Московский авиационный институт (Национальный исследовательский университет) Институт №8 «Информационные технологии и прикладная математика»

Кафедра вычислительной математики и программирования

Лабораторная работа №3 по курсу «Нейроинформатика»

Многослойные сети. Алгоритм обратного распространения ошибки

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Группа: 8О-408Б

Вариант: 17

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Оценка:

Лабораторная №3

Многослойные сети. Алгоритм обратного распространения ошибки

Вариант № 17

Красоткин Семён (М80-408Б-19)

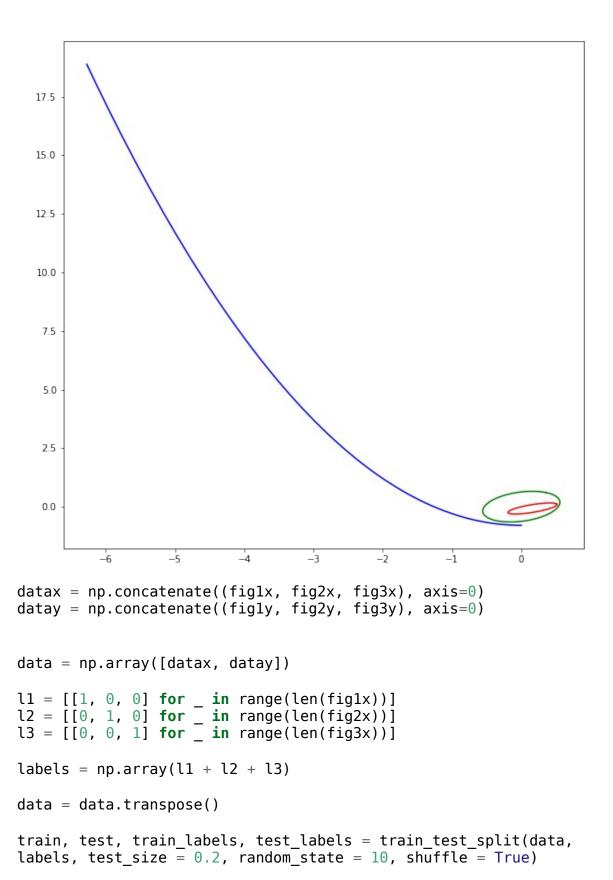
Цель работы

Исследование свойств многослойной нейронной сети прямого распространения и алгоритмов её обучения, применение сети в задачах классификации и аппроксимации функции.

Код

```
import keras
import tensorflow as tf
from keras.layers import *
import matplotlib.pyplot as plt
import numpy as np
import itertools
from sklearn.model selection import train test split
Классификация
# Уравнение эллипса в параметрическом виде.
def ellipse(t, a, b, x0, y0):
    x = x0 + a * np.cos(t)
    y = y0 + b * np.sin(t)
    return x, y
# Уравнение параболы в параметрическом виде.
def parabola(t, p, x0, y0):
 x = x0 + t ** 2 / (2. * p)
    y = y0 + t
    return x, y
# Функция вращения фигуры на заданный угол.
def rotate(x, y, alpha):
    xr = x * np.cos(alpha) - y * np.sin(alpha)
    yr = x * np.sin(alpha) + y * np.cos(alpha)
    return xr, yr
# Эллипс
a1 = 0.4
b1 = 0.15
alpha1 = np.pi / 6
x01 = 0.1
```

```
y01 = -0.15
# Эллипс
a2 = 0.7
b2 = 0.5
alpha2 = np.pi / 3
x02 = 0
y02 = 0
# Парабола
p = 1
alpha3 = np.pi / 2
x03 = -0.8
y03 = 0
t = np.arange(0, 2 * np.pi, 0.025)
fig1x, fig1y = ellipse(t, a1, b1, x01, y01)
fig1x, fig1y = rotate(fig1x, fig1y, alpha1)
fig2x, fig2y = ellipse(t, a2, b2, x02, y02)
fig2x, fig2y = rotate(fig2x, fig2y, alpha2)
fig3x, fig3y = parabola(t, p, x03, y03)
fig3x, fig3y = rotate(fig3x, fig3y, alpha3)
figure = plt.figure(figsize = (10, 10))
plt.plot(fig1x, fig1y, c = 'r')
plt.plot(fig2x, fig2y, c = 'g')
plt.plot(fig3x, fig3y, c = 'b')
plt.show()
```



```
model = keras.models.Sequential()
model.add(Dense(25, input dim = 2, activation = "tanh",
kernel initializer = keras.initializers.RandomNormal(stddev = 0.01),
bias initializer = keras.initializers.Zeros()))
model.add(Dense(57, activation = "tanh"))
model.add(Dense(3, activation = "sigmoid"))
model.compile(tf.keras.optimizers.SGD(0.05), 'mse')
hist = model.fit(train, train labels, batch size = 1, epochs = 200)
Epoch 1/200
Epoch 2/200
Epoch 3/200
604/604 [============= ] - 1s 1ms/step - loss: 0.1310
Epoch 4/200
604/604 [============] - 1s 1ms/step - loss: 0.1296
Epoch 5/200
Epoch 6/200
604/604 [============= ] - 1s 2ms/step - loss: 0.1284
Epoch 7/200
Epoch 8/200
Epoch 9/200
Epoch 10/200
Epoch 11/200
Epoch 12/200
604/604 [============= ] - 1s 2ms/step - loss: 0.1233
Epoch 13/200
Epoch 14/200
604/604 [============] - 1s 1ms/step - loss: 0.1208
Epoch 15/200
604/604 [============] - 1s 1ms/step - loss: 0.1200
Epoch 16/200
Epoch 17/200
604/604 [============] - 1s 1ms/step - loss: 0.1165
Epoch 18/200
604/604 [============= ] - 1s 1ms/step - loss: 0.1148
Epoch 19/200
```

Epoch 20,	/200						
	[=========]	_	1s	2ms/step	-	loss:	0.1107
Epoch 21,	/200			-			
604/604	[========]	-	1s	1ms/step	-	loss:	0.1080
Epoch 22,							
	[=======]	-	1s	1ms/step	-	loss:	0.1060
Epoch 23,						_	
	[=======]	-	1s	1ms/step	-	loss:	0.1030
Epoch 24,	/200		1 -	1		1	0 0001
	[=======]	-	ıs	ıms/step	-	LOSS:	0.0991
Epoch 25,	/ 200 [=========]		1.0	1mc/cton		10001	0 0053
Epoch 26,		_	13	III3/3 Cep	-	1055.	0.0955
	[=========]	_	1s	1ms/sten	_	1055:	0.0899
Epoch 27				1o, 5 cop			0.0000
	[=========]	_	1s	1ms/step	-	loss:	0.0845
Epoch 28,	/200			•			
604/604	[========]	-	1s	1ms/step	-	loss:	0.0791
Epoch 29,							
	[=======]	-	1s	1ms/step	-	loss:	0.0735
Epoch 30,			_	. , .		-	
	[=======]	-	ls	1ms/step	-	loss:	0.0690
Epoch 31,	/200 [=========]		1.	1mc/c+cn		1000.	0 0640
Epoch 32		-	15	ıııs/step	-	1055:	0.0049
	/ 200 [=========]		1 c	1mc/cten		1000	0 0614
Epoch 33,		_	13	Illis/ 3 cep	_		0.0014
	[=========]	_	1s	1ms/step	_	loss:	0.0579
Epoch 34,							
604/604	[=========]	-	1s	2ms/step	-	loss:	0.0556
Epoch 35,							
	[=======]	-	1s	2ms/step	-	loss:	0.0537
Epoch 36,			_	.		_	
	[=======]	-	ls	2ms/step	-	loss:	0.051/
Epoch 37,			1.	1mc/c+cn		1000.	0 0400
Epoch 38,	[=========]	-	12	ılıs/step	-	1055;	0.0499
	/ 200 [========]	_	1 c	2ms/sten	_	1055.	n n479
Epoch 39,			13	211137 3 CCP			0.0473
	[========]	_	1s	2ms/step	_	loss:	0.0457
Epoch 40				,			
	[========]	-	1s	2ms/step	-	loss:	0.0442
Epoch 41	/200			-			
604/604	[========]	-	1s	2ms/step	-	loss:	0.0430
Epoch 42,						_	
	[=======]	-	1s	2ms/step	-	loss:	0.0414
Epoch 43,			1 -	2ma / = ± = =		1	0 0200
	[=========]	-	TS	∠ms/step	-	LOSS:	U.U380
Epoch 44,	/200 [========]		1 c	2mc/c+on		1000	0 0364
004/004	[-	т2	ziiis/step	-	(055)	0.0304

Epoch 45	/200						
	[=========]	-	1s	2ms/step	-	loss:	0.0358
Epoch 46	/200						
604/604	[========]	-	1s	2ms/step	-	loss:	0.0353
Epoch 47							
	[=======]	-	1s	2ms/step	-	loss:	0.0344
Epoch 48,	/200						
	[========]	-	1s	2ms/step	-	loss:	0.0312
Epoch 49			_			_	
	[=======]	-	1s	2ms/step	-	loss:	0.0308
Epoch 50			-	2 / 1		,	0 0000
	[========]	-	IS	2ms/step	-	loss:	0.0289
Epoch 51,			1 -	2== /=+==		1	0 0200
	[========]	-	15	ziis/step	-	toss:	0.0280
Epoch 52,	/		1.0	2mc/cton		10001	0 0260
Epoch 53		-	15	ziiis/step	-	1055;	0.0200
	/ 200 [==========]		1 c	2mc/sten		1000	0 0255
Epoch 54	-	_	13	21113/3 CEP	_	1055.	0.0233
	, 200 [==========]	_	1 c	2ms/sten	_	1000	0 0250
Epoch 55	=		13	21113/3 CCP		(033.	0.0230
	[========]	_	1s	2ms/sten	_	loss:	0.0239
Epoch 56				2.113, 3 ccp			010233
	[=========]	_	1s	2ms/step	_	loss:	0.0223
Epoch 57				,			
	[=======]	_	1s	2ms/step	-	loss:	0.0215
Epoch 58,							
604/604	[========]	-	1s	1ms/step	-	loss:	0.0208
Epoch 59							
	[=======]	-	1s	1ms/step	-	loss:	0.0201
Epoch 60			_	.		_	
	[=======]	-	Is	Ims/step	-	loss:	0.0188
Epoch 61,			1 -	1/		1	0 0107
Epoch 62	(200	-	15	Illis/s cep	-	1055:	0.010/
	/ 200 [========]		1 c	1mc/cten		1000	0 0180
Epoch 63,		_	13	III3/3 CEP	-	1055.	0.0100
	[========]	_	1s	1ms/sten	_	1055.	0 0175
Epoch 64				111137 3 CCP			010175
	[==========]	_	1s	2ms/step	_	loss:	0.0163
Epoch 65							
	[========]	_	1s	2ms/step	-	loss:	0.0158
Epoch 66							
604/604	[========]	-	1s	1ms/step	-	loss:	0.0151
Epoch 67	/200			•			
604/604	[========]	-	1s	1ms/step	-	loss:	0.0144
Epoch 68,							
	[=======]	-	1s	1ms/step	-	loss:	0.0143
Epoch 69,			_			_	
604/604	[======]	-	ls	∠ms/step	-	loss:	0.0139

