```
#Matematyka Konkretna
#Laboratorium 8
#Setla Joanna https://github.com/ASetla/MK
#Wariant 1

import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import SimpleRNN, Dense

def generate_data_count(num_samples, seq_length):
    X = np.random.choice([0, 0.5, 1], size=(num_samples, seq_length,
1))
    y = np.sum(X == 0.5, axis=1)
    return X, y

num_samples = 30
seq_length = 20
input_dim = 1
output_dim = 1

X_train, y_train = generate_data_count(num_samples, seq_length)

model = Sequential()
model.add(SimpleRNN(units=10, input_shape=(seq_length, input_dim)))
model.add(Dense(units=output_dim, activation='linear'))

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

model.fit(X_train, y_train, epochs=100, batch_size=1, verbose=2)

X_test, y_test = generate_data_count(3, seq_length)
predictions = model.predict(X_test)

for i in range(len(X_test)):
    print("Input:", X_test[i].flatten())
    print("True Output:", y_test[i])
    print("Predicted Output:", predictions[i][0])
    print("\n")

Epoch 1/100
30/30 - 1s - loss: 48.5471 - mae: 6.7468 - 750ms/epoch - 25ms/step
Epoch 2/100
30/30 - 0s - loss: 34.8922 - mae: 5.5990 - 55ms/epoch - 2ms/step
Epoch 3/100
30/30 - 0s - loss: 22.0624 - mae: 4.3787 - 57ms/epoch - 2ms/step
Epoch 4/100
30/30 - 0s - loss: 16.5422 - mae: 3.6957 - 56ms/epoch - 2ms/step
Epoch 5/100
```

```
30/30 - 0s - loss: 13.3792 - mae: 3.2653 - 53ms/epoch - 2ms/step
Epoch 6/100
30/30 - 0s - loss: 11.1040 - mae: 2.9129 - 53ms/epoch - 2ms/step
Epoch 7/100
30/30 - 0s - loss: 9.4210 - mae: 2.6292 - 55ms/epoch - 2ms/step
Epoch 8/100
30/30 - 0s - loss: 8.0370 - mae: 2.4066 - 53ms/epoch - 2ms/step
Epoch 9/100
30/30 - 0s - loss: 7.0011 - mae: 2.1829 - 53ms/epoch - 2ms/step
Epoch 10/100
30/30 - 0s - loss: 6.1474 - mae: 1.9965 - 54ms/epoch - 2ms/step
Epoch 11/100
30/30 - 0s - loss: 5.4801 - mae: 1.8527 - 55ms/epoch - 2ms/step
Epoch 12/100
30/30 - 0s - loss: 4.9113 - mae: 1.7259 - 53ms/epoch - 2ms/step
Epoch 13/100
30/30 - 0s - loss: 4.5055 - mae: 1.6409 - 53ms/epoch - 2ms/step
Epoch 14/100
30/30 - 0s - loss: 4.2163 - mae: 1.5770 - 53ms/epoch - 2ms/step
Epoch 15/100
30/30 - 0s - loss: 3.9243 - mae: 1.4981 - 53ms/epoch - 2ms/step
Epoch 16/100
30/30 - 0s - loss: 3.7352 - mae: 1.4503 - 53ms/epoch - 2ms/step
Epoch 17/100
30/30 - 0s - loss: 3.5995 - mae: 1.3982 - 55ms/epoch - 2ms/step
