

Министерство науки и высшего образования РФ  
*Национальный исследовательский университет ИТМО*

Факультет Программной инженерии и компьютерных технологий

**По дисциплине:**  
**Системы искусственного интеллекта**

**Лабораторная работа №4.**  
*«Study of the neural network»*  
**Вариант 1**

**Выполнил:** До Зыонг Мань  
**Группа:** P33201

Санкт–Петербург  
2022 год.

## I. Описание задания

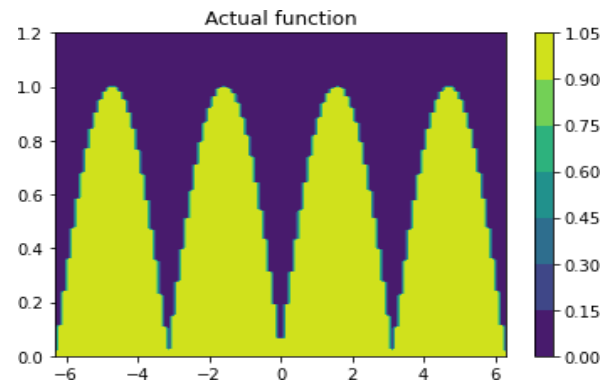
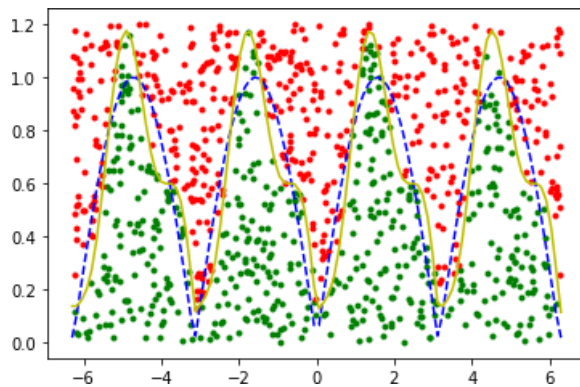
There are 2 parts of work in files named Lab1-Part1 and Lab1-Part2 respectively. Both parts represent work with collections of training and test data.

Part 1 represent recognition of basic math functions with illustrations of neural net vision of the functions for training.

Part 2 represent recognition of simple images for making following work.

Data usage represented at <https://keras.io/datasets/> and depends on variant.

Var	Part1 func	Part2 data	Hyperparameters
1	Absolute(Sin(x)) X: -6.3 ... 6.3 Y: 0 ... 1.2	CIFAR10	Layers count, neurons count per layer



There are represented such hyperparameters as:

- Layer count;
- Neurons count per layer (actually it's not hyperparameter but structure parameter);
- Learn rate;
- Regularization L1 and L2;
- Output layer activation type;
- Layer activation type;
- Loss function type;
- Epoch count.

1. By changing these hyperparameters try to reach max accuracy value(at least 0.95) for Part2 model with fixed epoch count 20;

2. Change 1st hyperparameter's value from min to max with minimal step depends on your variant;

3. Show impact on result using graphs;

4. Describe impact of each hyperparameter on accuracy;
5. Set hyperparameter value back to one which produced max accuracy;
6. Repeat 2-5 steps for second hyperparameter.

Make a report including:

- Each hyperparameter description and its impact on accuracy.
- Hyperparameters' values which were used to reach accuracy value 0.95.
- Graphs for these hyperparameters' values.

## II. Выполнение

### 1. Часть 1

#### а. Hyperparameters

Сколько:

Loss function:

Batch size:

Learn rate:

Regularization L1:

Regularization L2:

Output layer activation type:

Epoch count:

Neurons count in layer 1:

Neurons count in layer 2:

Neurons count in layer 1:

Neurons count in layer 1:

Layer 1 activation type:

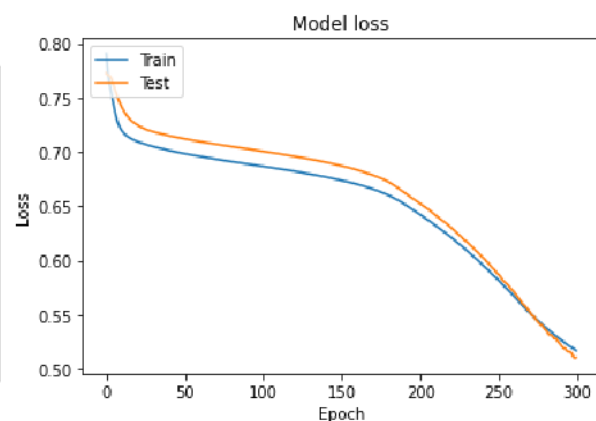
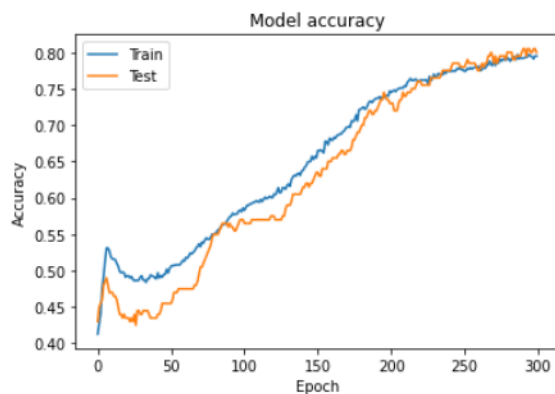
Layer 2 activation type:

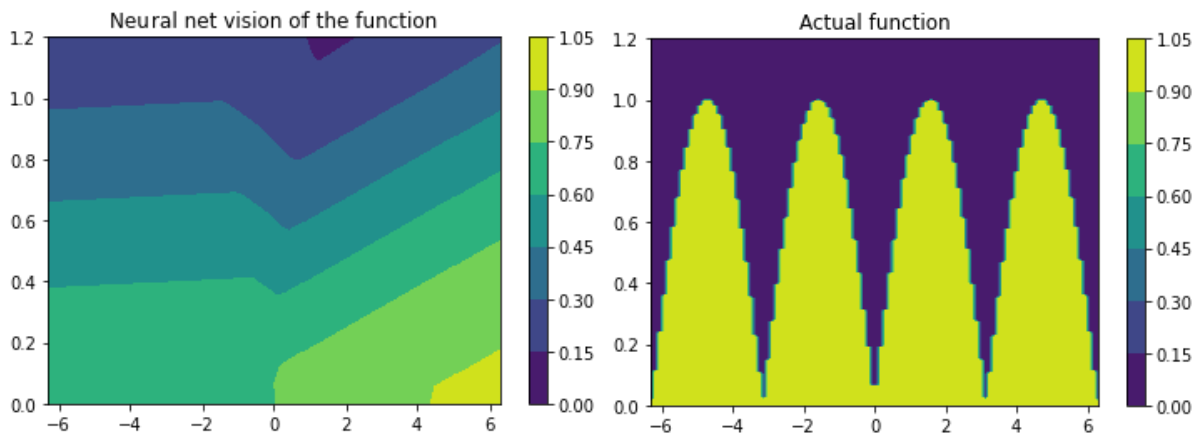
Layer 3 activation type:

