600			
	[======]	_	0s	487us/step - loss: 0.1128
	43/600			
	[=======]	_	0s	462us/step - loss: 0.1120
	44/600 [=======]		0 ~	454ug/gton logg, 0 1112
	45/600	_	US	454us/scep - 10ss: 0.1112
	[========]	_	0s	207us/step - loss: 0.1109
	46/600			
60/60	[======]	_	0s	168us/step - loss: 0.1102
	47/600			
	[=======]	-	0s	336us/step - loss: 0.1088
	48/600 [=======]		0 ~	460ug/gton logg. 0 1070
	49/600	_	US	460us/step - 10ss: 0.10/9
	[========]	_	0s	250us/step - loss: 0.1074
Epoch	50/600			_
	[======]	-	0s	480us/step - loss: 0.1069
	51/600			
	[========]	-	0s	393us/step - loss: 0.1071
	52/600 [======]	_	۸e	252ug/sten _ loss
	53/600		V S	232u3/scep - 1055. 0:1003
	[========]	_	0s	182us/step - loss: 0.1049
Epoch	54/600			
	[======]	-	0s	179us/step - loss: 0.1046
	55/600		^	202 / 1 2 2 2 1042
	[======] 56/600	-	US	223us/step - loss: 0.1042
	[========]	_	0s	196us/step - loss: 0.1029
	57/600			
60/60	[======]	_	0s	356us/step - loss: 0.1033
	58/600			
	[=========]	-	0s	641us/step - loss: 0.1019
	59/600 [=======]		٥٥	256ug/gton logg: 0 1011
	60/600	_	US	230us/scep - 10ss. 0:1011
	[=======]	_	0s	1ms/step - loss: 0.1006
Epoch	61/600			
	[======]	-	0s	264us/step - loss: 0.1007
	62/600		•	0.55 / 1
	[======] 63/600	-	0s	266us/step - loss: 0.0994
	[========]	_	0s	253us/sten = loss: 0.0988
	64/600		O D	2334878669 1088. 0.0300
	[=======]	_	0s	200us/step - loss: 0.0983
	65/600			
	[=======]	-	0s	240us/step - loss: 0.0978
	66/600 [=======]		0~	201ug/gton logg. 0 0071
	[=====================================	_	US	201us/step - 10ss: 0.09/1
	[========]	_	0s	208us/step - loss: 0.0968
	68/600			

60/60	[======]	_	0s	281us/step -	loss:	0.0963
	69/600			_		
	[=======]	-	0s	381us/step -	loss:	0.0956
	70/600	_	۸c	172119/sten -	1088.	0 0952
	71/600		0.5	1/2d5/5ccp -	1055.	0.0552
	[=======]	_	0s	161us/step -	loss:	0.0947
	72/600					
	[=======]	-	0s	166us/step -	loss:	0.0944
	73/600		۸c	195ug/gten	1055	0 0035
	74/600	_	V.S	103us/scep -	1055.	0.0733
	[======]	_	0s	230us/step -	loss:	0.0932
	75/600					
	[=======]	-	0s	162us/step -	loss:	0.0927
	76/600 [=======]	_	۸c	188115/sten -	1088.	0 0920
	77/600		US	100ds/scep -	1055.	0.0720
	[======]	_	0s	163us/step -	loss:	0.0921
	78/600				_	
	[======] 79/600	-	0s	194us/step -	loss:	0.0912
	[=========]	_	0s	192us/step -	loss:	0.0911
	80/600		Ů.	19245/5005	1000.	0.0011
	[======]	-	0s	228us/step -	loss:	0.0906
	81/600				-	
	[======] 82/600	-	0s	233us/step -	loss:	0.0902
	[========]	_	0s	195us/step -	loss:	0.0894
Epoch	83/600					
	[=====]	-	0s	205us/step -	loss:	0.0887
	84/600 [======]		٥٠	10/119/9405	1000.	0 0004
	85/600	_	US	194us/step -	TOSS:	0.0884
	[========]	_	0s	248us/step -	loss:	0.0884
	86/600					
	[========]	-	0s	237us/step -	loss:	0.0877
	87/600 [=======]	_	0 s	274115/sten -	1088:	0.0875
	88/600		O D	2710575005	1000.	0.0075
	[======]	_	0s	168us/step -	loss:	0.0866
	89/600		•	0.4.0	-	
	[======] 90/600	-	0s	242us/step -	loss:	0.0860
	[=========]	_	0s	241us/step -	loss:	0.0865
Epoch	91/600					
	[======]	-	0s	238us/step -	loss:	0.0872
	92/600		0 ~	225/=+==	1	0 0050
	[======] 93/600	_	US	235us/step -	loss:	0.0852
	[=========]	_	0s	196us/step -	loss:	0.0844
Epoch	94/600					
	[=======]	-	0s	253us/step -	loss:	0.0845
	95/600 [=======]		٥٥	211118/8+05	1000	0 0027
	96/600	_	US	ziius/step -	TOSS:	0.003/
	[========]	_	0s	233us/step -	loss:	0.0832
	_			_		

Epoch	97/600				
	[=======]	_	0s	294us/step - loss: 0.083	1
	98/600				
	[========]	-	0s	237us/step - loss: 0.082	2
	99/600 [======]	_	۸e	186us/step _ loss. 0 081	a
	100/600	_	VS	100us/scep - 10ss. 0.001	יכ
	[========]	_	0s	170us/step - loss: 0.081	5
	101/600				
	[=======]	-	0s	199us/step - loss: 0.081	0
	102/600 [======]	_	۸e	181us/sten = loss: 0 081	4
	103/600		V.S	101us/scep - 10ss. 0.001	7
	[======]	_	0s	196us/step - loss: 0.080	4
	104/600				
	[======] 105/600	-	0s	161us/step - loss: 0.079	8
	[==========]	_	٥q	279us/sten = loss: 0.080	4
	106/600		Ů.	2,745,5665 1655, 0.000	-
	[======]	-	0s	212us/step - loss: 0.079	5
	107/600		•	0.26 / 1	_
	[======] 108/600	-	0s	236us/step - loss: 0.0/8	6
	[=======]	_	0s	208us/step - loss: 0.078	2
Epoch	109/600				
	[======]	-	0s	185us/step - loss: 0.078	2
	110/600 [========]		0 ~	210/	0
	111/600	_	US	219us/step - 10ss: 0.0//	ð
	[=======]	_	0s	247us/step - loss: 0.078	8
Epoch	112/600				
	[=======]	-	0s	199us/step - loss: 0.077	2
	113/600 [=========]	_	۸e	245us/step _ loss. 0 076	4
	114/600		05	243u3/5ccp = 1055: 0:0/0	-
60/60	[======]	_	0s	199us/step - loss: 0.077	1
_	115/600				_
	[=======] 116/600	-	0s	208us/step - loss: 0.075	8
	[=======]	_	0s	212us/step - loss: 0.075	9
Epoch	117/600				
	[======]	-	0s	229us/step - loss: 0.076	1
	118/600 [=========]		٥٩	250:25/5405 1055 0 077	2
	119/600	_	US	259us/step - 10ss: 0.0//	2
	[========]	_	0s	200us/step - loss: 0.075	5
	120/600				
	[========]	-	0s	226us/step - loss: 0.074	9
	121/600 [=========]	_	۸e	221us/step _ loss. 0 074	1
	122/600		05	221u3/5ccp = 1055: 0:0/4	_
	[======]	_	0s	202us/step - loss: 0.074	0
	123/600			106	_
	[======] 124/600	-	0s	196us/step - loss: 0.074	3
	[=========]	_	0s	478us/step - loss: 0.074	6
	125/600			•	

60/60	[======]	_	0s	332us/step - loss:	0.0730
	126/600		•	015 / 1	0 0724
	[======] 127/600	-	0s	215us/step - loss:	0.0734
	[=======]	_	0s	245us/step - loss:	0.0728
Epoch	128/600				
	[======] 129/600	-	0s	179us/step - loss:	0.0722
	[=========]	_	0s	243us/step - loss:	0.0721
Epoch	130/600				
	[======]	-	0s	184us/step - loss:	0.0721
	131/600 [=========]	_	Λe	240us/sten - loss.	0 0720
	132/600		V.S	240us/scep - 10ss.	0.0720
	[======]	-	0s	249us/step - loss:	0.0722
	133/600		٥٩	22429/9409 1099	0 0700
	134/600	_	US	224us/step - loss:	0.0709
60/60	[======]	_	0s	226us/step - loss:	0.0713
	135/600		•	0.15	0 0515
	[======] 136/600	-	US	21/us/step - loss:	0.0/15
	[=======]	_	0s	243us/step - loss:	0.0707
	137/600				
	[======] 138/600	-	0s	281us/step - loss:	0.0706
	[========]	_	0s	272us/step - loss:	0.0713
Epoch	139/600				
	[=======]	-	0s	266us/step - loss:	0.0702
	140/600	_	0s	512us/step = loss:	0.0702
Epoch	141/600				
	[======]	-	0s	246us/step - loss:	0.0695
	142/600 [========]	_	۸e	28211g/gten = logg.	0 0695
Epoch	143/600				
	[======]	-	0s	213us/step - loss:	0.0698
	144/600	_	Λe	20311g/gton - logg.	0 0689
	145/600		V.S	203us/scep - 10ss.	0.0003
	[=======]	_	0s	192us/step - loss:	0.0690
	146/600		٥٥	201ug/g+on logg.	0 0600
	147/600	_	US	201us/scep - 10ss:	0.0000
60/60	[======]	-	0s	206us/step - loss:	0.0700
	148/600 [==========]		٥٩	21000/0400 1000	0 0607
	149/600	_	US	218us/step - 10ss:	0.0087
60/60	[======]	_	0s	214us/step - loss:	0.0685
	150/600		•	200 / 1	0.0600
	[======] 151/600	-	0s	200us/step - loss:	0.0680
	[========]	_	0s	213us/step - loss:	0.0697
	152/600		•	205 / : -	
	[======] 153/600	-	0s	395us/step - loss:	0.0681
	[========]	_	0s	192us/step - loss:	0.0690
	•			-	

Enoch	154/600				
	[=======]	_	0s	247us/step - loss:	0.0678
Epoch	155/600				
	[======]	_	0s	516us/step - loss:	0.0670
	156/600				
	[======================================	-	0s	344us/step - loss:	0.0683
	157/600 [======]		٥٥	35/ug/g+on logg.	0 0675
	158/600	_	US	554us/scep - 10ss:	0.0073
	[========]	_	0s	298us/step - loss:	0.0673
Epoch	159/600				
	[=======]	_	0s	225us/step - loss:	0.0671
	160/600		•	000 / 1	0.0680
	[=========]	_	0s	203us/step - loss:	0.0672
	161/600 [=======]	_	۸e	174us/sten - loss.	0 0670
	162/600		V S	1/4us/scep - 10ss.	0.0070
	[=========]	_	0s	186us/step - loss:	0.0673
Epoch	163/600				
	[=======]	-	0s	188us/step - loss:	0.0663
	164/600		•	155 /	0.0650
	[======] 165/600	-	0s	15/us/step - loss:	0.0659
	[=========]	_	0s	156us/step = loss:	0.0661
	166/600		٥٥	13048/2009 10884	0.0001
	[=======]	_	0s	171us/step - loss:	0.0660
	167/600				
	[=======]	-	0s	149us/step - loss:	0.0668
	168/600 [=======]		٥٥	170ug/g+on logg.	0 0666
	169/600	_	US	1/9us/step - loss:	0.0000
	[=======]	_	0s	390us/step - loss:	0.0657
Epoch	170/600				
	[]	_	0s	222us/step - loss:	0.0665
	171/600		•	105 / 1	0.000
	[======] 172/600	-	0s	18/us/step - loss:	0.0662
	[=========]	_	0s	197us/step - loss:	0.0653
	173/600		0.5	13,400,500p 1000t	
60/60	[=======]	_	0s	189us/step - loss:	0.0687
	174/600				
	[======================================	-	0s	176us/step - loss:	0.0655
	175/600 [=======]		Λc	192ug/g+on logg.	0 0656
	176/600	_	US	192us/scep - 10ss.	0.0030
	[=========]	_	0s	270us/step - loss:	0.0652
Epoch	177/600				
	[========]	-	0s	343us/step - loss:	0.0655
	178/600		^	406 / 1	0 0640
	[======] 179/600	_	US	426us/step - loss:	0.0649
	[=========]	_	0s	300us/step = loss:	0.0643
	180/600			11345, 200p 100b.	
60/60	[======]	_	0s	301us/step - loss:	0.0649
	181/600			-	
	[=========]	-	0s	249us/step - loss:	0.0644
гроси	182/600				

	[=====]	_	0s	395us/step - loss:	0.0641
	183/600 [=======]	_	Λe	29611g/gten _ logg.	0 0652
Epoch	184/600				
	[=======]	-	0s	189us/step - loss:	0.0646
	185/600 [=======]	_	0s	166us/step - loss:	0.0636
Epoch	186/600				
	[=======] 187/600	-	0s	238us/step - loss:	0.0637
	[=========]	_	0s	218us/step - loss:	0.0634
	188/600			-	
	[======] 189/600	-	0s	218us/step - loss:	0.0657
60/60	[======]	_	0s	258us/step - loss:	0.0651
	190/600 [=======]		0 a	240,19/9+09 1099	0 0630
	191/600	_	US	249us/step - 10ss:	0.0038
	[======]	-	0s	256us/step - loss:	0.0640
	192/600 [=======]	_	0s	340us/step = loss:	0.0632
Epoch	193/600			_	
	[======] 194/600	-	0s	249us/step - loss:	0.0629
	[=========]	_	0s	171us/step - loss:	0.0630
Epoch	195/600				
	[======] 196/600	-	0s	1/8us/step - loss:	0.0627
60/60	[======]	_	0s	162us/step - loss:	0.0630
	197/600 [=======]		۸c	195ug/gtop logg.	0 0624
	198/600	_	US	1930s/step - 10ss:	0.0024
	[========]	-	0s	173us/step - loss:	0.0623
	199/600 [=======]	_	0s	143us/step - loss:	0.0635
Epoch	200/600				
	[======] 201/600	-	0s	167us/step - loss:	0.0637
60/60	[======]	_	0s	167us/step - loss:	0.0628
	202/600 [======]		٥٥	150ug/g+on logg.	0 0622
	203/600	_	05	130us/step - 10ss:	0.0022
	[======]	-	0s	396us/step - loss:	0.0637
	204/600 [=========]	_	0s	302us/step - loss:	0.0623
Epoch	205/600				
	[======] 206/600	-	0s	251us/step - loss:	0.0622
	[======]	_	0s	283us/step - loss:	0.0621
	207/600		•	205 / 1	0.0615
	[======] 208/600	-	0s	28/us/step - loss:	0.061/
60/60	[======]	-	0s	382us/step - loss:	0.0622
	209/600 [=========]	_	Λe	62511g/gton logg.	0 0616
Epoch	210/600				
60/60	[======]	-	0s	220us/step - loss:	0.0617

Enoch	211/600						
	[=======]	_	0s	234us/step	_	loss:	0.0614
Epoch	212/600						
	[]	_	0s	131us/step	-	loss:	0.0617
	213/600		_	100 / .		-	
	[======================================	_	0s	188us/step	-	loss:	0.0611
	214/600 [=======]	_	۸e	19411g/g+en	_	1000	0 0610
	215/600		V S	тучив/всер	_	1055.	0.0010
	[=========]	_	0s	178us/step	_	loss:	0.0611
	216/600						
	[======]	-	0s	208us/step	-	loss:	0.0610
	217/600 [======]		٥٠	22222 / at on		1000	0 0600
	218/600	_	US	233us/step	_	TOSS:	0.0609
	[=======]	_	0s	261us/step	_	loss:	0.0610
Epoch	219/600						
	[======]	_	0s	214us/step	_	loss:	0.0635
	220/600		_			-	
	[======] 221/600	-	0s	535us/step	-	loss:	0.0641
	[=========]	_	0s	537us/sten	_	loss:	0.0618
	222/600		0 D	337 db7 bccp		1000.	0.0010
	[======]	_	0s	449us/step	_	loss:	0.0625
	223/600						
	[=========]	-	0s	469us/step	-	loss:	0.0612
	224/600 [======]		۸c	31/11c/c+on		1055	0 0619
	225/600	_	US	Ji4us/scep	_	TOSS.	0.0019
	[========]	_	0s	291us/step	_	loss:	0.0613
	226/600						
	[=======]	-	0s	213us/step	-	loss:	0.0617
	227/600 [======]		٥٥	227ug/g+op		locc.	0 0600
	228/600	_	US	zz/us/scep	_	1055:	0.0009
	[======]	_	0s	144us/step	_	loss:	0.0604
Epoch	229/600			_			
	[=========]	-	0s	146us/step	-	loss:	0.0601
-	230/600		٥٩	172,19 / 9+05		1000	0 0600
	[=======] 231/600	_	US	1/3us/scep	_	TOSS:	0.0600
	[=======]	_	0s	264us/step	_	loss:	0.0621
Epoch	232/600						
	[=======]	-	0s	283us/step	-	loss:	0.0622
	233/600		^	465 / 1			0.0607
	[======] 234/600	-	US	465us/step	-	loss:	0.0627
	[========]	_	0s	323us/step	_	loss:	0.0604
	235/600						
	[======]	_	0s	314us/step	-	loss:	0.0597
	236/600					_	
	[=========]	-	0s	411us/step	-	loss:	0.0599
	237/600 [======]	_	0,5	342us/sten	_	loss:	0.0612
	238/600		0.0	- 12 ab / b cop		_055.	J. J. J. Z.
60/60	[======]	-	0s	342us/step	_	loss:	0.0596
Epoch	239/600						