Epoch 18/100
30/30 - 0s - loss: 3.4849 - mae: 1.3753 - 53ms/epoch - 2ms/step
Epoch 19/100
30/30 - 0s - loss: 3.4144 - mae: 1.3841 - 54ms/epoch - 2ms/step
Epoch 20/100
30/30 - 0s - loss: 3.3477 - mae: 1.3829 - 55ms/epoch - 2ms/step
Epoch 21/100
30/30 - 0s - loss: 3.3167 - mae: 1.3813 - 54ms/epoch - 2ms/step
Epoch 22/100
30/30 - 0s - loss: 3.2782 - mae: 1.3813 - 54ms/epoch - 2ms/step
Epoch 23/100
30/30 - 0s - loss: 3.2635 - mae: 1.3878 - 54ms/epoch - 2ms/step
Epoch 24/100
30/30 - 0s - loss: 3.2603 - mae: 1.3938 - 53ms/epoch - 2ms/step
Epoch 25/100
30/30 - 0s - loss: 3.2450 - mae: 1.3967 - 55ms/epoch - 2ms/step
Epoch 26/100
30/30 - 0s - loss: 3.2388 - mae: 1.3978 - 54ms/epoch - 2ms/step
Epoch 27/100
30/30 - 0s - loss: 3.2453 - mae: 1.3983 - 54ms/epoch - 2ms/step
Epoch 28/100
30/30 - 0s - loss: 3.2357 - mae: 1.3998 - 56ms/epoch - 2ms/step
Epoch 29/100
30/30 - 0s - loss: 3.2307 - mae: 1.3990 - 55ms/epoch - 2ms/step
```

```
Epoch 30/100
30/30 - 0s - loss: 3.2308 - mae: 1.3997 - 54ms/epoch - 2ms/step
Epoch 31/100
30/30 - 0s - loss: 3.2513 - mae: 1.4083 - 54ms/epoch - 2ms/step
Epoch 32/100
30/30 - 0s - loss: 3.2280 - mae: 1.4009 - 54ms/epoch - 2ms/step
Epoch 33/100
30/30 - 0s - loss: 3.2314 - mae: 1.4020 - 54ms/epoch - 2ms/step
Epoch 34/100
30/30 - 0s - loss: 3.2385 - mae: 1.4073 - 55ms/epoch - 2ms/step
Epoch 35/100
30/30 - 0s - loss: 3.2408 - mae: 1.4069 - 54ms/epoch - 2ms/step
Epoch 36/100
30/30 - 0s - loss: 3.2242 - mae: 1.4008 - 55ms/epoch - 2ms/step
Epoch 37/100
30/30 - 0s - loss: 3.2355 - mae: 1.4038 - 56ms/epoch - 2ms/step
Epoch 38/100
30/30 - 0s - loss: 3.2267 - mae: 1.4032 - 55ms/epoch - 2ms/step
Epoch 39/100
30/30 - 0s - loss: 3.2341 - mae: 1.4049 - 55ms/epoch - 2ms/step
Epoch 40/100
30/30 - 0s - loss: 3.2299 - mae: 1.4052 - 53ms/epoch - 2ms/step
Epoch 41/100
30/30 - 0s - loss: 3.2279 - mae: 1.4033 - 52ms/epoch - 2ms/step
Epoch 42/100
30/30 - 0s - loss: 3.2378 - mae: 1.4039 - 55ms/epoch - 2ms/step
Epoch 43/100
30/30 - 0s - loss: 3.2241 - mae: 1.4033 - 53ms/epoch - 2ms/step
Epoch 44/100
30/30 - 0s - loss: 3.2286 - mae: 1.4013 - 53ms/epoch - 2ms/step
Epoch 45/100
30/30 - 0s - loss: 3.2246 - mae: 1.4002 - 53ms/epoch - 2ms/step
Epoch 46/100
30/30 - 0s - loss: 3.2315 - mae: 1.4051 - 53ms/epoch - 2ms/step
Epoch 47/100
30/30 - 0s - loss: 3.2392 - mae: 1.4035 - 54ms/epoch - 2ms/step
Epoch 48/100
30/30 - 0s - loss: 3.2345 - mae: 1.4051 - 53ms/epoch - 2ms/step
Epoch 49/100
30/30 - 0s - loss: 3.2192 - mae: 1.4006 - 52ms/epoch - 2ms/step
Epoch 50/100
30/30 - 0s - loss: 3.2212 - mae: 1.4020 - 53ms/epoch - 2ms/step
Epoch 51/100
30/30 - 0s - loss: 3.2196 - mae: 1.4025 - 55ms/epoch - 2ms/step
Epoch 52/100
30/30 - 0s - loss: 3.2155 - mae: 1.4007 - 53ms/epoch - 2ms/step
Epoch 53/100
30/30 - 0s - loss: 3.2285 - mae: 1.4044 - 53ms/epoch - 2ms/step
Epoch 54/100
```

```
30/30 - 0s - loss: 3.2270 - mae: 1.4026 - 53ms/epoch - 2ms/step
Epoch 55/100
30/30 - 0s - loss: 3.2293 - mae: 1.4051 - 54ms/epoch - 2ms/step
Epoch 56/100
30/30 - 0s - loss: 3.2255 - mae: 1.4028 - 54ms/epoch - 2ms/step
Epoch 57/100
30/30 - 0s - loss: 3.2269 - mae: 1.3979 - 53ms/epoch - 2ms/step
Epoch 58/100
30/30 - 0s - loss: 3.2160 - mae: 1.3970 - 77ms/epoch - 3ms/step
Epoch 59/100
30/30 - 0s - loss: 3.2369 - mae: 1.4057 - 56ms/epoch - 2ms/step
Epoch 60/100
30/30 - 0s - loss: 3.2351 - mae: 1.4058 - 67ms/epoch - 2ms/step
Epoch 61/100
30/30 - 0s - loss: 3.2163 - mae: 1.3984 - 53ms/epoch - 2ms/step
Epoch 62/100
30/30 - 0s - loss: 3.2166 - mae: 1.4005 - 52ms/epoch - 2ms/step
Epoch 63/100
30/30 - 0s - loss: 3.2252 - mae: 1.4004 - 54ms/epoch - 2ms/step
Epoch 64/100
30/30 - 0s - loss: 3.2225 - mae: 1.4004 - 54ms/epoch - 2ms/step
Epoch 65/100
30/30 - 0s - loss: 3.2237 - mae: 1.4036 - 54ms/epoch - 2ms/step
Epoch 66/100
30/30 - 0s - loss: 3.2035 - mae: 1.3961 - 54ms/epoch - 2ms/step
Epoch 67/100
30/30 - 0s - loss: 3.2293 - mae: 1.4014 - 54ms/epoch - 2ms/step
Epoch 68/100
30/30 - 0s - loss: 3.2090 - mae: 1.3979 - 55ms/epoch - 2ms/step
Epoch 69/100
30/30 - 0s - loss: 3.2153 - mae: 1.4000 - 54ms/epoch - 2ms/step
Epoch 70/100
30/30 - 0s - loss: 3.2124 - mae: 1.3971 - 55ms/epoch - 2ms/step
Epoch 71/100
30/30 - 0s - loss: 3.1955 - mae: 1.3950 - 53ms/epoch - 2ms/step
Epoch 72/100
30/30 - 0s - loss: 3.2284 - mae: 1.4011 - 53ms/epoch - 2ms/step
Epoch 73/100
30/30 - 0s - loss: 3.2027 - mae: 1.3948 - 53ms/epoch - 2ms/step
Epoch 74/100
30/30 - 0s - loss: 3.1971 - mae: 1.3945 - 54ms/epoch - 2ms/step
Epoch 75/100
30/30 - 0s - loss: 3.1947 - mae: 1.3941 - 55ms/epoch - 2ms/step
Epoch 76/100
30/30 - 0s - loss: 3.2158 - mae: 1.3935 - 52ms/epoch - 2ms/step
Epoch 77/100
30/30 - 0s - loss: 3.2062 - mae: 1.3994 - 53ms/epoch - 2ms/step
Epoch 78/100
30/30 - 0s - loss: 3.2170 - mae: 1.3959 - 53ms/epoch - 2ms/step
```

```
Epoch 79/100
30/30 - 0s - loss: 3.1840 - mae: 1.3915 - 53ms/epoch - 2ms/step
Epoch 80/100
30/30 - 0s - loss: 3.1863 - mae: 1.3887 - 53ms/epoch - 2ms/step
Epoch 81/100
30/30 - 0s - loss: 3.1821 - mae: 1.3915 - 52ms/epoch - 2ms/step
Epoch 82/100
30/30 - 0s - loss: 3.1821 - mae: 1.3914 - 55ms/epoch - 2ms/step
Epoch 83/100
30/30 - 0s - loss: 3.2060 - mae: 1.3964 - 54ms/epoch - 2ms/step
Epoch 84/100
30/30 - 0s - loss: 3.1960 - mae: 1.3924 - 54ms/epoch - 2ms/step
Epoch 85/100
30/30 - 0s - loss: 3.1799 - mae: 1.3896 - 53ms/epoch - 2ms/step
Epoch 86/100
30/30 - 0s - loss: 3.1865 - mae: 1.3888 - 54ms/epoch - 2ms/step
Epoch 87/100
30/30 - 0s - loss: 3.1835 - mae: 1.3887 - 55ms/epoch - 2ms/step
Epoch 88/100
30/30 - 0s - loss: 3.1682 - mae: 1.3845 - 55ms/epoch - 2ms/step
Epoch 89/100
30/30 - 0s - loss: 3.1774 - mae: 1.3905 - 55ms/epoch - 2ms/step
Epoch 90/100
30/30 - 0s - loss: 3.1731 - mae: 1.3899 - 54ms/epoch - 2ms/step
Epoch 91/100
30/30 - 0s - loss: 3.1648 - mae: 1.3861 - 54ms/epoch - 2ms/step
Epoch 92/100
30/30 - 0s - loss: 3.1703 - mae: 1.3863 - 54ms/epoch - 2ms/step
Epoch 93/100
30/30 - 0s - loss: 3.1581 - mae: 1.3808 - 54ms/epoch - 2ms/step
Epoch 94/100
30/30 - 0s - loss: 3.1716 - mae: 1.3855 - 53ms/epoch - 2ms/step
Epoch 95/100
30/30 - 0s - loss: 3.1584 - mae: 1.3838 - 54ms/epoch - 2ms/step
Epoch 96/100
30/30 - 0s - loss: 3.1747 - mae: 1.3820 - 54ms/epoch - 2ms/step
Epoch 97/100
30/30 - 0s - loss: 3.1592 - mae: 1.3803 - 55ms/epoch - 2ms/step
Epoch 98/100
30/30 - 0s - loss: 3.1514 - mae: 1.3805 - 54ms/epoch - 2ms/step
Epoch 99/100
30/30 - 0s - loss: 3.1510 - mae: 1.3810 - 55ms/epoch - 2ms/step
Epoch 100/100
30/30 - 0s - loss: 3.1599 - mae: 1.3867 - 53ms/epoch - 2ms/step
1/1 [==============================] - 0s 118ms/step
Input: [1.  0.5 0.  0.5 0.  0.  0.5 1.  0.5 0.  0.5 1.  1.  0.  0.5 0.
 1.  0.5
 1.  0.5]
True Output: [8]
```

```
Predicted Output: 6.6054335


Input: [0.5 0.5 0.5 0.  0.  0.  0.5 0.  0.5 1.  1.  1.  1.  0.5 0.5 0.
0.5 0.5
 0.5 0. ]
True Output: [10]
Predicted Output: 6.345116


Input: [0.  1.  1.  1.  1.  1.  0.5 0.5 0.5 0.  1.  0.5 0.  1.  0.  0.
1.  0.5
 0.  1. ]
True Output: [5]
Predicted Output: 6.7734313
```