Layer 4 activation type:

Граф для этих параметров:

Accuracy: 0.800000011920929

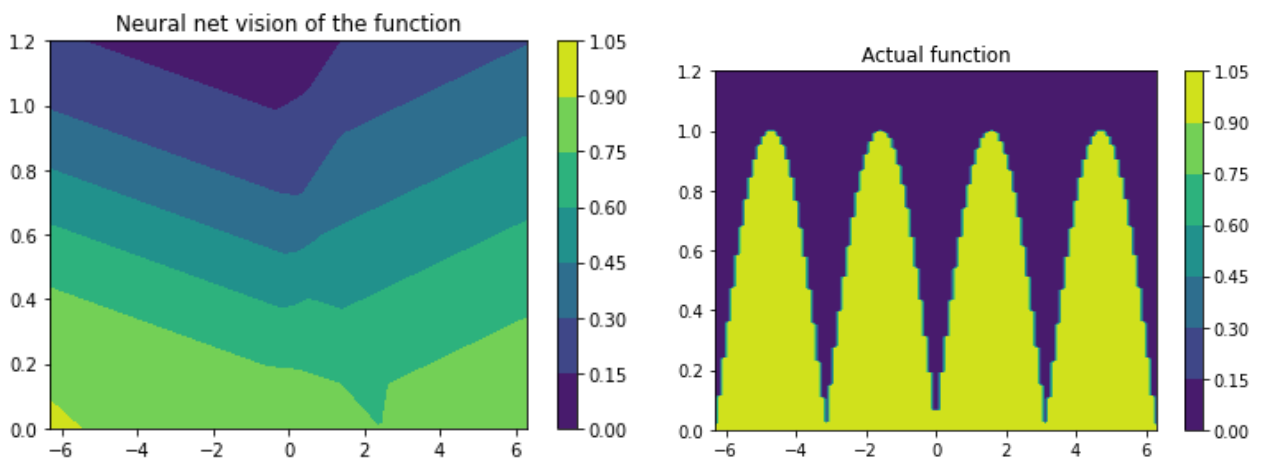
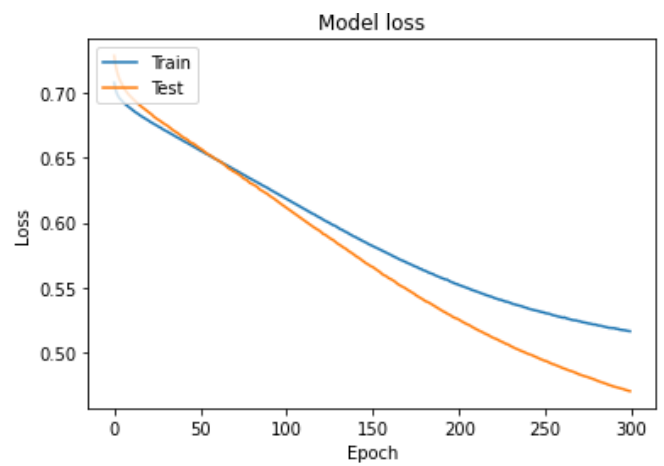
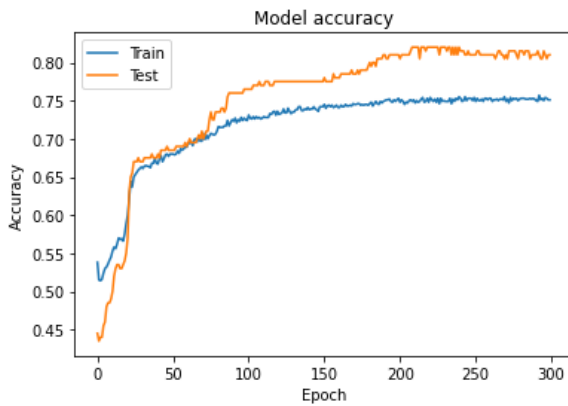




## б. Изменение слоев

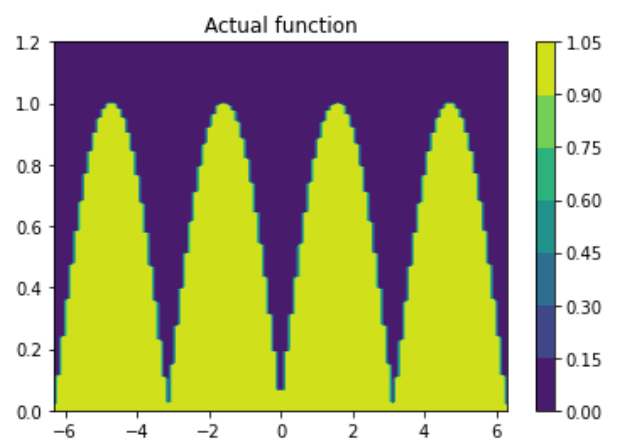
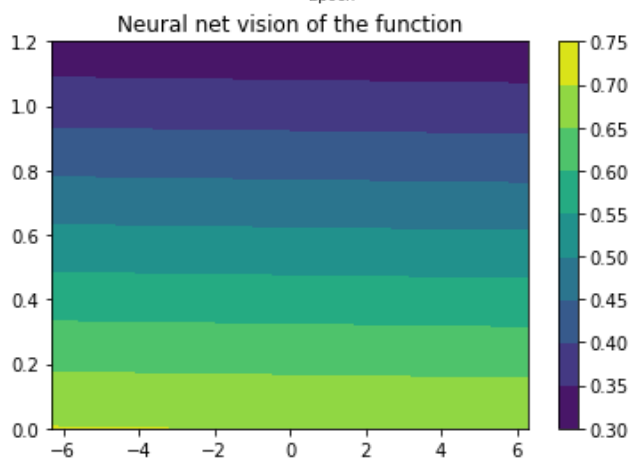
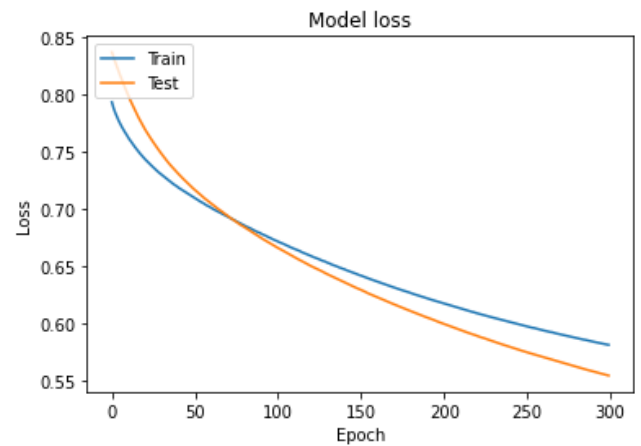
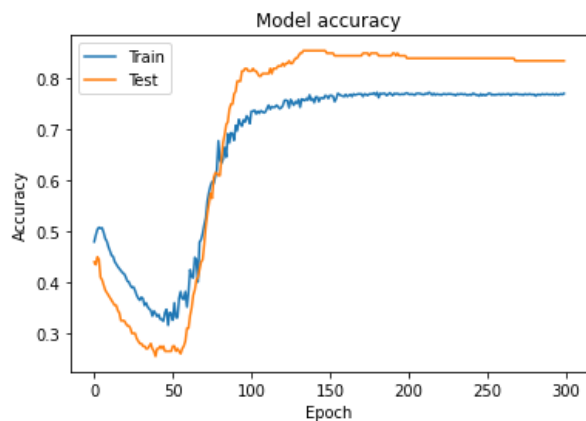
+) Слоев = 1

