

# LinioweRNN

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Sprawozdanie

Matematyka Konkretna

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Laboratorium 8

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Liniowe RNN Maksymilian Grygiel

Wariant 10

Dane wejściowe składają się z 30 sekwencji po 20 kroków czasowych każda. Każda sekwencja wejściowa jest generowana z jednolitego rozkładu losowego, który jest zaokrąglany do 0, 0.2, 0.4, 0.6, 0.8 lub 1. Cele wyjściowe  $t$  to suma liczb w sekwencji.

Link do repozytorium: <https://github.com/Maksiolo20/MK>

```
[4]: #!/pip install tensorflow jeżeli nie ma zainstalowanego tensorflow
import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import SimpleRNN, Dense

# Function to generate input and output data
def generate_data_sum(num_samples, seq_length):
    X = np.random.choice([0, 0.2, 0.4, 0.6, 0.8, 1], size=(num_samples, seq_length))
    y = np.sum(X, axis=1)
    return X, y

# Parameters
num_samples = 30
seq_length = 20
input_dim = 1 # Each time step contains one value (0, 0.2, 0.4, 0.6, 0.8, or 1)
output_dim = 1 # One output at the end of the sequence

# Generate data
X_train, y_train = generate_data_sum(num_samples, seq_length)

# Configure the RNN model
model = Sequential()
model.add(SimpleRNN(units=10, input_shape=(seq_length, input_dim)))
model.add(Dense(units=output_dim, activation='linear'))
```

```

# Compile the model
model.compile(optimizer='adam', loss='mean_squared_error', metrics=['accuracy'])

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

# Test the model on new data
X_test, y_test = generate_data_sum(5, seq_length)
predictions = model.predict(X_test)

# Display the results
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: 107.9691 - accuracy: 0.0000e+00 - 776ms/epoch - 26ms/step
Epoch 2/100
30/30 - 0s - loss: 95.4394 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step
Epoch 3/100
30/30 - 0s - loss: 82.0650 - accuracy: 0.0000e+00 - 57ms/epoch - 2ms/step
Epoch 4/100
30/30 - 0s - loss: 68.0366 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step
Epoch 5/100
30/30 - 0s - loss: 55.3818 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step
Epoch 6/100
30/30 - 0s - loss: 44.9061 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step
Epoch 7/100
30/30 - 0s - loss: 36.9271 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step
Epoch 8/100
30/30 - 0s - loss: 30.5907 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step
Epoch 9/100
30/30 - 0s - loss: 25.6369 - accuracy: 0.0000e+00 - 57ms/epoch - 2ms/step
Epoch 10/100
30/30 - 0s - loss: 21.6447 - accuracy: 0.0000e+00 - 57ms/epoch - 2ms/step
Epoch 11/100
30/30 - 0s - loss: 18.4575 - accuracy: 0.0000e+00 - 60ms/epoch - 2ms/step
Epoch 12/100
30/30 - 0s - loss: 15.8328 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step
Epoch 13/100
30/30 - 0s - loss: 13.6497 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step
Epoch 14/100
30/30 - 0s - loss: 11.7811 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step
Epoch 15/100
30/30 - 0s - loss: 10.2146 - accuracy: 0.0000e+00 - 60ms/epoch - 2ms/step

```

Epoch 16/100  
30/30 - 0s - loss: 8.8447 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 17/100  
30/30 - 0s - loss: 7.6697 - accuracy: 0.0000e+00 - 57ms/epoch - 2ms/step  
Epoch 18/100  
30/30 - 0s - loss: 6.6729 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 19/100  
30/30 - 0s - loss: 5.8174 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
Epoch 20/100  
30/30 - 0s - loss: 5.0876 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step  
Epoch 21/100  
30/30 - 0s - loss: 4.4587 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step  
Epoch 22/100  
30/30 - 0s - loss: 3.9298 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
Epoch 23/100  
30/30 - 0s - loss: 3.4812 - accuracy: 0.0000e+00 - 53ms/epoch - 2ms/step  
Epoch 24/100  
30/30 - 0s - loss: 3.0964 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step  
Epoch 25/100  
30/30 - 0s - loss: 2.7731 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
Epoch 26/100  
30/30 - 0s - loss: 2.5113 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step  
Epoch 27/100  
30/30 - 0s - loss: 2.2854 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 28/100  
30/30 - 0s - loss: 2.0969 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 29/100  
30/30 - 0s - loss: 1.9421 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 30/100  
30/30 - 0s - loss: 1.8160 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 31/100  
30/30 - 0s - loss: 1.7123 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 32/100  
30/30 - 0s - loss: 1.6319 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 33/100  
30/30 - 0s - loss: 1.5611 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 34/100  
30/30 - 0s - loss: 1.5065 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 35/100  
30/30 - 0s - loss: 1.4619 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 36/100  
30/30 - 0s - loss: 1.4278 - accuracy: 0.0000e+00 - 53ms/epoch - 2ms/step  
Epoch 37/100  
30/30 - 0s - loss: 1.3984 - accuracy: 0.0000e+00 - 53ms/epoch - 2ms/step  
Epoch 38/100  
30/30 - 0s - loss: 1.3781 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
Epoch 39/100  
30/30 - 0s - loss: 1.3624 - accuracy: 0.0000e+00 - 53ms/epoch - 2ms/step