60/60	[=====]	_	0s	386us/step - loss:	0.0602
	240/600			_	
	[======] 241/600	-	0s	383us/step - loss:	0.0616
	[==========]	_	0s	226us/step - loss:	0.0614
Epoch	242/600			_	
	[======]	-	0s	393us/step - loss:	0.0598
	243/600 [=======]		٥٩	266ug/ghon logge	0 0612
	244/600	_	US	200us/step - loss:	0.0613
	[=======]	_	0s	164us/step - loss:	0.0606
	245/600				
	[======] 246/600	-	0s	172us/step - loss:	0.0615
	[========]	_	0s	192us/step - loss:	0.0616
Epoch	247/600				
	[======]	-	0s	167us/step - loss:	0.0610
	248/600 [=======]	_	Λe	39611g/gton _ logg.	0 0591
	249/600	_	US	390ds/scep - 10ss.	0.0391
60/60	[======]	_	0s	161us/step - loss:	0.0621
	250/600		0	210/	0 0505
	[======] 251/600	-	US	219us/step - loss:	0.0595
	[=======]	_	0s	185us/step - loss:	0.0594
	252/600			_	
	[======] 253/600	-	0s	146us/step - loss:	0.0597
	[========]	_	0s	156us/step - loss:	0.0594
Epoch	254/600				
	[=======]	-	0s	185us/step - loss:	0.0599
	255/600 [=======]	_	0 s	155us/sten - loss:	0.0598
	256/600		O D	133db/ bccp 10bb.	0.0330
	[======]	-	0s	161us/step - loss:	0.0592
	257/600 [=======]		٥٥	267ug/gton logg.	0 0506
	258/600	_	US	30/us/scep - 10ss:	0.0360
60/60	[======]	_	0s	340us/step - loss:	0.0624
	259/600		0	200 / 1	0.0640
	[======] 260/600	-	US	322us/step - loss:	0.0643
	[=======]	_	0s	337us/step - loss:	0.0595
	261/600				
	[======] 262/600	-	0s	380us/step - loss:	0.0618
	[=======]	_	0s	307us/step - loss:	0.0587
Epoch	263/600				
	[=========]	-	0s	275us/step - loss:	0.0610
	264/600 [=======]	_	0s	315us/step = loss:	0.0594
Epoch	265/600				
	[======]	-	0s	208us/step - loss:	0.0584
	266/600 [=======]		٥٥	22511g/g+on logg.	0 0604
	267/600	_	υÞ	22Jus/scep - 10ss:	0.0004
	[======]	_	0s	290us/step - loss:	0.0624

Enoch	268/600				
	[========]	_	0s	176us/step - loss: 0.059	3
Epoch	269/600				
	[=======]	-	0s	264us/step - loss: 0.060	7
	270/600		_		
	[======] 271/600	-	0s	205us/step - loss: 0.059)4
	[======================================	_	Λe	190us/sten _ loss. 0 059	3 3
	272/600		V S	170us/scep - 10ss. 0.03	, ,
	[========]	_	0s	274us/step - loss: 0.058	36
	273/600				
	[=======]	-	0s	334us/step - loss: 0.058	34
	274/600 [=======]		0 -	427/	
	[=====================================	_	US	43/us/step - 10ss: 0.058	30
	[==========]	_	0s	287us/step - loss: 0.061	L 0
	276/600				
	[=======]	_	0s	298us/step - loss: 0.059	91
	277/600				
	[=======] 278/600	-	0s	273us/step - loss: 0.058	38
	[===========]	_	۸q	376us/sten = loss: 0 055	79
	279/600		0.D	370d375ccp - 1033: 0:037	
	[======================================	_	0s	382us/step - loss: 0.057	79
	280/600				
	[=======]	-	0s	460us/step - loss: 0.059	0
	281/600 [=======]		٥٥	192ug/gton logg. 0 055	7.0
	282/600	_	US	103us/scep - 10ss: 0.03/	19
	[=========]	_	0s	175us/step - loss: 0.059	95
Epoch	283/600				
	[======]	-	0s	167us/step - loss: 0.058	36
	284/600 [=======]		٥٥	217,13/3+02 logg. 0.059	0.0
	285/600	_	US	21/us/scep - 10ss: 0.036	כס
	[========]	_	0s	168us/step - loss: 0.057	79
Epoch	286/600				
	[========]	-	0s	177us/step - loss: 0.057	77
	287/600		0 -	107/	, _
	[=======] 288/600	_	US	18/us/step - 10ss: 0.05/	75
	[=========]	_	0s	224us/step - loss: 0.061	LO
Epoch	289/600				
	[========]	-	0s	323us/step - loss: 0.060)2
	290/600		^	210 / 1 2 0 061	_
	[=======] 291/600	_	US	318us/step - 10ss: 0.061	L5
	[==========]	_	0s	302us/step - loss: 0.059	93
	292/600				
	[=======]	_	0s	318us/step - loss: 0.058	32
	293/600		•	205 /	
	[=======] 294/600	-	υs	325us/step - loss: 0.057	/9
	[===========]	_	0,5	386us/step = loss: 0.055	74
	295/600		Ü	1000. 0.007	•
60/60	[=======]	_	0s	217us/step - loss: 0.059	91
Epoch	296/600				

	[=====]	_	0s	290us/step -	loss:	0.0610
	297/600		0 ~	224/5+5	1	0 0500
	[======] 298/600	_	US	234us/step -	Toss:	0.0580
60/60	[======]	_	0s	218us/step -	loss:	0.0576
	299/600		•	0.70 / 1	,	0 0500
	[======] 300/600	-	0s	2/2us/step -	loss:	0.0582
	[=======]	_	0s	250us/step -	loss:	0.0592
	301/600			0=6 / .	-	
	[======] 302/600	-	0s	256us/step -	loss:	0.0585
	[=======]	_	0s	218us/step -	loss:	0.0581
	303/600			00= / .	-	
	[======] 304/600	-	0s	207us/step -	loss:	0.0580
	[========]	_	0s	246us/step -	loss:	0.0575
	305/600				_	
	[======] 306/600	-	0s	231us/step -	loss:	0.0594
	[=======]	_	0s	237us/step -	loss:	0.0593
	307/600				_	
	[======] 308/600	-	0s	256us/step -	loss:	0.0589
	[=======]	_	0s	253us/step -	loss:	0.0577
Epoch	309/600					
	[======] 310/600	-	0s	204us/step -	loss:	0.0585
	[========]	_	0s	267us/step -	loss:	0.0586
Epoch	311/600					
	[======] 312/600	-	0s	185us/step -	loss:	0.0574
	[=======]	_	0s	149us/step -	loss:	0.0576
	313/600				_	
	[======] 314/600	-	0s	180us/step -	loss:	0.0596
	[=======]	_	0s	183us/step -	loss:	0.0580
	315/600		•	005 / 1	-	0.000
	[=======] 316/600	-	0s	206us/step -	loss:	0.0602
	[=======]	_	0s	247us/step -	loss:	0.0583
	317/600		•	150 / 1	-	0.0506
	[======] 318/600	-	0s	1/Ous/step -	loss:	0.0596
	[=======]	_	0s	171us/step -	loss:	0.0578
	319/600		•	160 / 1	-	0.0550
	[======] 320/600	-	0s	168us/step -	loss:	0.0570
	[=======]	_	0s	160us/step -	loss:	0.0569
	321/600		•	150 / .	-	0.0560
	[======] 322/600	-	0s	153us/step -	loss:	0.0568
	[========]	_	0s	171us/step -	loss:	0.0575
	323/600		•	201 / :	,	0 0551
	[======] 324/600	-	υs	201us/step -	TOSS:	0.0571
	[=========]	_	0s	203us/step -	loss:	0.0566

Enoch	325/600				
	[=======]	_	0s	370us/step - loss: (0.0573
Epoch	326/600			_	
	[======]	_	0s	301us/step - loss:	0.0583
	327/600				
	[========]	-	0s	446us/step - loss: (0.0582
	328/600 [======]		٥٥	332ug/gtop logg. (0 0603
	329/600	_	US	552us/scep - 10ss: (0.0003
	[=======]	_	0s	356us/step - loss: (0.0594
Epoch	330/600			_	
	[=======]	_	0s	238us/step - loss:	0.0591
	331/600		•	100 / 1	
	[======] 332/600	_	0s	193us/step - loss: (0.0572
	[=========]	_	۸e	298115/sten _ loss. (0 0563
	333/600		V S	270us/scep - 10ss.	0.0303
	[========]	_	0s	270us/step - loss:	0.0562
	334/600				
	[=======]	-	0s	316us/step - loss:	0.0577
	335/600		•	0.40	
	[======] 336/600	_	0s	242us/step - loss:	0.0570
	[=========]	_	0s	184us/step - loss: (0.0578
	337/600		O D	10145,5005	0.0370
	[========]	_	0s	171us/step - loss:	0.0561
	338/600				
	[======]	-	0s	202us/step - loss:	0.0562
	339/600 [======]		٥٠	175,45,55	0 0502
	340/600	_	US	1/5us/step - loss: (0.0582
	[=======]	_	0s	213us/step - loss:	0.0563
Epoch	341/600				
	[======]	_	0s	160us/step - loss: 0	0.0559
	342/600				
	[======] 343/600	-	0s	142us/step - loss: (0.0599
	[=========]	_	۸q	155us/sten - loss.	0 0564
	344/600		0.D	1334878669 - 1088.	0.0304
	[========]	_	0s	175us/step - loss:	0.0570
	345/600				
	[=======]	-	0s	308us/step - loss:	0.0574
	346/600		0 ~	216	0 0574
	[======] 347/600	_	US	316us/step - loss: (0.05/4
	[=======]	_	0s	228us/step - loss:	0.0579
	348/600				
	[======]	_	0s	387us/step - loss:	0.0570
	349/600				
	[======================================	-	0s	213us/step - loss:	0.0569
	350/600 [======]	_	Λe	195118/sten - loss.	0 0582
	351/600	_	US	193us/scep - 10ss.	0.0302
	[=======]	_	0s	221us/step - loss:	0.0580
Epoch	352/600				
	[=======]	-	0s	348us/step - loss:	0.0557
Epoch	353/600				

60/60	[=====]	_	0s	200us/step - loss:	0.0558
	354/600			2.5	
	[======] 355/600	-	0s	24/us/step - loss:	0.0561
	[=======]	_	0s	208us/step - loss:	0.0586
Epoch	356/600				
	[========]	-	0s	238us/step - loss:	0.0571
	357/600 [=======]	_	0s	291us/sten - loss:	0.0564
Epoch	358/600				
	[=====]	-	0s	207us/step - loss:	0.0555
	359/600 [=======]		٥٥	16/11g/gtop logg	0 0556
	360/600	_	US	104us/scep - 10ss	0.0330
60/60	[======]	_	0s	181us/step - loss:	0.0563
	361/600		0	014 / 1 3	0.0561
	[======] 362/600	-	0s	214us/step - loss:	0.0561
	[========]	_	0s	200us/step - loss:	0.0560
	363/600				
	[======] 364/600	-	0s	201us/step - loss:	0.0582
	[=========]	_	0s	187us/step - loss:	0.0576
Epoch	365/600				
	[======]	-	0s	164us/step - loss:	0.0573
	366/600 [=======]	_	Λe	162ug/gton _ logg	0 0556
	367/600		05	102us/scep - 10ss	0.0330
	[======]	-	0s	165us/step - loss:	0.0555
	368/600 [=======]		0 ~	160	0 0550
	369/600	_	US	108us/step - 10ss:	0.0558
60/60	[======]	_	0s	202us/step - loss:	0.0556
	370/600		•	100 / 1	0.0550
	[======] 371/600	-	0s	199us/step - loss:	0.0559
	[=======]	_	0s	187us/step - loss:	0.0593
	372/600				
	[======] 373/600	-	0s	161us/step - loss:	0.0555
	[=========]	_	0s	167us/step - loss:	0.0565
Epoch	374/600				
	[======] 375/600	-	0s	163us/step - loss:	0.0575
	[=========]	_	0s	153us/step - loss:	0.0564
Epoch	376/600				
	[=======]	-	0s	171us/step - loss:	0.0571
	377/600 [=======]	_	۸e	27111s/sten = loss	0 0555
	378/600		05	2/105/Scep - 1055	0.0333
	[======]	-	0s	504us/step - loss:	0.0552
	379/600 [=======]		0~	36/ug/g+on 1000	0 0554
	380/600	_	US	20402/20eb - 1022;	0.0354
60/60	[======]	_	0s	411us/step - loss:	0.0551
	381/600		•	240 / 1	0.0565
60/60	[=====]	-	υs	342us/step - loss:	0.0565

Epoch	382/600				
	[========]	_	0s	330us/step - loss: 0.05	83
Epoch	383/600				
	[======]	-	0s	205us/step - loss: 0.05	73
	384/600				
	[=======]	-	0s	269us/step - loss: 0.05	66
	385/600 [=======]		٥٥	273ug/g+op logg: 0.05	57
	386/600	_	US	2/3us/step = 10ss: 0.03	<i>31</i>
	[========]	_	0s	198us/step - loss: 0.05	89
Epoch	387/600				
	[=====]	-	0s	186us/step - loss: 0.05	49
	388/600		•	155 /	
	[======] 389/600	-	0s	15/us/step - loss: 0.05	52
	[======================================	_	۸e	168us/sten _ loss. 0 05	70
	390/600		V.S	100ds/scep = 10ss. 0.05	70
	[========]	_	0s	191us/step - loss: 0.05	58
Epoch	391/600				
	[======]	-	0s	195us/step - loss: 0.05	72
	392/600		•	150 /	
	[======] 393/600	-	0s	178us/step - loss: 0.05	50
	[==========]	_	۸c	158us/sten = loss. 0 05	54
	394/600		0.5	130dB/BCCP = 10BB: 0:03	J 1
	[=======]	_	0s	159us/step - loss: 0.05	59
	395/600				
	[======]	-	0s	326us/step - loss: 0.05	67
	396/600		0 -	107/	00
	[======] 397/600	-	US	18/us/step - loss: 0.05	82
	[=======]	_	0s	214us/step - loss: 0.05	58
	398/600		-		
	[======]	-	0s	197us/step - loss: 0.05	73
	399/600				
	[========]	-	0s	210us/step - loss: 0.05	81
	400/600	_	۸e	280us/step _ loss. 0 05	62
	401/600		V.S	200ds/scep = 10ss. 0.05	02
	[========]	_	0s	150us/step - loss: 0.05	64
	402/600				
	[=====]	-	0s	244us/step - loss: 0.05	63
	403/600		0 -	254/	4.0
	[======] 404/600	-	US	254us/step - loss: 0.05	48
	[=========]	_	0s	219us/step - loss: 0.05	49
	405/600		-		
60/60	[======]	_	0s	170us/step - loss: 0.05	54
	406/600				
	[========]	-	0s	221us/step - loss: 0.05	49
	407/600		٥٥	157ug/g+op logg: 0.05	10
	408/600	_	US	10,48/sceh - 1088: 0.00	4 0
	[========]	_	0s	179us/step - loss: 0.05	56
Epoch	409/600				
	[======]	-	0s	180us/step - loss: 0.05	48
Epoch	410/600				