Accuracy: 0.8100000023841858



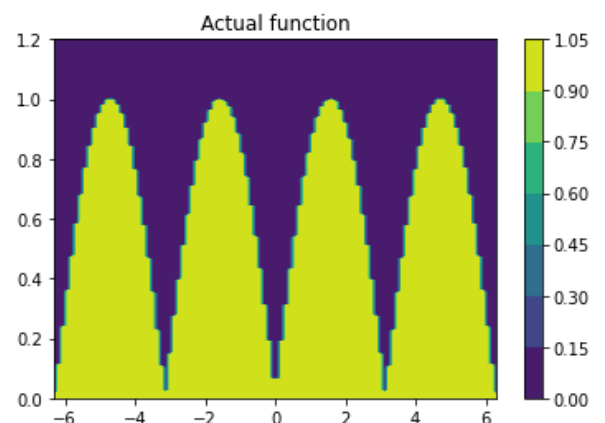
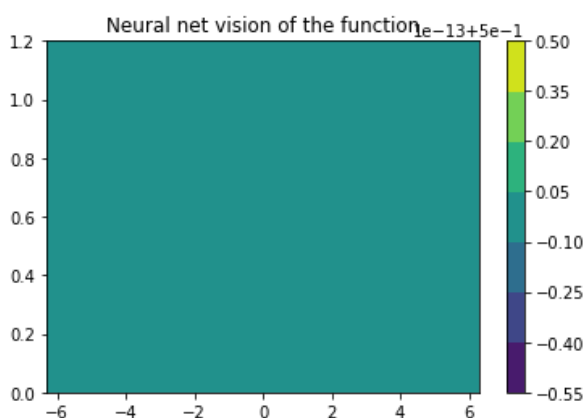
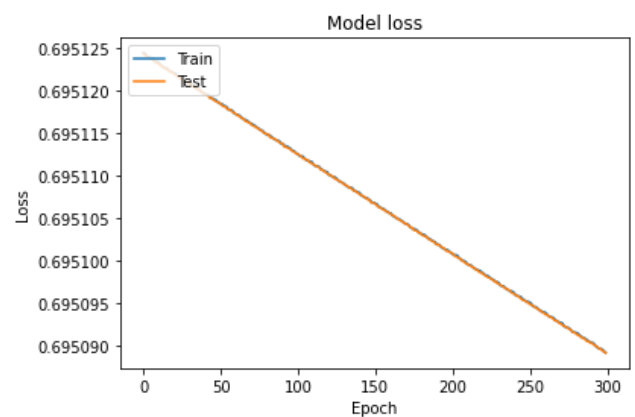
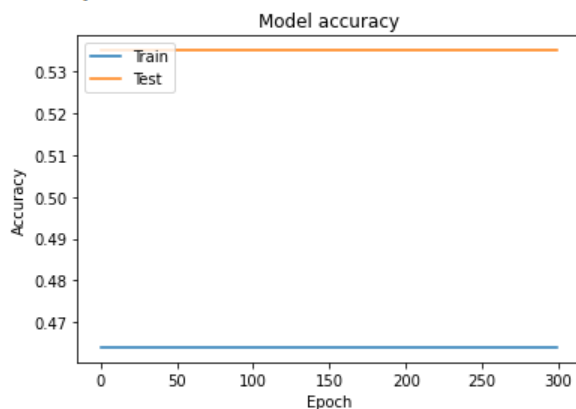
## +) Слой = 0

Accuracy: 0.8349999785423279



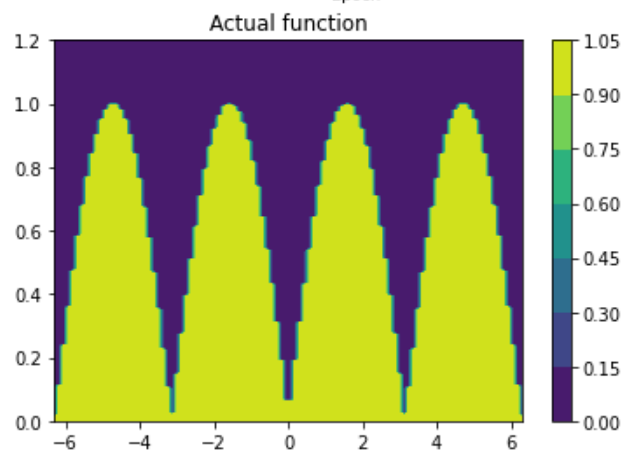
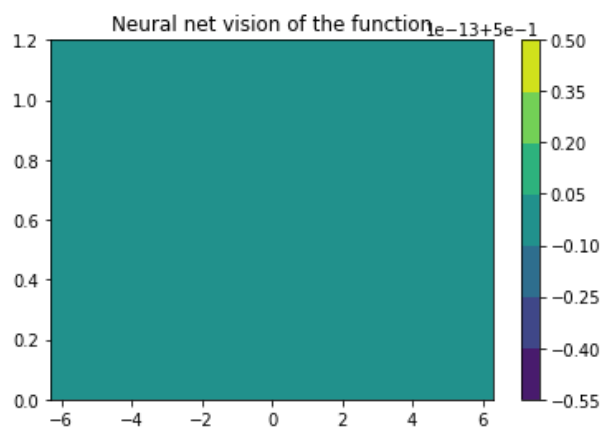
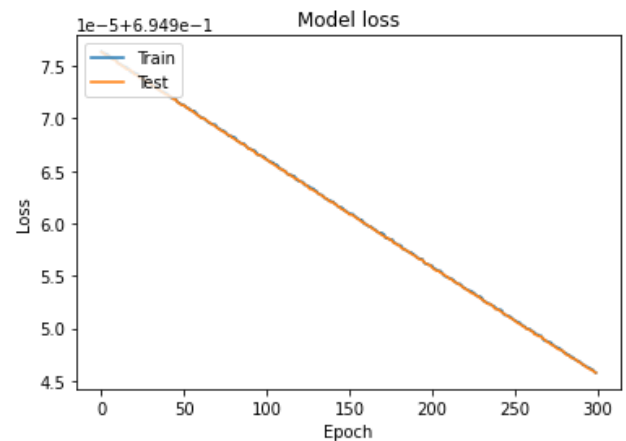
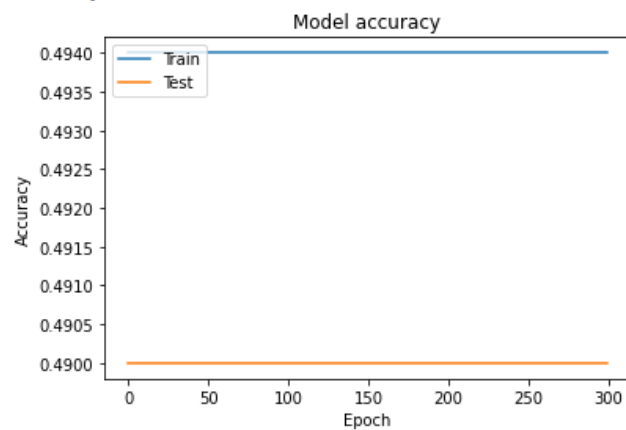
## +) Слой = 3