Epoch 70,	/200						
	[========]	_	1s	2ms/sten	_	1055:	0.0134
Epoch 71				2m3, 3 ccp			010151
	[========]	_	1s	2ms/step	_	loss:	0.0130
Epoch 72				,			
	[========]	_	1s	2ms/step	_	loss:	0.0134
Epoch 73				-,			
	[========]	-	1s	2ms/step	-	loss:	0.0126
Epoch 74,	/200						
604/604	[========]	-	1s	2ms/step	-	loss:	0.0126
Epoch 75,							
	[=========]	-	1s	2ms/step	-	loss:	0.0119
Epoch 76,	/200						
	[========]	-	1s	2ms/step	-	loss:	0.0116
Epoch 77,			_			_	
	[========]	-	1s	2ms/step	-	loss:	0.0110
Epoch 78,			_	.		-	0 0100
	[=======]	-	ls	2ms/step	-	loss:	0.0108
Epoch 79,			1 -	2/		1	0 0100
	[========]	-	IS	2ms/step	-	loss:	0.0103
Epoch 80,	/ 200 [=========]		1.	2ms/s+sn		1	0 0102
Epoch 81,		-	15	ziiis/s cep	-	LOSS:	0.0103
	[==========]		1 c	2mc/cten		1000	0 0106
Epoch 82,		-	13	Ziiis/step	-	1055.	0.0100
	[==========]	_	1 c	2mc/sten	_	1000	0 0102
Epoch 83,			13	2m3/3ccp			0.0102
	[========]	_	1s	2ms/step	_	loss:	0.0099
Epoch 84,				0, 0 10 0			
	[========]	-	1s	2ms/step	_	loss:	0.0097
Epoch 85,	/200			-			
604/604	[========]	-	1s	2ms/step	-	loss:	0.0097
Epoch 86,							
	[=========]	-	1s	2ms/step	-	loss:	0.0094
Epoch 87,							
	[========]	-	1s	2ms/step	-	loss:	0.0093
Epoch 88,			_	.		_	
	[========]	-	ls	2ms/step	-	loss:	0.0086
Epoch 89,			1 -	2/		1	0 0000
	[======================================	-	15	2ms/step	-	LOSS:	0.0089
Epoch 90,	/ 200 [=========]		1.	2mc/cton		10001	0 0000
Epoch 91,		-	15	ziiis/step	-	1055;	0.0000
	[=====================================	_	1 c	2mc/ctan	_	1000	0 0078
Epoch 92,		-	13	21113/3 CEβ	-	.033.	0.0070
	[=========]	_	1s	1ms/sten	_	loss:	0.0080
Epoch 93				z, z ccp			2.000
	[========]	-	1s	2ms/step	-	loss:	0.0080
Epoch 94,			-				
	[========]	-	1s	2ms/step	-	loss:	0.0078
				•			

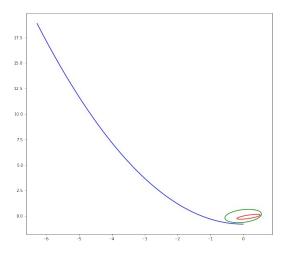
Epoch 95/200						
604/604 [====================================	-	1s	2ms/step	-	loss:	0.0084
Epoch 96/200			·			
604/604 [========]	-	1s	1ms/step	-	loss:	0.0076
Epoch 97/200 604/604 [====================================		1.0	2mc/cton		10001	0 0075
Epoch 98/200	-	15	ziiis/step	-	1055:	0.0075
604/604 [====================================	_	1s	2ms/step	_	loss:	0.0052
Epoch 99/200			-			
604/604 [=========]	-	1s	2ms/step	-	loss:	0.0081
Epoch 100/200		٦.	2		1	0 0000
604/604 [===========] Epoch 101/200	-	15	2ms/step	-	LOSS:	0.0069
604/604 [====================================	_	1s	2ms/sten	_	1055:	0.0075
Epoch 102/200			2m3, 3 ccp			0.0075
604/604 [====================================	-	1s	1ms/step	-	loss:	0.0071
Epoch 103/200					_	
604/604 [=========]	-	1s	1ms/step	-	loss:	0.0071
Epoch 104/200 604/604 [====================================		1.	1mc/cton		10001	0 0060
Epoch 105/200	-	12	IIIS/Step	-	1055;	0.0009
604/604 [====================================	_	1s	1ms/step	_	loss:	0.0067
Epoch 106/200			-			
604/604 [=======]	-	1s	2ms/step	-	loss:	0.0063
Epoch 107/200		_	.		_	
604/604 [==========]	-	ls	Ims/step	-	loss:	0.0065
Epoch 108/200 604/604 [====================================	_	1 c	1mc/sten	_	1000	0 0063
Epoch 109/200		13	III3/3 CCP			0.0003
604/604 [====================================	-	1s	2ms/step	-	loss:	0.0068
Epoch 110/200						
604/604 [=========]	-	1s	2ms/step	-	loss:	0.0069
Epoch 111/200 604/604 [====================================		1.0	2mc/cton		10001	0 0056
Epoch 112/200	-	15	ziiis/s tep	-	1055:	0.0000
604/604 [====================================	_	1s	2ms/step	_	loss:	0.0060
Epoch 113/200			-			
604/604 [=======]	-	1s	2ms/step	-	loss:	0.0055
Epoch 114/200		_	.		-	
604/604 [==========]	-	1s	1ms/step	-	loss:	0.0060
Epoch 115/200 604/604 [====================================		1 c	1mc/cten		1000	0 0050
Epoch 116/200	-	13	III3/3reh	-	1055.	0.0059
604/604 [====================================	_	1s	2ms/step	-	loss:	0.0058
Epoch 117/200			-			
604/604 [=========]	-	1s	1ms/step	-	loss:	0.0059
Epoch 118/200		1 -	1ma/===		1	0 0001
604/604 [====================================	-	IS	ıms/step	-	LOSS:	0.0061
Epoch 119/200 604/604 [====================================	_	1 c	1mc/cton	_	1066.	0 0048
007,007 []	_	тэ	71112/2rch	_	(033)	0.0040

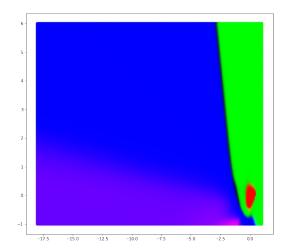
Frank 120 (200						
Epoch 120/200 604/604 [===========]		1.0	1mc/cton		10001	0 0050
Epoch 121/200	-	15	IIIS/Step	-	10551	0.0036
604/604 [====================================		1 c	1mc/ctan		1000	0 0054
Epoch 122/200		13	III3/3 Cep			0.0054
604/604 [====================================	_	1s	2ms/sten	_	1055.	0 0057
Epoch 123/200		13	211137 3 CCP			0.0057
604/604 [=========]	_	1s	2ms/sten	_	loss:	0.0040
Epoch 124/200			23, 3 ccp			010010
604/604 [====================================	_	1s	1ms/step	_	loss:	0.0049
Epoch 125/200						
604/604 [====================================	_	1s	1ms/step	_	loss:	0.0047
Epoch 126/200			-,,-			
604/604 [==========]	-	1s	1ms/step	-	loss:	0.0047
Epoch 127/200			, ,			
604/604 [====================================	-	1s	1ms/step	-	loss:	0.0052
Epoch 128/200			-			
604/604 [====================================	-	1s	1ms/step	-	loss:	0.0052
Epoch 129/200			-			
604/604 [==========]	-	1s	1ms/step	-	loss:	0.0054
Epoch 130/200						
604/604 [=========]	-	1s	1ms/step	-	loss:	0.0050
Epoch 131/200						
604/604 [========]	-	1s	1ms/step	-	loss:	0.0049
Epoch 132/200						
604/604 [=======]	-	1s	1ms/step	-	loss:	0.0040
Epoch 133/200					_	
604/604 [========]	-	1s	1ms/step	-	loss:	0.0055
Epoch 134/200		_			_	
604/604 [=========]	-	1s	1ms/step	-	loss:	0.0053
Epoch 135/200					-	0 00 10
604/604 [=========]	-	IS	lms/step	-	loss:	0.0043
Epoch 136/200			2 ()		,	0 0051
604/604 [=========]	-	IS	2ms/step	-	loss:	0.0051
Epoch 137/200		1.	1		1	0 0000
604/604 [====================================	-	IS	Ims/step	-	loss:	0.0039
Epoch 138/200		1 -	1 / a + a		1	0 0040
604/604 [==========]	-	15	Ims/step	-	toss:	0.0040
Epoch 139/200		1.	1mc/cton		1000.	0 0020
604/604 [===========]	-	15	Illis/step	-	1055:	0.0038
Epoch 140/200		1.	1mc/c+cn		1000.	0 0042
604/604 [====================================	-	15	Illis/step	-	1055:	0.0042
Epoch 141/200 604/604 [====================================		1.	1mc/cton		10001	0 0046
	-	15	IIIS/Step	-	10551	0.0040
Epoch 142/200 604/604 [====================================		1.	2mc/c+on		1000	0 0033
Epoch 143/200	-	12	ziiis/step	-	10551	0.0033
604/604 [===========================	_	1 c	2mc/ctan	_	1000	0 0042
Epoch 144/200	_	13	21113/31CP	-	.033.	0.0042
604/604 [==========]	_	1 c	2mg/stan	_	1000	0 0027
00¬, 00¬ []	_	тэ	21113/3 CCD	_	.033.	0.0057

