Лабораторная работа №1

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In [9]:
```
import pandas
from tensorflow.keras.layers import Dense
from tensorflow.keras.models import Sequential
from tensorflow.keras.utils import to_categorical
from sklearn.preprocessing import LabelEncoder
import keras
from matplotlib import pyplot as plt
```

In [10]:
```
dataframe = pandas.read_csv("C:\\Users\\loprz\\Downloads\\iris.data", header=Nor
dataset = dataframe.values
X = dataset[:,0:4].astype(float)
Y = dataset[:,4]
```

In [11]:
```
encoder = LabelEncoder()
encoder.fit(Y)
encoded_Y = encoder.transform(Y)
dummy_y = to_categorical(encoded_Y)
```

In [12]:
```
model = Sequential()
model.add(Dense(4, activation='relu'))
model.add(Dense(3, activation='softmax'))

model5 = Sequential()
model5.add(Dense(4, activation='relu'))
model5.add(Dense(3, activation='softmax'))

model6 = Sequential()
model6.add(Dense(4, activation='relu'))
model6.add(Dense(3, activation='softmax'))
```

In [13]:
```
model.compile(optimizer='adam',loss='categorical_crossentropy', metrics=['accura
model5.compile(optimizer='adam',loss='categorical_crossentropy', metrics=['accur
model6.compile(optimizer='SGD',loss='categorical_crossentropy', metrics=['accura
```

In [14]:
```
history = model.fit(X, dummy_y, epochs=75, batch_size=10, validation_split=0.1)
history5 = model5.fit(X, dummy_y, epochs=105, batch_size=16, validation_split=0.
history6 = model6.fit(X, dummy_y, epochs=105, batch_size=16, validation_split=0.
```

```
Epoch 1/75
14/14 [==============================] - 1s 17ms/step - loss: 2.0530 - accuracy:
0.0000e+00 - val_loss: 5.4702 - val_accuracy: 0.0000e+00
Epoch 2/75
14/14 [==============================] - 0s 5ms/step - loss: 1.9396 - accuracy:
0.0000e+00 - val_loss: 5.1003 - val_accuracy: 0.0000e+00
Epoch 3/75
14/14 [==============================] - 0s 5ms/step - loss: 1.8273 - accuracy:
0.0000e+00 - val_loss: 4.7614 - val_accuracy: 0.0000e+00
Epoch 4/75
14/14 [==============================] - 0s 5ms/step - loss: 1.7318 - accuracy:
0.0000e+00 - val_loss: 4.3693 - val_accuracy: 0.0000e+00
Epoch 5/75
14/14 [==============================] - 0s 5ms/step - loss: 1.6269 - accuracy:
0.0000e+00 - val_loss: 4.0487 - val_accuracy: 0.0000e+00
Epoch 6/75
14/14 [==============================] - 0s 5ms/step - loss: 1.5438 - accuracy:
0.0000e+00 - val_loss: 3.6661 - val_accuracy: 0.0000e+00
Epoch 7/75
14/14 [==============================] - 0s 5ms/step - loss: 1.4505 - accuracy:
0.0000e+00 - val_loss: 3.3544 - val_accuracy: 0.0000e+00
Epoch 8/75
14/14 [==============================] - 0s 5ms/step - loss: 1.3725 - accuracy:
0.0000e+00 - val_loss: 3.0304 - val_accuracy: 0.0000e+00
Epoch 9/75
14/14 [==============================] - 0s 4ms/step - loss: 1.2943 - accuracy:
0.0000e+00 - val_loss: 2.7371 - val_accuracy: 0.0000e+00
Epoch 10/75
14/14 [==============================] - 0s 5ms/step - loss: 1.2241 - accuracy:
0.0000e+00 - val_loss: 2.4259 - val_accuracy: 0.0000e+00
Epoch 11/75
14/14 [==============================] - 0s 4ms/step - loss: 1.1583 - accuracy:
0.0000e+00 - val_loss: 2.1272 - val_accuracy: 0.0000e+00
Epoch 12/75
14/14 [==============================] - 0s 4ms/step - loss: 1.0957 - accuracy:
0.0000e+00 - val_loss: 1.8855 - val_accuracy: 0.0000e+00
Epoch 13/75
14/14 [==============================] - 0s 4ms/step - loss: 1.0449 - accuracy:
0.0000e+00 - val_loss: 1.6636 - val_accuracy: 0.0000e+00
Epoch 14/75
14/14 [==============================] - 0s 4ms/step - loss: 1.0054 - accuracy:
0.0370 - val_loss: 1.4632 - val_accuracy: 0.0000e+00
Epoch 15/75
14/14 [==============================] - 0s 5ms/step - loss: 0.9701 - accuracy:
0.0593 - val_loss: 1.3218 - val_accuracy: 0.0667
Epoch 16/75
14/14 [==============================] - 0s 5ms/step - loss: 0.9438 - accuracy:
0.1333 - val_loss: 1.2003 - val_accuracy: 0.2667
Epoch 17/75
14/14 [==============================] - 0s 5ms/step - loss: 0.9200 - accuracy:
0.4074 - val_loss: 1.1264 - val_accuracy: 0.3333
Epoch 18/75
14/14 [==============================] - 0s 5ms/step - loss: 0.9019 - accuracy:
0.5778 - val_loss: 1.0545 - val_accuracy: 0.5333
Epoch 19/75
14/14 [==============================] - 0s 4ms/step - loss: 0.8865 - accuracy:
0.7185 - val_loss: 0.9975 - val_accuracy: 0.6000
Epoch 20/75
14/14 [==============================] - 0s 5ms/step - loss: 0.8724 - accuracy:
0.7481 - val_loss: 0.9523 - val_accuracy: 0.6667
```