Accuracy: 0.5350000262260437



**+) Слоев = 4**

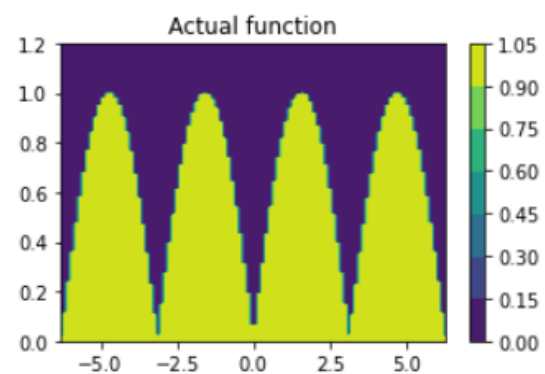
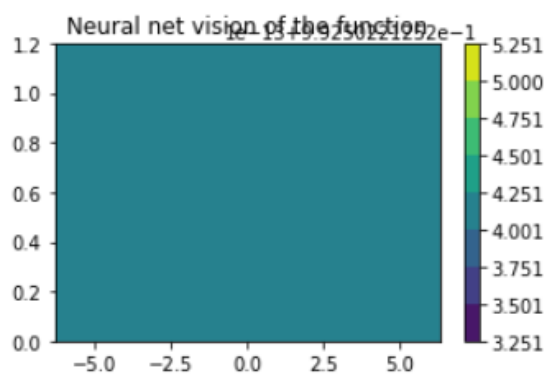
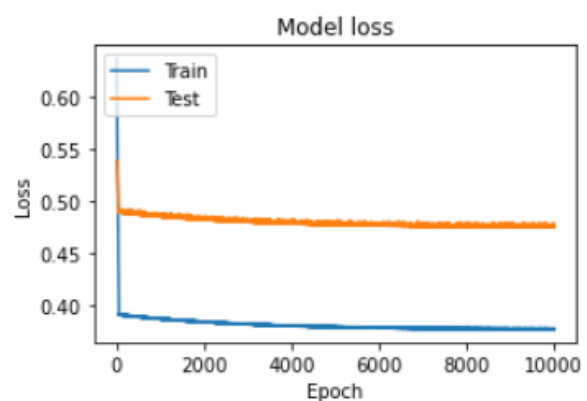
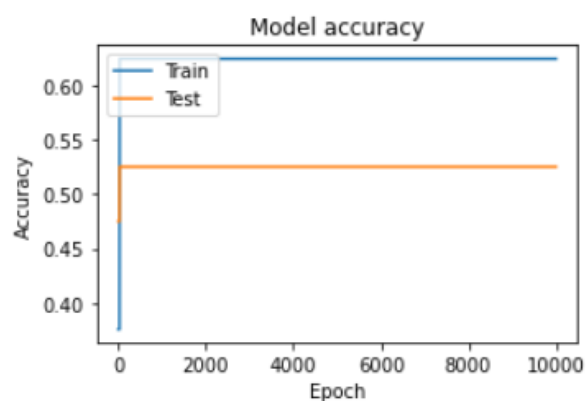
Accuracy: 0.49000000953674316