Epoch 145/200					
604/604 [====================================	1s	1ms/step	-	loss:	0.0042
Epoch 146/200		2 / 1			0 0000
604/604 [==========] - Epoch 147/200	IS	2ms/step	-	loss:	0.0039
604/604 [=========] -	1s	2ms/step	_	loss:	0.0040
Epoch 148/200		2o, 5 cop			0.00.0
604/604 [========] -	1s	1ms/step	-	loss:	0.0046
Epoch 149/200	1 _	1		1	0 0047
604/604 [==========] - Epoch 150/200	IS	ıms/step	-	loss:	0.004/
604/604 [=========] -	1s	2ms/step	_	loss:	0.0036
Epoch 151/200		•			
604/604 [========] -	1s	2ms/step	-	loss:	0.0039
Epoch 152/200	1 _	2		1	0 0027
604/604 [===========] - Epoch 153/200	15	ziis/step	-	toss:	0.0037
604/604 [====================================	1s	1ms/step	_	loss:	0.0046
Epoch 154/200		•			
604/604 [========] -	1s	2ms/step	-	loss:	0.0040
Epoch 155/200 604/604 [========] -	1.	2mc/cton		1000.	0 0022
Epoch 156/200	15	ziiis/step	-	1055:	0.0033
604/604 [==========] -	1s	2ms/step	_	loss:	0.0039
Epoch 157/200		•			
604/604 [========] -	1s	1ms/step	-	loss:	0.0039
Epoch 158/200 604/604 [========] -	1.	2mc/cton		10001	0 0020
Epoch 159/200	12	ziiis/step	-	10551	0.0039
604/604 [====================================	1s	1ms/step	-	loss:	0.0040
Epoch 160/200					
604/604 [========] -	1s	2ms/step	-	loss:	0.0032
Epoch 161/200 604/604 [========] -	1.	2mc/cton		10001	0 0041
Epoch 162/200	15	ziiis/step	-	1055;	0.0041
604/604 [====================================	1s	2ms/step	-	loss:	0.0036
Epoch 163/200		-			
604/604 [====================================	1s	2ms/step	-	loss:	0.0038
Epoch 164/200 604/604 [========] -	1 c	2mc/ctan		1000	0 0022
Epoch 165/200	12	ziiis/step	-	1055.	0.0022
604/604 [====================================	1s	1ms/step	-	loss:	0.0028
Epoch 166/200		-			
604/604 [====================================	1s	2ms/step	-	loss:	0.0031
Epoch 167/200 604/604 [=======] -	1 c	1mc/cton		1000	0 0034
Epoch 168/200	т2	TIII 2 / 2 reh	-	(035)	0.0034
604/604 [====================================	1s	1ms/step	-	loss:	0.0038
Epoch 169/200					
604/604 [=======] -	1s	lms/step	-	loss:	0.0035

Epoch 170/200	
604/604 [============] - 1s	2ms/step - loss: 0.0036
Epoch 171/200	
604/604 [===========] - 1s	1ms/step - loss: 0.0030
Epoch 172/200	2/-1
604/604 [============] - 1s Epoch 173/200	2ms/step - loss: 0.0029
604/604 [============] - 1s	2ms/sten = loss: 0 0036
Epoch 174/200	2 2 113 / 3 Cep - 1033 . 0 . 0030
604/604 [====================================	1ms/step - loss: 0.0036
Epoch 175/200	, , , , , , , , , , , , , , , , , , ,
	2ms/step - loss: 0.0032
Epoch 176/200	
604/604 [====================================	2ms/step - loss: 0.0032
Epoch 177/200	1/
604/604 [====================================	s ims/step - loss: 0.0041
Epoch 178/200 604/604 [==========] - 1s	1ms/sten - loss: 0 0031
Epoch 179/200	11113/3 tep - t033. 0.0031
604/604 [====================================	2ms/step - loss: 0.0024
Epoch 180/200	, o top
	2ms/step - loss: 0.0025
Epoch 181/200	_
604/604 [====================================	2ms/step - loss: 0.0022
Epoch 182/200	2
604/604 [===========] - 1s Epoch 183/200	2ms/step - loss: 0.0029
604/604 [============] - 1s	2ms/sten - loss: 0 0023
Epoch 184/200	2 iii 3 / 3 CCp
604/604 [====================================	1ms/step - loss: 0.0029
Epoch 185/200	
604/604 [============] - 1s	2ms/step - loss: 0.0023
Epoch 186/200	
604/604 [====================================	2ms/step - loss: 0.0022
Epoch 187/200	1
604/604 [============] - 1s Epoch 188/200	1ms/step - loss: 0.0023
604/604 [============] - 1s	2ms/sten - loss: 0 0016
Epoch 189/200	2 Ziii 3 / 3 CCP - CO33 : 0 : 00 I O
604/604 [====================================	2ms/step - loss: 0.0021
Epoch 190/200	, , , , , , , , , , , , , , , , , , ,
604/604 [============] - 1s	1ms/step - loss: 0.0032
Epoch 191/200	
604/604 [============] - 1s	1ms/step - loss: 0.0023
Epoch 192/200	2
604/604 [===========] - 1s Epoch 193/200	2ms/step - toss: 0.0018
604/604 [============] - 1s	1ms/sten - loss: A AA20
Epoch 194/200	25, 5 top 10025
604/604 [====================================	2ms/step - loss: 0.0021
•	·

```
Epoch 195/200
604/604 [============= ] - 1s 2ms/step - loss: 0.0028
Epoch 196/200
Epoch 197/200
Epoch 198/200
Epoch 199/200
Epoch 200/200
figure = plt.figure(figsize = (10, 5))
histx = []
for i in range(len(hist.history['loss'])):
  histx.append(i)
plt.plot(histx, hist.history['loss'])
plt.title("loss")
plt.show()
                     loss
 0.16
 0.14
 0.12
 0.10
 0.08
 0.06
 0.04
 0.02
 0.00
         25
             50
                 75
                                   175
                      100
                          125
                              150
                                       200
x = np.linspace(-18, 1, 200)
y = np.linspace(-1, 6, 200)
figure = plt.figure(figsize = (24, 10))
ax1 = figure.add subplot(1, 2, 1)
ax2 = figure.add_subplot(1, 2, 2)
ax1.plot(fig1x, fig1y, c = 'r')
```





Аппроксимация

```
f = lambda t: np.cos(-5*t**2 + 10*t - 5)
t = np.arange(0, 2.5, 0.01)
ft = f(t)

figure = plt.figure(figsize = (10, 5))

plt.plot(t, ft)
plt.show()
```

```
0.75
 0.50
 0.25
 0.00
 -0.25
 -0.50
 -0.75
 -1.00
    0.0
           0.5
                       1.5
                              2.0
model = keras.models.Sequential()
model.add(Dense(20, input dim = 1, activation = "tanh",
kernel initializer = keras.initializers.RandomNormal(stddev = 0.01),
bias initializer = keras.initializers.Zeros()))
model.add(Dense(100, activation = "tanh"))
model.add(Dense(40, activation = "tanh"))
model.add(Dense(1, activation = "linear"))
model.compile(tf.keras.optimizers.SGD(0.01), 'mse')
hist = model.fit(t, ft, batch size = 1, epochs = 600, shuffle = True)
Epoch 1/600
Epoch 2/600
Epoch 3/600
250/250 [============== ] - Os 1ms/step - loss: 0.5712
Epoch 4/600
250/250 [=====
               Epoch 5/600
250/250 [========
             Epoch 6/600
Epoch 7/600
Epoch 8/600
Epoch 9/600
Epoch 10/600
```

1.00

Epoch 11	/600						
	[=========]	-	0s	2ms/step	-	loss:	0.5569
Epoch 12,							
	[=======]	-	0s	2ms/step	-	loss:	0.5426
Epoch 13,			0-	2== /=+==		1	0 5576
250/250 Epoch 14,	[=========]	-	05	zms/step	-	LOSS:	0.55/6
	/ 000 [=========]	_	05	2ms/sten	_	1055.	0 5605
Epoch 15,			03	211137 3 CCP			0.5005
	[=========]	-	0s	2ms/step	-	loss:	0.5579
Epoch 16,	/600						
	[=======]	-	0s	2ms/step	-	loss:	0.5459
Epoch 17,			_	.		-	0 5507
	[========]	-	θS	Ims/step	-	loss:	0.559/
Epoch 18,	/ 000 [=========]	_	٩c	1mc/cten		1000	0 5550
Epoch 19,		-	03	Illis/step	-	1055.	0.5559
	[==========]	_	0s	2ms/step	_	loss:	0.5600
Epoch 20,							
	[========]	-	0s	1ms/step	-	loss:	0.5575
Epoch 21,			_			_	
	[=======]	-	0s	2ms/step	-	loss:	0.5566
Epoch 22,	/600 [=========]		0.0	2ms/ston		1000.	O EE10
Epoch 23,		-	05	ziiis/s cep	-	1055:	0.5519
	[========]	_	05	1ms/sten	_	1055:	0.5578
Epoch 24			U.J	111137 3 CCP			013370
	[========]	-	0s	1ms/step	-	loss:	0.5563
Epoch 25,							
	[=======]	-	0s	1ms/step	-	loss:	0.5562
Epoch 26,	/600 [=========]		0.0	2ms/ston		1000.	O EE21
Epoch 27		-	05	ziiis/step	-	1055;	0.5551
	[=========]	_	05	1ms/sten	_	1055:	0.5584
Epoch 28			U.J	111137 3 CCP			013301
	[=========]	-	0s	1ms/step	-	loss:	0.5452
Epoch 29,	/600						
	[=======]	-	0s	1ms/step	-	loss:	0.5545
Epoch 30,			0 -	1		1	0 5536
250/250 Epoch 31,	[==========]	-	05	ıms/step	-	LOSS:	0.5520
	/ 000 [=========]	_	05	2ms/sten	_	1055.	ი 5510
Epoch 32,			03	211137 3 CCP			0.5515
	[=========]	-	0s	2ms/step	-	loss:	0.5557
Epoch 33,	/600			•			
	[=======]	-	0s	2ms/step	-	loss:	0.5536
Epoch 34,			^	2		1.	0
	[=========]	-	٥s	2ms/step	-	loss:	0.5535
Epoch 35,	/600 [=========]	_	0.5	1mc/cton	_	1000	0 5532
230/230	[=================================	-	05	Tillo\ 2 reb	-	1055	0.3332