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Epoch 21/75
14/14 [==============================] - 0s 5ms/step - loss: 0.8583 - accuracy:
0.8000 - val_loss: 0.9383 - val_accuracy: 0.6667
Epoch 22/75
14/14 [==============================] - 0s 5ms/step - loss: 0.8465 - accuracy:
0.8074 - val_loss: 0.9468 - val_accuracy: 0.6000
Epoch 23/75
14/14 [==============================] - 0s 5ms/step - loss: 0.8332 - accuracy:
0.8148 - val_loss: 0.8976 - val_accuracy: 0.7333
Epoch 24/75
14/14 [==============================] - 0s 4ms/step - loss: 0.8208 - accuracy:
0.8074 - val_loss: 0.8932 - val_accuracy: 0.7333
Epoch 25/75
14/14 [==============================] - 0s 5ms/step - loss: 0.8089 - accuracy:
0.8222 - val_loss: 0.8809 - val_accuracy: 0.7333
Epoch 26/75
14/14 [==============================] - 0s 5ms/step - loss: 0.7972 - accuracy:
0.8296 - val_loss: 0.8898 - val_accuracy: 0.6000
Epoch 27/75
14/14 [==============================] - 0s 5ms/step - loss: 0.7851 - accuracy:
0.8370 - val_loss: 0.8746 - val_accuracy: 0.6000
Epoch 28/75
14/14 [==============================] - 0s 4ms/step - loss: 0.7736 - accuracy:
0.8370 - val_loss: 0.8750 - val_accuracy: 0.6000
Epoch 29/75
14/14 [==============================] - 0s 4ms/step - loss: 0.7626 - accuracy:
0.8593 - val_loss: 0.8638 - val_accuracy: 0.6000
Epoch 30/75
14/14 [==============================] - 0s 5ms/step - loss: 0.7509 - accuracy:
0.8593 - val_loss: 0.8683 - val_accuracy: 0.6000
Epoch 31/75
14/14 [==============================] - 0s 5ms/step - loss: 0.7392 - accuracy:
0.8815 - val_loss: 0.8593 - val_accuracy: 0.6000
Epoch 32/75
14/14 [==============================] - 0s 5ms/step - loss: 0.7280 - accuracy:
0.8889 - val_loss: 0.8651 - val_accuracy: 0.5333
Epoch 33/75
14/14 [==============================] - 0s 5ms/step - loss: 0.7171 - accuracy:
0.8815 - val_loss: 0.8462 - val_accuracy: 0.6000
Epoch 34/75
14/14 [==============================] - 0s 5ms/step - loss: 0.7067 - accuracy:
0.8889 - val_loss: 0.8397 - val_accuracy: 0.6000
Epoch 35/75
14/14 [==============================] - 0s 4ms/step - loss: 0.6951 - accuracy:
0.8815 - val_loss: 0.8504 - val_accuracy: 0.4667
Epoch 36/75
14/14 [==============================] - 0s 5ms/step - loss: 0.6843 - accuracy:
0.8741 - val_loss: 0.8593 - val_accuracy: 0.4000
Epoch 37/75
14/14 [==============================] - 0s 4ms/step - loss: 0.6742 - accuracy:
0.8741 - val_loss: 0.8651 - val_accuracy: 0.3333
Epoch 38/75
14/14 [==============================] - 0s 4ms/step - loss: 0.6642 - accuracy:
0.8741 - val_loss: 0.8546 - val_accuracy: 0.4000
Epoch 39/75
14/14 [==============================] - 0s 5ms/step - loss: 0.6545 - accuracy:
0.8741 - val_loss: 0.8515 - val_accuracy: 0.3333
Epoch 40/75
14/14 [==============================] - 0s 4ms/step - loss: 0.6443 - accuracy:
0.8741 - val_loss: 0.8233 - val_accuracy: 0.4000
```

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Epoch 41/75
14/14 [==============================] - 0s 4ms/step - loss: 0.6355 - accuracy:
0.8815 - val_loss: 0.8228 - val_accuracy: 0.4000
Epoch 42/75
14/14 [==============================] - 0s 6ms/step - loss: 0.6259 - accuracy:
0.8815 - val_loss: 0.8116 - val_accuracy: 0.4000
Epoch 43/75
14/14 [==============================] - 0s 5ms/step - loss: 0.6170 - accuracy:
0.8889 - val_loss: 0.7904 - val_accuracy: 0.4667
Epoch 44/75
14/14 [==============================] - 0s 5ms/step - loss: 0.6081 - accuracy:
0.8889 - val_loss: 0.7856 - val_accuracy: 0.4667
Epoch 45/75
14/14 [==============================] - 0s 5ms/step - loss: 0.6001 - accuracy:
0.8889 - val_loss: 0.7855 - val_accuracy: 0.4667
Epoch 46/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5911 - accuracy:
0.8889 - val_loss: 0.7967 - val_accuracy: 0.4000
Epoch 47/75
14/14 [==============================] - 0s 4ms/step - loss: 0.5834 - accuracy:
0.8889 - val_loss: 0.8006 - val_accuracy: 0.4000
Epoch 48/75
14/14 [==============================] - 0s 4ms/step - loss: 0.5752 - accuracy:
0.8815 - val_loss: 0.7924 - val_accuracy: 0.4000
Epoch 49/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5683 - accuracy:
0.8815 - val_loss: 0.8024 - val_accuracy: 0.4000
Epoch 50/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5604 - accuracy:
0.8889 - val_loss: 0.7815 - val_accuracy: 0.4000
Epoch 51/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5535 - accuracy:
0.8889 - val_loss: 0.7695 - val_accuracy: 0.4000
Epoch 52/75
14/14 [==============================] - 0s 4ms/step - loss: 0.5464 - accuracy:
0.8963 - val_loss: 0.7708 - val_accuracy: 0.4000
Epoch 53/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5401 - accuracy:
0.8889 - val_loss: 0.7888 - val_accuracy: 0.4000
Epoch 54/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5330 - accuracy:
0.8815 - val_loss: 0.7719 - val_accuracy: 0.4000
Epoch 55/75
14/14 [==============================] - 0s 4ms/step - loss: 0.5271 - accuracy:
0.8889 - val_loss: 0.7862 - val_accuracy: 0.4000
Epoch 56/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5212 - accuracy:
0.8889 - val_loss: 0.7540 - val_accuracy: 0.4000
Epoch 57/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5148 - accuracy:
0.9037 - val_loss: 0.7532 - val_accuracy: 0.4000
Epoch 58/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5091 - accuracy:
0.8963 - val_loss: 0.7701 - val_accuracy: 0.4000
Epoch 59/75
14/14 [==============================] - 0s 5ms/step - loss: 0.5034 - accuracy:
0.9037 - val_loss: 0.7583 - val_accuracy: 0.4000
Epoch 60/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4985 - accuracy:
0.9037 - val_loss: 0.7770 - val_accuracy: 0.3333
```

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Epoch 61/75
14/14 [==============================] - 0s 4ms/step - loss: 0.4929 - accuracy:
0.8963 - val_loss: 0.7612 - val_accuracy: 0.4000
Epoch 62/75
14/14 [==============================] - 0s 4ms/step - loss: 0.4877 - accuracy:
0.9037 - val_loss: 0.7583 - val_accuracy: 0.4000
Epoch 63/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4831 - accuracy:
0.9037 - val_loss: 0.7661 - val_accuracy: 0.4000
Epoch 64/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4780 - accuracy:
0.8963 - val_loss: 0.7572 - val_accuracy: 0.4000
Epoch 65/75
14/14 [==============================] - 0s 4ms/step - loss: 0.4736 - accuracy:
0.9111 - val_loss: 0.7355 - val_accuracy: 0.4000
Epoch 66/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4696 - accuracy:
0.8889 - val_loss: 0.7621 - val_accuracy: 0.3333
Epoch 67/75
14/14 [==============================] - 0s 4ms/step - loss: 0.4647 - accuracy:
0.8889 - val_loss: 0.7614 - val_accuracy: 0.3333
Epoch 68/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4605 - accuracy:
0.8963 - val_loss: 0.7444 - val_accuracy: 0.4000
Epoch 69/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4560 - accuracy:
0.9111 - val_loss: 0.7224 - val_accuracy: 0.4000
Epoch 70/75
14/14 [==============================] - 0s 4ms/step - loss: 0.4522 - accuracy:
0.9185 - val_loss: 0.7207 - val_accuracy: 0.4000
Epoch 71/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4483 - accuracy:
0.9185 - val_loss: 0.7250 - val_accuracy: 0.4000
Epoch 72/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4447 - accuracy:
0.9111 - val_loss: 0.7429 - val_accuracy: 0.4000
Epoch 73/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4411 - accuracy:
0.9111 - val_loss: 0.7176 - val_accuracy: 0.4000
Epoch 74/75
14/14 [==============================] - 0s 5ms/step - loss: 0.4376 - accuracy:
0.9185 - val_loss: 0.7123 - val_accuracy: 0.4000
Epoch 75/75
14/14 [==============================] - 0s 4ms/step - loss: 0.4335 - accuracy:
0.9111 - val_loss: 0.7311 - val_accuracy: 0.4000
Epoch 1/105
9/9 [==============================] - 1s 25ms/step - loss: 0.9705 - accuracy: 0.
4222 - val_loss: 1.6181 - val_accuracy: 0.0000e+00
Epoch 2/105
9/9 [==============================] - 0s 6ms/step - loss: 0.8917 - accuracy: 0.5
259 - val_loss: 1.5921 - val_accuracy: 0.0000e+00
Epoch 3/105
9/9 [==============================] - 0s 6ms/step - loss: 0.8338 - accuracy: 0.6
296 - val_loss: 1.5526 - val_accuracy: 0.0000e+00
Epoch 4/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7933 - accuracy: 0.7
111 - val_loss: 1.4808 - val_accuracy: 0.0000e+00
Epoch 5/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7625 - accuracy: 0.7
259 - val_loss: 1.4412 - val_accuracy: 0.0000e+00
```

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Epoch 6/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7348 - accuracy: 0.7
259 - val_loss: 1.3500 - val_accuracy: 0.0000e+00
Epoch 7/105
9/9 [==============================] - 0s 7ms/step - loss: 0.7094 - accuracy: 0.7
185 - val_loss: 1.2463 - val_accuracy: 0.0000e+00
Epoch 8/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6834 - accuracy: 0.7
111 - val_loss: 1.2059 - val_accuracy: 0.0000e+00
Epoch 9/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6657 - accuracy: 0.7
037 - val_loss: 1.1946 - val_accuracy: 0.0000e+00
Epoch 10/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6520 - accuracy: 0.6
815 - val_loss: 1.1354 - val_accuracy: 0.0000e+00
Epoch 11/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6376 - accuracy: 0.6
815 - val_loss: 1.0928 - val_accuracy: 0.0000e+00
Epoch 12/105
9/9 [==============================] - 0s 7ms/step - loss: 0.6264 - accuracy: 0.6
815 - val_loss: 1.0467 - val_accuracy: 0.0000e+00
Epoch 13/105
9/9 [==============================] - 0s 7ms/step - loss: 0.6125 - accuracy: 0.6
963 - val_loss: 1.0352 - val_accuracy: 0.0000e+00
Epoch 14/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6074 - accuracy: 0.7
185 - val_loss: 1.0621 - val_accuracy: 0.0000e+00
Epoch 15/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5913 - accuracy: 0.7
111 - val_loss: 0.9512 - val_accuracy: 0.0000e+00
Epoch 16/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5867 - accuracy: 0.6
074 - val_loss: 0.8555 - val_accuracy: 0.0667
Epoch 17/105
9/9 [==============================] - 0s 7ms/step - loss: 0.5759 - accuracy: 0.5
778 - val_loss: 0.8540 - val_accuracy: 0.1333
Epoch 18/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5669 - accuracy: 0.6
000 - val_loss: 0.8427 - val_accuracy: 0.2000
Epoch 19/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5590 - accuracy: 0.6
296 - val_loss: 0.8554 - val_accuracy: 0.1333
Epoch 20/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5523 - accuracy: 0.6
519 - val_loss: 0.8446 - val_accuracy: 0.1333
Epoch 21/105
9/9 [==============================] - 0s 7ms/step - loss: 0.5466 - accuracy: 0.6
519 - val_loss: 0.8120 - val_accuracy: 0.2667
Epoch 22/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5387 - accuracy: 0.6
444 - val_loss: 0.8213 - val_accuracy: 0.2667
Epoch 23/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5336 - accuracy: 0.6
741 - val_loss: 0.8316 - val_accuracy: 0.2000
Epoch 24/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5276 - accuracy: 0.6
815 - val_loss: 0.8227 - val_accuracy: 0.2667
Epoch 25/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5210 - accuracy: 0.7
037 - val_loss: 0.7823 - val_accuracy: 0.2667
```

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Epoch 26/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5160 - accuracy: 0.6
963 - val_loss: 0.7935 - val_accuracy: 0.2667
Epoch 27/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5108 - accuracy: 0.6
963 - val_loss: 0.7425 - val_accuracy: 0.5333
Epoch 28/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5040 - accuracy: 0.7
185 - val_loss: 0.7464 - val_accuracy: 0.5333
Epoch 29/105
9/9 [==============================] - 0s 7ms/step - loss: 0.4991 - accuracy: 0.7
185 - val_loss: 0.7444 - val_accuracy: 0.5333
Epoch 30/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4950 - accuracy: 0.7
259 - val_loss: 0.7160 - val_accuracy: 0.5333
Epoch 31/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4886 - accuracy: 0.7
333 - val_loss: 0.7216 - val_accuracy: 0.5333
Epoch 32/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4847 - accuracy: 0.7
259 - val_loss: 0.7512 - val_accuracy: 0.4667
Epoch 33/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4803 - accuracy: 0.7
630 - val_loss: 0.7285 - val_accuracy: 0.5333
Epoch 34/105
9/9 [==============================] - 0s 7ms/step - loss: 0.4752 - accuracy: 0.7
704 - val_loss: 0.7306 - val_accuracy: 0.5333
Epoch 35/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4713 - accuracy: 0.7
778 - val_loss: 0.7160 - val_accuracy: 0.5333
Epoch 36/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4664 - accuracy: 0.7
852 - val_loss: 0.6822 - val_accuracy: 0.6000
Epoch 37/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4618 - accuracy: 0.7
852 - val_loss: 0.6640 - val_accuracy: 0.6000
Epoch 38/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4577 - accuracy: 0.8
000 - val_loss: 0.6835 - val_accuracy: 0.6000
Epoch 39/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4537 - accuracy: 0.8
148 - val_loss: 0.6629 - val_accuracy: 0.6000
Epoch 40/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4497 - accuracy: 0.8
148 - val_loss: 0.6520 - val_accuracy: 0.6000
Epoch 41/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4476 - accuracy: 0.8
148 - val_loss: 0.6646 - val_accuracy: 0.6000
Epoch 42/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4416 - accuracy: 0.8
296 - val_loss: 0.6162 - val_accuracy: 0.6667
Epoch 43/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4389 - accuracy: 0.8
296 - val_loss: 0.6005 - val_accuracy: 0.7333
Epoch 44/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4343 - accuracy: 0.8
444 - val_loss: 0.6202 - val_accuracy: 0.6667
Epoch 45/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4314 - accuracy: 0.8
519 - val_loss: 0.6440 - val_accuracy: 0.6000
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Epoch 46/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4276 - accuracy: 0.8
593 - val_loss: 0.6299 - val_accuracy: 0.6000
Epoch 47/105
9/9 [==============================] - 0s 7ms/step - loss: 0.4242 - accuracy: 0.8
593 - val_loss: 0.6030 - val_accuracy: 0.7333
Epoch 48/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4217 - accuracy: 0.8
519 - val_loss: 0.5902 - val_accuracy: 0.8000
Epoch 49/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4180 - accuracy: 0.8
593 - val_loss: 0.5943 - val_accuracy: 0.7333
Epoch 50/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4145 - accuracy: 0.8
741 - val_loss: 0.6001 - val_accuracy: 0.7333
Epoch 51/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4118 - accuracy: 0.8
667 - val_loss: 0.5848 - val_accuracy: 0.8000
Epoch 52/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4090 - accuracy: 0.8
667 - val_loss: 0.5751 - val_accuracy: 0.8000
Epoch 53/105
9/9 [==============================] - 0s 8ms/step - loss: 0.4077 - accuracy: 0.8
667 - val_loss: 0.5950 - val_accuracy: 0.7333
Epoch 54/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4032 - accuracy: 0.8
667 - val_loss: 0.5655 - val_accuracy: 0.8000
Epoch 55/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3999 - accuracy: 0.8
667 - val_loss: 0.5516 - val_accuracy: 0.8000
Epoch 56/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3973 - accuracy: 0.8
667 - val_loss: 0.5508 - val_accuracy: 0.8000
Epoch 57/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3946 - accuracy: 0.8
667 - val_loss: 0.5651 - val_accuracy: 0.8000
Epoch 58/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3918 - accuracy: 0.8
741 - val_loss: 0.5533 - val_accuracy: 0.8000
Epoch 59/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3897 - accuracy: 0.8
815 - val_loss: 0.5709 - val_accuracy: 0.8000
Epoch 60/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3869 - accuracy: 0.8
889 - val_loss: 0.5732 - val_accuracy: 0.8000
Epoch 61/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3844 - accuracy: 0.8
889 - val_loss: 0.5550 - val_accuracy: 0.8000
Epoch 62/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3816 - accuracy: 0.8
889 - val_loss: 0.5467 - val_accuracy: 0.8000
Epoch 63/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3788 - accuracy: 0.8
815 - val_loss: 0.5195 - val_accuracy: 0.8000
Epoch 64/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3767 - accuracy: 0.8
815 - val_loss: 0.5241 - val_accuracy: 0.8000
Epoch 65/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3742 - accuracy: 0.8
815 - val_loss: 0.5034 - val_accuracy: 0.8000
```

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Epoch 66/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3716 - accuracy: 0.8
889 - val_loss: 0.5165 - val_accuracy: 0.8000
Epoch 67/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3693 - accuracy: 0.8
889 - val_loss: 0.4925 - val_accuracy: 0.8000
Epoch 68/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3670 - accuracy: 0.8
889 - val_loss: 0.4967 - val_accuracy: 0.8000
Epoch 69/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3652 - accuracy: 0.8
889 - val_loss: 0.4813 - val_accuracy: 0.8000
Epoch 70/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3621 - accuracy: 0.8
815 - val_loss: 0.5006 - val_accuracy: 0.8000
Epoch 71/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3595 - accuracy: 0.8
963 - val_loss: 0.5082 - val_accuracy: 0.8000
Epoch 72/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3573 - accuracy: 0.8
963 - val_loss: 0.5031 - val_accuracy: 0.8000
Epoch 73/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3551 - accuracy: 0.9
037 - val_loss: 0.4983 - val_accuracy: 0.8000
Epoch 74/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3525 - accuracy: 0.8
963 - val_loss: 0.4706 - val_accuracy: 0.8000
Epoch 75/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3514 - accuracy: 0.8
815 - val_loss: 0.4532 - val_accuracy: 0.8000
Epoch 76/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3497 - accuracy: 0.8
963 - val_loss: 0.4838 - val_accuracy: 0.8000
Epoch 77/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3465 - accuracy: 0.8
963 - val_loss: 0.5032 - val_accuracy: 0.8000
Epoch 78/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3454 - accuracy: 0.8
963 - val_loss: 0.4663 - val_accuracy: 0.8000
Epoch 79/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3416 - accuracy: 0.8
963 - val_loss: 0.4697 - val_accuracy: 0.8000
Epoch 80/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3387 - accuracy: 0.9
037 - val_loss: 0.4978 - val_accuracy: 0.8000
Epoch 81/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3376 - accuracy: 0.9
037 - val_loss: 0.4729 - val_accuracy: 0.8000
Epoch 82/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3348 - accuracy: 0.9
037 - val_loss: 0.4698 - val_accuracy: 0.8000
Epoch 83/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3329 - accuracy: 0.9
037 - val_loss: 0.4479 - val_accuracy: 0.8000
Epoch 84/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3309 - accuracy: 0.8
963 - val_loss: 0.4432 - val_accuracy: 0.8000
Epoch 85/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3289 - accuracy: 0.8
963 - val_loss: 0.4678 - val_accuracy: 0.8000
```