**с. Изменение количества нейронов на слой**

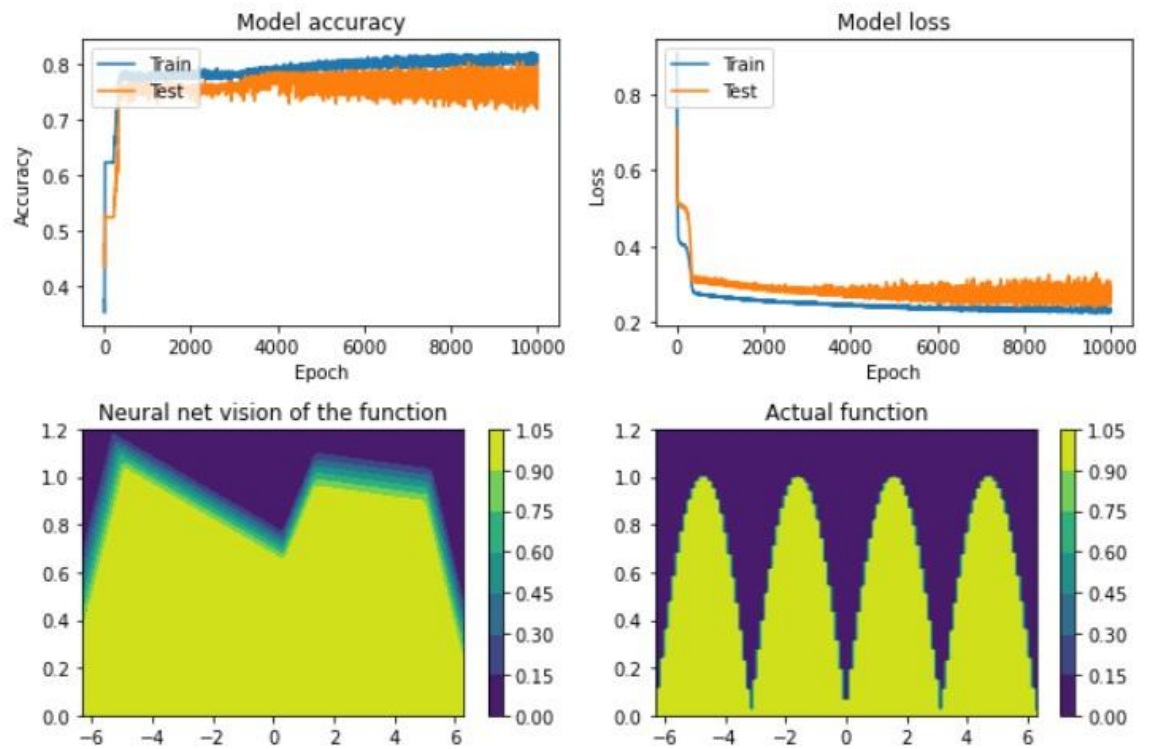
**d. 1 neuron**

Accuracy: 0.5249999761581421



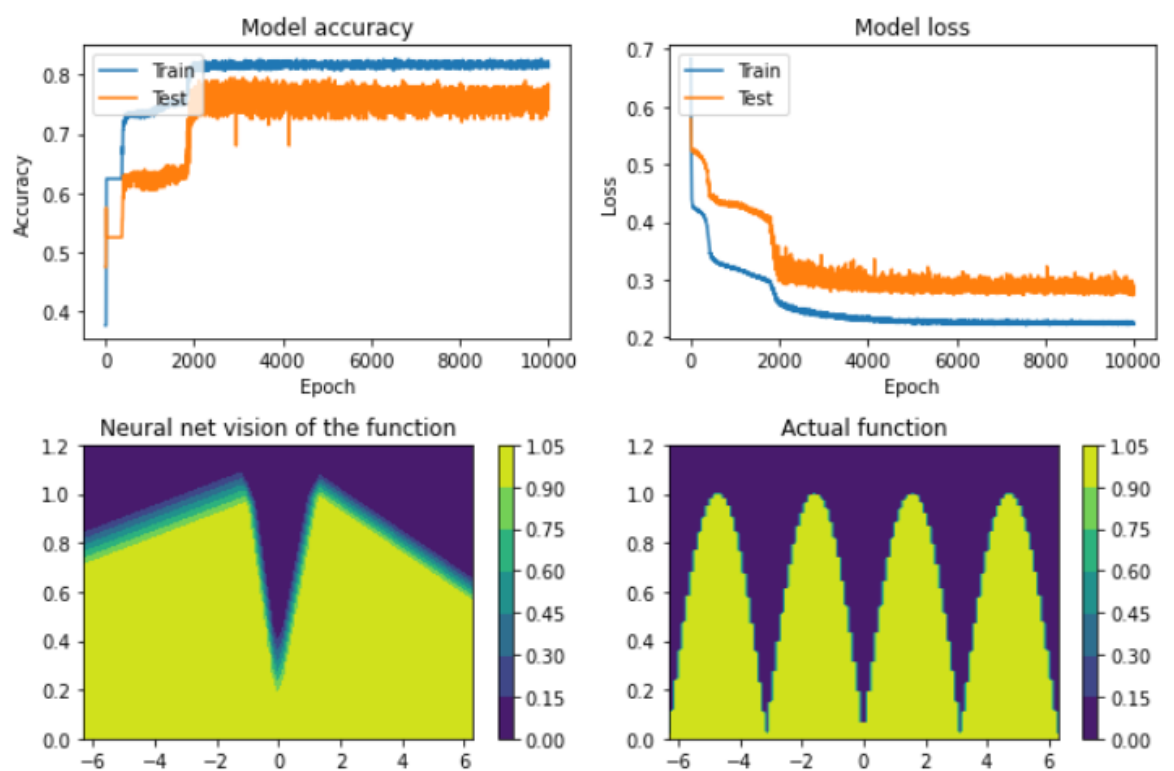
### 3 neurons

Accuracy: 0.7400000095367432



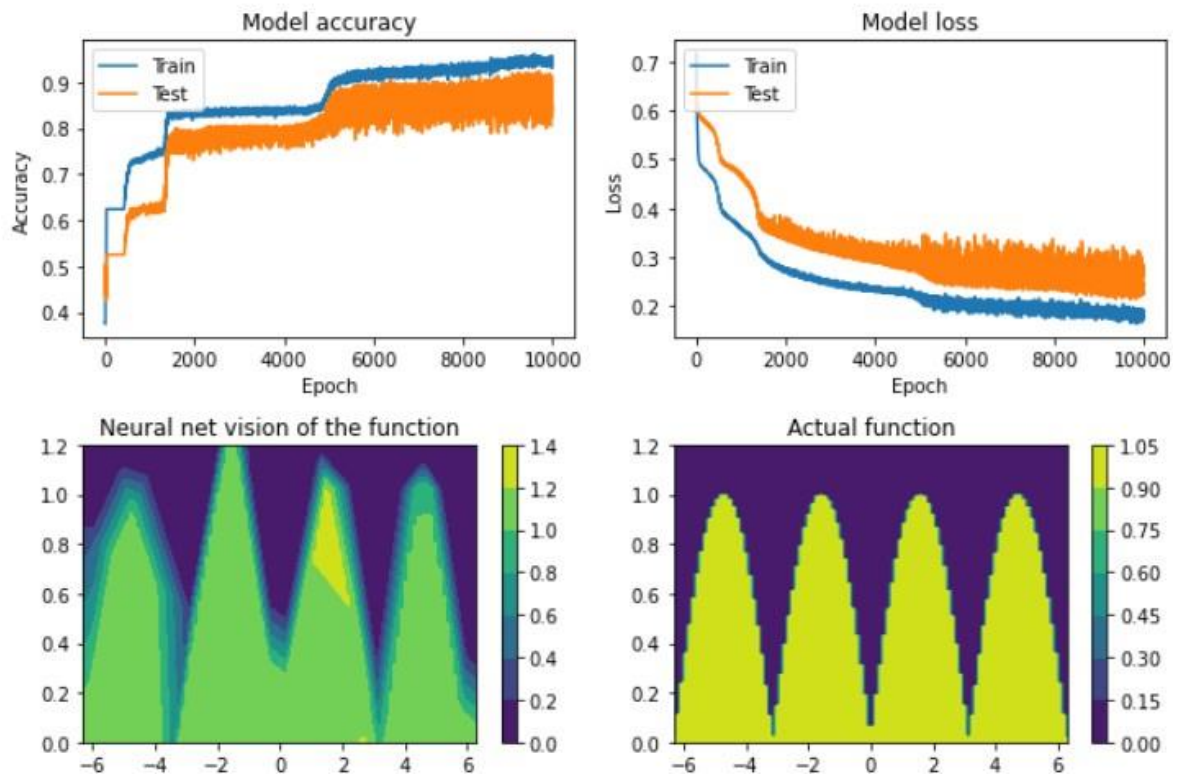
### 5 neuron

Accuracy: 0.7799999713897705



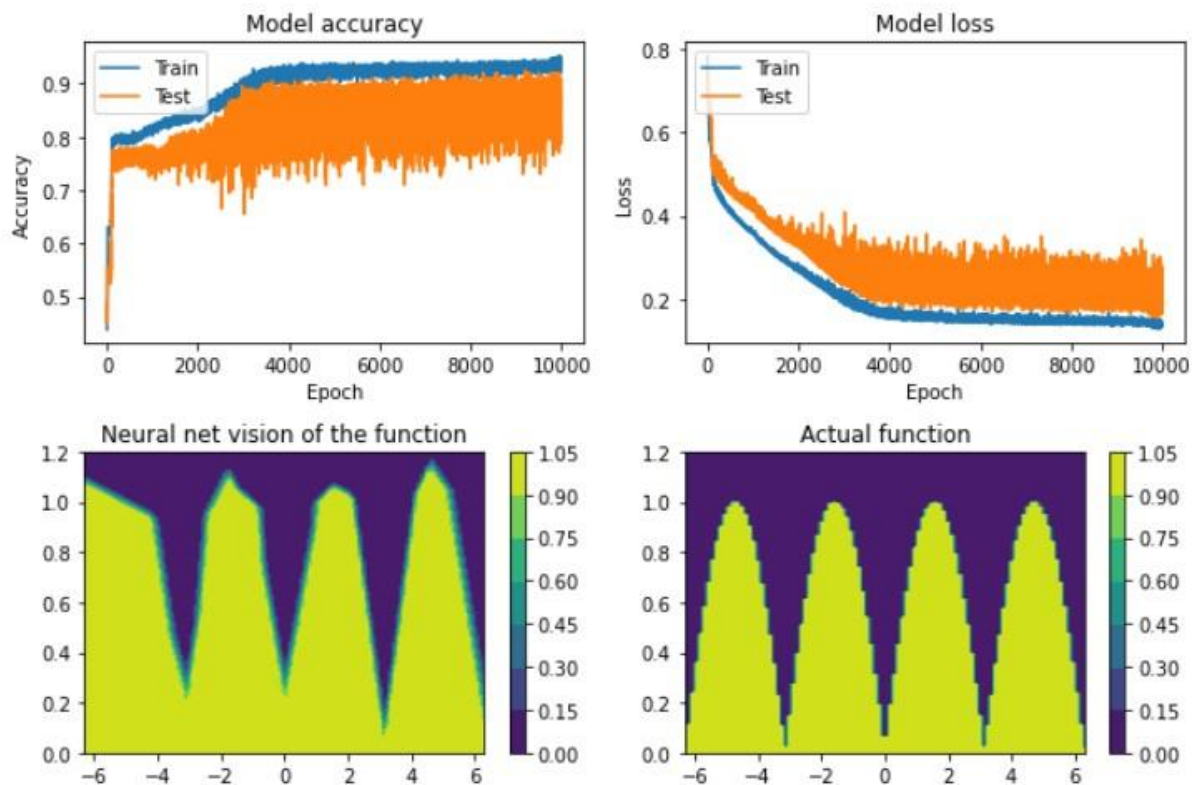
## 10 neurons

Accuracy: 0.8500000238418579



## 15 neuron

Accuracy: 0.875





## Нейронная сеть с лучшим гиперпараметром:

Слоев:

Loss function:

Batch size:

Learn rate:

Regularization L1:

Regularization L2:

Output layer activation type:

Epoch count:

Neurons count in layer 1:

Neurons count in layer 2:

Neurons count in layer 1:

Neurons count in layer 1:

Layer 1 activation type:

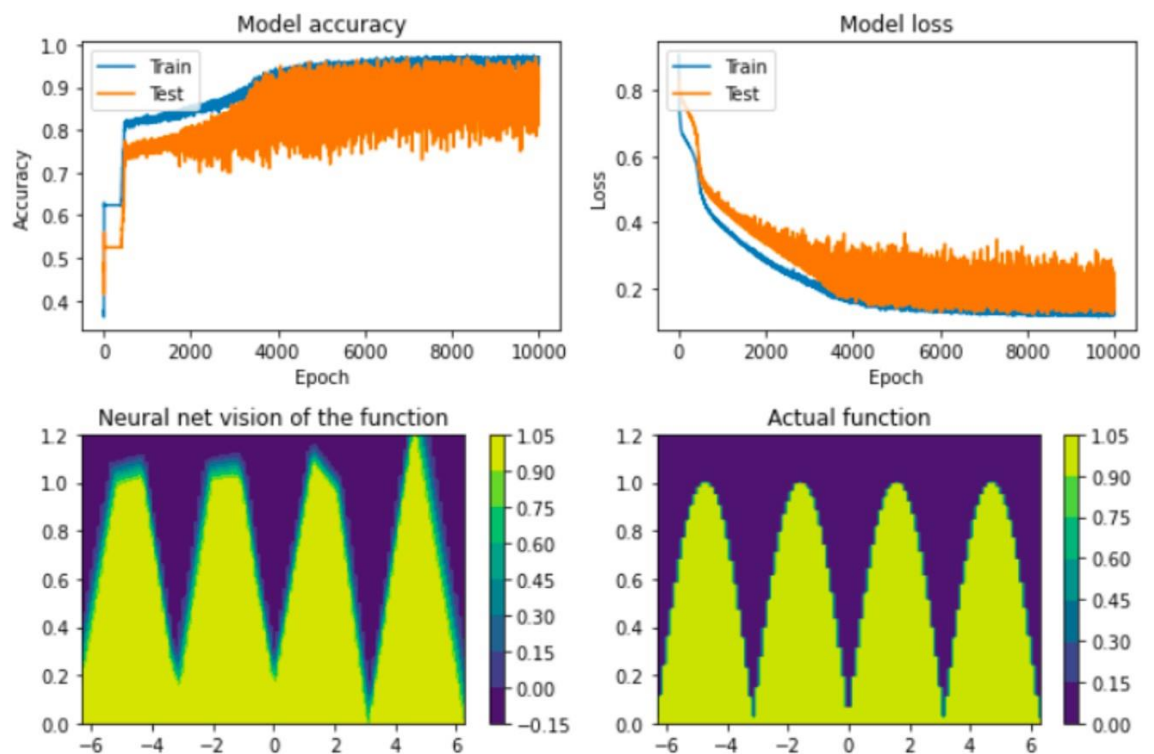
Layer 2 activation type:

Layer 3 activation type:

Layer 4 activation type:

Accuracy: 0.925000011920929

## Результат:



## 2. Часть 2

Layers:  2

Loss function:

Batch size:

Learn rate: 