	[=====]	-	0s	284us/step	_	loss:	0.0559
	411/600	_	0 s	361us/sten	_	1099:	0.0552
Epoch	412/600			_			
	[======] 413/600	-	0s	219us/step	-	loss:	0.0579
	[========]	_	0s	340us/step	_	loss:	0.0556
	414/600		•	-		,	
	[======] 415/600	-	0s	229us/step	_	loss:	0.0552
60/60	[======]	-	0s	310us/step	-	loss:	0.0578
	416/600 [=======]	_	Λς	17211g/gten	_	10991	0 0551
Epoch	417/600			_			
	[======] 418/600	-	0s	207us/step	-	loss:	0.0543
	[=======]	_	0s	236us/step	_	loss:	0.0545
	419/600 [======]		0 -	212/		1	0 0557
	[=====================================	_	US	212us/step	_	Toss:	0.055/
60/60	[======]	_	0s	203us/step	-	loss:	0.0563
	421/600 [=======]	_	0s	265us/step	_	loss:	0.0562
Epoch	422/600						
	[======] 423/600	-	0s	302us/step	-	loss:	0.0576
	[=======]	_	0s	359us/step	_	loss:	0.0547
	424/600		0 -	427/		1	0.0566
	[======] 425/600	_	US	42/us/step	_	Toss:	0.0566
60/60	[======]	_	0s	305us/step	-	loss:	0.0544
	426/600 [=======]	_	0s	345us/step	_	loss:	0.0556
Epoch	427/600			_			
	[=======] 428/600	-	0s	431us/step	-	loss:	0.0573
	[========]	_	0s	306us/step	_	loss:	0.0562
	429/600 [======]		0 a	110112/2405		1000	0 0561
	430/600	_	US	449us/scep	_	TOSS:	0.0561
	[======]	-	0s	301us/step	-	loss:	0.0548
	431/600 [=======]	_	0s	390us/step	_	loss:	0.0549
Epoch	432/600						
	[======] 433/600	-	0s	402us/step	-	loss:	0.0549
60/60	[======]	_	0s	416us/step	_	loss:	0.0572
	434/600 [==========]		Λα	296ug/g+op		logg•	0 0542
	435/600	_	US	200us/scep	_	1055:	0.0342
	[========]	-	0s	263us/step	-	loss:	0.0565
	436/600 [=======]	_	0s	235us/step	_	loss:	0.0543
Epoch	437/600						
	[=======] 438/600	-	0s	205us/step	-	loss:	0.0546
	[======]	-	0s	274us/step	-	loss:	0.0544

Enoch	439/600					
	[=======]	_	0s	246us/step -	loss:	0.0550
Epoch	440/600			_		
	[======]	-	0s	206us/step -	loss:	0.0555
	441/600		•	0.70	-	0 0 5 4 0
	[======] 442/600	_	0s	279us/step -	loss:	0.0542
	[=========]	_	۸c	21711g/gten -	1099.	0 0541
	443/600		0.D	ZI/db/bccp -	1055.	0.0341
	[========]	_	0s	238us/step -	loss:	0.0551
	444/600					
	[=======]	-	0s	262us/step -	loss:	0.0543
	445/600 [=======]		۸c	26811g/g+on	1000	0 0562
	446/600	_	US	zoous/step -	TOSS:	0.0302
	[========]	_	0s	173us/step -	loss:	0.0539
Epoch	447/600					
	[=====]	-	0s	141us/step -	loss:	0.0539
	448/600		٥~	102/5+5	1	0 0541
	[======] 449/600	-	US	192us/step -	loss:	0.0541
	[========]	_	0s	159us/step -	loss:	0.0551
Epoch	450/600					
	[=======]	-	0s	260us/step -	loss:	0.0559
	451/600		^	100 / 1	,	0 0540
	[======] 452/600	-	US	180us/step -	loss:	0.0540
	[========]	_	0s	192us/step -	loss:	0.0542
	453/600					
	[======]	_	0s	153us/step -	loss:	0.0543
	454/600				-	
	[======] 455/600	_	0s	18/us/step -	loss:	0.0572
	[=========]	_	0s	163us/step -	loss:	0.0545
	456/600					
	[======]	_	0s	163us/step -	loss:	0.0581
_	457/600				_	
	[========] 458/600	-	0s	160us/step -	loss:	0.0555
_	[=========]	_	0s	170us/step -	loss:	0.0561
	459/600		O D	1,000,000	1000.	0.0301
	[======]	_	0s	202us/step -	loss:	0.0546
	460/600				_	
	[=======] 461/600	-	0s	216us/step -	loss:	0.0544
	[=========]	_	0s	233us/step -	loss:	0.0539
	462/600		0.5	200007 2002	1000.	0.0303
60/60	[======]	_	0s	150us/step -	loss:	0.0568
	463/600				_	
	[======] 464/600	-	0s	197us/step -	loss:	0.0556
	[=========]	_	Λs	17211s/sten -	1055:	0.0542
	465/600		0.0	_,_a,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1000.	3.0312
60/60	[======]	-	0s	209us/step -	loss:	0.0538
	466/600				-	
	[======] 467/600	-	υs	226us/step -	loss:	0.0540
Phocii	±0//000					

60/60	[=====]	_	0s	197us/step - los	ss:	0.0538
	468/600		0	071 / 1		0.0500
	[======] 469/600	-	0s	2/lus/step - los	SS:	0.0539
	[=======]	_	0s	209us/step - los	ss:	0.0544
Epoch	470/600					
	[========]	-	0s	167us/step - los	ss:	0.0539
	471/600 [=======]	_	0s	164us/step = los	ss:	0.0537
Epoch	472/600					
	[=====]	-	0s	199us/step - los	ss:	0.0538
	473/600 [=======]		٥٥	220ug/g+on los		0 0527
	474/600	_	US	230us/scep - 10s	, 50	0.0337
60/60	[======]	_	0s	169us/step - los	ss:	0.0538
	475/600		0	100 / 1		0 0507
	[======] 476/600	-	0s	180us/step - los	3S:	0.0537
	[=======]	_	0s	152us/step - los	ss:	0.0531
	477/600					
	[======] 478/600	-	0s	146us/step - los	3S:	0.0538
	[========]	_	0s	153us/step - los	ss:	0.0538
Epoch	479/600					
	[======]	-	0s	167us/step - los	ss:	0.0547
	480/600 [=======]		۸e	194ug/gten _ los	20.	0 0559
	481/600		US	174us/scep - 10s		0.0337
	[======]	-	0s	280us/step - los	ss:	0.0552
	482/600 [=======]		0 ~	201/		0 0545
	483/600	_	US	281us/step - 10s	35:	0.0545
60/60	[======]	_	0s	217us/step - los	ss:	0.0554
	484/600		•	201 / 1		0 0544
	[======] 485/600	-	0s	224us/step - los	3S:	0.0544
	[=======]	_	0s	219us/step - los	ss:	0.0533
	486/600					
	[=======] 487/600	-	0s	230us/step - los	3S:	0.0535
	[========]	_	0s	216us/step - los	ss:	0.0559
Epoch	488/600					
	[=========]	-	0s	207us/step - los	ss:	0.0554
	489/600 [=======]	_	0s	184us/step = los	ss:	0.0561
Epoch	490/600					
	[======]	-	0s	167us/step - los	3S:	0.0538
	491/600 [=======]	_	۸e	185us/sten = los	20.	0 0566
	492/600		US	103us/scep - 10s		0.0300
60/60	[======]	_	0s	167us/step - los	3S:	0.0532
	493/600		0	177ug/g+o- 1	3.6.5	0 0555
	[======] 494/600	_	US	1//us/step - 108) S :	0.0555
	[=======]	_	0s	198us/step - los	ss:	0.0555
	495/600		0	160 / 1		0.0500
60/60	[=====]	-	US	16Uus/step - los	3S:	0.0532

```
Epoch 496/600
       Restoring model weights from the end of the best epoch
       Epoch 00496: early stopping
       best epoch v2 = 476
       smallest loss v2 = 0.05309077377120654
In [71]:
       historyDatav3 = modelv3.fit(xarray,yarray,epochs=600,callbacks=[es])
        loss histv3 = historyDatav3.history['loss']
        best epochv3 = np.argmin(historyDatav3.history['loss']) + 1
        print ('best epoch v3 = ', best epochv3)
        print('smallest loss v3 =', np.min(loss histv3))
       Epoch 1/600
       60/60 [============== ] - 1s 10ms/step - loss: 1.1264
       Epoch 2/600
       60/60 [============= ] - 0s 187us/step - loss: 1.0720
       Epoch 3/600
       Epoch 4/600
       60/60 [============== ] - 0s 236us/step - loss: 0.9773
       Epoch 5/600
       60/60 [============= ] - 0s 304us/step - loss: 0.9433
       Epoch 6/600
       60/60 [============= ] - 0s 377us/step - loss: 0.9195
       Epoch 7/600
       60/60 [============= ] - 0s 307us/step - loss: 0.9022
       Epoch 8/600
       60/60 [===============] - 0s 261us/step - loss: 0.8852
       Epoch 9/600
       60/60 [============== ] - 0s 209us/step - loss: 0.8678
       Epoch 10/600
       60/60 [============== ] - 0s 371us/step - loss: 0.8502
       Epoch 11/600
       60/60 [============= ] - 0s 262us/step - loss: 0.8322
       Epoch 12/600
       60/60 [=============== ] - 0s 293us/step - loss: 0.8138
       Epoch 13/600
       60/60 [============== ] - 0s 356us/step - loss: 0.7951
       Epoch 14/600
       60/60 [================ ] - 0s 165us/step - loss: 0.7758
       Epoch 15/600
       60/60 [=============== ] - 0s 142us/step - loss: 0.7560
       Epoch 16/600
       60/60 [============== ] - 0s 182us/step - loss: 0.7356
       Epoch 17/600
       60/60 [============== ] - 0s 289us/step - loss: 0.7146
       Epoch 18/600
       60/60 [=============== ] - 0s 513us/step - loss: 0.6928
       Epoch 19/600
       60/60 [===============] - 0s 191us/step - loss: 0.6703
       Epoch 20/600
       60/60 [============== ] - 0s 211us/step - loss: 0.6470
       Epoch 21/600
```

60/60	[======]	_	0s	357us/step - loss:	0.6227
	22/600				
	[======]	-	0s	228us/step - loss:	0.5974
	23/600 [=========]		٥٥	276ug/gton logg.	0 5700
	24/600	_	US	3/6us/step - 10ss:	0.5709
	[========]	_	0s	337us/step - loss:	0.5449
	25/600				
60/60	[======]	_	0s	332us/step - loss:	0.5219
	26/600				
	[=======]	-	0s	503us/step - loss:	0.5021
	27/600 [======]		Λc	208ug/gton logg.	0 4866
	28/600	_	US	200us/scep - 10ss.	0.4000
	[========]	_	0s	213us/step - loss:	0.4729
	29/600				
	[=====]	-	0s	157us/step - loss:	0.4606
	30/600		0 ~	17Fug/gton logg.	0 4400
	31/600	_	US	1/5us/step - 10ss:	0.4489
	[=========]	_	0s	161us/step - loss:	0.4375
Epoch	32/600				
	[=====]	-	0s	130us/step - loss:	0.4255
	33/600		0 ~	22222/2422 1022	0 4120
	34/600	_	US	333us/step - 10ss:	0.4139
	[=======]	_	0s	327us/step - loss:	0.4022
Epoch	35/600				
	[=====]	-	0s	328us/step - loss:	0.3905
	36/600 [=======]		٥٥	20622/2402 1022	0 2705
	37/600	_	US	286us/step - 10ss:	0.3/83
	[=========]	_	0s	370us/step - loss:	0.3666
Epoch	38/600				
	[======]	-	0s	564us/step - loss:	0.3551
	39/600 [=======]		٥٥	220ug/gtop logg.	0 3426
	40/600	_	US	220us/step - 10ss:	0.3420
	[=========]	_	0s	152us/step - loss:	0.3306
	41/600				
	[=======]	-	0s	184us/step - loss:	0.3180
	42/600 [=======]		٥٥	1/1ug/gtop logg.	0 2055
	43/600	_	US	141us/scep - 10ss.	0.3033
	[========]	_	0s	246us/step - loss:	0.2928
	44/600				
	[=======]	-	0s	228us/step - loss:	0.2800
	45/600 [=======]		٥٥	149ug/gtop logg.	0 2671
	46/600	_	US	149us/step - 10ss:	0.2071
	[========]	_	0s	229us/step - loss:	0.2550
Epoch	47/600				
	[======]	-	0s	153us/step - loss:	0.2432
	48/600 [=======]		0~	2/011g/g+on 10g-	n 2221
	49/600	_	US	240us/step - 10ss:	0.2321
	[========]	_	0s	145us/step - loss:	0.2211
	•			-	

Enoch	50/600			
	[=======]	_	0s	142us/step - loss: 0.2106
	51/600		0.2	
	[========]	_	0s	118us/step - loss: 0.2010
	52/600			
	[======]	_	0s	152us/step - loss: 0.1922
	53/600			
	[=======]	-	0s	147us/step - loss: 0.1846
	54/600 [======]		0.4	22000/2400 1022 0 1701
	55/600	_	US	220us/step - 10ss: 0.1/61
	[========]	_	0s	139us/step - loss: 0.1722
	56/600			
60/60	[=======]	_	0s	166us/step - loss: 0.1668
	57/600			
	[=======]	-	0s	129us/step - loss: 0.1619
	58/600 [======]		0.0	100ug/gton logg. 0 1501
	59/600	_	US	199us/scep = 10ss: 0:1301
	[=======]	_	0s	217us/step - loss: 0.1554
Epoch	60/600			_
	[======]	_	0s	319us/step - loss: 0.1533
	61/600		•	405 / 1 3 0 4544
	[======] 62/600	_	0s	425us/step - loss: 0.1511
	[=========]	_	0s	397us/sten = loss: 0.1504
	63/600		OB	1000. 0:1301
	[========]	_	0s	264us/step - loss: 0.1484
	64/600			
	[======]	-	0s	284us/step - loss: 0.1470
	65/600 [======]		0.4	205:27/3400]033. 0 1454
	[] 66/600	_	US	303us/step - 10ss: 0:1434
	[=======]	_	0s	212us/step - loss: 0.1444
Epoch	67/600			_
	[======]	_	0s	193us/step - loss: 0.1434
_	68/600		•	004 / 1 3 0 1405
	[======] 69/600	-	0s	284us/step - loss: 0.1425
	[=========]	_	0s	156us/sten = loss: 0.1414
	70/600		OB	13045/5005 1055. 0:1111
	[=======]	_	0s	127us/step - loss: 0.1403
	71/600			
	[=======]	-	0s	126us/step - loss: 0.1394
	72/600 [======]		0.4	12000/0400 1000 0 1201
	73/600	_	US	130us/step - 10ss: 0.1391
	[=======]	_	0s	202us/step - loss: 0.1379
	74/600			
	[======]	_	0s	169us/step - loss: 0.1371
	75/600		•	160 / 1
	[=========]	_	0s	168us/step - loss: 0.1364
	76/600 [======]	_	Λα	133us/sten = loss. 0 1356
	77/600	_	va	10000/ Deep - 1000. 0.1000
	[=======]	_	0s	150us/step - loss: 0.1349
Epoch	78/600			

