

```
#Matematyka konkretna
#Wariant 15 Karolina Baron

#Opracować rekurencyjną sieć neuronową która implementuje operacje na
dwóch liczbach binarnych zgodnie z wariantem zadania:
#Różnica dwóch liczb 20-bitowych
```

```
import tensorflow as tf
import numpy as np

def generate_data(num_samples=1000, num_bits=20):
    X = np.random.randint(0, 2, size=(num_samples, num_bits, 2))
    Y = np.diff(X, axis=1)[:, :, 0] # Różnica między kolumnami
    return X, Y
```

```
model = tf.keras.Sequential([
    tf.keras.layers.SimpleRNN(16, input_shape=(20, 2),
activation='relu', return_sequences=True),
    tf.keras.layers.SimpleRNN(16, activation='relu'),
    tf.keras.layers.Dense(1, activation='linear')
])
```

```
model.compile(optimizer='adam', loss='mean_squared_error',
metrics=['mae'])
```

```
X_train, Y_train = generate_data()
```

```
model.fit(X_train, Y_train, epochs=10, batch_size=32)
```

```
X_test, Y_test = generate_data(10)
predictions = model.predict(X_test)
```

```
for i in range(10):
    input_data = X_test[i]
    true_output = Y_test[i]
    predicted_output = predictions[i].round()

    print(f"Wejscie: {input_data}")
    print(f"Prawdziwa roznica: {true_output}")
    print(f"Przewidziana roznica: {predicted_output}")
    print()
```

```
WARNING:tensorflow:From C:\Users\nextn\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
packages\Python311\site-packages\keras\src\losses.py:2976: The name
tf.losses.sparse_softmax_cross_entropy is deprecated. Please use
tf.compat.v1.losses.sparse_softmax_cross_entropy instead.
```

```
WARNING:tensorflow:From C:\Users\nextn\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
packages\Python311\site-packages\keras\src\layers\rnn\
```

```
simple_rnn.py:130: The name tf.executing_eagerly_outside_functions is
deprecated. Please use
tf.compat.v1.executing_eagerly_outside_functions instead.
```

```
WARNING:tensorflow:From C:\Users\nextn\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
packages\Python311\site-packages\keras\src\optimizers\__init__.py:309:
The name tf.train.Optimizer is deprecated. Please use
tf.compat.v1.train.Optimizer instead.
```

Epoch 1/10

```
WARNING:tensorflow:From C:\Users\nextn\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
packages\Python311\site-packages\keras\src\utils\tf_utils.py:492: The
name tf.ragged.RaggedTensorValue is deprecated. Please use
tf.compat.v1.ragged.RaggedTensorValue instead.
```

```
WARNING:tensorflow:From C:\Users\nextn\AppData\Local\Packages\
PythonSoftwareFoundation.Python.3.11_qbz5n2kfra8p0\LocalCache\local-
packages\Python311\site-packages\keras\src\engine\
base_layer_utils.py:384: The name
tf.executing_eagerly_outside_functions is deprecated. Please use
tf.compat.v1.executing_eagerly_outside_functions instead.
```

```
32/32 [=====] - 2s 5ms/step - loss: 0.6102 -
mae: 0.6179
```

Epoch 2/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5192 -
mae: 0.5551
```

Epoch 3/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5127 -
mae: 0.5433
```

Epoch 4/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5092 -
mae: 0.5365
```

Epoch 5/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5070 -
mae: 0.5315
```

Epoch 6/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5055 -
mae: 0.5277
```

Epoch 7/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5043 -
mae: 0.5248
```

Epoch 8/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5035 -
mae: 0.5225
```

Epoch 9/10

```
32/32 [=====] - 0s 5ms/step - loss: 0.5028 -
mae: 0.5205
```

```
Epoch 10/10
32/32 [=====] - 0s 5ms/step - loss: 0.5022 -
mae: 0.5187
1/1 [=====] - 0s 246ms/step
Wejscie: [[1 1]
[0 0]
[0 0]
[1 0]
[1 1]
[0 1]
[0 0]
[1 0]
[1 0]
[1 0]
[0 1]
[1 1]
[1 0]
[0 0]
[1 1]
[0 0]
[1 0]
[0 0]
[1 0]
[0 0]]
Prawdziwa roznica: [-1 0 1 0 -1 0 1 0 0 -1 1 0 -1 1 -1 1 -1
1 -1]
Przewidziana roznica: [0.]

Wejscie: [[0 1]
[0 0]
[0 0]
[1 0]
[1 0]
[1 1]
[1 0]
[1 1]
[1 1]
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[1 1]]
Prawdziwa roznica: [ 0 0 1 0 0 0 0 0 0 -1 1 -1 1 0 0 0 0
```

0 0]

Przewidziana roznica: [0.]

Wejscie: [[1 1]

[1 1]

[0 0]

[0 0]

[1 1]

[0 1]

[0 0]

[0 1]

[1 1]

[1 0]

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[0 1]]

Prawdziwa roznica: [ 0 -1 0 1 -1 0 0 1 0 0 -1 0 0 1 0 0 -1  
1 -1]

Przewidziana roznica: [0.]

Wejscie: [[0 0]

[1 0]

[1 0]

[1 0]

[0 0]

[1 1]

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[0 1]

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[0 0]]

Prawdziwa roznica: [ 1 0 0 -1 1 0 -1 1 0 0 -1 1 -1 1 -1 1 -1  
0 0]

Przewidziana roznica: [-0.]

Wejscie: [[1 0]

[1 0]

[0 1]

[0 0]

[0 0]

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Prawdziwa roznica: [ 0 -1 0 0 1 -1 0 1 -1 1 -1 0 0 0 1 0 0  
-1 1]

Przewidziana roznica: [0.]

Wejscie: [[0 0]

[0 1]

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Prawdziwa roznica: [ 0 0 0 0 1 0 0 0 0 0 -1 0 0 0 0 0 1  
-1 0]

Przewidziana roznica: [-0.]

Wejscie: [[0 1]

[0 1]

[1 1]

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[0 1]]

Prawdziwa roznica: [ 0 1 -1 1 0 0 0 0 -1 0 1 -1 1 0 0 -1 1  
-1 0]

Przewidziana roznica: [-0.]

Wejscie: [[1 0]

[0 0]

[0 1]

[1 0]

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[0 1]]

Prawdziwa roznica: [-1 0 1 0 0 -1 0 1 0 0 -1 0 0 0 1 -1 1  
-1 0]

Przewidziana roznica: [-0.]

Wejscie: [[0 1]

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[1 0]
[1 1]
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[1 1]
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```

Prawdziwa roznica: [ 1 0 0 -1 0 1 0 0 0 -1 1 -1 0 0 1 -1 1  
-1 0]

Przewidziana roznica: [-0.]

Wejscie: [[0 0]

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[0 1]
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[0 1]
[0 1]
```

Prawdziwa roznica: [ 0 0 0 1 -1 1 -1 0 1 -1 1 0 -1 0 1 0 0  
-1 0]

Przewidziana roznica: [0.]