-0.1	0	0.001	0.01	0.05	0.1	0.5	1	5
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Regularization L1: 

-0.1	0	0.0001	0.0005	0.001	0.005	0.01	0.05	0.1
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Regularization L2: 

-0.1	0	0.0001	0.0005	0.001	0.005	0.01	0.05	0.1
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Output layer activation type:

Epoch count:  20

Neurons per layer:  6

Layer 1 activation type:

Layer 2 activation type:

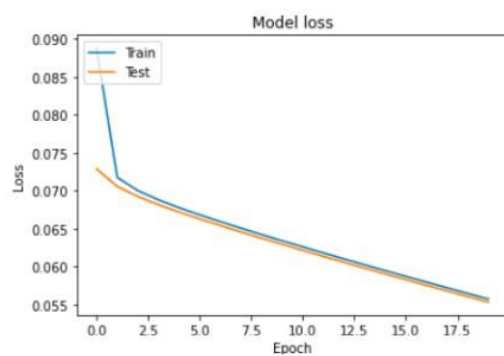
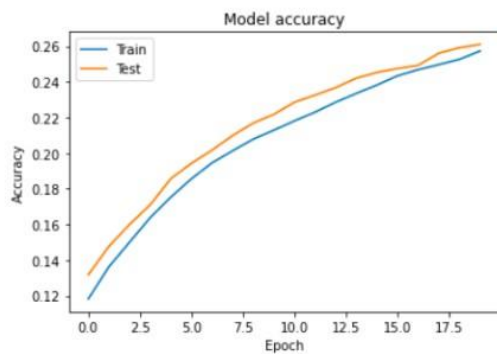
Layer 3 activation type:

Layer 4 activation type:

## а. Изменение количества слоев

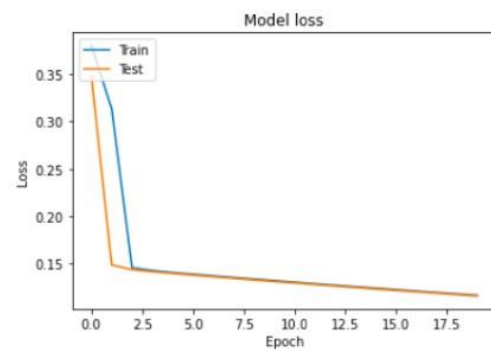
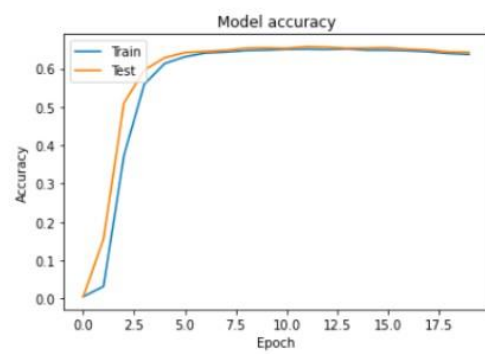
### 0 слоев

Accuracy: 0.26100000739097595



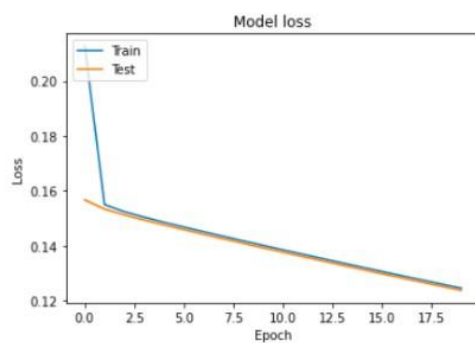
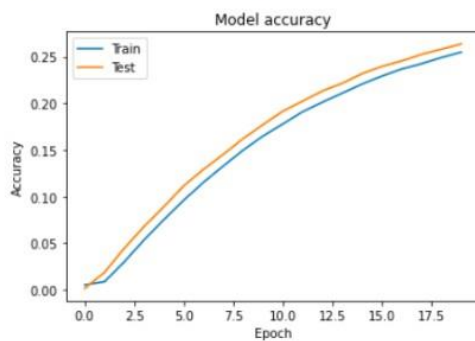
### 1 слой

Accuracy: 0.6427000164985657



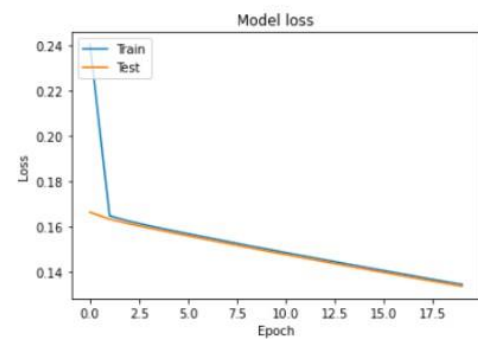
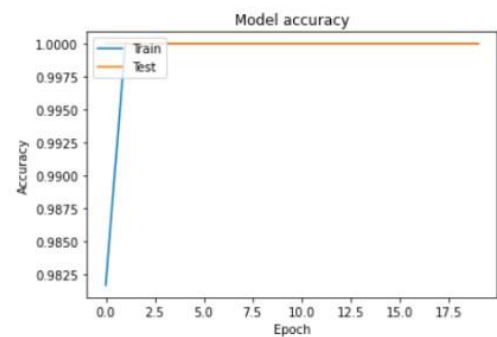
### 2 слоя

Accuracy: 0.2635999917984009



### 3 слоя

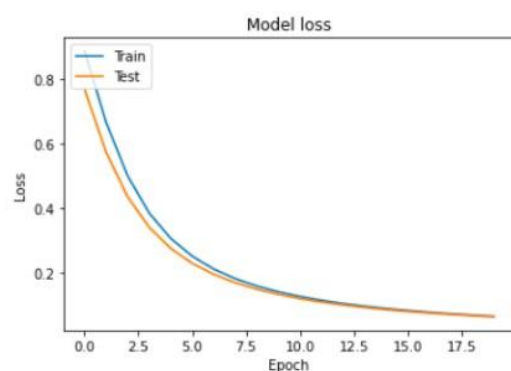
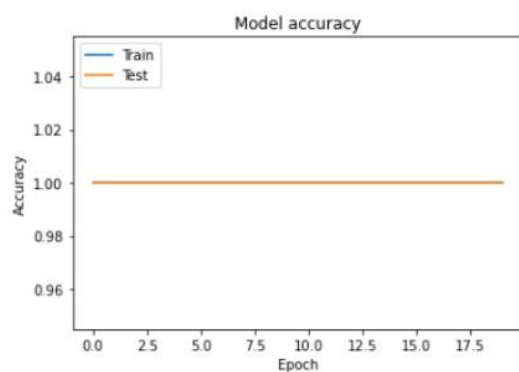
Accuracy: 1.0



## б. Изменение количества нейронов на слой

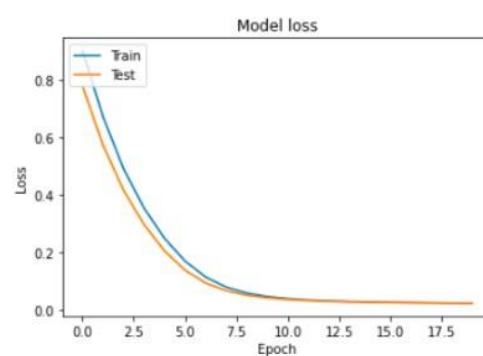
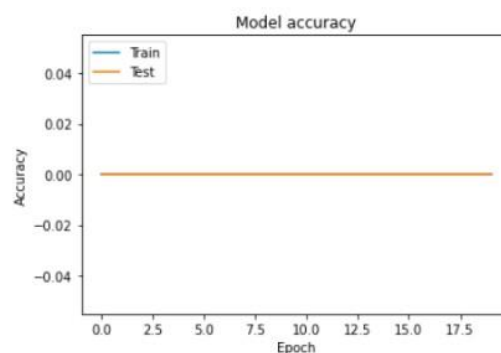
### 1 neuron

Accuracy: 1.0



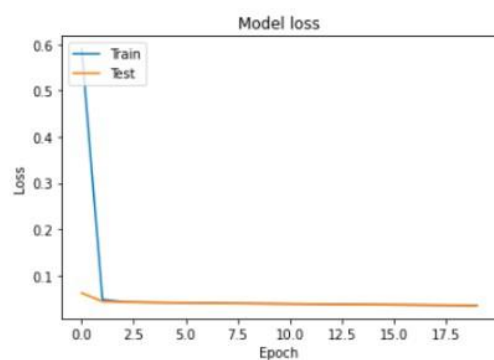
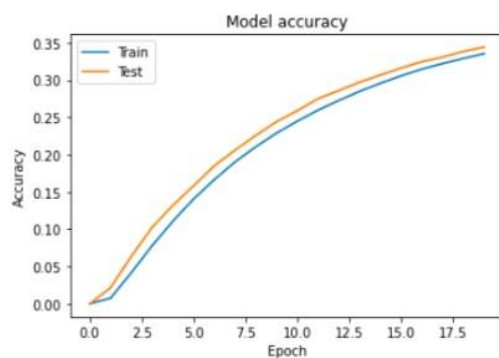
### 3 neurons

Accuracy: 0.0



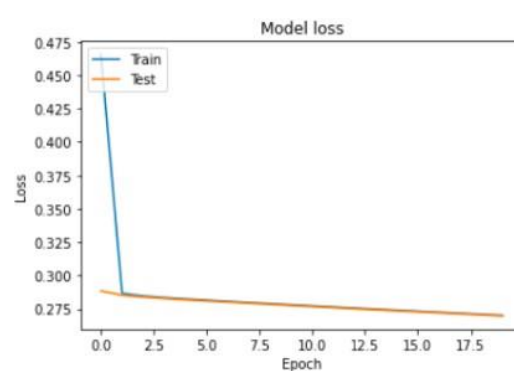
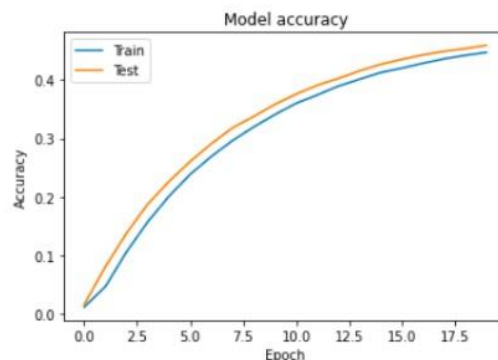
### 5 neurons

Accuracy: 0.3440999984741211



### 10 neurons

Accuracy: 0.45890000462532043



Лучшие гиперпараметры для точности более 0.95:

Layers:  4

Loss function:

Batch size:

Learn rate: 

-0.1	0	0.001	0.01	0.05
0.1	0.5	1	5	

Regularization L1: 

-0.1	0	0.0001	0.0005	0.001
0.005	0.01	0.05	0.1	

Regularization L2: 

-0.1	0	0.0001	0.0005	0.001
0.005	0.01	0.05	0.1	

Output layer activation type:

Epoch count:  20

Neurons per layer:  20

Layer 1 activation type:

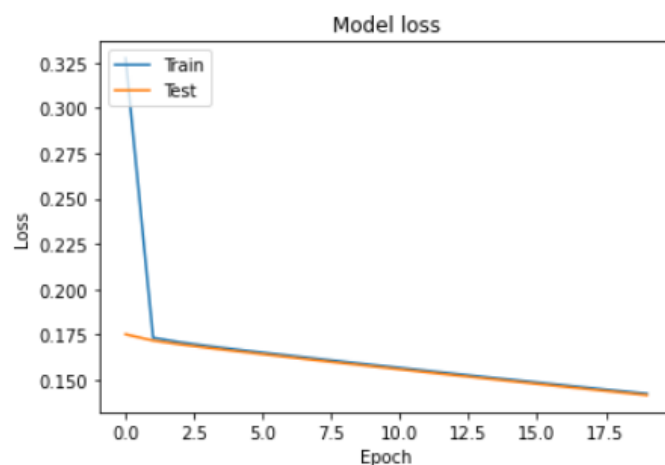
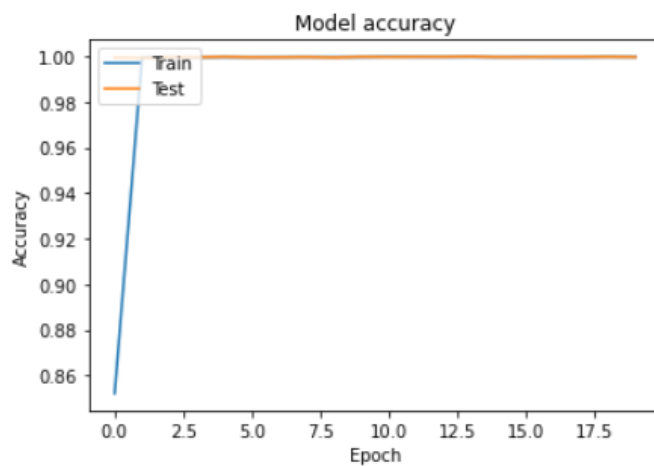
Layer 2 activation type:

Layer 3 activation type:

Layer 4 activation type:

и результат

Accuracy: 0.9997000098228455



### **III. Вывод**

При выполнении лабораторной работы я потратил много времени на настройку гиперпараметров модели с максимальной возможной точностью. На самом деле это было не так просто, так как комбинаций много, поэтому выбор одного требовал внимания.