	[=====]	_	0s	193us/step	_	loss:	0.1340
	79/600 [======]		Λσ	176ug/g+an		1000	0 1332
	80/600	_	US	170us/scep	_	1055.	0.1332
	[=====]	-	0s	234us/step	-	loss:	0.1326
	81/600 [======]	_	0s	278us/sten	_	loss:	0.1320
Epoch	82/600			_			
	[======] 83/600	-	0s	219us/step	-	loss:	0.1311
	[==========]	_	0s	430us/step	_	loss:	0.1305
Epoch	84/600			_			
	[======] 85/600	-	0s	457us/step	-	loss:	0.1300
	[========]	_	0s	510us/step	_	loss:	0.1296
	86/600		0 -	226/-		1	0 1000
	[======] 87/600	-	0s	336us/step	_	loss:	0.1289
60/60	[======]	_	0s	399us/step	_	loss:	0.1280
	88/600 [======]		٥٥	20/11c/c+on		1055	0 1260
Epoch	89/600			_			
	[=====]	-	0s	218us/step	-	loss:	0.1263
	90/600	_	0s	240us/sten	_	loss:	0.1256
Epoch	91/600			_			
	[========]	-	0s	195us/step	-	loss:	0.1249
	92/600	_	0s	247us/step	_	loss:	0.1242
Epoch	93/600			_			
	[======] 94/600	-	0s	211us/step	-	loss:	0.1238
	[========]	_	0s	165us/step	_	loss:	0.1228
	95/600					-	
	[======] 96/600	-	0s	164us/step	_	loss:	0.1222
	[======]	_	0s	246us/step	_	loss:	0.1215
	97/600 [=======]		٥٥	21919/9+05		1000.	0 1200
	98/600	_	05	21ous/scep	_	1055;	0.1209
	[======]	-	0s	194us/step	-	loss:	0.1201
	99/600	_	0s	180us/sten	_	loss:	0.1195
Epoch	100/600						
	[=========]	-	0s	180us/step	-	loss:	0.1194
	101/600 [==========]	_	0s	221us/step	_	loss:	0.1185
Epoch	102/600						
	[======] 103/600	-	0s	187us/step	-	loss:	0.1183
	[=======]	_	0s	187us/step	_	loss:	0.1173
Epoch	104/600						
	[======] 105/600	-	US	163us/step	-	TOSS:	0.1166
60/60	[======]	_	0s	291us/step	-	loss:	0.1159
	106/600		0~	111ng/g+c=		1000	0 1152
00/60	[=====]	-	US	441us/step	_	TOSS:	0.1153

```
Epoch 107/600
60/60 [=============== ] - 0s 338us/step - loss: 0.1146
Epoch 108/600
60/60 [============= ] - 0s 406us/step - loss: 0.1150
Epoch 109/600
60/60 [=========== ] - 0s 191us/step - loss: 0.1143
Epoch 110/600
60/60 [=========== ] - 0s 182us/step - loss: 0.1129
Epoch 111/600
Epoch 112/600
60/60 [============== ] - 0s 175us/step - loss: 0.1120
Epoch 113/600
60/60 [=============== ] - 0s 143us/step - loss: 0.1113
Epoch 114/600
60/60 [=============== ] - 0s 218us/step - loss: 0.1119
Epoch 115/600
60/60 [============== ] - 0s 200us/step - loss: 0.1099
Epoch 116/600
Epoch 117/600
Epoch 118/600
60/60 [============== ] - 0s 258us/step - loss: 0.1082
Epoch 119/600
60/60 [============= ] - 0s 595us/step - loss: 0.1076
Epoch 120/600
60/60 [=========== ] - 0s 478us/step - loss: 0.1076
Epoch 121/600
60/60 [=========== ] - 0s 516us/step - loss: 0.1064
Epoch 122/600
60/60 [============= ] - 0s 206us/step - loss: 0.1058
Epoch 123/600
- loss: 0.1053
Epoch 124/600
60/60 [===========] - 0s 271us/step - loss: 0.1047
Epoch 125/600
60/60 [============== ] - 0s 370us/step - loss: 0.1043
Epoch 126/600
60/60 [============= ] - 0s 288us/step - loss: 0.1038
Epoch 127/600
60/60 [=============== ] - 0s 733us/step - loss: 0.1032
Epoch 128/600
60/60 [============== ] - 0s 965us/step - loss: 0.1025
Epoch 129/600
60/60 [============= ] - 0s 565us/step - loss: 0.1022
Epoch 130/600
Epoch 131/600
60/60 [============= ] - 0s 302us/step - loss: 0.1019
Epoch 132/600
Epoch 133/600
Epoch 134/600
60/60 [============== ] - 0s 212us/step - loss: 0.1000
```

Epoch	135/600				
	[========]	_	0s	159us/step - loss: 0.09	95
Epoch	136/600				
	[======]	-	0s	319us/step - loss: 0.09	89
	137/600				
	[========]	-	0s	204us/step - loss: 0.09	84
	138/600 [=========]		٥٥	193ug/g+op logg. 0 00	70
	139/600	_	US	103us/scep = 10ss: 0.09	70
	[========]	_	0s	304us/step - loss: 0.09	76
Epoch	140/600			_	
	[======]	-	0s	177us/step - loss: 0.09	71
	141/600				
	[========]	-	0s	269us/step - loss: 0.09	64
	142/600		٥٥	472ug/g+op logg. 0.00	60
	143/600	_	US	4/2us/scep - 10ss: 0.09	00
	[========]	_	0s	175us/step - loss: 0.09	54
Epoch	144/600				
	[======]	-	0s	332us/step - loss: 0.09	50
	145/600				
	[========]	-	0s	270us/step - loss: 0.09	48
	146/600		٥٥	E20ug/gton logg. 0.00	12
	147/600	_	US	539us/step = 10ss: 0.09	42
	[========]	_	0s	269us/step - loss: 0.09	41
	148/600				
60/60	[=======]	_	0s	509us/step - loss: 0.09	33
	149/600				
	[======]	-	0s	238us/step - loss: 0.09	35
	150/600		0~	210	2.5
	[======] 151/600	-	US	210us/step - 10ss: 0.09	25
	[========]	_	0s	257us/step - loss: 0.09	26
	152/600				
	[======]	_	0s	249us/step - loss: 0.09	34
-	153/600				
	[======================================	-	0s	276us/step - loss: 0.09	14
	154/600 [=======]		0.0	22222/2+07 1022 0 00	0.0
	155/600	_	US	233us/step = 10ss: 0.09	09
	[========]	_	0s	244us/step - loss: 0.09	04
	156/600			<u>.</u>	
	[======]	-	0s	181us/step - loss: 0.09	07
	157/600				
	[======================================	-	0s	192us/step - loss: 0.08	97
	158/600 [======]		٥٥	120ug/gton logg. 0.00	0.0
	159/600	_	US	138us/step - 10ss: 0.08	90
	[========]	_	0s	179us/step - loss: 0.08	91
	160/600				-
60/60	[======]	_	0s	208us/step - loss: 0.08	89
	161/600				
	[======================================	-	0s	128us/step - loss: 0.08	79
	162/600 [=======]		0 ~	170ug/gtop 10gg 0.00	70
	163/600	_	US	1/005/scep - 1055: 0.08	70
TPOCII	100,000				

60/60	[=====]	_	0s	259us/step - loss	0.0875
	164/600		•	0.71	0 0004
	[======] 165/600	-	0s	2/lus/step - loss	: 0.0884
	[=======]	_	0s	292us/step - loss	0.0867
Epoch	166/600				
	[========]	-	0s	379us/step - loss	: 0.0861
	167/600 [======]	_	0s	504us/step = loss	. 0.0857
Epoch	168/600			_	
	[=====]	-	0s	323us/step - loss	: 0.0851
	169/600 [=======]		٥٥	225ug/gton logg	. 0 0050
	170/600	_	US	223us/step - 10ss	. 0.0033
60/60	[======]	_	0s	200us/step - loss	0.0842
	171/600		0	245 / 1 3	0 0000
	[======] 172/600	-	0s	345us/step - loss	: 0.0839
	[=======]	_	0s	237us/step - loss	0.0845
	173/600				
	[======] 174/600	-	0s	311us/step - loss	: 0.0832
	[========]	_	0s	161us/step - loss	: 0.0825
Epoch	175/600				
	[======]	-	0s	144us/step - loss	: 0.0821
	176/600 [=======]	_	0 s	156us/sten - loss	. 0.0818
Epoch	177/600				
	[=======]	_	0s	125us/step - loss	: 0.0813
	178/600 [=======]		٥٥	160ug/gtop logg	. 0 0000
	179/600	_	US	100us/step - 10ss	. 0.0000
60/60	[======]	_	0s	249us/step - loss	0.0806
	180/600		0	140/-1 1	0 0000
	[======] 181/600	-	US	149us/step - loss	0.0802
	[=======]	_	0s	132us/step - loss	0.0797
	182/600			207 /	
	[=======] 183/600	-	0s	227us/step - loss	: 0.0798
	[=======]	_	0s	268us/step - loss	0.0817
Epoch	184/600				
	[======] 185/600	-	0s	346us/step - loss	: 0.0789
	[========]	_	0s	319us/step - loss	: 0.0780
Epoch	186/600				
	[=========]	-	0s	331us/step - loss	: 0.0777
	187/600 [=======]	_	0 s	181115/sten - loss	. 0.0773
	188/600		Ů.	10100,0000	. 0.0770
	[======]	-	0s	192us/step - loss	0.0770
	189/600 [=======]		٥٥	209ug/g+on logg	• 0 0764
	190/600	_	υÞ	209us/scep - 1055	. 0.0/04
60/60	[======]	-	0s	145us/step - loss	0.0760
	191/600		0	16/119/2405	. 0 0750
00/60	[=====]	-	υS	104us/step - 10ss	. 0.0/58

```
Epoch 192/600
- loss: 0.0752
Epoch 193/600
60/60 [============== ] - 0s 165us/step - loss: 0.0749
Epoch 194/600
60/60 [============== ] - 0s 228us/step - loss: 0.0744
Epoch 195/600
Epoch 196/600
Epoch 197/600
60/60 [============== ] - 0s 118us/step - loss: 0.0731
Epoch 198/600
60/60 [============== ] - 0s 132us/step - loss: 0.0729
Epoch 199/600
60/60 [============== ] - 0s 159us/step - loss: 0.0723
Epoch 200/600
60/60 [============= ] - 0s 136us/step - loss: 0.0719
Epoch 201/600
60/60 [============= ] - 0s 176us/step - loss: 0.0725
Epoch 202/600
60/60 [=============== ] - 0s 171us/step - loss: 0.0716
Epoch 203/600
Epoch 204/600
60/60 [=============== ] - 0s 167us/step - loss: 0.0709
Epoch 205/600
Epoch 206/600
60/60 [=============== ] - 0s 183us/step - loss: 0.0702
Epoch 207/600
60/60 [============== ] - 0s 199us/step - loss: 0.0703
Epoch 208/600
60/60 [============== ] - 0s 171us/step - loss: 0.0697
Epoch 209/600
60/60 [============ ] - 0s 264us/step - loss: 0.0694
Epoch 210/600
60/60 [============== ] - 0s 318us/step - loss: 0.0689
Epoch 211/600
60/60 [============= ] - 0s 287us/step - loss: 0.0687
Epoch 212/600
60/60 [============ ] - 0s 498us/step - loss: 0.0684
Epoch 213/600
60/60 [============== ] - 0s 239us/step - loss: 0.0680
Epoch 214/600
60/60 [============ ] - 0s 362us/step - loss: 0.0679
Epoch 215/600
Epoch 216/600
60/60 [============= ] - 0s 338us/step - loss: 0.0676
Epoch 217/600
Epoch 218/600
60/60 [============= ] - 0s 284us/step - loss: 0.0671
Epoch 219/600
60/60 [============= ] - 0s 371us/step - loss: 0.0671
```

Enoch	220/600					
	[=======]	_	0s	253us/step - los	s:	0.0674
	221/600		٥٥			0000, -
60/60	[======]	_	0s	160us/step - los	s:	0.0669
	222/600					
	[======]	-	0s	140us/step - los	s:	0.0665
	223/600 [======]		٥٠	26229/9409 109		0 0667
	224/600	_	US	263us/step - los	s:	0.0667
	[=======]	_	0s	162us/step - los	s:	0.0670
	225/600					
	[======]	-	0s	263us/step - los	s:	0.0666
	226/600					
	[=========]	-	0s	241us/step - los	s:	0.0663
	227/600 [======]		Λc	157ug/g+on log		0 0661
	228/600	_	US	13/us/scep - 10s	5.	0.0001
	[=======]	_	0s	153us/step - los	s:	0.0662
Epoch	229/600					
	[=======]	-	0s	159us/step - los	s:	0.0661
	230/600		_			
	[======] 231/600	-	0s	170us/step - los	s:	0.0658
	[=========]	_	Λs	213us/sten = los	. c •	0.0658
	232/600		OB	21345/5005 105		0.0050
	[======]	_	0s	173us/step - los	s:	0.0656
	233/600					
	[======]	-	0s	136us/step - los	s:	0.0654
	234/600 [=======]		٥٥	155ug/g+on log		0 0655
	235/600	_	US	133us/scep - 10s	5.	0.0033
	[=======]	_	0s	192us/step - los	s:	0.0651
	236/600			_		
	[======]	-	0s	198us/step - los	s:	0.0652
	237/600		0~	170		0.0656
	[======] 238/600	_	US	1/Uus/step - los	s:	0.0656
_	[=======]	_	0s	188us/step - los	s:	0.0654
	239/600			.		
	[======]	-	0s	157us/step - los	s:	0.0650
	240/600		•	150 /		0.0640
	[=======] 241/600	-	0s	159us/step - los	s:	0.0648
	[=========]	_	0s	166us/step = los	s:	0.0645
	242/600		OB	100007 5000		0.0013
	[======]	_	0s	291us/step - los	s:	0.0650
	243/600					
	[=======]	-	0s	254us/step - los	s:	0.0645
	244/600 [=======]		٥٥	277ug/g+on log		0 0643
	245/600	_	US	2//us/step - 10s	5:	0.0043
	[=======]	_	0s	276us/step - los	s:	0.0644
Epoch	246/600					
	[======]	-	0s	385us/step - los	s:	0.0640
	247/600		0 -	252/		0 0647
	[======] 248/600	-	US	JoJus/step - los	s:	0.064/
просп	240,000					

60/60	[=====]	_	0s	355us/step - loss:	0.0640
	249/600				
	[======] 250/600	-	0s	132us/step - loss:	0.0639
	[========]	_	0s	155us/step - loss:	0.0639
Epoch	251/600				
	[======]	-	0s	142us/step - loss:	0.0636
	252/600 [=======]		٥٥	105ug/gton logg.	0 0630
	253/600	_	US	193us/step - 10ss:	0.0039
	[=======]	_	0s	246us/step - loss:	0.0642
	254/600				
	[======] 255/600	-	0s	173us/step - loss:	0.0636
	[=========]	_	0s	195us/step - loss:	0.0633
Epoch	256/600				
	[======]	-	0s	152us/step - loss:	0.0635
	257/600 [=======]		۸c	201us/sten loss.	0 0637
	258/600		US	201us/scep - 10ss.	0.0037
	[======]	_	0s	175us/step - loss:	0.0633
	259/600		0 -	201/	0 0621
	[======] 260/600	_	US	281us/step - loss:	0.0631
	[=======]	_	0s	126us/step - loss:	0.0635
Epoch	261/600				
	[======] 262/600	-	0s	172us/step - loss:	0.0635
	[=========]	_	0s	148us/step - loss:	0.0634
Epoch	263/600				
	[======]	-	0s	150us/step - loss:	0.0630
	264/600 [=======]	_	۸e	175us/sten = loss.	0 0632
	265/600		05	173d5/5ccp - 1055.	0.0032
	[======]	-	0s	175us/step - loss:	0.0631
	266/600 [=======]		٥٥	240ug/g+on logg.	0 0626
	267/600	_	US	240us/step - 10ss:	0.0030
60/60	[======]	_	0s	240us/step - loss:	0.0626
	268/600		0 ~	121/	0 0626
	[======] 269/600	_	US	131us/step - 10ss:	0.0626
	[=======]	_	0s	129us/step - loss:	0.0628
	270/600				
	[======] 271/600	-	0s	1/4us/step - loss:	0.0627
	[========]	_	0s	146us/step - loss:	0.0628
Epoch	272/600				
	[=========]	-	0s	216us/step - loss:	0.0626
	273/600 [=======]	_	0s	273us/step - loss:	0.0629
Epoch	274/600				
	[========]	-	0s	161us/step - loss:	0.0623
	275/600 [=======]	_	Λe	152118/sten = loss.	0.0621
	276/600	_	U.S	10200/acep - 10a5:	0.0021
	[=====]	_	0s	148us/step - loss:	0.0636

Epoch	277/600				
	[=======]	_	0s	166us/step - loss:	0.0630
Epoch	278/600				
	[======]	-	0s	178us/step - loss:	0.0619
	279/600				
	[======================================	-	0s	147us/step - loss:	0.0620
	280/600 [======]		٥٥	205ug/gtop logg.	0 0621
	281/600	_	US	200us/step - 10ss:	0.0021
	[=======]	_	0s	174us/step - loss:	0.0634
Epoch	282/600				
	[======]	-	0s	169us/step - loss:	0.0629
	283/600		•	0.60 / 1	
	[======] 284/600	-	0s	263us/step - loss:	0.0621
	[==========]		۸e	218ug/gten _ logg.	0 0625
	285/600		V.S	210us/scep - 10ss.	0.0023
	[========]	_	0s	180us/step - loss:	0.0617
Epoch	286/600				
	[======]	-	0s	178us/step - loss:	0.0618
	287/600		•	155 /	0 0615
	[======] 288/600	-	0s	1/5us/step - loss:	0.0615
	[=========]	_	0s	127us/step - loss:	0.0614
	289/600		V D	12/45/5000 1055.	0.0011
	[=======]	_	0s	157us/step - loss:	0.0646
	290/600				
	[======]	-	0s	139us/step - loss:	0.0616
	291/600		0~	16649/9499 1999	0 0612
	[======] 292/600	_	US	166us/step - 10ss:	0.0613
	[=======]	_	0s	157us/step - loss:	0.0622
	293/600		-		
	[======]	_	0s	170us/step - loss:	0.0622
	294/600				
	[======================================	-	0s	183us/step - loss:	0.0618
	295/600 [=======]		Λc	190us/sten loss.	0 0612
	296/600	_	US	100us/scep - 10ss.	0.0012
	[=======]	_	0s	149us/step - loss:	0.0615
Epoch	297/600				
	[======]	-	0s	165us/step - loss:	0.0623
	298/600		^	165 / 1	0 0616
	[======] 299/600	-	0s	165us/step - loss:	0.0616
	[========]	_	0s	151us/step - loss:	0.0612
	300/600		٥٥	10145, 500p 1055	
60/60	[=======]	_	0s	165us/step - loss:	0.0610
	301/600				
	[=======]	-	0s	160us/step - loss:	0.0625
	302/600		٥٩	474ug/g+on logge	0 0615
	[======] 303/600	_	υS	4/4us/step - 10ss:	0.0013
	[=======]	_	0s	160us/step - loss:	0.0623
Epoch	304/600				
	[=======]	-	0s	169us/step - loss:	0.0621
Epoch	305/600				

60/60	[=====]	_	0s	168us/step - loss:	0.0611
	306/600				
	[======] 307/600	-	0s	145us/step - loss:	0.0610
	[=======]	_	0s	162us/step - loss:	0.0609
Epoch	308/600				
	[=========]	-	0s	189us/step - loss:	0.0612
	309/600 [=========]	_	0s	193us/step - loss:	0.0610
Epoch	310/600				
	[======]	-	0s	178us/step - loss:	0.0612
	311/600 [=======]	_	۸e	248us/sten = loss.	0 0606
Epoch	312/600				
	[=====]	-	0s	201us/step - loss:	0.0611
	313/600 [=======]		Λσ	206us/sten loss.	0 0607
	314/600	_	US	200us/scep - 10ss.	0.0007
	[======]	-	0s	382us/step - loss:	0.0605
	315/600 [=======]		٥٥	122ug/g+on logg.	0 0612
	316/600	_	05	132us/step - 10ss:	0.0012
60/60	[======]	-	0s	187us/step - loss:	0.0611
	317/600 [=======]		٥٥	251ug/g+on logg.	0 0606
	318/600	_	US	251us/step - 10ss:	0.0000
60/60	[======]	_	0s	312us/step - loss:	0.0619
	319/600 [=======]		0 ~	240	0.0607
	320/600	_	US	248us/step - 10ss:	0.0607
60/60	[======]	_	0s	342us/step - loss:	0.0605
	321/600 [======]		0	202/	0 0614
	322/600	_	US	203us/step - loss:	0.0614
60/60	[======]	_	0s	180us/step - loss:	0.0604
	323/600 [=========]		0	160/	0.0603
	324/600	_	US	162us/step - loss:	0.0603
60/60	[======]	_	0s	131us/step - loss:	0.0610
	325/600		0 ~	215/5+0	0 0601
	[======] 326/600	_	US	215us/step - loss:	0.0601
60/60	[======]	_	0s	197us/step - loss:	0.0611
	327/600		0 ~	104	0 0601
	[======] 328/600	_	US	184us/step - loss:	0.0601
60/60	[======]	_	0s	134us/step - loss:	0.0601
	329/600		0 -	165/	0.0605
	[======] 330/600	_	US	165us/step - 10ss:	0.0605
	[=======]	_	0s	222us/step - loss:	0.0606
	331/600		0	262/	0 0603
	[======] 332/600	-	US	203US/Step - loss:	0.0601
	[========]	_	0s	267us/step - loss:	0.0612
	333/600		0	201/	0 0610
60/60	[=====]	-	υs	Zylus/step - loss:	0.0619

Epoch	334/600				
	[=======]	_	0s	304us/step - loss:	0.0602
	335/600		_	201	
	[======] 336/600	-	0s	324us/step - loss:	0.0610
	[==========]	_	0s	292us/step - loss:	0.0606
	337/600		٥٥		
	[=======]	_	0s	363us/step - loss:	0.0598
	338/600				
	[======] 339/600	-	0s	316us/step - loss:	0.0598
	[==========]	_	Λs	28711s/sten - loss:	0.0598
	340/600		٥٥	2074575000	0.0000
	[=======]	_	0s	304us/step - loss:	0.0598
	341/600				
	[======================================	-	0s	357us/step - loss:	0.0603
	342/600 [=======]	_	۸e	41511g/gten - logg.	0 0598
	343/600		OB	113db/bccp 10bb.	0.0370
60/60	[=======]	_	0s	377us/step - loss:	0.0598
	344/600				
	[======] 345/600	-	0s	267us/step - loss:	0.0601
	[==========]	_	Λs	33711s/sten = loss:	0.0597
	346/600		OB	3374B7BCCP 10BB.	0.0337
60/60	[=======]	_	0s	142us/step - loss:	0.0594
	347/600				
	[======================================	-	0s	149us/step - loss:	0.0595
	348/600 [========]	_	0s	192us/step = loss:	0.0595
	349/600		٥٥		0.0000
	[======]	_	0s	210us/step - loss:	0.0597
	350/600		•	1.45 /	0.0506
	[======] 351/600	_	0s	14/us/step - loss:	0.0596
_	[=========]	_	0s	141us/step - loss:	0.0598
	352/600				
	[========]	-	0s	133us/step - loss:	0.0602
	353/600 [=======]		0~	155/	0 0601
	354/600	_	US	issus/step - ioss:	0.0001
	[========]	_	0s	147us/step - loss:	0.0602
Epoch	355/600				
	[========]	-	0s	174us/step - loss:	0.0601
	356/600 [=======]		٥٥	200ug/gton logg.	0 0601
	357/600	_	US	200us/step - 10ss:	0.0001
	[========]	_	0s	162us/step - loss:	0.0595
Epoch	358/600				
	[======================================	_	0s	142us/step - loss:	0.0594
	359/600 [=======]	_	۸e	145ug/gten - logg.	0 0591
	360/600		V.S	14303/Scep - 1055.	0.0371
60/60	[=======]	_	0s	168us/step - loss:	0.0610
	361/600		_	-	
	[======] 362/600	-	0s	188us/step - loss:	0.0600
Ebocii	302/000				

60/60	[=====]	_	0s	205us/step -	loss:	0.0593
	363/600					
	[=======]	-	0s	164us/step -	loss:	0.0593
	364/600 [=======]	_	۸c	20011g/sten -	1088.	0 0591
	365/600		V S	Zoous/scep -	1055.	0.0371
	[=======]	_	0s	140us/step -	loss:	0.0592
	366/600					
	[=======]	-	0s	165us/step -	loss:	0.0596
	367/600 [=======]	_	Λc	19811g/gten -	1000	0 0591
	368/600		V.S	17005/5cep -	1055.	0.0371
	[=======]	_	0s	165us/step -	loss:	0.0597
	369/600					
	[=======]	-	0s	241us/step -	loss:	0.0590
	370/600 [======]	_	۸c	266119/sten -	1088.	0 0596
	371/600		V S	Zoous/scep -	1055.	0.0370
	[=======]	_	0s	258us/step -	loss:	0.0615
	372/600				_	
	[========]	-	0s	280us/step -	loss:	0.0593
	373/600 [======]	_	۸c	73911g/gten -	1088.	0 0589
	374/600		V S	/J/us/scep -	1055.	0.0307
	[========]	_	0s	264us/step -	loss:	0.0601
	375/600					
	[=======]	-	0s	201us/step -	loss:	0.0598
	376/600 [======]	_	Λc	34211g/gten -	1000	0 0589
	377/600		V S	JiZus/Scep -	1055.	0.0307
	[=======]	_	0s	203us/step -	loss:	0.0590
	378/600				_	
	[======] 379/600	-	0s	202us/step -	loss:	0.0590
	[========]	_	0s	273us/step -	loss:	0.0587
	380/600			- / C G D / D C O P	_000	
	[======]	-	0s	250us/step -	loss:	0.0592
	381/600		0	050 / 1	1	0.0500
	[======] 382/600	-	US	250us/step -	loss:	0.0590
	[=======]	_	0s	166us/step -	loss:	0.0587
Epoch	383/600					
	[======]	-	0s	171us/step -	loss:	0.0589
	384/600		0	100/	1	0 0504
	[======] 385/600	-	0S	189us/step -	loss:	0.0594
	[=======]	_	0s	199us/step -	loss:	0.0589
Epoch	386/600					
	[======]	-	0s	173us/step -	loss:	0.0587
	387/600		0 -	167/	1	0 0500
	[======] 388/600	_	US	16/us/step -	loss:	0.0590
	[=======]	_	0s	169us/step -	loss:	0.0588
Epoch	389/600					
	[======]	-	0s	188us/step -	loss:	0.0585
	390/600 [=======]		0~	150119/5+05	loggs	0 0507
00/00	[]	-	US	isous/step -	TOSS:	0.058/

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Epoch 391/600
60/60 [============= ] - 0s 217us/step - loss: 0.0586
Epoch 392/600
60/60 [============= ] - 0s 182us/step - loss: 0.0587
Epoch 393/600
60/60 [============== ] - 0s 181us/step - loss: 0.0589
Epoch 394/600
Epoch 395/600
60/60 [============= ] - 0s 149us/step - loss: 0.0587
Epoch 396/600
60/60 [============== ] - 0s 143us/step - loss: 0.0587
Epoch 397/600
Epoch 398/600
60/60 [=============== ] - 0s 327us/step - loss: 0.0584
Epoch 399/600
60/60 [=========== ] - 0s 307us/step - loss: 0.0584
Epoch 400/600
60/60 [============== ] - 0s 245us/step - loss: 0.0589
Epoch 401/600
60/60 [=============== ] - 0s 336us/step - loss: 0.0584
Epoch 402/600
60/60 [============= ] - 0s 399us/step - loss: 0.0587
Epoch 403/600
60/60 [============= ] - 0s 276us/step - loss: 0.0584
Epoch 404/600
60/60 [=========== ] - 0s 587us/step - loss: 0.0590
Epoch 405/600
60/60 [============ ] - 0s 222us/step - loss: 0.0597
Epoch 406/600
- loss: 0.0597
Epoch 407/600
60/60 [============= ] - 0s 263us/step - loss: 0.0588
Epoch 408/600
60/60 [============== ] - 0s 185us/step - loss: 0.0583
Epoch 409/600
60/60 [============== ] - 0s 249us/step - loss: 0.0591
Epoch 410/600
60/60 [============= ] - 0s 155us/step - loss: 0.0584
Epoch 411/600
Epoch 412/600
60/60 [============== ] - 0s 265us/step - loss: 0.0596
Epoch 413/600
60/60 [============= ] - 0s 174us/step - loss: 0.0586
Epoch 414/600
60/60 [=============== ] - 0s 163us/step - loss: 0.0584
Epoch 415/600
60/60 [============= ] - 0s 145us/step - loss: 0.0590
Epoch 416/600
Epoch 417/600
60/60 [=============== ] - 0s 153us/step - loss: 0.0582
Epoch 418/600
60/60 [============== ] - 0s 178us/step - loss: 0.0585
```

```
Epoch 419/600
60/60 [=============== ] - 0s 181us/step - loss: 0.0582
Epoch 420/600
60/60 [============= ] - 0s 229us/step - loss: 0.0582
Epoch 421/600
60/60 [=========== ] - 0s 203us/step - loss: 0.0584
Epoch 422/600
Epoch 423/600
Epoch 424/600
60/60 [============== ] - 0s 149us/step - loss: 0.0581
Epoch 425/600
Epoch 426/600
Epoch 427/600
60/60 [=========== ] - 0s 153us/step - loss: 0.0584
Epoch 428/600
Epoch 429/600
60/60 [================ ] - 0s 162us/step - loss: 0.0580
Epoch 430/600
60/60 [============= ] - 0s 202us/step - loss: 0.0588
Epoch 431/600
60/60 [============= ] - 0s 171us/step - loss: 0.0582
Epoch 432/600
60/60 [============ ] - 0s 248us/step - loss: 0.0582
Epoch 433/600
60/60 [============ ] - 0s 172us/step - loss: 0.0583
Epoch 434/600
60/60 [============= ] - 0s 215us/step - loss: 0.0579
Epoch 435/600
60/60 [============= ] - 0s 132us/step - loss: 0.0582
Epoch 436/600
Epoch 437/600
60/60 [=============== ] - 0s 143us/step - loss: 0.0584
Epoch 438/600
- loss: 0.0582
Epoch 439/600
Epoch 440/600
60/60 [============== ] - 0s 208us/step - loss: 0.0579
Epoch 441/600
Epoch 442/600
60/60 [=============== ] - 0s 168us/step - loss: 0.0579
Epoch 443/600
60/60 [============== ] - 0s 178us/step - loss: 0.0578
Epoch 444/600
Epoch 445/600
60/60 [============= ] - 0s 151us/step - loss: 0.0577
Epoch 446/600
```

Epoch	447/600			
	[=======]	_	0s	154us/step - loss: 0.0579
Epoch	448/600			
	[======]	-	0s	169us/step - loss: 0.0577
	449/600			
	[========]	-	0s	136us/step - loss: 0.0578
	450/600 [=======]		٥٥	16/ug/gton logg: 0.0575
	451/600	_	US	104us/scep - 10ss: 0.03/3
	[=======]	_	0s	184us/step - loss: 0.0578
Epoch	452/600			
	[======]	-	0s	205us/step - loss: 0.0588
	453/600		•	252 /
	[========]	-	0s	350us/step - loss: 0.0577
	454/600 [=======]		۸e	345us/sten _ loss. 0 0576
	455/600		V.S	343us/scep - 10ss. 0.0370
	[=======]	_	0s	275us/step - loss: 0.0578
	456/600			
	[======]	-	0s	302us/step - loss: 0.0579
	457/600		^	252 / 1 2 2 2572
	[======] 458/600	-	0s	352us/step - loss: 0.05/8
	[========]	_	0s	281us/step = loss: 0.0577
	459/600		Ů.D	1000 1000 1
	[======]	_	0s	444us/step - loss: 0.0575
	460/600			
	[=======]	-	0s	221us/step - loss: 0.0582
	461/600 [=======]		٥٥	277ug/g+on logg: 0.0570
	462/600	_	US	2//us/scep - 10ss: 0.03/9
	[=======]	_	0s	339us/step - loss: 0.0575
Epoch	463/600			
	[======]	-	0s	272us/step - loss: 0.0577
	464/600		^	200 / 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
	[======] 465/600	-	0s	209us/step - loss: 0.05/4
	[========]	_	0s	230us/step - loss: 0.0575
	466/600		٥٥	2004B, 200P 2002 0000, 0
60/60	[======]	_	0s	273us/step - loss: 0.0583
	467/600			
	[========]	-	0s	257us/step - loss: 0.0575
	468/600 [=======]		٥٥	195ug/g+on logg: 0 0579
	469/600	_	US	193us/scep - 10ss: 0.03/6
	[=======]	_	0s	268us/step - loss: 0.0576
Epoch	470/600			
	[======]	-	0s	239us/step - loss: 0.0575
	471/600		_	
	[=========]	-	0s	136us/step - loss: 0.0574
	472/600 [=======]	_	0 =	146us/step = loss: 0.0576
	473/600	_	O D	11005/500p 1055. 0.05/0
	[=======]	_	0s	174us/step - loss: 0.0572
	474/600			
	[=========]	-	0s	128us/step - loss: 0.0575
Epoch	475/600			

60/60	[======]	_	0s	151us/step - loss	: 0.0588
	476/600 [=======]		0 ~	20129/9509 1099	. 0 0572
	477/600	_	US	zulus/step - loss	: 0.05/3
60/60	[======]	_	0s	209us/step - loss	: 0.0573
	478/600 [=======]		٥٥	207ug/g+on logg	. 0 0572
	479/600	_	05	20/us/step - 10ss	: 0.03/3
60/60	[======]	_	0s	195us/step - loss	: 0.0585
	480/600 [=======]		۸c	191ug/g+op logg	• 0 0573
	481/600	_	US	101us/scep - 10ss	. 0.0373
	[======]	-	0s	237us/step - loss	: 0.0575
	482/600 [=======]	_	0 s	338us/sten - loss	• 0.0574
Epoch	483/600			_	
	[=======]	-	0s	258us/step - loss	: 0.0573
	484/600 [=======]	_	0s	274us/step - loss	: 0.0574
Epoch	485/600				
	[======] 486/600	-	0s	347us/step - loss	: 0.0573
	[========]	_	0s	346us/step - loss	: 0.0574
	487/600		•	150 / 1	0.0550
	[======] 488/600	-	0s	1/3us/step - loss	: 0.0578
60/60	[======]	_	0s	345us/step - loss	: 0.0572
	489/600 [=======]		٥٥	236ug/g+op logg	• 0 0576
Epoch	490/600				
	[======]	-	0s	174us/step - loss	: 0.0571
	491/600 [=======]	_	0s	240us/step - loss	: 0.0571
Epoch	492/600				
	[======] 493/600	-	0s	177us/step - loss	: 0.0576
	[=======]	_	0s	334us/step - loss	: 0.0576
	494/600		•	205 / 1	0 0551
	[======] 495/600	-	0s	305us/step - loss	: 0.0571
60/60	[======]	_	0s	354us/step - loss	: 0.0585
	496/600 [=======]		٥٥	196ug/g+op logg	• 0 0577
	497/600	_	US	190us/scep - 10ss	• 0.0377
	[======]	-	0s	366us/step - loss	: 0.0571
	498/600 [=======]	_	0s	258us/step - loss	: 0.0570
Epoch	499/600				
	[======] 500/600	-	0s	179us/step - loss	: 0.0572
	[========]	_	0s	182us/step - loss	: 0.0581
Epoch	501/600				
	[======] 502/600	-	US	2/3us/step - loss	: 0.0570
60/60	[======]	_	0s	256us/step - loss	: 0.0572
	503/600 [=========]		٥٥	313ug/g+on 1000	• 0 0560
00/00	[==]	_	υS	JiJus/step - IOSS	• 0.0309