Epoch 36/600						
250/250 [====================================	-	0s	1ms/step	-	loss:	0.5473
Epoch 37/600		•	1 ()		-	0 5500
250/250 [============] Epoch 38/600	-	0S	lms/step	-	loss:	0.5523
250/250 [====================================	_	0s	2ms/step	_	loss:	0.5502
Epoch 39/600						
250/250 [====================================	-	0s	1ms/step	-	loss:	0.5540
Epoch 40/600 250/250 [=========]	_	05	2ms/sten	_	loss:	0.5501
Epoch 41/600			-			
250/250 [==========]	-	0s	1ms/step	-	loss:	0.5548
Epoch 42/600 250/250 [====================================		0.0	1mc/cton		10001	0 5517
Epoch 43/600	-	05	IIIS/Step	-	1055:	0.3317
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5551
Epoch 44/600		_	.		_	
250/250 [===========] Epoch 45/600	-	0s	1ms/step	-	loss:	0.5521
250/250 [====================================	_	0s	2ms/step	_	loss:	0.5371
Epoch 46/600						
250/250 [==========]	-	0s	1ms/step	-	loss:	0.5502
Epoch 47/600 250/250 [====================================	_	٩c	1mc/cton	_	1000	0 5501
Epoch 48/600	_	03	III3/3 CCh	_	1055.	0.5501
250/250 [=======]	-	0s	2ms/step	-	loss:	0.5517
Epoch 49/600		0 -	1		1	0 5530
250/250 [============] Epoch 50/600	-	US	ıms/step	-	LOSS:	0.5538
250/250 [===========================	_	0s	2ms/step	_	loss:	0.5511
Epoch 51/600						
250/250 [===========] Epoch 52/600	-	0s	1ms/step	-	loss:	0.5492
250/250 [===========]	_	0s	1ms/step	_	loss:	0.5524
Epoch 53/600			о, о тор			
250/250 [====================================	-	0s	1ms/step	-	loss:	0.5489
Epoch 54/600 250/250 [====================================	_	Θc	1mc/cten	_	1066.	o 5413
Epoch 55/600		03	тіііз/ з сер			0.5415
250/250 [=======]	-	0s	1ms/step	-	loss:	0.5500
Epoch 56/600		0 -	1		1	0 5571
250/250 [===========] Epoch 57/600	-	υs	ıms/step	-	LOSS:	0.55/1
250/250 [==========]	_	0s	1ms/step	_	loss:	0.5528
Epoch 58/600			•			
250/250 [====================================	-	0s	1ms/step	-	loss:	0.5488
Epoch 59/600 250/250 [====================================	_	05	2ms/sten	_	loss:	0.5529
Epoch 60/600			о, о сор			3.3323
250/250 [========]	-	0s	2ms/step	-	loss:	0.5542

Epoch 61/600							
250/250 [=========]	-	0s	2ms/step	-	loss:	0.5477
Epoch 62/600	1		0 -	2		1	0 5524
250/250 [============ Epoch 63/600	=======]	-	υs	2ms/step	-	loss:	0.5524
250/250 [=========]	_	0s	1ms/step	-	loss:	0.5527
Epoch 64/600	,		_			-	0 ==10
250/250 [=========== Epoch 65/600	-=====]	-	٥s	lms/step	-	loss:	0.5516
250/250 [========	-====]	-	0s	2ms/step	-	loss:	0.5540
Epoch 66/600	_		_			_	
250/250 [=========== Epoch 67/600	-====]	-	0s	1ms/step	-	loss:	0.548/
250/250 [=========	-====]	-	0s	1ms/step	-	loss:	0.5524
Epoch 68/600			_			_	
250/250 [=========== Epoch 69/600]	-	0s	1ms/step	-	loss:	0.5528
250/250 [==========]	_	0s	1ms/step	_	loss:	0.5477
Epoch 70/600			_			_	
250/250 [=========== Epoch 71/600]	-	0s	lms/step	-	loss:	0.5524
250/250 [==========	-=====]	_	0s	2ms/step	_	loss:	0.5498
Epoch 72/600				•			
250/250 [====================================	-=====]	-	0s	2ms/step	-	loss:	0.5485
Epoch 73/600 250/250 [====================================	-=====1	_	05	2ms/sten	_	loss:	0.5519
Epoch 74/600				•			
250/250 [====================================	-=====]	-	0s	1ms/step	-	loss:	0.5504
Epoch 75/600 250/250 [====================================	-=====1	_	0s	2ms/step	_	loss:	0.5518
Epoch 76/600							
250/250 [====================================	-=====]	-	0s	2ms/step	-	loss:	0.5524
Epoch 77/600 250/250 [====================================	-=====1	_	05	1ms/sten	_	loss:	0.5547
Epoch 78/600	•		03	111137 3 CCP			013317
250/250 [=============	-====]	-	0s	2ms/step	-	loss:	0.5534
Epoch 79/600 250/250 [====================================	-=====1	_	05	2ms/sten	_	loss:	0.5452
Epoch 80/600				-			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.5543
Epoch 81/600 250/250 [====================================	1		٩c	1mc/ctan	_	1000	0 5536
Epoch 82/600	,		03	тіііз/ з сер			0.5550
250/250 [==========]	-	0s	2ms/step	-	loss:	0.5516
Epoch 83/600 250/250 [====================================	1		Θc	2mc/stan		1000	0 5520
Epoch 84/600		-	U3	21113/3CEP	-	(033)	0.3320
250/250 [=========]	-	0s	2ms/step	-	loss:	0.5537
Epoch 85/600 250/250 [====================================	1		0 c	2mc/c+on		1000	0 5517
2JU/2JU [===============	================	-	05	ziiis/step	-	1055:	0.221/

Epoch 86/600						
250/250 [==========]	-	0s	2ms/step	_	loss:	0.5475
Epoch 87/600			-			
250/250 [===========] Epoch 88/600	-	0s	2ms/step	-	loss:	0.5510
250/250 [===========]	_	05	2ms/sten	_	loss:	0.5494
Epoch 89/600		U J	23, 3 ccp			013131
250/250 [==========]	-	0s	1ms/step	-	loss:	0.5525
Epoch 90/600 250/250 [===========]		٥٥	2mc/cton		1000	0 5526
Epoch 91/600	_	03	21113/3 CCP	_	1055.	0.3320
250/250 [=======]	-	0s	2ms/step	-	loss:	0.5517
Epoch 92/600		0 -	2 /-+		1	0 5400
250/250 [====================================	-	US	zms/step	-	LOSS:	0.5488
250/250 [====================================	-	0s	2ms/step	_	loss:	0.5482
Epoch 94/600		_			_	
250/250 [===========] Epoch 95/600	-	0s	2ms/step	-	loss:	0.5530
250/250 [===========]	_	0s	1ms/step	_	loss:	0.5490
Epoch 96/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.5441
Epoch 97/600 250/250 [====================================		٥٥	2mc/cton		1000	0 5538
Epoch 98/600	_	03	21113/3 CCP	_	1055.	0.5550
250/250 [=======]	-	0s	2ms/step	-	loss:	0.5528
Epoch 99/600		0 -	2 /-+		1	0 5300
250/250 [===========] Epoch 100/600	-	US	zms/step	-	LOSS:	0.5390
250/250 [===========================	-	0s	2ms/step	_	loss:	0.5520
Epoch 101/600						
250/250 [===========] Epoch 102/600	-	0s	2ms/step	-	loss:	0.5526
250/250 [====================================	_	0s	1ms/step	_	loss:	0.5488
Epoch 103/600			•			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5512
Epoch 104/600 250/250 [============]	_	05	2ms/sten	_	1055.	0 5520
Epoch 105/600		03	211137 3 CCP			0.5520
250/250 [=======]	-	0s	2ms/step	-	loss:	0.5449
Epoch 106/600		0 -	2 /		1	0 5400
250/250 [===========] Epoch 107/600	-	θS	2ms/step	-	LOSS:	0.5492
250/250 [===========================	-	0s	1ms/step	_	loss:	0.5534
Epoch 108/600			-			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5501
Epoch 109/600 250/250 [====================================	_	0s	2ms/sten	_	loss:	0.5492
Epoch 110/600			·			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.5534

Epoch 111/600						
250/250 [=======]	-	0s	2ms/step	-	loss:	0.5518
Epoch 112/600		0.5	2ms/ston		1000.	0 5530
250/250 [===========] Epoch 113/600	-	05	ZIIIS/STEP	-	toss:	0.5520
250/250 [====================================	_	0s	2ms/step	_	loss:	0.5479
Epoch 114/600						
250/250 [==========]	-	0s	1ms/step	-	loss:	0.5506
Epoch 115/600 250/250 [====================================		0.0	2mc/cton		10001	0 5406
Epoch 116/600	_	03	21113/3 LEP	-	1055.	0.5400
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5528
Epoch 117/600					_	
250/250 [====================================	-	1s	2ms/step	-	loss:	0.5489
Epoch 118/600 250/250 [====================================	_	0.5	2ms/sten	_	1055	ი 5499
Epoch 119/600		03	211137 3 CCP			0.5455
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5525
Epoch 120/600		_			_	
250/250 [===========] Epoch 121/600	-	0s	2ms/step	-	loss:	0.5425
250/250 [====================================	_	05	2ms/sten	_	1055.	0 5559
Epoch 122/600		03	2m3/ 3 ccp			013333
250/250 [=======]	-	1s	2ms/step	-	loss:	0.5494
Epoch 123/600		_	2		-	
250/250 [===========] Epoch 124/600	-	IS	2ms/step	-	loss:	0.5503
250/250 [====================================	_	1s	2ms/step	_	loss:	0.5521
Epoch 125/600						
250/250 [===========]	-	0s	2ms/step	-	loss:	0.5493
Epoch 126/600 250/250 [====================================		0.0	2mc/cton		10001	0 55/1
Epoch 127/600	-	05	ZIIIS/Step	-	1055.	0.3341
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5518
Epoch 128/600			·			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5507
Epoch 129/600 250/250 [====================================	_	0 c	2mc/ctan		1000	0 5520
Epoch 130/600	_	03	21113/3 LEP	-	1055.	0.3329
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5464
Epoch 131/600					_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5528
Epoch 132/600 250/250 [====================================	_	0.0	2ms/sten	_	1055	0 5533
Epoch 133/600		03	211137 3 CCP			0.5555
250/250 [====================================	-	1s	2ms/step	-	loss:	0.5486
Epoch 134/600			2 / :		-	0 5550
250/250 [===========] Epoch 135/600	-	IS	∠ms/step	-	LOSS:	0.5513
250/250 [====================================	_	0,5	2ms/sten	_	loss:	0.5538
			5, 5 ccp			3.2333

Epoch 136/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5496
Epoch 137/600		•	2 / 1		-	0 5500
250/250 [===========] Epoch 138/600	-	٥s	2ms/step	-	loss:	0.5522
250/250 [==========]	_	05	2ms/sten	_	loss:	0.5538
Epoch 139/600			5, 5 top			0.5550
250/250 [=======]	-	0s	2ms/step	-	loss:	0.5530
Epoch 140/600		0 -	2		1	0 5400
250/250 [============] Epoch 141/600	-	ΘS	2ms/step	-	LOSS:	0.5499
250/250 [====================================	_	05	1ms/sten	_	loss:	0.5542
Epoch 142/600		0.5	13, 3 ccp			013312
250/250 [========]	-	0s	2ms/step	-	loss:	0.5516
Epoch 143/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5540
Epoch 144/600 250/250 [====================================	_	0.5	1mc/cten	_	1000	0 5528
Epoch 145/600		03	III3/3 CCb			0.5520
250/250 [====================================	-	0s	2ms/step	_	loss:	0.5521
Epoch 146/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.5502
Epoch 147/600		0 -	1/		1	0 5511
250/250 [============] Epoch 148/600	-	05	ıms/step	-	LOSS:	0.5511
250/250 [====================================	_	05	2ms/sten	_	1055:	0.5516
Epoch 149/600			5, 5 top			0.5510
250/250 [=======]	-	0s	1ms/step	-	loss:	0.5448
Epoch 150/600		_	2 / 1		,	0 5516
250/250 [===========] Epoch 151/600	-	ΘS	2ms/step	-	LOSS:	0.5516
250/250 [====================================	_	05	2ms/sten	_	1055:	0.5499
Epoch 152/600		0.5	23, 3 ccp			013133
250/250 [====================================	-	0s	2ms/step	-	loss:	0.5506
Epoch 153/600		_			_	
250/250 [==========]	-	0s	2ms/step	-	loss:	0.5506
Epoch 154/600 250/250 [===========]		0.5	2mc/cton		1000	0 5/06
Epoch 155/600	_	05	ziiis/step	-	1055.	0.5490
250/250 [===========================	_	0s	2ms/step	_	loss:	0.5480
Epoch 156/600			•			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.5435
Epoch 157/600		0 -	2/-+		1	0 5422
250/250 [===========] Epoch 158/600	-	05	zms/step	-	LOSS:	0.5432
250/250 [==========]	_	05	2ms/sten	_	loss:	0.5284
Epoch 159/600			•			
250/250 [=======]	-	0s	1ms/step	-	loss:	0.5111
Epoch 160/600		•	.		-	0 4000
250/250 [============]	-	٥s	<pre>Ims/step</pre>	-	loss:	0.4683

Epoch 161/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.3960
Epoch 162/600		0 -	2		1	0 2266
250/250 [===========] Epoch 163/600	-	٥s	2ms/step	-	loss:	0.3266
250/250 [====================================	_	0s	2ms/step	_	loss:	0.2612
Epoch 164/600		0.5	s, s top			0.2022
250/250 [========]	-	0s	2ms/step	-	loss:	0.2432
Epoch 165/600		0 -	1		1	0 2522
250/250 [===========] Epoch 166/600	-	US	ıms/step	-	loss:	0.2533
250/250 [====================================	_	0s	2ms/step	_	loss:	0.2366
Epoch 167/600			•			
250/250 [=======]	-	0s	1ms/step	-	loss:	0.2507
Epoch 168/600		_	2 / 1		,	0 2242
250/250 [===========] Epoch 169/600	-	ΘS	2ms/step	-	loss:	0.2342
250/250 [====================================	_	05	2ms/sten	_	1055:	0.2409
Epoch 170/600		U J	23, 3 ccp			012103
250/250 [====================================	-	0s	2ms/step	-	loss:	0.2355
Epoch 171/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.2425
Epoch 172/600 250/250 [====================================	_	Ωc	1mc/sten	_	1000	0 2280
Epoch 173/600		03	тііі 3/3 сер			0.2200
250/250 [====================================	-	0s	2ms/step	-	loss:	0.2286
Epoch 174/600					_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.2263
Epoch 175/600 250/250 [====================================	_	٩c	2mc/stan	_	1000	0 2233
Epoch 176/600	_	03	21113/3 CCP	_	1033.	0.2233
250/250 [====================================	-	0s	2ms/step	-	loss:	0.2316
Epoch 177/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.2204
Epoch 178/600 250/250 [====================================		۵۵	2mc/cton		10001	0 2003
Epoch 179/600	-	05	ZIIIS/Step	-	1055.	0.2093
250/250 [====================================	_	0s	2ms/step	-	loss:	0.2138
Epoch 180/600			-			
250/250 [=========]	-	0s	2ms/step	-	loss:	0.2139
Epoch 181/600		0-	2		1	0 2165
250/250 [===========] Epoch 182/600	-	US	zms/step	-	loss:	0.2105
250/250 [====================================	_	0s	2ms/step	_	loss:	0.2081
Epoch 183/600						
250/250 [=======]	-	0s	2ms/step	-	loss:	0.2051
Epoch 184/600		0 -	2		1	0.2004
250/250 [==========] Epoch 185/600	-	٥s	∠ms/step	-	LOSS:	⊍.∠084
250/250 [====================================	_	05	2ms/sten	_	1055.	0.2038
		55	<i>5</i> , <i>5</i> ccp			3.2030

Epoch 186/600						
250/250 [====================================	_	0s	2ms/step	_	loss:	0.2010
Epoch 187/600			,			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.2039
Epoch 188/600			-			
250/250 [=======]	-	0s	1ms/step	-	loss:	0.2011
Epoch 189/600						
250/250 [=========]	-	0s	2ms/step	-	loss:	0.1996
Epoch 190/600		_			_	
250/250 [==========]	-	0s	1ms/step	-	loss:	0.1924
Epoch 191/600		•	2 / 1		,	0 1045
250/250 [===========]	-	ΘS	2ms/step	-	loss:	0.1945
Epoch 192/600 250/250 [====================================		0.0	2mc/cton		10001	0 1070
Epoch 193/600	-	05	ziiis/step	-	1055;	0.19/9
250/250 [====================================		0.5	2mc/cten		1000	0 1020
Epoch 194/600	_	03	21113/3 CEP		(033.	0.1920
250/250 [====================================	_	05	2ms/sten	_	1055:	0.1920
Epoch 195/600		03	2m3/3ccp			011320
250/250 [====================================	_	0s	2ms/step	_	loss:	0.1897
Epoch 196/600			0, 0 10 0			0.2007
250/250 [====================================	_	0s	1ms/step	_	loss:	0.1883
Epoch 197/600			-			
250/250 [==========]	-	0s	1ms/step	-	loss:	0.1868
Epoch 198/600						
250/250 [=======]	-	0s	2ms/step	-	loss:	0.1869
Epoch 199/600						
250/250 [=========]	-	0s	1ms/step	-	loss:	0.1798
Epoch 200/600		_	.		_	
250/250 [===========]	-	0s	2ms/step	-	loss:	0.1694
Epoch 201/600		0-	1/		1	0 1006
250/250 [===========] Epoch 202/600	-	05	ılıs/s cep	-	1055:	0.1000
250/250 [====================================		۵۵	2mc/cton		1000	0 1753
Epoch 203/600	_	03	21113/3 LEP	_	1055.	0.1/55
250/250 [====================================	_	05	1ms/sten	_	1055.	0 1753
Epoch 204/600		03	1m3/3ccp			011733
250/250 [====================================	_	0s	1ms/step	_	loss:	0.1715
Epoch 205/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1633
Epoch 206/600						
250/250 [=======]	-	0s	2ms/step	-	loss:	0.1669
Epoch 207/600						
250/250 [=========]	-	0s	1ms/step	-	loss:	0.1644
Epoch 208/600		^	.		,	0 100:
250/250 [====================================	-	٥s	ıms/step	-	LOSS:	0.1604
Epoch 209/600		0	1mc/c+c=		1000	0 1612
250/250 [===========] Epoch 210/600	-	ชร	ıııs/step	-	LUSS:	U.1013
250/250 [====================================	_	00	2mc/ctan	_	1000	ი 1502
230/230 []	-	U.S	21113/3 LEβ	-	.033	0.1380

Epoch 211/600 250/250 [====================================
Epoch 212/600 250/250 [====================================
Epoch 213/600 250/250 [====================================
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Epoch 214/600 250/250 [====================================
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Epoch 235/600
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Epoch 236/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1254
Epoch 237/600					_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0884
Epoch 238/600 250/250 [====================================		0.0	2mc/ston		10001	0 1160
Epoch 239/600	-	05	ziiis/step	-	1055	0.1109
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0962
Epoch 240/600		0.5	o, o cop			0.0502
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0877
Epoch 241/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.1108
Epoch 242/600		0 -	2		1	0 1171
250/250 [===========] Epoch 243/600	-	US	zms/step	-	toss:	0.11/1
250/250 [====================================	_	0 c	2ms/sten	_	1000	0 0887
Epoch 244/600		03	21113/3 CEP		1033.	0.0007
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0981
Epoch 245/600			-,,-			
250/250 [=========]	-	0s	1ms/step	-	loss:	0.1200
Epoch 246/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0854
Epoch 247/600		0 -	1		1	0 0004
250/250 [====================================	-	θS	Ims/step	-	loss:	0.0884
Epoch 248/600 250/250 [====================================		0.5	2mc/sten		1000	0 1101
Epoch 249/600	_	03	21113/3 CEP	-	1055.	0.1101
250/250 [====================================	_	0s	1ms/step	_	loss:	0.1070
Epoch 250/600						
250/250 [=======]	-	0s	1ms/step	-	loss:	0.0760
Epoch 251/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1051
Epoch 252/600 250/250 [====================================		0.0	2mc/ston		10001	0 0043
Epoch 253/600	-	05	ziiis/step	-	1055;	0.0043
250/250 [====================================	_	05	2ms/sten	_	1055:	0.0976
Epoch 254/600		U.S	23, 3 ccp			010370
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1056
Epoch 255/600						
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0860
Epoch 256/600		_			_	
250/250 [====================================	-	0s	1ms/step	-	loss:	0.1044
Epoch 257/600		0-	2/		1	0 1012
250/250 [===========] Epoch 258/600	-	US	zms/step	-	toss:	0.1013
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0504
Epoch 259/600		55	<i>5, 5 ccp</i>			3.0337
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0648
Epoch 260/600						
250/250 [========]	-	0s	2ms/step	-	loss:	0.0837

Epoch 261/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0611
Epoch 262/600		^	2 / 1		,	0 1070
250/250 [===========] Epoch 263/600	-	٥s	2ms/step	-	loss:	0.12/3
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0916
Epoch 264/600			s, s top			0.0520
250/250 [========]	-	0s	2ms/step	-	loss:	0.0822
Epoch 265/600		0 -	2		1	0 0001
250/250 [===========] Epoch 266/600	-	05	zms/step	-	LOSS:	0.0991
250/250 [====================================	_	0s	1ms/step	_	loss:	0.0922
Epoch 267/600			, 0 10			
250/250 [=======]	-	0s	1ms/step	-	loss:	0.0716
Epoch 268/600		^	2 / 1		,	0.000
250/250 [===========] Epoch 269/600	-	ΘS	2ms/step	-	loss:	0.0686
250/250 [====================================	_	05	2ms/sten	_	loss:	0.0659
Epoch 270/600		03	2m3/ 3 ccp		(055)	0.0055
250/250 [============]	-	0s	2ms/step	-	loss:	0.0654
Epoch 271/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0732
Epoch 272/600 250/250 [====================================	_	Θc	1mc/cten	_	1066.	0 0721
Epoch 273/600		03	тіііз/ з сер		(033.	0.0721
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0824
Epoch 274/600					_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0739
Epoch 275/600 250/250 [====================================	_	۸c	2mc/ctan	_	1000	0 0702
Epoch 276/600	_	03	21113/3 CCP	_		0.0702
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0538
Epoch 277/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0780
Epoch 278/600 250/250 [====================================		۵۵	2mc/cton		10001	0 0575
Epoch 279/600	-	05	ZIIIS/Step	-	1055.	0.0373
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0701
Epoch 280/600			•			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0498
Epoch 281/600		٥٥	2ms/ston		1000.	0 0607
250/250 [===========] Epoch 282/600	-	05	Ziiis/s tep	-	1055:	0.0087
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0646
Epoch 283/600						
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0800
Epoch 284/600		0-	2ma /a+a		1	0 0572
250/250 [===========] Epoch 285/600	-	US	ziiis/step	-	LOSS:	U.U5/3
250/250 [====================================	_	05	2ms/sten	_	loss:	0.0685
,		55	, с сер		-5551	2.0000

Epoch 286/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0699
Epoch 287/600			·			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0552
Epoch 288/600 250/250 [====================================		0.0	1mc/cton		10001	0 0500
Epoch 289/600	-	05	Illis/step	-	1055;	0.0500
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0503
Epoch 290/600						
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0516
Epoch 291/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0471
Epoch 292/600 250/250 [====================================		0.0	2mc/ston		10001	0.0520
Epoch 293/600	-	05	ziiis/step	-	10551	0.0559
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0445
Epoch 294/600						
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0514
Epoch 295/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0698
Epoch 296/600		0-	2/		1	0 0571
250/250 [===========] Epoch 297/600	-	05	zms/step	-	toss:	0.05/1
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0446
Epoch 298/600		03	211137 3 CCP			010110
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0539
Epoch 299/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0579
Epoch 300/600		0 -	2		1	0 0000
250/250 [===========] Epoch 301/600	-	US	2ms/step	-	LOSS:	0.0008
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0493
Epoch 302/600		03	211137 3 CCP			010133
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0485
Epoch 303/600						
250/250 [===========]	-	0s	2ms/step	-	loss:	0.0457
Epoch 304/600		0 -	2		1	0 0420
250/250 [===========] Epoch 305/600	-	ΘS	2ms/step	-	LOSS:	0.0438
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0514
Epoch 306/600		03	211137 3 CCP			0.0314
250/250 [====================================	-	0s	2ms/step	_	loss:	0.0627
Epoch 307/600			•			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0384
Epoch 308/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.04/1
Epoch 309/600 250/250 [====================================	_	0.0	2mc/ctan	_	1000	0 0637
Epoch 310/600	-	U.S	21113/3 LEβ	-	.033.	0.0037
250/250 [====================================	_	0s	2ms/sten	_	loss:	0.0397
•			, 6			

Epoch 311/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0398
Epoch 312/600			·			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0515
Epoch 313/600 250/250 [====================================		0.0	2mc/cton		10001	0 0490
Epoch 314/600	-	05	ziiis/step	-	1055:	0.0469
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0376
Epoch 315/600						
250/250 [========]	-	0s	2ms/step	-	loss:	0.0351
Epoch 316/600		0 -	2		1	0 0260
250/250 [===========] Epoch 317/600	-	ΘS	2ms/step	-	LOSS:	0.0360
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0440
Epoch 318/600		03	211137 3 CCP		(055)	010110
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0484
Epoch 319/600					_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0847
Epoch 320/600 250/250 [====================================		0.0	2ms/ston		10001	0 0270
Epoch 321/600	-	05	ziiis/step	-	1055;	0.0379
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0381
Epoch 322/600			, 0 10			0.000_
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0461
Epoch 323/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0442
Epoch 324/600 250/250 [====================================		0 c	2mc/ctan	_	1000	0 0444
Epoch 325/600	_	03	21113/3 CEP	_	1033.	0.0444
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0439
Epoch 326/600						
250/250 [===========]	-	0s	2ms/step	-	loss:	0.0370
Epoch 327/600		٥٥	2ms/ston		1000.	0 0222
250/250 [===========] Epoch 328/600	-	05	ziiis/s cep	-	1055:	0.0333
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0444
Epoch 329/600			s, s top			0.0
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0540
Epoch 330/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0378
Epoch 331/600 250/250 [====================================		0.5	2mc/sten		1000	0 0471
Epoch 332/600	_	03	21113/3 CEP	-	1055.	0.04/1
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0488
Epoch 333/600						
250/250 [========]	-	0s	2ms/step	-	loss:	0.0427
Epoch 334/600		^	2		1	0 0040
250/250 [====================================	-	٥s	∠ms/step	-	LOSS:	⊍.⊎342
Epoch 335/600 250/250 [====================================	_	00	2ms/stan	_	1066.	0 031 <i>1</i>
230, 230 []	_	U3	21113/31Ch	_	.033.	0.0014

Epoch 336/600						
250/250 [===========================	-	0s	2ms/step	-	loss:	0.0306
Epoch 337/600		•	2 / 1		-	0 0000
250/250 [===========] Epoch 338/600	-	0s	2ms/step	-	loss:	0.0368
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0429
Epoch 339/600			•			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0298
Epoch 340/600 250/250 [====================================	_	05	2ms/sten	_	1055	ი ი299
Epoch 341/600		03	2m3/ 5 ccp			0.0233
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0389
Epoch 342/600		٥٥	2ms/ston		1	0 0200
250/250 [====================================	-	05	Ziiis/s tep	-	LOSS:	0.0308
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0293
Epoch 344/600		_			_	
250/250 [====================================	-	0s	1ms/step	-	loss:	0.0323
250/250 [==========]	_	05	2ms/sten	_	1055:	0.0269
Epoch 346/600						
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0706
Epoch 347/600 250/250 [====================================		0.0	2ms/ston		10001	0 0275
Epoch 348/600	-	05	ziiis/step	-	1055:	0.02/5
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0276
Epoch 349/600		_	.		_	
250/250 [===========] Epoch 350/600	-	0s	1ms/step	-	loss:	0.0360
250/250 [==========]	_	05	2ms/sten	_	loss:	0.0399
Epoch 351/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0284
Epoch 352/600 250/250 [====================================		0.0	2ms/ston		10001	0 0240
Epoch 353/600	-	05	ziiis/step	-	1055:	0.0249
250/250 [====================================	-	0s	1ms/step	-	loss:	0.0292
Epoch 354/600		_	.		_	
250/250 [===========] Epoch 355/600	-	0s	1ms/step	-	loss:	0.0264
250/250 [===========]	_	0s	2ms/step	_	loss:	0.0376
Epoch 356/600			-			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0252
Epoch 357/600 250/250 [====================================		0.0	2mc/cton		10001	0 0204
Epoch 358/600	-	05	ziiis/step	-	1055.	0.0304
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0257
Epoch 359/600		_	2		-	0 045-
250/250 [===========] Fnoch 360/600	-	0s	∠ms/step	-	loss:	0.0431
Epoch 360/600 250/250 [====================================	_	05	2ms/sten	_	1055.	0.0410
		0.5	э, э сер			3.3.113

Epoch 361/600	
250/250 [====================================	2ms/step - loss: 0.0349
Epoch 362/600	
250/250 [===========] - 0s 2 Epoch 363/600	2ms/step - loss: 0.0234
250/250 [===========] - 0s 2	2ms/sten - loss: 0.0210
Epoch 364/600	23, 3 ccp
250/250 [=========] - 0s :	2ms/step - loss: 0.0254
Epoch 365/600	
250/250 [===========] - 0s 2 Epoch 366/600	2ms/step - loss: 0.0218
250/250 [===========] - 0s 2	2ms/sten - loss: 0.0226
Epoch 367/600	23, 3 ccp
250/250 [=========] - 0s :	2ms/step - loss: 0.0236
Epoch 368/600	
250/250 [====================================	2ms/step - loss: 0.0231
Epoch 369/600 250/250 [==========] - 0s 2	2ms/sten - loss: 0 0551
Epoch 370/600	23, 3 ccp
250/250 [==========] - 0s :	2ms/step - loss: 0.0338
Epoch 371/600	
250/250 [====================================	2ms/step - loss: 0.0213
Epoch 372/600 250/250 [=========] - 0s 2	2ms/sten - loss: 0 0308
Epoch 373/600	2m3, 3 ccp
250/250 [===========] - 0s :	2ms/step - loss: 0.0363
Epoch 374/600	
250/250 [====================================	2ms/step - loss: 0.0191
Epoch 375/600 250/250 [===========] - 0s 2	2ms/sten - loss: 0 0235
Epoch 376/600	2m3, 3 ccp
250/250 [==========] - 0s :	2ms/step - loss: 0.0220
Epoch 377/600	
250/250 [====================================	2ms/step - loss: 0.0324
Epoch 378/600 250/250 [==========] - 0s	1ms/sten - loss: 0 0385
Epoch 379/600	111137 3 CCP C0331 0.0303
250/250 [==========] - 0s :	2ms/step - loss: 0.0217
Epoch 380/600	
250/250 [====================================	2ms/step - loss: 0.0212
Epoch 381/600 250/250 [===========] - 0s 2	2ms/sten - loss: 0 0235
Epoch 382/600	2m3, 3 ccp
250/250 [==========] - 0s :	2ms/step - loss: 0.0186
Epoch 383/600	
250/250 [============] - 0s :	Ims/step - loss: 0.01/6
Epoch 384/600 250/250 [==========] - 0s 2	2ms/sten - loss: 0.0184
Epoch 385/600	2, 5 10
250/250 [=========] - 0s 2	2ms/step - loss: 0.0691

Epoch 386/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0279
Epoch 387/600			·		_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0167
Epoch 388/600 250/250 [====================================		0.0	1mc/cton		10001	0 0102
Epoch 389/600	-	05	IIIS/Step	-	1055:	0.0193
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0189
Epoch 390/600			о, о тор			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0219
Epoch 391/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0218
Epoch 392/600 250/250 [====================================		0.0	2mc/ston		10001	0 0477
Epoch 393/600	-	05	ziiis/step	-	10551	0.0477
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0142
Epoch 394/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0291
Epoch 395/600						
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0182
Epoch 396/600		0-	2/		1	0 0220
250/250 [===========] Epoch 397/600	-	05	zms/step	-	toss:	0.0320
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0211
Epoch 398/600		03	211137 3 CCP			010211
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0187
Epoch 399/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0158
Epoch 400/600		0-	2/		1	0 0127
250/250 [===========] Epoch 401/600	-	US	zms/step	-	toss:	0.013/
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0140
Epoch 402/600		03	211137 3 CCP			010110
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0544
Epoch 403/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0330
Epoch 404/600		0 -	2		1	0 0260
250/250 [===========] Epoch 405/600	-	ΘS	2ms/step	-	LOSS:	0.0260
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0217
Epoch 406/600		03	211137 3 CCP			0.0217
250/250 [====================================	-	0s	2ms/step	_	loss:	0.0305
Epoch 407/600			-			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0172
Epoch 408/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0626
Epoch 409/600 250/250 [====================================	_	0.0	2mc/ctan	_	1000	0 0365
Epoch 410/600	-	U.S	21113/3 LEβ	-	.033.	0.000
250/250 [====================================	_	0s	2ms/sten	_	loss:	0.0127
			, 6			

Epoch 411/600						
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0134
Epoch 412/600			-			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0113
Epoch 413/600 250/250 [============]		0.0	2mc/cton		10001	0 0101
Epoch 414/600	-	05	ziiis/s tep	-	1055:	0.0101
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0135
Epoch 415/600			•			
250/250 [========]	-	0s	2ms/step	-	loss:	0.0147
Epoch 416/600		_	2 / 1		,	0.0160
250/250 [==========] Epoch 417/600	-	ΘS	2ms/step	-	loss:	0.0163
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0186
Epoch 418/600		03	211137 3 CCP		(055)	0.0100
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0724
Epoch 419/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0197
Epoch 420/600 250/250 [========]		۵۵	2mc/ctan		1000	0 0153
Epoch 421/600	_	03	21113/3 LEP	-	1033.	0.0133
250/250 [===========]	-	0s	2ms/step	-	loss:	0.0414
Epoch 422/600			·			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0420
Epoch 423/600 250/250 [====================================		0.0	2mc/cton		10001	0 0150
Epoch 424/600	-	05	ziiis/step	-	1055;	0.0159
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0115
Epoch 425/600			•			
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0180
Epoch 426/600		٥٥	2ms/ston		1000.	0 0120
250/250 [==========] Epoch 427/600	-	05	ziiis/s tep	-	1055:	0.0130
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0143
Epoch 428/600			o, o top			
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0193
Epoch 429/600		_	2 / 1		,	0 0110
250/250 [==========] Epoch 430/600	-	0s	2ms/step	-	loss:	0.0110
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0235
Epoch 431/600		03	211137 3 CCP		(055)	010233
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0113
Epoch 432/600					_	
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0418
Epoch 433/600 250/250 [============]		۵۵	2mc/cton		10001	0 0214
Epoch 434/600	-	05	21113/3 LEβ	-	(035)	0.0214
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0112
Epoch 435/600			•			
250/250 [========]	-	0s	2ms/step	-	loss:	0.0315

Epoch 436/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0135
Epoch 437/600			·		_	
250/250 [============]	-	0s	2ms/step	-	loss:	0.0226
Epoch 438/600 250/250 [====================================		0.0	2mc/cton		10001	0 0126
Epoch 439/600	-	05	ziiis/step	-	1055:	0.0130
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0147
Epoch 440/600			•			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0106
Epoch 441/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0383
Epoch 442/600 250/250 [====================================		0.0	2mc/cton		10001	0 0160
Epoch 443/600	-	05	ziiis/step	-	1055;	0.0100
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0129
Epoch 444/600			,			
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0182
Epoch 445/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0134
Epoch 446/600		0-	2/		1	0 0000
250/250 [===========] Epoch 447/600	-	05	zms/step	-	toss:	0.0099
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0373
Epoch 448/600		03	2m3/3ccp		.0551	010373
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0114
Epoch 449/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0161
Epoch 450/600		0-	2/		1	0 0111
250/250 [===========] Epoch 451/600	-	US	zms/step	-	toss:	0.0111
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0115
Epoch 452/600		03	2m3/3ccp		.0551	0.0113
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0397
Epoch 453/600			-			
250/250 [===========]	-	0s	2ms/step	-	loss:	0.0134
Epoch 454/600		0 -	2		1	0 0220
250/250 [===========] Epoch 455/600	-	ΘS	2ms/step	-	LOSS:	0.0320
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0096
Epoch 456/600		03	211137 3 CCP			0.0050
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0098
Epoch 457/600			-			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0109
Epoch 458/600		_	.		_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0152
Epoch 459/600 250/250 [====================================	_	0.0	2mc/ctan	_	1000	0 0102
Epoch 460/600	-	U.S	21113/3 LEβ	-	10331	0.0102
250/250 [====================================	_	0s	2ms/sten	_	loss:	0.0203
· •			,		= -	

Epoch 461/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0101
Epoch 462/600			·			
250/250 [===========]	-	0s	2ms/step	-	loss:	0.0142
Epoch 463/600 250/250 [====================================		0.0	2mc/cton		10001	0 0125
Epoch 464/600	-	05	ziiis/step	-	1055;	0.0125
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0122
Epoch 465/600			,			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0146
Epoch 466/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0102
Epoch 467/600 250/250 [====================================		0.0	2mc/cton		10001	0 0000
Epoch 468/600	-	05	ziiis/step	-	1055;	0.0099
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0333
Epoch 469/600			,			
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0157
Epoch 470/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0404
Epoch 471/600		0-	2/		1	0 0000
250/250 [===========] Epoch 472/600	-	05	zms/step	-	toss:	0.0090
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0108
Epoch 473/600		03	2m3/3ccp			0.0100
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0128
Epoch 474/600			-			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0076
Epoch 475/600		0-	2/		1	0 0100
250/250 [===========] Epoch 476/600	-	US	zms/step	-	toss:	0.0108
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0183
Epoch 477/600		03	2m3/3ccp			0.0103
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0274
Epoch 478/600			-			
250/250 [===========]	-	0s	2ms/step	-	loss:	0.0144
Epoch 479/600		0 -	2		1	0 0000
250/250 [===========] Epoch 480/600	-	ΘS	2ms/step	-	LOSS:	0.0222
250/250 [====================================	_	05	2ms/sten	_	1055.	0 0413
Epoch 481/600		03	211137 3 CCP			0.0413
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0107
Epoch 482/600			-			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0229
Epoch 483/600		_	.		_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0408
Epoch 484/600 250/250 [====================================	_	0.0	2mc/ctan	_	1000	0 0235
Epoch 485/600	-	U.S	21113/3 LEβ	-	.033.	0.0233
250/250 [====================================	_	0s	2ms/sten	_	loss:	0.0147
•			,			

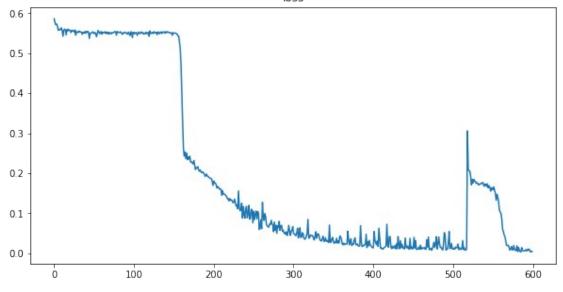
Epoch 486/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0146
Epoch 487/600			·		_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0104
Epoch 488/600 250/250 [====================================		0.0	2mc/cton		10001	0 0004
Epoch 489/600	-	05	ziiis/step	-	1055:	0.0004
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0242
Epoch 490/600			•			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0517
Epoch 491/600		•	2		-	0 0401
250/250 [====================================	-	0S	2ms/step	-	loss:	0.0431
Epoch 492/600 250/250 [====================================	_	0.5	2ms/sten	_	1055.	0 0081
Epoch 493/600		03	211137 3 CCP			0.0001
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0100
Epoch 494/600			·			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0104
Epoch 495/600		0-	2/		1	0 0240
250/250 [===========] Epoch 496/600	-	05	zms/step	-	toss:	0.0249
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0543
Epoch 497/600			o, o top			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0118
Epoch 498/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0128
Epoch 499/600 250/250 [====================================	_	٩c	2mc/stan	_	1000	0 0247
Epoch 500/600	_	03	21113/3 CEP	_		0.0247
250/250 [====================================	-	1s	2ms/step	-	loss:	0.0109
Epoch 501/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0112
Epoch 502/600		٥٥	2ms/ston		1000.	0 0127
250/250 [===========] Epoch 503/600	-	05	ziiis/step	-	1055:	0.0127
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0099
Epoch 504/600			•			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0157
Epoch 505/600		_	.		_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0134
Epoch 506/600 250/250 [====================================		۵c	2mc/ctan		1000	0 01/7
Epoch 507/600	_	03	21113/3 CEP	-	1055.	0.0147
250/250 [====================================	-	0s	2ms/step	_	loss:	0.0231
Epoch 508/600						
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0090
Epoch 509/600		^	2		1	0 0107
250/250 [====================================	-	٥s	∠ms/step	-	LOSS:	0.013/
Epoch 510/600 250/250 [====================================	_	0,c	2ms/stan	_	1066.	0 0125
250,250 []	_	03	21113/3 CEP	_	.033.	0.0123