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Epoch 86/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3261 - accuracy: 0.8
963 - val_loss: 0.4414 - val_accuracy: 0.8000
Epoch 87/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3239 - accuracy: 0.8
963 - val_loss: 0.4372 - val_accuracy: 0.8000
Epoch 88/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3232 - accuracy: 0.9
037 - val_loss: 0.4073 - val_accuracy: 0.8667
Epoch 89/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3203 - accuracy: 0.9
259 - val_loss: 0.4159 - val_accuracy: 0.8000
Epoch 90/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3217 - accuracy: 0.8
963 - val_loss: 0.4630 - val_accuracy: 0.8000
Epoch 91/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3158 - accuracy: 0.9
037 - val_loss: 0.4423 - val_accuracy: 0.8000
Epoch 92/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3138 - accuracy: 0.8
963 - val_loss: 0.4143 - val_accuracy: 0.8000
Epoch 93/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3126 - accuracy: 0.9
185 - val_loss: 0.4051 - val_accuracy: 0.8000
Epoch 94/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3122 - accuracy: 0.9
037 - val_loss: 0.4467 - val_accuracy: 0.8000
Epoch 95/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3084 - accuracy: 0.9
037 - val_loss: 0.4268 - val_accuracy: 0.8000
Epoch 96/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3070 - accuracy: 0.9
037 - val_loss: 0.4399 - val_accuracy: 0.8000
Epoch 97/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3046 - accuracy: 0.9
037 - val_loss: 0.3825 - val_accuracy: 0.8667
Epoch 98/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3031 - accuracy: 0.9
259 - val_loss: 0.3776 - val_accuracy: 0.8667
Epoch 99/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3014 - accuracy: 0.9
259 - val_loss: 0.3808 - val_accuracy: 0.8667
Epoch 100/105
9/9 [==============================] - 0s 6ms/step - loss: 0.2987 - accuracy: 0.9
259 - val_loss: 0.4063 - val_accuracy: 0.8000
Epoch 101/105
9/9 [==============================] - 0s 6ms/step - loss: 0.2983 - accuracy: 0.9
111 - val_loss: 0.4330 - val_accuracy: 0.8000
Epoch 102/105
9/9 [==============================] - 0s 6ms/step - loss: 0.2955 - accuracy: 0.9
037 - val_loss: 0.4242 - val_accuracy: 0.8000
Epoch 103/105
9/9 [==============================] - 0s 6ms/step - loss: 0.2955 - accuracy: 0.9
037 - val_loss: 0.4452 - val_accuracy: 0.8000
Epoch 104/105
9/9 [==============================] - 0s 6ms/step - loss: 0.2926 - accuracy: 0.9
037 - val_loss: 0.3932 - val_accuracy: 0.8000
Epoch 105/105
9/9 [==============================] - 0s 7ms/step - loss: 0.2906 - accuracy: 0.9
185 - val_loss: 0.3729 - val_accuracy: 0.8667
```

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Epoch 1/105
9/9 [==============================] - 1s 24ms/step - loss: 2.3149 - accuracy: 0.
4444 - val_loss: 0.4711 - val_accuracy: 1.0000
Epoch 2/105
9/9 [==============================] - 0s 6ms/step - loss: 1.3640 - accuracy: 0.6
296 - val_loss: 0.4818 - val_accuracy: 1.0000
Epoch 3/105
9/9 [==============================] - 0s 6ms/step - loss: 1.0450 - accuracy: 0.6
296 - val_loss: 0.6402 - val_accuracy: 1.0000
Epoch 4/105
9/9 [==============================] - 0s 6ms/step - loss: 0.9209 - accuracy: 0.6
222 - val_loss: 0.7839 - val_accuracy: 1.0000
Epoch 5/105
9/9 [==============================] - 0s 6ms/step - loss: 0.8612 - accuracy: 0.6
222 - val_loss: 0.9013 - val_accuracy: 1.0000
Epoch 6/105
9/9 [==============================] - 0s 6ms/step - loss: 0.8290 - accuracy: 0.6
222 - val_loss: 0.9470 - val_accuracy: 1.0000
Epoch 7/105
9/9 [==============================] - 0s 7ms/step - loss: 0.8043 - accuracy: 0.6
148 - val_loss: 1.0125 - val_accuracy: 1.0000
Epoch 8/105
9/9 [==============================] - 0s 7ms/step - loss: 0.7748 - accuracy: 0.6
741 - val_loss: 1.0538 - val_accuracy: 0.9333
Epoch 9/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7600 - accuracy: 0.7
407 - val_loss: 1.0550 - val_accuracy: 0.7333
Epoch 10/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7493 - accuracy: 0.7
778 - val_loss: 1.0318 - val_accuracy: 0.9333
Epoch 11/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7381 - accuracy: 0.8
222 - val_loss: 1.0406 - val_accuracy: 0.6667
Epoch 12/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7276 - accuracy: 0.8
444 - val_loss: 1.0489 - val_accuracy: 0.5333
Epoch 13/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7179 - accuracy: 0.8
148 - val_loss: 1.0054 - val_accuracy: 0.9333
Epoch 14/105
9/9 [==============================] - 0s 6ms/step - loss: 0.7079 - accuracy: 0.9
111 - val_loss: 1.0055 - val_accuracy: 0.9333
Epoch 15/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6987 - accuracy: 0.9
111 - val_loss: 0.9724 - val_accuracy: 0.9333
Epoch 16/105
9/9 [==============================] - 0s 7ms/step - loss: 0.6890 - accuracy: 0.9
333 - val_loss: 0.9802 - val_accuracy: 0.9333
Epoch 17/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6806 - accuracy: 0.9
037 - val_loss: 0.9694 - val_accuracy: 0.9333
Epoch 18/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6721 - accuracy: 0.9
259 - val_loss: 0.9546 - val_accuracy: 0.9333
Epoch 19/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6630 - accuracy: 0.9
407 - val_loss: 0.9668 - val_accuracy: 0.9333
Epoch 20/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6548 - accuracy: 0.9
407 - val_loss: 0.9459 - val_accuracy: 0.9333
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Epoch 21/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6464 - accuracy: 0.9
407 - val_loss: 0.9009 - val_accuracy: 1.0000
Epoch 22/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6386 - accuracy: 0.9
481 - val_loss: 0.9117 - val_accuracy: 0.9333
Epoch 23/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6306 - accuracy: 0.9
556 - val_loss: 0.8930 - val_accuracy: 1.0000
Epoch 24/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6228 - accuracy: 0.9
556 - val_loss: 0.8738 - val_accuracy: 1.0000
Epoch 25/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6158 - accuracy: 0.9
407 - val_loss: 0.8464 - val_accuracy: 1.0000
Epoch 26/105
9/9 [==============================] - 0s 7ms/step - loss: 0.6082 - accuracy: 0.9
259 - val_loss: 0.8843 - val_accuracy: 0.9333
Epoch 27/105
9/9 [==============================] - 0s 6ms/step - loss: 0.6009 - accuracy: 0.9
556 - val_loss: 0.8432 - val_accuracy: 1.0000
Epoch 28/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5944 - accuracy: 0.9
481 - val_loss: 0.8656 - val_accuracy: 0.9333
Epoch 29/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5870 - accuracy: 0.9
704 - val_loss: 0.8558 - val_accuracy: 0.9333
Epoch 30/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5803 - accuracy: 0.9
556 - val_loss: 0.8499 - val_accuracy: 0.9333
Epoch 31/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5740 - accuracy: 0.9
630 - val_loss: 0.8388 - val_accuracy: 0.9333
Epoch 32/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5672 - accuracy: 0.9
556 - val_loss: 0.8581 - val_accuracy: 0.9333
Epoch 33/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5626 - accuracy: 0.9
630 - val_loss: 0.8113 - val_accuracy: 1.0000
Epoch 34/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5564 - accuracy: 0.9
704 - val_loss: 0.7893 - val_accuracy: 1.0000
Epoch 35/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5500 - accuracy: 0.9
704 - val_loss: 0.7340 - val_accuracy: 1.0000
Epoch 36/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5463 - accuracy: 0.9
407 - val_loss: 0.7919 - val_accuracy: 1.0000
Epoch 37/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5381 - accuracy: 0.9
778 - val_loss: 0.7334 - val_accuracy: 1.0000
Epoch 38/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5335 - accuracy: 0.9
407 - val_loss: 0.7732 - val_accuracy: 1.0000
Epoch 39/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5277 - accuracy: 0.9
704 - val_loss: 0.7970 - val_accuracy: 0.9333
Epoch 40/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5220 - accuracy: 0.9
630 - val_loss: 0.7266 - val_accuracy: 1.0000
```

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Epoch 41/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5169 - accuracy: 0.9
481 - val_loss: 0.7310 - val_accuracy: 1.0000
Epoch 42/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5145 - accuracy: 0.9
630 - val_loss: 0.6987 - val_accuracy: 1.0000
Epoch 43/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5069 - accuracy: 0.9
556 - val_loss: 0.7034 - val_accuracy: 1.0000
Epoch 44/105
9/9 [==============================] - 0s 6ms/step - loss: 0.5032 - accuracy: 0.9
481 - val_loss: 0.7015 - val_accuracy: 1.0000
Epoch 45/105
9/9 [==============================] - 0s 8ms/step - loss: 0.4979 - accuracy: 0.9
704 - val_loss: 0.7305 - val_accuracy: 1.0000
Epoch 46/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4911 - accuracy: 0.9
630 - val_loss: 0.7039 - val_accuracy: 1.0000
Epoch 47/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4874 - accuracy: 0.9
481 - val_loss: 0.6414 - val_accuracy: 1.0000
Epoch 48/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4849 - accuracy: 0.9
333 - val_loss: 0.6747 - val_accuracy: 1.0000
Epoch 49/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4801 - accuracy: 0.9
556 - val_loss: 0.6699 - val_accuracy: 1.0000
Epoch 50/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4712 - accuracy: 0.9
481 - val_loss: 0.7413 - val_accuracy: 0.9333
Epoch 51/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4693 - accuracy: 0.9
778 - val_loss: 0.6336 - val_accuracy: 1.0000
Epoch 52/105
9/9 [==============================] - 0s 7ms/step - loss: 0.4655 - accuracy: 0.9
481 - val_loss: 0.7155 - val_accuracy: 0.9333
Epoch 53/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4631 - accuracy: 0.9
630 - val_loss: 0.6646 - val_accuracy: 1.0000
Epoch 54/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4551 - accuracy: 0.9
556 - val_loss: 0.6849 - val_accuracy: 1.0000
Epoch 55/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4542 - accuracy: 0.9
778 - val_loss: 0.6466 - val_accuracy: 1.0000
Epoch 56/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4484 - accuracy: 0.9
704 - val_loss: 0.6697 - val_accuracy: 1.0000
Epoch 57/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4454 - accuracy: 0.9
556 - val_loss: 0.6596 - val_accuracy: 1.0000
Epoch 58/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4397 - accuracy: 0.9
704 - val_loss: 0.7174 - val_accuracy: 0.8667
Epoch 59/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4391 - accuracy: 0.9
630 - val_loss: 0.6057 - val_accuracy: 1.0000
Epoch 60/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4349 - accuracy: 0.9
407 - val_loss: 0.6034 - val_accuracy: 1.0000
```

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Epoch 61/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4272 - accuracy: 0.9
481 - val_loss: 0.6501 - val_accuracy: 1.0000
Epoch 62/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4255 - accuracy: 0.9
630 - val_loss: 0.6011 - val_accuracy: 1.0000
Epoch 63/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4232 - accuracy: 0.9
704 - val_loss: 0.5524 - val_accuracy: 1.0000
Epoch 64/105
9/9 [==============================] - 0s 7ms/step - loss: 0.4191 - accuracy: 0.9
259 - val_loss: 0.6867 - val_accuracy: 0.8667
Epoch 65/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4156 - accuracy: 0.9
556 - val_loss: 0.6616 - val_accuracy: 0.9333
Epoch 66/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4116 - accuracy: 0.9
630 - val_loss: 0.5248 - val_accuracy: 1.0000
Epoch 67/105
9/9 [==============================] - 0s 6ms/step - loss: 0.4123 - accuracy: 0.9
556 - val_loss: 0.7230 - val_accuracy: 0.8667
Epoch 68/105
9/9 [==============================] - 0s 7ms/step - loss: 0.4070 - accuracy: 0.9
704 - val_loss: 0.6212 - val_accuracy: 0.9333
Epoch 69/105
9/9 [==============================] - 0s 7ms/step - loss: 0.4007 - accuracy: 0.9
778 - val_loss: 0.6048 - val_accuracy: 1.0000
Epoch 70/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3961 - accuracy: 0.9
778 - val_loss: 0.5487 - val_accuracy: 1.0000
Epoch 71/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3951 - accuracy: 0.9
704 - val_loss: 0.5427 - val_accuracy: 1.0000
Epoch 72/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3926 - accuracy: 0.9
630 - val_loss: 0.5144 - val_accuracy: 1.0000
Epoch 73/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3884 - accuracy: 0.9
704 - val_loss: 0.6410 - val_accuracy: 0.8667
Epoch 74/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3870 - accuracy: 0.9
778 - val_loss: 0.6243 - val_accuracy: 0.9333
Epoch 75/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3821 - accuracy: 0.9
778 - val_loss: 0.5597 - val_accuracy: 1.0000
Epoch 76/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3779 - accuracy: 0.9
778 - val_loss: 0.6554 - val_accuracy: 0.8667
Epoch 77/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3776 - accuracy: 0.9
704 - val_loss: 0.5202 - val_accuracy: 1.0000
Epoch 78/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3725 - accuracy: 0.9
704 - val_loss: 0.4803 - val_accuracy: 1.0000
Epoch 79/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3695 - accuracy: 0.9
704 - val_loss: 0.5320 - val_accuracy: 1.0000
Epoch 80/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3678 - accuracy: 0.9
778 - val_loss: 0.5953 - val_accuracy: 0.9333
```

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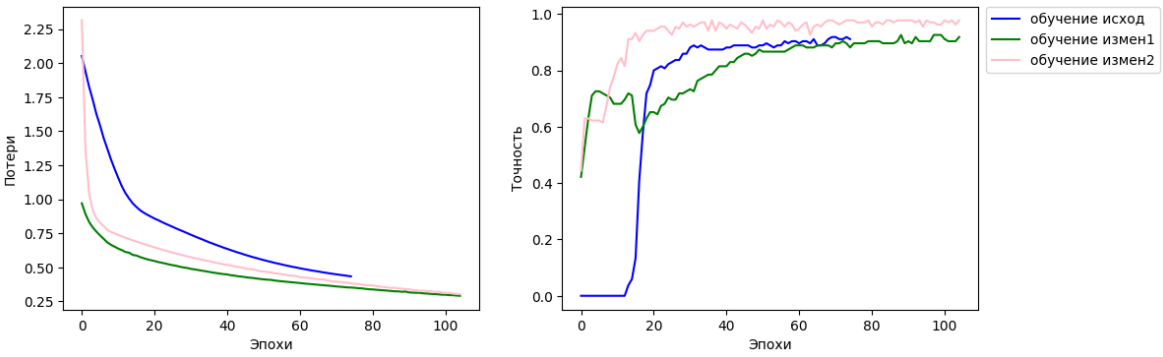
Epoch 81/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3669 - accuracy: 0.9
556 - val_loss: 0.5880 - val_accuracy: 0.9333
Epoch 82/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3610 - accuracy: 0.9
704 - val_loss: 0.5092 - val_accuracy: 1.0000
Epoch 83/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3579 - accuracy: 0.9
704 - val_loss: 0.5088 - val_accuracy: 1.0000
Epoch 84/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3554 - accuracy: 0.9
630 - val_loss: 0.5750 - val_accuracy: 0.9333
Epoch 85/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3523 - accuracy: 0.9
778 - val_loss: 0.5857 - val_accuracy: 0.9333
Epoch 86/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3487 - accuracy: 0.9
778 - val_loss: 0.4138 - val_accuracy: 1.0000
Epoch 87/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3497 - accuracy: 0.9
704 - val_loss: 0.4434 - val_accuracy: 1.0000
Epoch 88/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3451 - accuracy: 0.9
778 - val_loss: 0.5481 - val_accuracy: 0.9333
Epoch 89/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3434 - accuracy: 0.9
778 - val_loss: 0.4859 - val_accuracy: 1.0000
Epoch 90/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3387 - accuracy: 0.9
778 - val_loss: 0.4486 - val_accuracy: 1.0000
Epoch 91/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3388 - accuracy: 0.9
778 - val_loss: 0.4413 - val_accuracy: 1.0000
Epoch 92/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3332 - accuracy: 0.9
778 - val_loss: 0.5776 - val_accuracy: 0.8667
Epoch 93/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3313 - accuracy: 0.9
704 - val_loss: 0.4792 - val_accuracy: 1.0000
Epoch 94/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3268 - accuracy: 0.9
778 - val_loss: 0.6315 - val_accuracy: 0.8667
Epoch 95/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3289 - accuracy: 0.9
556 - val_loss: 0.4899 - val_accuracy: 1.0000
Epoch 96/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3245 - accuracy: 0.9
778 - val_loss: 0.5501 - val_accuracy: 0.9333
Epoch 97/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3235 - accuracy: 0.9
704 - val_loss: 0.4576 - val_accuracy: 1.0000
Epoch 98/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3188 - accuracy: 0.9
704 - val_loss: 0.3597 - val_accuracy: 1.0000
Epoch 99/105
9/9 [==============================] - 0s 7ms/step - loss: 0.3217 - accuracy: 0.9
630 - val_loss: 0.5069 - val_accuracy: 0.9333
Epoch 100/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3148 - accuracy: 0.9
630 - val_loss: 0.4753 - val_accuracy: 1.0000
```

```
Epoch 101/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3121 - accuracy: 0.9
778 - val_loss: 0.4216 - val_accuracy: 1.0000
Epoch 102/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3114 - accuracy: 0.9
704 - val_loss: 0.4329 - val_accuracy: 1.0000
Epoch 103/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3071 - accuracy: 0.9
778 - val_loss: 0.5261 - val_accuracy: 0.9333
Epoch 104/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3047 - accuracy: 0.9
630 - val_loss: 0.4232 - val_accuracy: 1.0000
Epoch 105/105
9/9 [==============================] - 0s 6ms/step - loss: 0.3023 - accuracy: 0.9
778 - val_loss: 0.4255 - val_accuracy: 1.0000
```

In [17]:
```
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(history.history['loss'], label='обучение исход', color='blue')
plt.plot(history5.history['loss'], label='обучение измен5', color='green')
plt.plot(history6.history['loss'], label='обучение измен6', color='pink')
plt.xlabel('Эпохи')
plt.ylabel('Потери')

plt.subplot(1, 2, 2)
plt.plot(history.history['accuracy'], label='обучение исход', color='blue')
plt.plot(history5.history['accuracy'], label='обучение измен1', color='green')
plt.plot(history6.history['accuracy'], label='обучение измен2', color='pink')
plt.xlabel('Эпохи')
plt.ylabel('Точность')
plt.legend(bbox_to_anchor=( 1.02 , 1 ), loc='upper left', borderaxespad= 0 )

plt.show()
```



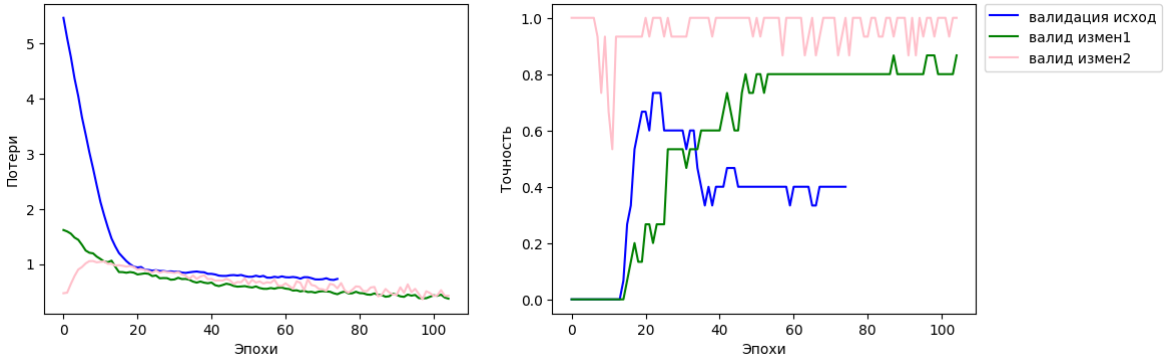
In [18]:
```
plt.figure(figsize=(12, 4))

plt.subplot(1, 2, 1)
plt.plot(history.history['val_loss'], label='валидация исход', color='blue')
plt.plot(history5.history['val_loss'], label='валид измен1', color='green')
plt.plot(history6.history['val_loss'], label='валид измен2', color='pink')
plt.xlabel('Эпохи')
plt.ylabel('Потери')

plt.subplot(1, 2, 2)
plt.plot(history.history['val_accuracy'], label='валидация исход', color='blue')
plt.plot(history5.history['val_accuracy'], label='валид измен1', color='green')
plt.plot(history6.history['val_accuracy'], label='валид измен2', color='pink')
plt.xlabel('Эпохи')
```

```
plt.ylabel('Точность')
plt.legend(bbox_to_anchor=( 1.02 , 1 ), loc='upper left', borderaxespad= 0 )

plt.show()
```



Вывод: мы изучили различные архитектуры ИНС (Разное кол-во слоев, разное кол-во нейронов на слоях), так же мы изучили обучение при различных параметрах обучения (таких как epochs, batch_size, validation_split), пПостролиь графики ошибок и точности в ходе обучени, а так же выбрали наилучшую модель путем эксперомтов с различными параметрами(изменение функции активаации, оптимизатора и параметров функции fit)ь