```
Epoch 504/600
60/60 [============== ] - 0s 356us/step - loss: 0.0569
Epoch 505/600
60/60 [============= ] - 0s 288us/step - loss: 0.0570
Epoch 506/600
60/60 [============== ] - 0s 316us/step - loss: 0.0568
Epoch 507/600
60/60 [============= ] - 0s 345us/step - loss: 0.0574
Epoch 508/600
60/60 [============ ] - 0s 421us/step - loss: 0.0569
Epoch 509/600
60/60 [============= ] - 0s 293us/step - loss: 0.0569
Epoch 510/600
Epoch 511/600
Epoch 512/600
60/60 [============ ] - 0s 353us/step - loss: 0.0573
Epoch 513/600
Epoch 514/600
- loss: 0.0569
Epoch 515/600
60/60 [=============== ] - 0s 173us/step - loss: 0.0576
Epoch 516/600
60/60 [=============== ] - 0s 195us/step - loss: 0.0568
Epoch 517/600
Epoch 518/600
Epoch 519/600
Epoch 520/600
60/60 [============== ] - 0s 159us/step - loss: 0.0569
Epoch 521/600
60/60 [============== ] - 0s 191us/step - loss: 0.0570
Epoch 522/600
60/60 [============== ] - 0s 152us/step - loss: 0.0570
Epoch 523/600
60/60 [============= ] - 0s 157us/step - loss: 0.0567
Epoch 524/600
Epoch 525/600
60/60 [============== ] - 0s 159us/step - loss: 0.0582
Epoch 526/600
60/60 [============= ] - 0s 170us/step - loss: 0.0566
Epoch 527/600
Epoch 528/600
60/60 [============= ] - 0s 140us/step - loss: 0.0573
Epoch 529/600
Epoch 530/600
60/60 [============= ] - 0s 165us/step - loss: 0.0573
Epoch 531/600
60/60 [============== ] - 0s 188us/step - loss: 0.0568
```

Epoch	532/600				
60/60	[=======]	_	0s	152us/step - loss:	0.0566
	533/600				
	[=========]	-	0s	198us/step - loss:	0.0575
	534/600 [========]	_	۸e	17111g/gten - logg	0 0568
	535/600		0.D	171d5/5ccp - 1055.	0.0500
	[=========]	_	0s	150us/step - loss:	0.0566
	536/600				
	[=======]	-	0s	161us/step - loss:	0.0566
	537/600 [=======]		Λc	163ug/gton logg	0 0570
	538/600		V S	10303/3cep - 1035.	0.0370
	[=========]	_	0s	180us/step - loss:	0.0565
	539/600				
	[=======]	-	0s	171us/step - loss:	0.0565
	540/600 [========]		٥٥	196ug/g+op logg	0 0566
	541/600	_	US	100us/scep - 10ss:	0.0300
	[========]	_	0s	189us/step - loss:	0.0564
Epoch	542/600				
	[=======]	_	0s	201us/step - loss:	0.0564
	543/600 [========]		٥٥	202ug/gton logg	0 0565
	544/600	_	US	zuzus/step - ioss:	0.0565
	[========]	_	0s	207us/step - loss:	0.0570
Epoch	545/600				
	[=====]	-	0s	171us/step - loss:	0.0566
	546/600		0~	242/5+5	0 0564
	[======] 547/600	_	US	243us/step - loss:	0.0564
	[=======]	_	0s	239us/step - loss:	0.0565
Epoch	548/600				
	[]	-	0s	178us/step - loss:	0.0568
_	549/600 [=======]		0 ~	107	0 0567
	550/600	_	US	18/us/step - 10ss:	0.0567
_	[=======]	_	0s	217us/step - loss:	0.0566
Epoch	551/600			_	
	[=========]	_	0s	229us/step - loss:	0.0564
	552/600		٥٩	211,12/2+05 1022	0 0570
	[=======] 553/600	_	US	ziius/step - ioss:	0.05/8
	[========]	_	0s	182us/step - loss:	0.0569
Epoch	554/600				
	[========]	-	0s	339us/step - loss:	0.0564
	555/600		0	211/	0 0564
	[======] 556/600	_	US	211us/step - loss:	0.0564
	[=======]	_	0s	239us/step - loss:	0.0566
Epoch	557/600				
	[]	_	0s	277us/step - loss:	0.0564
	558/600		0 -	20419/5455	0 0570
	[======] 559/600	-	US	ZU4us/step - loss:	0.05/0
	[=========]	_	0s	145us/step - loss:	0.0564
	560/600			_	

60/60	[=====]	_	0s	156us/step - lo	ss:	0.0562
	561/600					
	[========]	-	0s	145us/step - lo	ss:	0.0566
	562/600 [======]	_	۸c	16911g/gten = 10	cc •	0 0563
	563/600		V S	107d3/3cep - 10	55.	0.0303
	[=======]	_	0s	157us/step - lo	ss:	0.0563
	564/600					
	[=======]	-	0s	152us/step - lo	ss:	0.0573
	565/600 [=======]	_	Λc	150ug/gten _ lo	cc•	0 0563
	566/600	_	US	130ds/scep - 10	55.	0.0303
	[========]	_	0s	199us/step - lo	ss:	0.0563
	567/600					
	[=======]	-	0s	188us/step - lo	ss:	0.0563
	568/600 [=======]	_	۸c	29511g/gten = 10	cc •	0 0562
	569/600		V S	273d3/3cep - 10	55.	0.0302
	[======]	_	0s	267us/step - lo	ss:	0.0561
	570/600					
	[========]	-	0s	330us/step - lo	ss:	0.0561
	571/600 [======]	_	۸c	34211g/gten = 10	cc •	0 0562
	572/600		V S	342d3/3cep - 10	55.	0.0302
	[=======]	_	0s	333us/step - lo	ss:	0.0565
	573/600					
	[=======]	-	0s	320us/step - lo	ss:	0.0564
	574/600 [=======]	_	۸c	200us/step = 10	cc •	0 0562
	575/600		05	200d5/5ccp - 10	55.	0.0302
60/60	[======]	_	0s	261us/step - lo	ss:	0.0562
	576/600					
	[======] 577/600	-	0s	230us/step - 1o	ss:	0.0561
	[=========]	_	0s	217us/step - lo	ss:	0.0563
	578/600					
	[======]	-	0s	162us/step - lo	ss:	0.0564
	579/600		0	050 / 1		0.0560
	[=======] 580/600	-	0S	259us/step - 10	ss:	0.0563
	[=======]	_	0s	169us/step - lo	ss:	0.0561
Epoch	581/600					
	[=====]	-	0s	166us/step - lo	ss:	0.0561
	582/600		0 ~	15//5+0		0 0561
	[======] 583/600	_	US	154us/step - 10	SS:	0.0561
	[=======]	_	0s	160us/step - lo	ss:	0.0562
Epoch	584/600					
	[======]	-	0s	165us/step - lo	ss:	0.0564
	585/600 [=======]		٥٥	228118/8+05 10	C C -	0 0564
	586/600	_	US	220us/step - 10	35:	0.0304
	[=======]	_	0s	189us/step - lo	ss:	0.0560
Epoch	587/600					
	[=========]	-	0s	138us/step - lo	ss:	0.0560
	588/600 [=======]		٥٥	13711g/g+on 10	cc •	0 0550
00/00	[]	_	υÞ	13/ds/sceb - 10	35.	0.0333

```
Epoch 589/600
      60/60 [=============== ] - 0s 147us/step - loss: 0.0561
      Epoch 590/600
      60/60 [=============== ] - 0s 158us/step - loss: 0.0564
      Epoch 591/600
      60/60 [============== ] - 0s 171us/step - loss: 0.0560
      Epoch 592/600
      Epoch 593/600
      60/60 [============= ] - 0s 221us/step - loss: 0.0562
      Epoch 594/600
      Epoch 595/600
      60/60 [=============== ] - 0s 238us/step - loss: 0.0567
      Epoch 596/600
      60/60 [=============== ] - 0s 201us/step - loss: 0.0561
      Epoch 597/600
      60/60 [=========== ] - 0s 216us/step - loss: 0.0562
      Epoch 598/600
      60/60 [============== ] - 0s 249us/step - loss: 0.0560
      Epoch 599/600
      Epoch 600/600
      60/60 [============== ] - 0s 221us/step - loss: 0.0561
      best epoch v3 = 588
      smallest loss v3 = 0.05589737569292386
In [72]:
       historyDatav4 = modelv4.fit(xarray,yarray,epochs=600,callbacks=[es])
       loss histv4 = historyDatav4.history['loss']
       best epochv4 = np.argmin(historyDatav4.history['loss']) + 1
       print ('best epoch v4 = ', best_epochv4)
       print('smallest loss v4 =', np.min(loss histv4))
      Epoch 1/600
      Epoch 2/600
      60/60 [=============== ] - 0s 231us/step - loss: 0.9451
      Epoch 3/600
      60/60 [============= ] - 0s 278us/step - loss: 0.9036
      Epoch 4/600
      Epoch 5/600
      60/60 [=============== ] - 0s 429us/step - loss: 0.8169
      Epoch 6/600
      60/60 [============= ] - 0s 396us/step - loss: 0.7709
      Epoch 7/600
      60/60 [============== ] - 0s 274us/step - loss: 0.7238
      Epoch 8/600
      60/60 [============== ] - 0s 340us/step - loss: 0.6768
      Epoch 9/600
      60/60 [===========] - 0s 207us/step - loss: 0.6291
      Epoch 10/600
      60/60 [============== ] - 0s 199us/step - loss: 0.5792
      Epoch 11/600
```

60/60	[======]	_	0s	174us/step - loss: 0.5267	,
	12/600				
	[=======]	-	0s	249us/step - loss: 0.4696	1
	13/600 [=========]	_	۸c	200us/sten = loss. 0 4112	,
	14/600		V S	200us/step - 10ss. 0.4112	
	[======]	_	0s	202us/step - loss: 0.3576	
	15/600				
	[=======]	-	0s	271us/step - loss: 0.3063	1
	16/600 [=======]	_	Λc	231us/sten _ loss• 0 2592	,
	17/600	_	US	231us/scep - 10ss. 0.2392	
	[=======]	_	0s	343us/step - loss: 0.2207	,
	18/600				
	[=======]	-	0s	312us/step - loss: 0.1882	
	19/600 [=======]	_	۸c	268us/sten = loss. 0 1661	
	20/600		V S	200ds/step = 10ss. 0:1001	
	[======]	_	0s	259us/step - loss: 0.1526	
	21/600				
	[======] 22/600	-	0s	225us/step - loss: 0.1436	
	[=========]	_	0s	161us/step = loss: 0.1410	j
	23/600		Ů.	10145, 5005	
	[======]	-	0s	137us/step - loss: 0.1359	1
	24/600				
	[======] 25/600	-	0s	143us/step - loss: 0.1350	1
	[========]	_	0s	145us/step - loss: 0.1289	,
Epoch	26/600				
	[=====]	-	0s	149us/step - loss: 0.1264	:
	27/600 [======]		٥٩	22799/9+09 1099 0 1220	
	28/600	_	US	23/us/step - 10ss: 0.1239	1
	[=========]	_	0s	161us/step - loss: 0.1210	J
	29/600				
	[========]	-	0s	163us/step - loss: 0.1197	
	30/600	_	0 =	133us/sten = loss: 0.1197	,
	31/600		O D	10000, 001137	
	[======]	_	0s	137us/step - loss: 0.1143	
	32/600		•	140 /	
	[======] 33/600	-	0s	148us/step - loss: 0.1122	
	[=========]	_	0s	155us/step - loss: 0.1117	!
Epoch	34/600				
	[======]	-	0s	154us/step - loss: 0.1082	
	35/600		0 ~	141/	
	[======] 36/600	_	US	141us/step - 10ss: 0.10/2	
	[=======]	_	0s	173us/step - loss: 0.1063	,
Epoch	37/600				
	[=======]	-	0s	261us/step - loss: 0.1025	,
	38/600 [=======]		٥٥	199us/sten loss 0 1013	,
	39/600	_	US	100ds/scep - 10ss: 0.1012	
	[========]	_	0s	299us/step - loss: 0.0994	į.
	•			_	

Epoch 40/600 60/60 [====================================	0.0964 0.0932 0.0909 0.0913
Epoch 41/600 60/60 [====================================	0.0964 0.0932 0.0909 0.0913
Epoch 42/600 60/60 [====================================	0.0932
60/60 [====================================	0.0909
Epoch 43/600 60/60 [====================================	0.0909
60/60 [=============] - 0s 259us/step - loss: 0	0.0913
	0.0913
Epoch 44/600	
60/60 [==============] - 0s 526us/step - loss: 0	.0896
Epoch 45/600	0.0896
60/60 [=============] - 0s 190us/step - loss: 0	
Epoch 46/600 60/60 [====================================	0.0866
Epoch 47/600	.0000
60/60 [====================================	.0869
Epoch 48/600	
60/60 [=============] - 0s 181us/step - loss: 0	.0843
Epoch 49/600 60/60 [====================================	0017
Epoch 50/600	.081/
60/60 [====================================	.0807
Epoch 51/600	
60/60 [=============] - 0s 158us/step - loss: 0	.0788
Epoch 52/600	
60/60 [=============] - 0s 131us/step - loss: 0 Epoch 53/600	.0789
60/60 [====================================	0.0779
Epoch 54/600	
60/60 [=============] - 0s 127us/step - loss: 0	.0759
Epoch 55/600	
60/60 [=============] - 0s 191us/step - loss: 0 Epoch 56/600	0.0753
60/60 [====================================	0.0743
Epoch 57/600	
60/60 [=============] - 0s 151us/step - loss: 0	.0763
Epoch 58/600	
60/60 [=============] - 0s 166us/step - loss: 0	.0731
Epoch 59/600 60/60 [==============] - 0s 228us/step - loss: 0	0721
Epoch 60/600	.0721
60/60 [====================================	0.0714
Epoch 61/600	
60/60 [=============] - 0s 799us/step - loss: 0	.0713
Epoch 62/600 60/60 [====================================	0706
Epoch 63/600	.0700
60/60 [====================================	.0696
Epoch 64/600	
60/60 [=============] - 0s 404us/step - loss: 0	.0700
Epoch 65/600 60/60 [====================================	0606
Epoch 66/600	.0000
60/60 [====================================	.0684
Epoch 67/600	
60/60 [==============] - 0s 230us/step - loss: 0	.0677
Epoch 68/600	

```
60/60 [============== ] - 0s 199us/step - loss: 0.0679
Epoch 69/600
60/60 [============ ] - 0s 346us/step - loss: 0.0678
Epoch 70/600
Epoch 71/600
60/60 [============= ] - 0s 608us/step - loss: 0.0671
Epoch 72/600
60/60 [======== ] - 0s 362us/step - loss: 0.0666
Epoch 73/600
60/60 [=============== ] - 0s 190us/step - loss: 0.0656
Epoch 74/600
Epoch 75/600
Epoch 76/600
60/60 [============== ] - 0s 207us/step - loss: 0.0678
Epoch 77/600
Epoch 78/600
Epoch 79/600
60/60 [============== ] - 0s 255us/step - loss: 0.0644
Epoch 80/600
60/60 [============= ] - 0s 207us/step - loss: 0.0636
Epoch 81/600
60/60 [=============== ] - 0s 713us/step - loss: 0.0633
Epoch 82/600
60/60 [=========== ] - 0s 676us/step - loss: 0.0639
Epoch 83/600
60/60 [============== ] - 0s 251us/step - loss: 0.0629
Epoch 84/600
Epoch 85/600
60/60 [============== ] - 0s 236us/step - loss: 0.0626
Epoch 86/600
60/60 [============= ] - 0s 242us/step - loss: 0.0632
Epoch 87/600
60/60 [============== ] - 0s 472us/step - loss: 0.0631
Epoch 88/600
60/60 [============ ] - 0s 1ms/step - loss: 0.0620
Epoch 89/600
60/60 [============= ] - 0s 218us/step - loss: 0.0622
Epoch 90/600
60/60 [============== ] - 0s 225us/step - loss: 0.0633
Epoch 91/600
60/60 [============= ] - 0s 185us/step - loss: 0.0621
Epoch 92/600
Epoch 93/600
60/60 [============= ] - 0s 275us/step - loss: 0.0616
Epoch 94/600
Epoch 95/600
60/60 [============= ] - 0s 217us/step - loss: 0.0614
Epoch 96/600
```

Epoch	97/600				
	[========]	_	0s	300us/step - loss:	0.0620
	98/600				
	[=========]	-	0s	274us/step - loss:	0.0653
	99/600		۸e	244us/sten - loss.	0 0610
	100/600	_	US	244us/scep - 10ss.	0.0010
	[========]	_	0s	194us/step - loss:	0.0592
	101/600				
	[=========]	-	0s	285us/step - loss:	0.0612
	102/600 [======]	_	۸e	20411s/sten = loss.	0 0632
	103/600		0.D	204ub/bccp - 10bb.	0.0032
	[=======]	_	0s	195us/step - loss:	0.0609
	104/600				
	[======] 105/600	-	0s	173us/step - loss:	0.0604
	[=========]	_	Λς	19611s/sten - loss:	0.0595
	106/600		O D	13048,8009 1088	0.0333
	[======]	-	0s	185us/step - loss:	0.0623
	107/600		•	160 / 1	0.005
	[======] 108/600	-	0s	160us/step - loss:	0.0625
	[=========]	_	0s	167us/step - loss:	0.0587
Epoch	109/600				
	[======]	-	0s	211us/step - loss:	0.0592
	110/600		0~	21//	0 0500
	111/600	_	US	314us/step - 10ss:	0.0592
	[========]	_	0s	171us/step - loss:	0.0587
Epoch	112/600				
	[========]	-	0s	250us/step - loss:	0.0582
	113/600 [=========]		۸e	276us/sten - loss.	0 0582
	114/600		V.S	27003/Step - 1055.	0.0302
	[=======]	_	0s	452us/step - loss:	0.0583
_	115/600				
	[=======] 116/600	-	0s	300us/step - loss:	0.0604
	[=========]	_	0s	432us/step - loss:	0.0585
	117/600				
	[======]	-	0s	439us/step - loss:	0.0581
	118/600		0~	107/	0 0617
	[======] 119/600	_	US	19/us/step - loss:	0.0617
	[========]	_	0s	241us/step - loss:	0.0594
Epoch	120/600				
	[========]	-	0s	283us/step - loss:	0.0572
	121/600 [=======]		۸e	302ug/gten - logg.	0 0572
	122/600		V.S	302us/scep - 10ss.	0.0372
60/60	[======]	_	0s	247us/step - loss:	0.0572
	123/600		_	200 / : -	
	[======] 124/600	-	υs	3/2us/step - loss:	0.0574
	[=========]	_	0s	252us/step - loss:	0.0573
	125/600			. 1	

60/60	[======]	_	0s	335us/step - lo	oss:	0.0581
	126/600 [========]		0 ~	22224/4409		0 0572
	127/600	_	US	223us/step - 10)55:	0.0572
60/60	[======]	_	0s	212us/step - lo	oss:	0.0572
	128/600 [=========]		٥٥	207ug/g+on 1c	200	0 0565
	129/600	_	US	20/us/step = 10)55:	0.0565
60/60	[======]	_	0s	202us/step - lo	oss:	0.0571
	130/600		٥٥	220ug/g+on lo	200	0 0566
	131/600	_	05	229us/step - 10	155:	0.0500
	[=======]	-	0s	316us/step - lo	oss:	0.0577
	132/600	_	Λe	25611g/g+an _ lo	nee•	0 0619
Epoch	133/600			_		
	[======]	-	0s	535us/step - lo	oss:	0.0569
	134/600 [=========]	_	0s	269us/step = 1c	oss:	0.0567
Epoch	135/600					
	[======] 136/600	-	0s	387us/step - lo	oss:	0.0573
	[=========]	_	0s	314us/step - lo	oss:	0.0573
Epoch	137/600			_		
	[======] 138/600	-	0s	230us/step - lo	oss:	0.0574
	[======]	_	0s	200us/step - lo	oss:	0.0571
	139/600		0 -	200/		0 0500
	[======] 140/600	_	US	288us/step - 10)ss:	0.0599
60/60	[======]	-	0s	296us/step - lo	oss:	0.0568
	141/600 [========]	_	Λe	34211g/g+en _ lo	nee•	0 0560
Epoch	142/600					
	[=======]	-	0s	182us/step - lo	oss:	0.0560
	143/600	_	0s	219us/step - lo	oss:	0.0564
Epoch	144/600			_		
	[======] 145/600	-	0s	260us/step - lo	oss:	0.0588
	[========]	_	0s	344us/step - lo	oss:	0.0567
	146/600		٥٩	201,12 / at on 1 a		0 0556
	147/600	_	05	zyrus/step - ic	155:	0.0556
	[======]	-	0s	257us/step - lo	oss:	0.0556
	148/600	_	0s	198us/step = lo	oss:	0.0555
Epoch	149/600					
	[========]	-	0s	187us/step - lo	oss:	0.0573
	150/600 [=========]	_	0s	190us/step - lo	oss:	0.0578
Epoch	151/600					
	[=======] 152/600	-	0s	1/lus/step - lo	oss:	0.0571
60/60	[======]	_	0s	176us/step - lo	oss:	0.0572
	153/600		0~	2/2115/5+0-	200	0 0555
00/60	[=====]	-	υS	∠4∠us/step – 10	JSS :	0.0555

Epoch	154/600			
	[========]	_	0s	137us/step - loss: 0.0551
Epoch	155/600			
	[=======]	-	0s	152us/step - loss: 0.0554
	156/600		^	160 / 1 0 0500
	[======] 157/600	-	0s	168us/step - 10ss: 0.0588
	[=========]	_	0s	171us/step = loss: 0.0588
	158/600		٥٥	1,145,556p 1055 00000
	[======]	_	0s	182us/step - loss: 0.0552
	159/600			
	[======] 160/600	-	0s	212us/step - loss: 0.0578
	[==========]	_	0 s	204us/step = loss: 0.0574
	161/600		V D	20145, 5005
60/60	[======]	_	0s	191us/step - loss: 0.0567
	162/600			
	[======] 163/600	-	0s	229us/step - loss: 0.0550
	[==========]	_	0s	255us/step = loss: 0.0561
Epoch	164/600			_
	[======]	-	0s	226us/step - loss: 0.0590
	165/600		^	244 /
	[======] 166/600	-	US	344us/step - loss: 0.0550
	[=======]	_	0s	298us/step - loss: 0.0561
Epoch	167/600			
	[======]	-	0s	321us/step - loss: 0.0559
	168/600 [=======]		Λc	323ug/gton logg: 0 0570
	169/600	_	US	323us/scep - 10ss. 0.03/0
	[========]	_	0s	218us/step - loss: 0.0543
	170/600			
	[======] 171/600	-	0s	182us/step - loss: 0.0544
	[=========]	_	0s	211us/step - loss: 0.0545
	172/600			
	[=======]	-	0s	187us/step - loss: 0.0575
	173/600		0 ~	2200-/
	[======] 174/600	_	US	320us/step - 10ss: 0.0595
	[=======]	_	0s	242us/step - loss: 0.0547
Epoch	175/600			
	[========]	-	0s	210us/step - loss: 0.0549
	176/600 [======]		Λc	200us/stan loss: 0.0546
	177/600		V.S	200ds/scep - 10ss. 0:0540
	[=======]	_	0s	181us/step - loss: 0.0549
	178/600			
	[======] 179/600	-	0s	154us/step - loss: 0.0558
	[=========]	_	0s	156us/step - loss: 0.0542
Epoch	180/600			
	[=====]	-	0s	136us/step - loss: 0.0552
	181/600 [======]		0	165ug/gton 1055 0 0543
	[=====================================	_	υS	103us/step - 10ss: 0.0543
	- · 			

	[=====]	_	0s	170us/step	- loss:	0.0537
	183/600 [=======]		0 a	154	1000	0 0527
	[========] 184/600	_	US	154us/step	- loss:	0.0537
60/60	[======]	_	0s	187us/step	- loss:	0.0549
	185/600		0	172 / 1	-	0 0541
	[======] 186/600	-	0s	1/3us/step	- loss:	0.0541
60/60	[======]	_	0s	195us/step	- loss:	0.0554
	187/600		0 -	217/	1	0 0544
	[======] 188/600	_	US	21/us/step -	- loss:	0.0544
60/60	[======]	_	0s	173us/step	- loss:	0.0601
	189/600 [=======]		0 ~	160:19/9+05	1000	0 0540
	190/600	_	US	100us/step	- 10SS:	0.0548
60/60	[======]	_	0s	180us/step	- loss:	0.0558
	191/600 [=======]		۸c	100115/5+05	logge	0 0555
	192/600	_	05	199us/step	- 1055:	0.0555
	[=======]	-	0s	219us/step	- loss:	0.0567
	193/600 [=======]	_	Λe	20511g/gten	_ loss•	0 0558
Epoch	194/600					
	[======]	-	0s	304us/step	- loss:	0.0533
	195/600 [=======]	_	Λς	170us/sten .	_ 1099•	0 0541
Epoch	196/600					
	[=======]	-	0s	235us/step	- loss:	0.0534
	197/600 [=======]	_	0s	302us/step	- loss:	0.0531
Epoch	198/600					
	[=======] 199/600	-	0s	191us/step	- loss:	0.0527
	[=========]	_	0s	206us/step	- loss:	0.0553
Epoch	200/600					
	[======] 201/600	-	0s	234us/step	- loss:	0.0537
	[=======]	_	0s	188us/step	- loss:	0.0528
	202/600		0	100 / 1	-	0.0500
	[======] 203/600	_	US	189us/step	- loss:	0.0533
60/60	[======]	-	0s	202us/step	- loss:	0.0533
	204/600 [=========]		۸c	212115/5+05	logge	0 0535
	205/600	_	US	zizus/step -	- 1055:	0.0333
	[=======]	-	0s	202us/step	- loss:	0.0535
	206/600 [==========]	_	Λe	27111g/gten	_ loss•	0 0538
	207/600		05	Z/Ius/scep	- 1055.	0.0550
	[======]	-	0s	151us/step	- loss:	0.0580
	208/600 [==========]	_	0 <	290115/sten	- 1055.	0.0558
Epoch	209/600					
	[=======]	-	0s	271us/step	- loss:	0.0532
	210/600 [=======]	_	0s	152us/step	- loss:	0.0579
- 0, 00				,p		

Enoch	211/600				
	[=======]	_	0s	148us/step - loss: 0.053	7
	212/600		٥٥		•
60/60	[======]	_	0s	157us/step - loss: 0.052	2
	213/600				
	[=====]	-	0s	141us/step - loss: 0.052	1
	214/600		0 -	102/	^
	[======] 215/600	_	US	193us/step - 10ss: 0.053	U
	[========]	_	0s	242us/step = loss: 0.052	1
	216/600				_
	[======]	-	0s	172us/step - loss: 0.051	8
	217/600				
	[=========]	-	0s	155us/step - loss: 0.052	4
	218/600 [=======]		Λc	169us/step loss 0 05/	6
	219/600		V.S	10745/5CEP - 1055. 0.034	U
	[=======]	_	0s	176us/step - loss: 0.052	1
Epoch	220/600				
	[=====]	-	0s	237us/step - loss: 0.051	7
	221/600 [======]		0~	155	1
	222/600	_	US	155us/step - 10ss: 0.053	1
	[=======]	_	0s	200us/step - loss: 0.051	6
Epoch	223/600				
	[======]	-	0s	166us/step - loss: 0.051	6
	224/600		^	001 / 1 0 050	_
	[======] 225/600	-	0s	231us/step - 10ss: 0.052	2
	[=======]	_	0s	359us/step - loss: 0.052	6
	226/600		-		
	[======]	-	0s	274us/step - loss: 0.052	5
	227/600		•	100 / 1 0 051	_
	[======] 228/600	-	0s	199us/step - loss: 0.051	5
	[========]	_	0s	225us/step = loss: 0.054	0
	229/600		٥٥		
	[======]	-	0s	193us/step - loss: 0.054	1
	230/600				_
	[=======] 231/600	-	0s	207us/step - loss: 0.052	1
	[=========]	_	0s	192us/step = loss: 0.052	0
	232/600		٥٥	19248, 8009 10081 01002	
60/60	[======]	-	0s	207us/step - loss: 0.052	2
	233/600				
	[=========]	-	0s	217us/step - loss: 0.052	0
	234/600 [=======]	_	۸e	188us/sten - loss. 0 050	9
	235/600		0.5	10003/3009 - 1033: 0:030	
	[========]	_	0s	232us/step - loss: 0.050	9
	236/600				
	[=======]	-	0s	173us/step - loss: 0.050	9
	237/600 [======]		Λe	218ug/gten - logg. 0 051	6
	238/600	_	υÞ	21003/306p - 1055: 0.031	J
	[=======]	_	0s	227us/step - loss: 0.051	3
	239/600				

60/60	[======]	_	0s	223us/step - loss	0.0511
	240/600				
	[======] 241/600	-	0s	314us/step - loss	: 0.0517
	[=========]	_	0s	252us/step - loss	0.0507
Epoch	242/600			_	
	[======]	-	0s	179us/step - loss	0.0516
	243/600 [=======]		٥٥	16/ug/gton logg	0 0502
	244/600	_	US	104us/scep - 10ss	. 0.0302
60/60	[======]	_	0s	141us/step - loss	0.0501
	245/600				
	[======] 246/600	-	0s	192us/step - loss	: 0.0519
	[=======]	_	0s	180us/step - loss	0.0558
Epoch	247/600				
	[=======]	-	0s	178us/step - loss	0.0532
	248/600 [=======]	_	۸e	19811s/sten - loss	0 0522
	249/600		05	170us/scep - 10ss	0.0322
	[======]	-	0s	191us/step - loss	0.0544
	250/600		0	225/	0 0515
	[======] 251/600	-	0s	225us/step - loss	0.0515
	[========]	_	0s	418us/step - loss	0.0501
Epoch	252/600				
	[=======]	-	0s	309us/step - loss	: 0.0516
	253/600 [=======]	_	0s	518us/step = loss	0.0508
Epoch	254/600				
	[======]	-	0s	272us/step - loss	0.0505
	255/600 [=======]		٥٥	100ug/gtop logg	0 0512
	256/600	_	05	190us/step - 10ss	0.0312
	[=======]	_	0s	226us/step - loss	0.0522
	257/600				
	[======] 258/600	-	0s	206us/step - loss	0.0532
	[=======]	_	0s	184us/step - loss	0.0531
Epoch	259/600				
	[========]	-	0s	166us/step - loss	0.0523
	260/600 [=======]	_	0s	182us/step = loss	0.0520
	261/600			10145, 200F 1055	
	[=====]	-	0s	162us/step - loss	0.0518
	262/600 [======]		٥٥	146ug/gtop logg	0 0500
	263/600	_	05	140us/step - 10ss	0.0300
	[=======]	_	0s	160us/step - loss	0.0522
	264/600		•	154 / 1	0.0105
	[======] 265/600	-	0s	1/4us/step - loss	: 0.0493
	[=========]	_	0s	214us/step - loss	0.0505
Epoch	266/600				
	[=========]	-	0s	187us/step - loss	0.0497
	267/600 [=======]	_	0 =	163us/sten = loss	0.0511
00/00		_	V D	10300/ aceb - 1088	. 0.0311

Epoch	268/600				
60/60	[======]	_	0s	196us/step - loss:	0.0582
	269/600				
	[=======]	-	0s	185us/step - loss:	0.0530
	270/600		0~	16000 / 0 + 0 0 1 0 0 0 0	0 0531
	[======] 271/600	_	US	168us/step - loss:	0.0531
	[=========]	_	0s	184us/step - loss:	0.0529
	272/600		Ů.	10100,000	0.0323
	[=======]	_	0s	223us/step - loss:	0.0549
	273/600				
	[=======]	-	0s	178us/step - loss:	0.0499
	274/600 [======]		0 a	21799/9409 1099	0 0400
	275/600	_	US	zi/us/step - loss:	0.0498
	[=======]	_	0s	270us/step - loss:	0.0563
	276/600		٥٥	_, vas, seepess.	
	[=======]	_	0s	322us/step - loss:	0.0532
	277/600				
	[======]	-	0s	287us/step - loss:	0.0498
	278/600		0~	270/a+an lagge	0 0510
	[======] 279/600	_	US	2/8us/step - loss:	0.0512
	[=========]	_	0s	277us/step = loss:	0.0487
	280/600		Ů.D	2774575000	0.0107
	[========]	_	0s	277us/step - loss:	0.0487
	281/600				
	[=======]	_	0s	264us/step - loss:	0.0500
	282/600		•	100 / 1	0 0516
	[======] 283/600	-	0s	199us/step - loss:	0.0516
	[=========]	_	۸e	166us/sten - loss.	0 0491
	284/600		0.5	100db/bccp - 10bb.	0.0471
	[========]	_	0s	220us/step - loss:	0.0490
_	285/600				
	[==========]	-	0s	156us/step - loss:	0.0488
_	286/600		0 -	105/	0 0402
	[======] 287/600	_	US	195us/step - loss:	0.0483
	[========]	_	0s	188us/step - loss:	0.0516
	288/600		٥٥	100 db, 200p 100b;	00000
	[=======]	_	0s	211us/step - loss:	0.0511
	289/600				
	[=======]	-	0s	188us/step - loss:	0.0494
	290/600		0~	205/5+0	0 0404
	[======] 291/600	_	US	zubus/step - loss:	0.0494
	[=======]	_	0s	179us/step - loss:	0.0496
	292/600		-		
60/60	[======]	_	0s	333us/step - loss:	0.0487
	293/600				
	[======================================	-	0s	192us/step - loss:	0.0552
	294/600 [=======]		Λe	161ug/gten logg.	0 05/5
	295/600	_	υÞ	10102/20ch - 1022:	0.0043
	[=======]	_	0s	172us/step - loss:	0.0527
	296/600			-	

60/60	[======]	_	0s	158us/step -	- loss	s: 0.0498	3
	297/600		0 ~	106	1	0 0520	_
	[======] 298/600	_	US	196us/step -	- loss	S: 0.0526)
60/60	[======]	_	0s	199us/step -	- loss	s: 0.0524	ļ
	299/600		0	160 / 1	,	0 0400	
	[======] 300/600	-	0s	160us/step -	- loss	S: 0.049 ₂	4
	[=======]	_	0s	153us/step -	- loss	s: 0.0482	2
	301/600		•	106 / 1	,	0 0400	
	[======] 302/600	-	0s	136us/step -	- loss	S: 0.0483	3
60/60	[======]	_	0s	190us/step -	- loss	s: 0.0482	2
	303/600		0	150 / 1	,	0.0500	•
	[======] 304/600	-	0s	159us/step -	- loss	S: 0.0500)
	[=======]	_	0s	178us/step -	- loss	s: 0.0503	3
	305/600		•	225	,	0 0455	_
	[======] 306/600	-	0s	226us/step -	- loss	S: 0.0475)
	[=======]	_	0s	352us/step -	- loss	s: 0.0528	3
	307/600		•		,	0 0510	
	[======] 308/600	-	0s	228us/step -	- loss	s: 0.0519)
	[=======]	_	0s	187us/step -	- loss	s: 0.0490)
	309/600		•	156 / .	,	0 0405	_
	[======] 310/600	-	0s	176us/step -	- loss	s: 0.0485)
	[=======]	_	0s	210us/step -	- loss	s: 0.0487	7
	311/600		•	100 / 1	,	0 0 4 0 4	
	[======] 312/600	-	0s	198us/step -	- loss	S: 0.0494	Ŧ
60/60	[======]	_	0s	177us/step -	- loss	s: 0.0479)
	313/600		0 -	220/	1	- 0 0475	_
	[======] 314/600	_	US	220us/step -	- loss	S: 0.04/5)
60/60	[======]	_	0s	357us/step -	- loss	s: 0.0501	L
	315/600 [=======]		0 ~	101,12 / 24 05	1000	. 0 0526	_
	316/600	_	US	191us/step -	- 1088	3: U.U320)
60/60	[======]	-	0s	170us/step -	- loss	s: 0.0481	L
	317/600 [======]		٥٥	19/119/9+05	1000	. 0 0/01	1
	318/600	_	US	104us/scep -	- 1058	5. 0.0491	L
	[======]	-	0s	190us/step -	- loss	s: 0.0500)
	319/600 [=========]		٥٥	205ug/gtop	1000	. 0 0550	2
	320/600	_	US	203us/scep -	- 1058	5. 0.0555	,
	[=======]	-	0s	192us/step -	- loss	s: 0.0605	5
	321/600 [=======]		Λσ	17/11g/g+en	1000	. 0 0517	7
	322/600	_	UB	Tirnstaceh -	_ TOP;	. U.UJI/	
60/60	[======]	_	0s	221us/step -	- loss	s: 0.0478	3
	323/600 [==========]	_	Λc	21611g/g+an	_ 1000	s: 0 0507	7
	324/600	_	va	zious/scep -	TOSS	. 0.0307	
60/60	[=====]	-	0s	186us/step -	- loss	s: 0.0643	3

Epoch	325/600				
	[========]	_	0s	174us/step - loss: 0.04	174
Epoch	326/600				
	[======]	_	0s	182us/step - loss: 0.05	542
	327/600				
	[========]	-	0s	310us/step - loss: 0.04	193
	328/600 [======]		٥٥	199ug/gton logg. 0 0/	170
	329/600	_	US	100us/scep - 10ss: 0.04	1 / 9
	[=======]	_	0s	171us/step - loss: 0.04	168
Epoch	330/600			_	
	[======]	_	0s	151us/step - loss: 0.04	175
	331/600				
	[=========]	-	0s	245us/step - loss: 0.05	02
	332/600 [======]	_	۸e	215us/sten _ loss. 0 05	570
	333/600		V S	213ds/scep - 10ss. 0.05	,,,
	[=======]	_	0s	170us/step - loss: 0.04	184
Epoch	334/600			_	
	[======]	_	0s	180us/step - loss: 0.04	179
	335/600		•	105 / 1 2 2 2 2	
	[======] 336/600	_	0s	195us/step - loss: 0.04	189
	[=========]	_	۸q	201us/step = loss. 0 04	161
	337/600		0.D	20103/3000 - 1033. 0.04	.01
	[=========]	_	0s	179us/step - loss: 0.04	169
	338/600				
	[=====]	-	0s	164us/step - loss: 0.04	181
	339/600 [======]		٥-	257/	
	340/600	-	US	25/us/step - loss: 0.04	19/
	[========]	_	0s	300us/step - loss: 0.05	551
	341/600				_
	[======]	_	0s	297us/step - loss: 0.04	169
	342/600				
	[======================================	-	0s	222us/step - loss: 0.04	169
	343/600 [======]	_	۸e	210us/step _ loss. 0 0/	1 2 4
	344/600		V S	210ds/scep - 10ss. 0.0-	101
	[=========]	_	0s	226us/step - loss: 0.04	163
Epoch	345/600				
	[=====]	-	0s	232us/step - loss: 0.04	187
	346/600		٥-	206/	1 6 1
	[======] 347/600	_	US	206us/step - loss: 0.04	10 T
	[========]	_	0s	236us/step - loss: 0.04	160
	348/600				
60/60	[======]	_	0s	257us/step - loss: 0.04	180
	349/600				
	[======================================	-	0s	299us/step - loss: 0.05	05
	350/600 [======]		٥٥	250ug/gton logg. 0 05	
	351/600	_	US	20008/scep - 1088: 0.05	,00
	[=======]	_	0s	237us/step - loss: 0.06	517
Epoch	352/600				
	[=======]	-	0s	171us/step - loss: 0.04	174
Epoch	353/600				

60/60	[=====]	_	0s	258us/step - loss:	0.0457
	354/600				
	[=======]	-	0s	133us/step - loss:	0.0453
	355/600 [=======]	_	۸e	144us/sten - loss.	0 0454
	356/600		US	14405/50ep - 1055.	0.0434
	[=======]	_	0s	201us/step - loss:	0.0451
	357/600				
	[=======]	-	0s	207us/step - loss:	0.0484
	358/600 [=======]	_	۸e	188ug/sten _ loss.	0 0474
	359/600	_	US	100us/scep - 10ss.	0.04/4
	[========]	_	0s	163us/step - loss:	0.0468
	360/600				
	[=======]	-	0s	169us/step - loss:	0.0488
	361/600 [=======]	_	۸e	185us/sten = loss.	0 0472
	362/600		US	103da/acep - 10aa.	0.04/2
	[======]	_	0s	156us/step - loss:	0.0457
	363/600				
	[======] 364/600	-	0s	165us/step - loss:	0.0491
	[==========]	_	0s	205us/step = loss:	0.0523
	365/600		O D	20345/5005 1055.	0.0323
	[======]	_	0s	175us/step - loss:	0.0503
	366/600				
	[======] 367/600	-	0s	262us/step - loss:	0.0487
	[=========]	_	0s	191us/step - loss:	0.0452
Epoch	368/600				
	[=====]	-	0s	224us/step - loss:	0.0450
	369/600 [=======]		٥٥	22224/4+09 1044	0 0440
	370/600	_	US	223us/step - 10ss:	0.0448
	[=========]	_	0s	216us/step - loss:	0.0471
	371/600				
	[=======]	-	0s	202us/step - loss:	0.0470
	372/600 [=======]	_	0 s	172us/sten - loss:	0.0486
	373/600		O D	1724575000	0.0100
	[======]	_	0s	153us/step - loss:	0.0542
	374/600				
	[======] 375/600	-	0s	1/0us/step - loss:	0.0485
	[=========]	_	0s	187us/step - loss:	0.0460
	376/600		-		
	[======]	-	0s	197us/step - loss:	0.0457
	377/600		0 ~	211/	0 0446
	[======] 378/600	_	US	ziius/step - ioss:	0.0446
	[=======]	_	0s	188us/step - loss:	0.0462
Epoch	379/600				
	[=======]	-	0s	175us/step - loss:	0.0481
	380/600 [=======]		٥٥	178ug/g+on logg.	0 0445
	381/600	_	US	1/0us/scep - 1088:	0.0443
	[=======]	_	0s	179us/step - loss:	0.0448
	•			_	

Enoch	382/600						
	[=======]	_	0s	155us/step	_	loss:	0.0456
	383/600						
	[======]	-	0s	148us/step	-	loss:	0.0446
	384/600					_	
	[=========]	-	0s	190us/step	-	loss:	0.0491
	385/600 [=======]		Λc	179ug/g+op		1000	0 0478
	386/600	_	US	1/9us/scep	_	TOSS:	0.0476
	[=======]	_	0s	171us/step	_	loss:	0.0491
Epoch	387/600			_			
	[======]	-	0s	184us/step	-	loss:	0.0540
	388/600		•	161 / 1			0 0 1 0 1
	[======] 389/600	-	0s	16lus/step	-	loss:	0.0481
	[==========]	_	۸e	171112/sten	_	1000	0 0482
	390/600		V.S	1/1ds/scep		1055.	0.0402
	[=======]	_	0s	185us/step	_	loss:	0.0441
	391/600						
	[======]	-	0s	152us/step	-	loss:	0.0446
	392/600		•	164 / 1			
	[======] 393/600	-	0s	164us/step	-	loss:	0.0448
	[==========]	_	۸e	176119/sten	_	1000.	0 0441
	394/600		0.5	1700575005		1055.	0.0111
	[========]	_	0s	164us/step	_	loss:	0.0442
Epoch	395/600						
	[======]	-	0s	151us/step	-	loss:	0.0452
	396/600		^	160 / 1		,	0 0441
	[======] 397/600	-	0s	168us/step	-	loss:	0.0441
	[==========]	_	0 s	160us/sten	_	1055:	0.0481
	398/600		V D	тооць, всер		TODD.	0.0101
	[======]	_	0s	164us/step	_	loss:	0.0530
	399/600						
	[======]	-	0s	145us/step	-	loss:	0.0436
	400/600		٥٥	152ug/g+on		1000.	0 0425
	401/600	_	US	132us/scep	_	1055:	0.0433
	[=======]	_	0s	168us/step	_	loss:	0.0447
Epoch	402/600						
	[======]	-	0s	191us/step	-	loss:	0.0457
	403/600		_				
	[========]	-	0s	166us/step	-	loss:	0.0465
	404/600 [=======]	_	۸e	178112/sten	_	1000	0 0594
	405/600		V.S	170ds/scep		1055.	0.0374
	[=======]	_	0s	203us/step	_	loss:	0.0472
Epoch	406/600						
	[=====]	-	0s	147us/step	-	loss:	0.0631
	407/600		•	150 / 1			0 0 1 0 1
	[========]	-	0s	1/3us/step	-	loss:	0.0481
	408/600 [=======]	_	0,5	217us/sten	_	loss:	0.0515
	409/600		<i>.</i>	, дв, всер		1000.	0.0010
60/60	[======]	_	0s	158us/step	_	loss:	0.0504
Epoch	410/600						

	[=====]	_	0s	260us/step - loss: 0.0	525
	411/600 [=======]	_	0s	226us/step - loss: 0.0	535
Epoch	412/600				
	[======] 413/600	-	0s	186us/step - loss: 0.0	482
60/60	[======]	_	0s	171us/step - loss: 0.0	458
	414/600 [=======]	_	0s	166us/step - loss: 0.0	433
Epoch	415/600				
	[======] 416/600	-	0s	167us/step - loss: 0.0	452
60/60	[======]	_	0s	224us/step - loss: 0.0	469
	417/600 [======]	_	0s	169us/step - loss: 0.0	467
Epoch	418/600			_	
	[======] 419/600	-	0s	223us/step - loss: 0.0	470
60/60	[======]	_	0s	161us/step - loss: 0.0	504
	420/600 [=======]	_	0s	249us/step - loss: 0.0	597
Epoch	421/600				
	[======] 422/600	-	0s	216us/step - loss: 0.0	542
60/60	[======]	_	0s	183us/step - loss: 0.0	534
	423/600 [======]	_	0 s	164us/sten - loss: 0.0	542
Epoch	424/600			_	
	[======] 425/600	-	0s	163us/step - loss: 0.0	460
60/60	[======]	_	0s	196us/step - loss: 0.0	452
	426/600 [=======]	_	Λς	15911s/sten = loss. 0 0	500
Epoch	427/600			_	
	[======] 428/600	-	0s	178us/step - loss: 0.0	531
60/60	[======]	_	0s	188us/step - loss: 0.0	568
	429/600 [=======]	_	0s	175us/step - loss: 0.0	487
Epoch	430/600			_	
	[=======] 431/600	-	0s	201us/step - loss: 0.0	437
60/60	[======]	-	0s	172us/step - loss: 0.0	434
	432/600 [=======]	_	0s	182us/step - loss: 0.0	433
Epoch	433/600				
	[=======] 434/600	-	0s	168us/step - loss: 0.0	423
60/60	[======]	-	0s	137us/step - loss: 0.0	439
	435/600 [========]	_	0s	192us/step - loss: 0.0	481
Epoch	436/600				
	[======] 437/600	-	0s	165us/step - loss: 0.0	432
60/60	[======]	-	0s	170us/step - loss: 0.0	124
	438/600 [=======]	_	0s	181us/step - loss: 0.0	134
- 0, 00	. J				

```
Epoch 439/600
60/60 [============== ] - 0s 182us/step - loss: 0.0444
Epoch 440/600
Epoch 441/600
60/60 [============== ] - 0s 208us/step - loss: 0.0487
Epoch 442/600
60/60 [============= ] - 0s 156us/step - loss: 0.0457
Epoch 443/600
60/60 [============= ] - 0s 228us/step - loss: 0.0438
Epoch 444/600
60/60 [=========== ] - 0s 185us/step - loss: 0.0443
Epoch 445/600
60/60 [=============== ] - 0s 180us/step - loss: 0.0483
Epoch 446/600
60/60 [=============== ] - 0s 158us/step - loss: 0.0454
Epoch 447/600
60/60 [=========== ] - 0s 188us/step - loss: 0.0465
Epoch 448/600
60/60 [============== ] - 0s 159us/step - loss: 0.0493
Epoch 449/600
60/60 [================ ] - 0s 184us/step - loss: 0.0447
Epoch 450/600
60/60 [============== ] - 0s 270us/step - loss: 0.0432
Epoch 451/600
60/60 [============ ] - 0s 286us/step - loss: 0.0439
Epoch 452/600
60/60 [============== ] - 0s 379us/step - loss: 0.0430
Epoch 453/600
60/60 [============= ] - 0s 459us/step - loss: 0.0494
Restoring model weights from the end of the best epoch
Epoch 00453: early stopping
best epoch v4 = 433
smallest loss v4 = 0.04233019823829333
```

In [83]:

#Task2.4 Table

from tabulate import tabulate

table = [['Original Model', np.min(loss_hist), best_epoch, 'baseline'], ['Mod
print(tabulate(table,headers=['Model Name', 'minimum loss value', '# of epoch

Model Name	minimum loss value	# of epoch	compared to baseline
Original Model	0.0543997	598	baseline
Model v1	0.0559068	350	smaller
Model v2	0.0530908	476	smaller
Model v3	0.0558974	588	similar
Model v4	0.0423302	433	smaller