Epoch 40/100  
 30/30 - 0s - loss: 1.3481 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
 Epoch 41/100  
 30/30 - 0s - loss: 1.3420 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
 Epoch 42/100  
 30/30 - 0s - loss: 1.3327 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step  
 Epoch 43/100  
 30/30 - 0s - loss: 1.3246 - accuracy: 0.0000e+00 - 61ms/epoch - 2ms/step  
 Epoch 44/100  
 30/30 - 0s - loss: 1.3194 - accuracy: 0.0000e+00 - 61ms/epoch - 2ms/step  
 Epoch 45/100  
 30/30 - 0s - loss: 1.3216 - accuracy: 0.0000e+00 - 62ms/epoch - 2ms/step  
 Epoch 46/100  
 30/30 - 0s - loss: 1.3182 - accuracy: 0.0000e+00 - 63ms/epoch - 2ms/step  
 Epoch 47/100  
 30/30 - 0s - loss: 1.3114 - accuracy: 0.0000e+00 - 61ms/epoch - 2ms/step  
 Epoch 48/100  
 30/30 - 0s - loss: 1.3102 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
 Epoch 49/100  
 30/30 - 0s - loss: 1.3092 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
 Epoch 50/100  
 30/30 - 0s - loss: 1.3079 - accuracy: 0.0000e+00 - 61ms/epoch - 2ms/step  
 Epoch 51/100  
 30/30 - 0s - loss: 1.3067 - accuracy: 0.0000e+00 - 65ms/epoch - 2ms/step  
 Epoch 52/100  
 30/30 - 0s - loss: 1.3103 - accuracy: 0.0000e+00 - 64ms/epoch - 2ms/step  
 Epoch 53/100  
 30/30 - 0s - loss: 1.3086 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step  
 Epoch 54/100  
 30/30 - 0s - loss: 1.3058 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step  
 Epoch 55/100  
 30/30 - 0s - loss: 1.3089 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step  
 Epoch 56/100  
 30/30 - 0s - loss: 1.3077 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step  
 Epoch 57/100  
 30/30 - 0s - loss: 1.3067 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step  
 Epoch 58/100  
 30/30 - 0s - loss: 1.3037 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step  
 Epoch 59/100  
 30/30 - 0s - loss: 1.3049 - accuracy: 0.0000e+00 - 57ms/epoch - 2ms/step  
 Epoch 60/100  
 30/30 - 0s - loss: 1.3116 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
 Epoch 61/100  
 30/30 - 0s - loss: 1.3091 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
 Epoch 62/100  
 30/30 - 0s - loss: 1.3100 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
 Epoch 63/100  
 30/30 - 0s - loss: 1.3096 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step

Epoch 64/100  
30/30 - 0s - loss: 1.3071 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 65/100  
30/30 - 0s - loss: 1.3106 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 66/100  
30/30 - 0s - loss: 1.3053 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 67/100  
30/30 - 0s - loss: 1.3090 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 68/100  
30/30 - 0s - loss: 1.3118 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 69/100  
30/30 - 0s - loss: 1.3100 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 70/100  
30/30 - 0s - loss: 1.3162 - accuracy: 0.0000e+00 - 53ms/epoch - 2ms/step  
Epoch 71/100  
30/30 - 0s - loss: 1.3066 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
Epoch 72/100  
30/30 - 0s - loss: 1.3041 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
Epoch 73/100  
30/30 - 0s - loss: 1.3067 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step  
Epoch 74/100  
30/30 - 0s - loss: 1.3042 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step  
Epoch 75/100  
30/30 - 0s - loss: 1.3048 - accuracy: 0.0000e+00 - 55ms/epoch - 2ms/step  
Epoch 76/100  
30/30 - 0s - loss: 1.3025 - accuracy: 0.0000e+00 - 54ms/epoch - 2ms/step  
Epoch 77/100  
30/30 - 0s - loss: 1.3053 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 78/100  
30/30 - 0s - loss: 1.3026 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
Epoch 79/100  
30/30 - 0s - loss: 1.3033 - accuracy: 0.0000e+00 - 60ms/epoch - 2ms/step  
Epoch 80/100  
30/30 - 0s - loss: 1.3051 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
Epoch 81/100  
30/30 - 0s - loss: 1.3021 - accuracy: 0.0000e+00 - 68ms/epoch - 2ms/step  
Epoch 82/100  
30/30 - 0s - loss: 1.3022 - accuracy: 0.0000e+00 - 70ms/epoch - 2ms/step  
Epoch 83/100  
30/30 - 0s - loss: 1.3037 - accuracy: 0.0000e+00 - 63ms/epoch - 2ms/step  
Epoch 84/100  
30/30 - 0s - loss: 1.3033 - accuracy: 0.0000e+00 - 62ms/epoch - 2ms/step  
Epoch 85/100  
30/30 - 0s - loss: 1.3030 - accuracy: 0.0000e+00 - 64ms/epoch - 2ms/step  
Epoch 86/100  
30/30 - 0s - loss: 1.3085 - accuracy: 0.0000e+00 - 62ms/epoch - 2ms/step  
Epoch 87/100  
30/30 - 0s - loss: 1.3068 - accuracy: 0.0000e+00 - 56ms/epoch - 2ms/step