Epoch 511/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0093
Epoch 512/600			·			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0118
Epoch 513/600 250/250 [====================================		0.0	2mc/cton		10001	a a210
Epoch 514/600	-	05	ziiis/step	-	1055:	0.0310
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0091
Epoch 515/600						
250/250 [========]	-	0s	2ms/step	-	loss:	0.0138
Epoch 516/600		0 -	2		1	0 0070
250/250 [===========] Epoch 517/600	-	ΘS	2ms/step	-	loss:	0.0078
250/250 [====================================	_	05	2ms/sten	_	loss:	0.0081
Epoch 518/600		U.J	23, 3 ccp			0.0001
250/250 [=========]	-	0s	2ms/step	-	loss:	0.0116
Epoch 519/600		_			_	
250/250 [====================================	-	1s	2ms/step	-	loss:	0.3061
Epoch 520/600 250/250 [====================================		۵c	2mc/cton		1000	0 2078
Epoch 521/600	_	03	21113/3 LEP	_	1055.	0.2070
250/250 [====================================	-	0s	2ms/step	_	loss:	0.2069
Epoch 522/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.2050
Epoch 523/600		0-	2ma/atan		1	0 1021
250/250 [===========] Epoch 524/600	-	05	ziiis/step	-	toss:	0.1921
250/250 [====================================	_	0s	2ms/step	_	loss:	0.1711
Epoch 525/600			, 0 10			• • • • • • • • • • • • • • • • • • • •
250/250 [=======]	-	0s	2ms/step	-	loss:	0.1845
Epoch 526/600		•			-	0 1750
250/250 [===========] Epoch 527/600	-	ΘS	2ms/step	-	loss:	0.1/53
250/250 [====================================	_	05	2ms/sten	_	1055.	0 1846
Epoch 528/600		03	211137 3 CCP		(055)	011010
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1804
Epoch 529/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1797
Epoch 530/600 250/250 [====================================		۵۵	2mc/cton		10001	0 17/5
Epoch 531/600	-	05	ziiis/step	-	(055)	0.1743
250/250 [====================================	_	0s	2ms/step	_	loss:	0.1761
Epoch 532/600			•			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.1748
Epoch 533/600		^	2 / 1		,	0 1707
250/250 [====================================	-	ΘS	2ms/step	-	loss:	0.1/0/
Epoch 534/600 250/250 [====================================	_	0<	2ms/sten	_	1055.	0.1727
Epoch 535/600		0.5	5, 5 ccp			J. 1/2/
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1739

Epoch 536/600						
250/250 [====================================	_	0s	2ms/step	-	loss:	0.1732
Epoch 537/600		_			_	
250/250 [===========] Epoch 538/600	-	0s	2ms/step	-	loss:	0.1754
250/250 [====================================	_	05	2ms/sten	_	loss:	0.1774
Epoch 539/600		03	23, 3 ccp			011//
250/250 [==========]	-	0s	2ms/step	-	loss:	0.1722
Epoch 540/600 250/250 [====================================		٥٥	2ms/ston		1	0 1674
Epoch 541/600	-	05	ziiis/step	-	1055:	0.10/4
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1737
Epoch 542/600			-			
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1714
Epoch 543/600 250/250 [====================================	_	0 c	2mc/stan	_	1000	0 1674
Epoch 544/600	_	03	21113/3 CCP	-	1055.	0.10/4
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1736
Epoch 545/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1636
Epoch 546/600 250/250 [====================================	_	05	2ms/sten	_	1055.	0 1687
Epoch 547/600		U.J	23, 3 ccp			011007
250/250 [=======]	-	0s	2ms/step	-	loss:	0.1663
Epoch 548/600		0 -	2		1	0 1550
250/250 [===========] Epoch 549/600	-	US	zms/step	-	LOSS:	0.1553
250/250 [====================================	_	0s	2ms/step	_	loss:	0.1627
Epoch 550/600			•			
250/250 [===========]	-	0s	2ms/step	-	loss:	0.1635
Epoch 551/600 250/250 [====================================		0.5	2mc/cton		1000	0 1586
Epoch 552/600	_	03	21113/3 CCP	-	1055.	0.1300
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1661
Epoch 553/600		_			_	
250/250 [===========] Epoch 554/600	-	0s	2ms/step	-	loss:	0.1574
250/250 [====================================	_	05	2ms/sten	_	1055:	0.1499
Epoch 555/600		03	211137 3 CCP			0.1133
250/250 [=======]	-	0s	2ms/step	-	loss:	0.1324
Epoch 556/600		ο -	2		1	0 1470
250/250 [===========] Epoch 557/600	-	٥s	2ms/step	-	loss:	0.14/2
250/250 [====================================	_	0s	2ms/step	_	loss:	0.1401
Epoch 558/600			-			
250/250 [==========]	-	0s	2ms/step	-	loss:	0.1304
Epoch 559/600 250/250 [====================================		0.0	2mc/c+on		1000	a 1001
Epoch 560/600	-	05	21115/5 LEβ	-	1055;	0.1001
250/250 [====================================	-	0s	2ms/step	-	loss:	0.1034

Epoch 561/600						
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0999
Epoch 562/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0863
Epoch 563/600 250/250 [====================================		0.0	2mc/cton		10001	0 0606
Epoch 564/600	-	05	Ziiis/step	-	1055.	0.0000
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0543
Epoch 565/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0458
Epoch 566/600		0 -	2		1	0 0410
250/250 [===========] Epoch 567/600	-	05	zms/step	-	LOSS:	0.0418
250/250 [====================================	_	05	2ms/sten	_	loss:	0.0298
Epoch 568/600		03	211137 3 CCP		(055)	010230
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0194
Epoch 569/600					_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0198
Epoch 570/600 250/250 [====================================		0.0	2ms/ston		10001	0 0202
Epoch 571/600	-	05	ziiis/step	-	1055;	0.0202
250/250 [====================================	_	0s	2ms/step	_	loss:	0.0158
Epoch 572/600			, 0 10			0.0200
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0086
Epoch 573/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0086
Epoch 574/600 250/250 [====================================	_	0 c	2mc/ctan	_	1000	0 0167
Epoch 575/600	_	03	21113/3 CEP	_	1033.	0.0107
250/250 [====================================	-	0s	2ms/step	_	loss:	0.0113
Epoch 576/600						
250/250 [==========]	-	0s	2ms/step	-	loss:	0.0078
Epoch 577/600		0 -	2		1	0.0100
250/250 [============] Epoch 578/600	-	05	zms/step	-	LOSS:	0.0196
250/250 [====================================	_	05	2ms/sten	_	loss:	0.0096
Epoch 579/600		0.5	23, 3 ccp			0.0050
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0078
Epoch 580/600					_	
250/250 [===========]	-	0s	2ms/step	-	loss:	0.0064
Epoch 581/600		٥٥	2ms/ston		1000.	0 0106
250/250 [===========] Epoch 582/600	-	05	ziiis/s cep	-	1055:	0.0100
250/250 [====================================	_	05	2ms/sten	_	loss:	0.0043
Epoch 583/600			, 0 10			
250/250 [=======]	-	0s	2ms/step	-	loss:	0.0146
Epoch 584/600		_			_	
250/250 [====================================	-	0s	2ms/step	-	loss:	0.0078
Epoch 585/600 250/250 [====================================		0.0	2mc/c+on		1000	U UUSO
230/230 [====================================	-	05	ziiis/step	-	1055:	0.0036

```
Epoch 586/600
Epoch 587/600
Epoch 588/600
Epoch 589/600
Epoch 590/600
Epoch 591/600
Epoch 592/600
Epoch 593/600
Epoch 594/600
Epoch 595/600
Epoch 596/600
250/250 [============= ] - Os 2ms/step - loss: 0.0107
Epoch 597/600
Epoch 598/600
Epoch 599/600
Epoch 600/600
250/250 [============= ] - 0s 2ms/step - loss: 0.0043
figure = plt.figure(figsize = (10, 5))
histx = []
for i in range(len(hist.history['loss'])):
 histx.append(i)
plt.plot(histx, hist.history['loss'])
plt.title("loss")
plt.show()
```



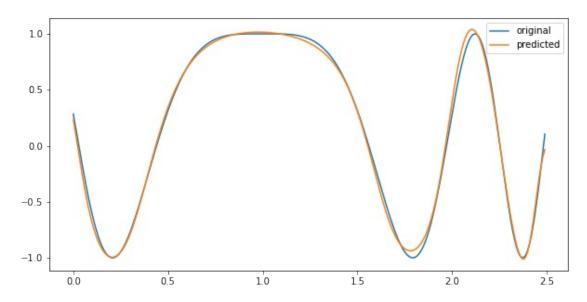
t2 = np.arange(0, 2.5, 0.01)

pred = model.predict(t2)

figure = plt.figure(figsize = (10, 5))

plt.plot(t, ft, label = 'original')
plt.plot(t2, pred, label = 'predicted')
plt.legend()
plt.show()

8/8 [=======] - 0s 3ms/step



Выводы

Ознакомился с многослойными нейронными сетями и их свойствами. Реализовал две многослойные модели для решения задач классификации и апроскимации.