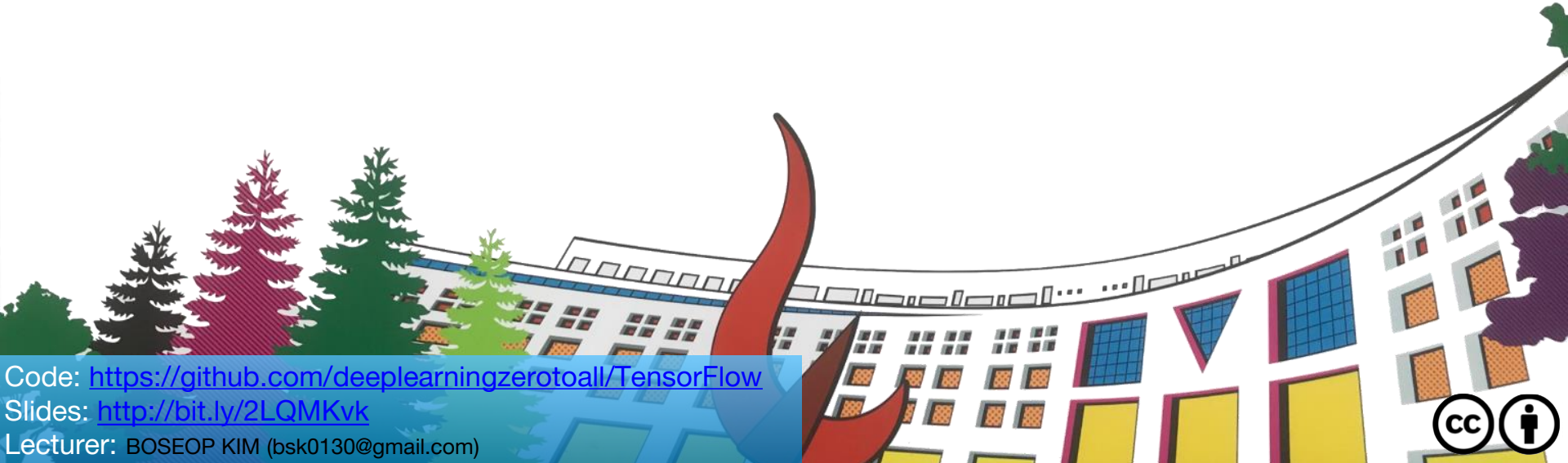
ML/DL for Everyone Season2

with TensorFlow

Lab 12-0 rnn basics

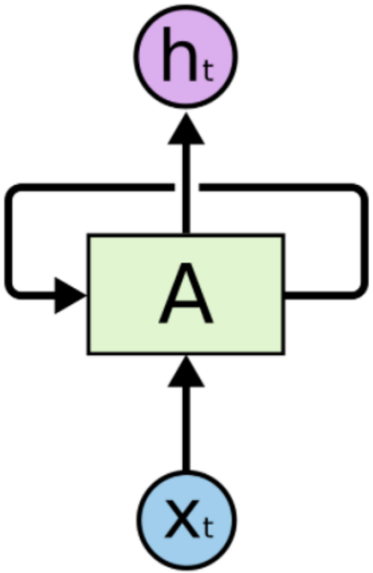


Code: https://github.com/deeplearningzerotoall/TensorFlow
Slides: http://bit.ly/2LQMKvk
Lecturer: BOSEOP KIM (bsk0130@gmail.com)

rnn basics

- RNN in TensorFlow
- One cell: 4 (input-dim), 2 (hidden_size)
- Unfolding to n sequences
- Batching input

RNN in TensorFlow 2.0




```
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers

                                    ⋮

cell = layers.SimpleRNNCell(units=hidden_size)
rnn = layers.RNN(cell, return_sequences=True, return_state=True)
outputs, states = rnn(x_data)
```

구현방법 두가지

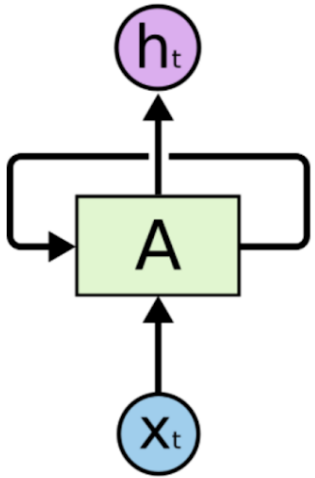
```
rnn = layers.SimpleRNN(units=hidden_size, return_sequences=True,
                       return_state=True)
outputs, states = rnn(x_data)
```

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-0-rnn-basics-keras-eager.ipynb

One cell: 4 (input-dim), 2 (hidden_size)

[[[x,x]]]
shape=(1,1,2)

hidden_size=2



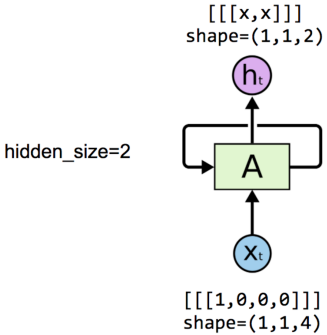

```
# One hot encoding
h = [1, 0, 0, 0]
e = [0, 1, 0, 0]
l = [0, 0, 1, 0]
o = [0, 0, 0, 1]
```

[[[1,0,0,0]]] H에 해당
shape=(1,1,4)

(벤치 사이즈 , 시퀀스 렝스 , 인풋 디멘젼)

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-0-rnn-basics-keras-eager.ipynb

One cell: 4 (input-dim), 2 (hidden_size)




```
# One hot encoding
h = [1, 0, 0, 0]
e = [0, 1, 0, 0]
l = [0, 0, 1, 0]
o = [0, 0, 0, 1]
```

RNN

Ron에 입력으로 전달

```
# One cell RNN input_dim (4) -> output_dim (2)
x_data = np.array([[h]], dtype=np.float32)
```

전처리

```
hidden_size = 2
cell = layers.SimpleRNNCell(units=hidden_size)
rnn = layers.RNN(cell, return_sequences=True, return_state=True)
outputs, states = rnn(x_data)

# equivalent to above
# rnn = layers.SimpleRNN(units=hidden_size, return_sequences=True,
#                        return_state=True)
# outputs, states = rnn(x_data)
```

```
# setup
import numpy as np
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers

print(tf.__version__)
tf.enable_eager_execution()
```

처리결과 프린트

```
print('x_data: {}, shape: {}'.format(x_data, x_data.shape))
print('outputs: {}, shape: {}'.format(outputs, outputs.shape))
print('states: {}, shape: {}'.format(states, states.shape))
```

```
# One hot encoding for each char in 'hello'
h = [1, 0, 0, 0]
e = [0, 1, 0, 0]
l = [0, 0, 1, 0]
o = [0, 0, 0, 1]
```

원-핫 벡터 생성

```
x_data: [[[1. 0. 0. 0.]]], shape: (1, 1, 4)
outputs: [[[0.32261637 0.5036928 ]]], shape: (1, 1, 2)
states: [[0.32261637 0.5036928 ]], shape: (1, 2)
```

아웃풋과 스테이트 값은 같은데, shape가 다르다

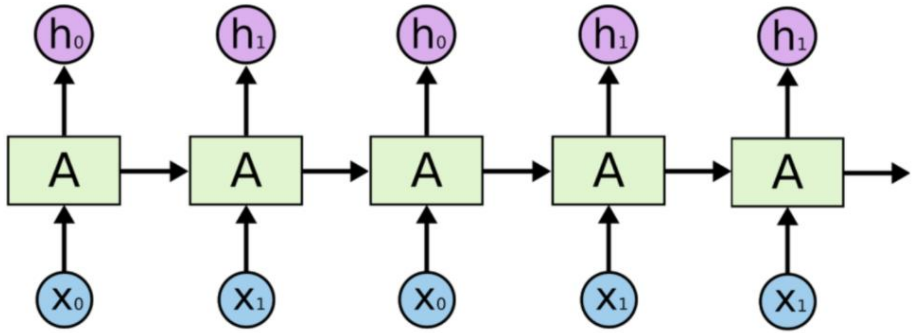
아웃풋에는 히든 스테이츠 값을 가지고 , 스테이츠엔 시퀀스에 마지막 스테이츠

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-0-rnn-basics-keras-eager.ipynb

Unfolding to n sequences

hidden_size=2
sequance_length=5

shape=(1,5,2): [[[x,x], [x,x], [x,x], [x,x], [x,x]]]



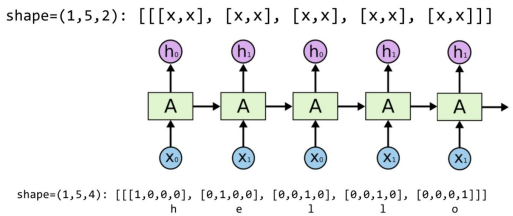
hello입력받아 전처리한다

shape=(1,5,4): [[[1,0,0,0], [0,1,0,0], [0,0,1,0], [0,0,1,0], [0,0,0,1]]]
h e l l o

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-0-rnn-basics-keras-eager.ipynb

Unfolding to n sequences

hidden_size=2
sequance_length=5




```
# One cell RNN input_dim (4) -> output_dim (2). sequence: 5
x_data = np.array([[h, e, l, l, o]], dtype=np.float32)

hidden_size = 2
rnn = layers.SimpleRNN(units=2, return_sequences=True, return_state=True)
outputs, states = rnn(x_data)

print('x_data: {}, shape: {} \n'.format(x_data, x_data.shape))
print('outputs: {}, shape: {} \n'.format(outputs, outputs.shape))
print('states: {}, shape: {}'.format(states, states.shape))
```

```
x_data: [[[1. 0. 0. 0.]
  [0. 1. 0. 0.]
  [0. 0. 1. 0.]
  [0. 0. 1. 0.]
  [0. 0. 0. 1.]]], shape: (1, 5, 4)
```

```
outputs: [[[ 0.36337885  0.73452437]
  [ 0.23541063 -0.28505793]
  [-0.19638212 -0.54805404]
  [-0.589804   -0.65221256]
  [-0.8427679   0.19108507]]], shape: (1, 5, 2)

states: [[-0.8427679   0.19108507]], shape: (1, 2)
```

전체 시퀀스에 대한 히든 스테이츠 값을 가진다

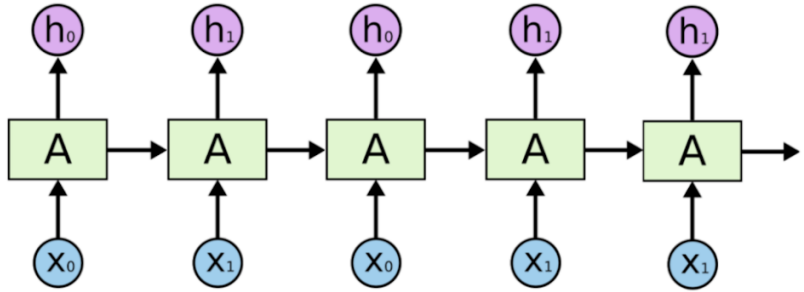
마지막 값은 아웃풋과 같은을 확인

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-0-rnn-basics-keras-eager.ipynb

Batching input

hidden_size=2
sequacne_length=5
batch = 3

```
shape=(3,5,2): [[[x,x], [x,x], [x,x], [x,x], [x,x]],
                [[x,x], [x,x], [x,x], [x,x], [x,x]],
                [[x,x], [x,x], [x,x], [x,x], [x,x]]]
```

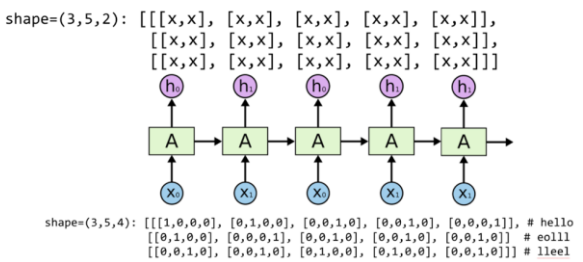



```
shape=(3,5,4): [[[1,0,0,0], [0,1,0,0], [0,0,1,0], [0,0,1,0], [0,0,0,1]], # hello
                [[0,1,0,0], [0,0,0,1], [0,0,1,0], [0,0,1,0], [0,0,1,0]]  # eolll
                [[0,0,1,0], [0,0,1,0], [0,1,0,0], [0,1,0,0], [0,0,1,0]]] # lleel
```

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-0-rnn-basics-keras-eager.ipynb

Batching input

hidden_size=2
sequacne_length=5
batch = 3




```
x_data: [[[1. 0. 0. 0.]    [[0. 1. 0. 0.]     [[0. 0. 1. 0.]
 [0. 1. 0. 0.]              [0. 0. 0. 1.]      [0. 0. 1. 0.]
 [0. 0. 1. 0.]              [0. 0. 1. 0.]      [0. 1. 0. 0.]
 [0. 0. 1. 0.]              [0. 0. 1. 0.]      [0. 1. 0. 0.]
 [0. 0. 0. 1.]]             [0. 0. 1. 0.]]     [0. 0. 1. 0.]]], shape: (3, 5, 4)
```

```
# One cell RNN input_dim (4) -> output_dim (2). sequence: 5, batch 3
# 3 batches 'hello', 'eolll', 'lleel'
x_data = np.array([[h, e, l, l, o],
                   [e, o, l, l, l],
                   [l, l, e, e, l]], dtype=np.float32)

hidden_size = 2
rnn = layers.SimpleRNN(units=2, return_sequences=True, return_state=True)
outputs, states = rnn(x_data)

print('x_data: {}, shape: {} \n'.format(x_data, x_data.shape))
print('outputs: {}, shape: {} \n'.format(outputs, outputs.shape))
print('states: {}, shape: {}'.format(states, states.shape))
```

```
outputs: [[[-0.56743866 -0.23173441]
 [ 0.8334968   0.30382484]
 [-0.93795335 -0.53330624]
 [-0.0874121   0.45240858]
 [-0.52966034 -0.5007928 ]]

[[ 0.58572567  0.00302648]
 [-0.8668559  -0.19943324]
 [-0.10968345  0.14605513]
 [-0.6695559  -0.29440066]
 [-0.30860662  0.20964848]]

[[-0.73496014 -0.17280702]
 [-0.23251031  0.10149368]
 [ 0.723902   -0.06399264]
 [-0.0544093  -0.03742061]
 [-0.7118617  -0.12900047]]], shape: (3, 5, 2)

states: [[-0.52966034 -0.5007928 ]
[-0.30860662  0.20964848]
[-0.7118617  -0.12900047]], shape: (3, 2)
```

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-0-rnn-basics-keras-eager.ipynb

What’s Next?

- many to one