Epoch 88/100  
 30/30 - 0s - loss: 1.3014 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
 Epoch 89/100  
 30/30 - 0s - loss: 1.3072 - accuracy: 0.0000e+00 - 60ms/epoch - 2ms/step  
 Epoch 90/100  
 30/30 - 0s - loss: 1.3019 - accuracy: 0.0000e+00 - 58ms/epoch - 2ms/step  
 Epoch 91/100  
 30/30 - 0s - loss: 1.3060 - accuracy: 0.0000e+00 - 59ms/epoch - 2ms/step  
 Epoch 92/100  
 30/30 - 0s - loss: 1.2995 - accuracy: 0.0000e+00 - 57ms/epoch - 2ms/step  
 Epoch 93/100  
 30/30 - 0s - loss: 1.3015 - accuracy: 0.0000e+00 - 63ms/epoch - 2ms/step  
 Epoch 94/100  
 30/30 - 0s - loss: 1.2988 - accuracy: 0.0000e+00 - 63ms/epoch - 2ms/step  
 Epoch 95/100  
 30/30 - 0s - loss: 1.3016 - accuracy: 0.0000e+00 - 65ms/epoch - 2ms/step  
 Epoch 96/100  
 30/30 - 0s - loss: 1.2981 - accuracy: 0.0000e+00 - 64ms/epoch - 2ms/step  
 Epoch 97/100  
 30/30 - 0s - loss: 1.3029 - accuracy: 0.0000e+00 - 64ms/epoch - 2ms/step  
 Epoch 98/100  
 30/30 - 0s - loss: 1.3067 - accuracy: 0.0000e+00 - 62ms/epoch - 2ms/step  
 Epoch 99/100  
 30/30 - 0s - loss: 1.3090 - accuracy: 0.0000e+00 - 62ms/epoch - 2ms/step  
 Epoch 100/100  
 30/30 - 0s - loss: 1.3113 - accuracy: 0.0000e+00 - 63ms/epoch - 2ms/step  
 1/1 [=====] - 0s 128ms/step  
 Input: [0. 0.2 1. 1. 0. 0.2 0. 1. 0.2 0.8 0. 0. 0.6 0.8 1. 0. 0.6 0.2  
 0. 0. ]  
 True Output: 7.6000000000000005  
 Predicted Output: 10.301594

Input: [0.8 1. 0.4 0. 0.2 1. 0.2 0.2 1. 0.8 0.2 0.2 0. 1. 0.4 0.2 1. 0.6  
 0. 1. ]  
 True Output: 10.200000000000001  
 Predicted Output: 10.428625

Input: [0.4 0.4 0.4 0.4 1. 0.8 0.4 0.6 0.6 1. 0.2 0.8 1. 0.6 0.8 1. 0.4 0.6  
 0.4 1. ]  
 True Output: 12.8  
 Predicted Output: 10.433655

Input: [0.4 0.4 1. 0. 0.8 1. 0.8 0.2 0.4 0.6 1. 0.8 0.2 0. 0.4 0. 0.6 0.4  
 0.6 0.6]  
 True Output: 10.2

Predicted Output: 10.405594

Input: [0. 0.8 0.2 1. 0.8 0.8 1. 0.8 0.6 0.8 0.6 0.6 1. 1. 0.6 1. 0.4 1.  
0.8 0.2]

True Output: 14.000000000000002

Predicted Output: 10.355679

[ ]: