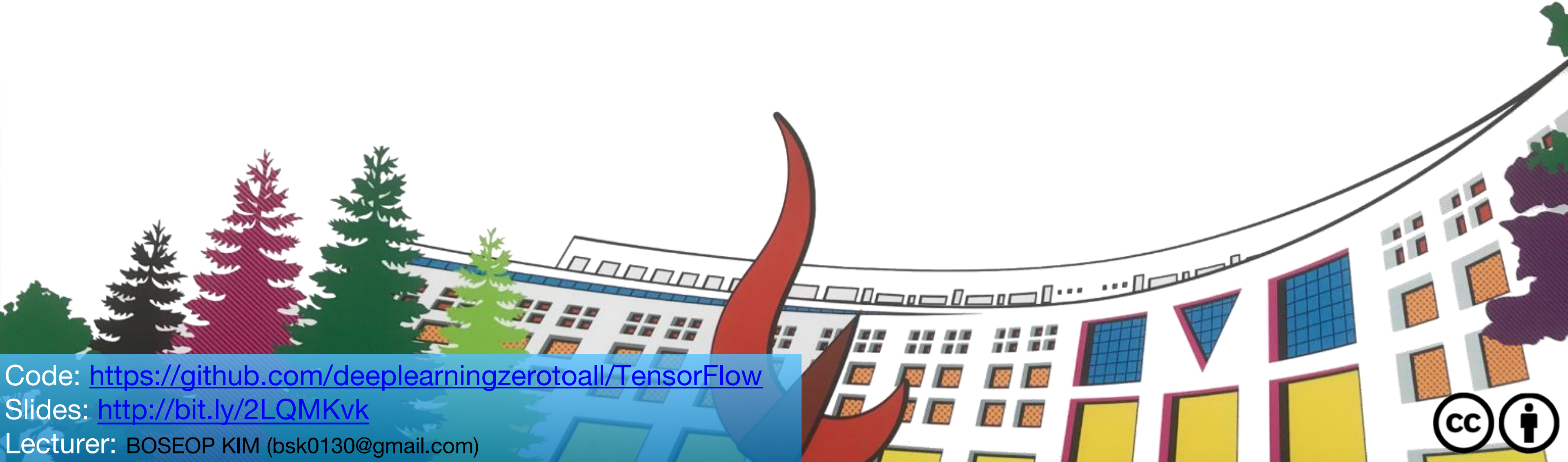
ML/DL for Everyone Season2

with TensorFlow

Lab 12-2 many to one stacking



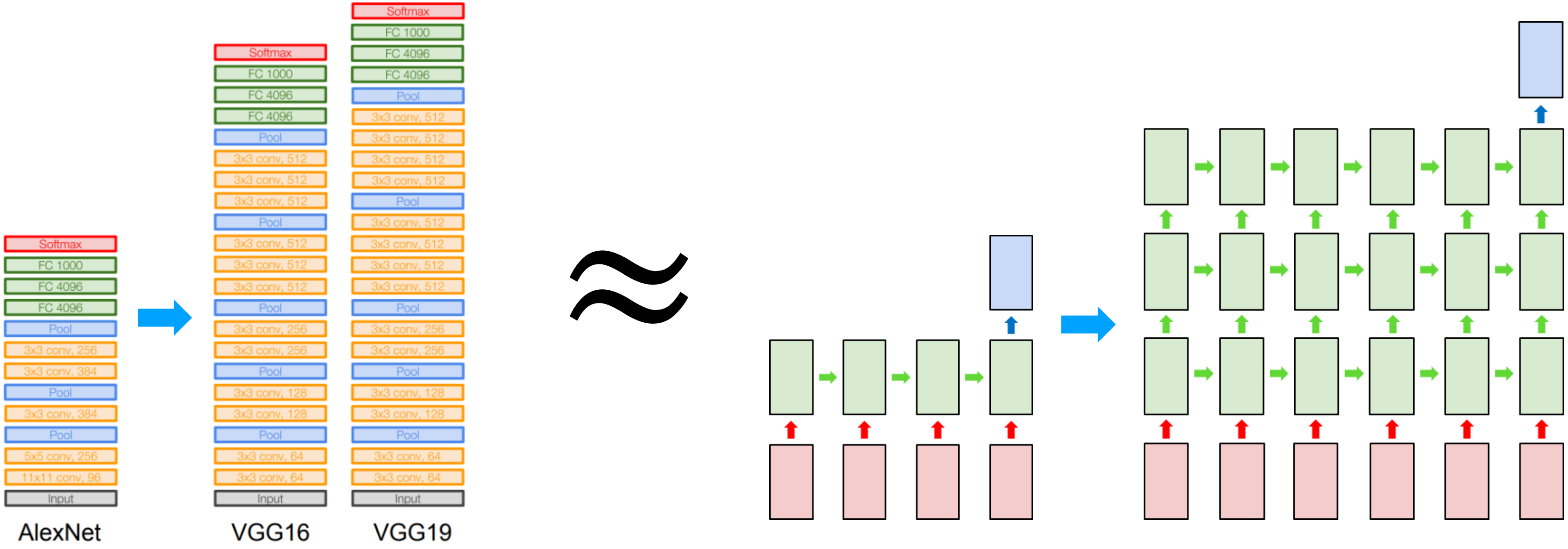
Code: https://github.com/deeplearningzerotoall/TensorFlow
Slides: http://bit.ly/2LQMKvk
Lecturer: BOSEOP KIM (bsk0130@gmail.com)

many to one stacking

- What is “stacking”?
- many to one stacking
- Example : sentence classification
  - Preparing dataset
  - Creating and training model
  - Checking performance

What is “stacking”?

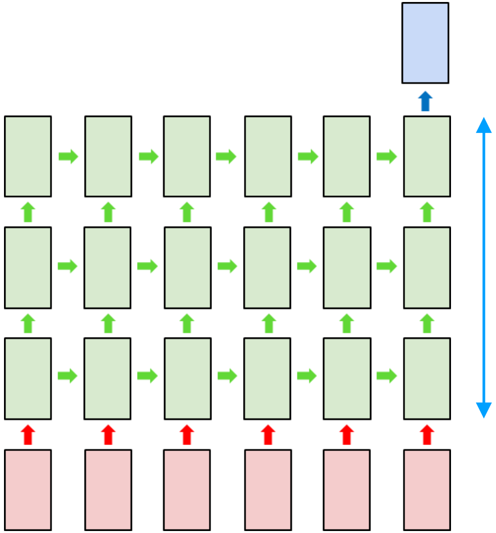
While it is not theoretically clear what is the additional power gained by the deeper architecture, it was observed empirically that deep RNNs work better than shallower ones on some tasks.



http://cs231n.stanford.edu/slides/2018/cs231n_2018_lecture09.pdf

What is “stacking”?

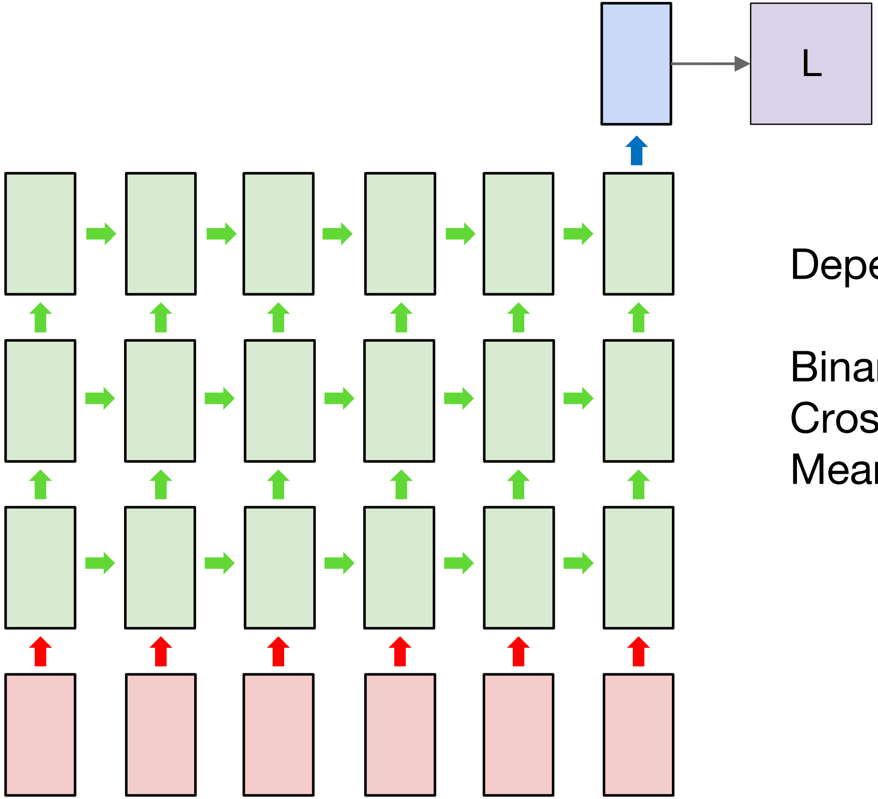
Besides, many works have shown that different layers of deep RNNs encode different types of information.



Encoding more semantic information

Encoding more syntactic information

many to one stacking



Depending on the task…

Binary entropy loss (binary classifier)
Cross entropy loss (softmax classifier)
Mean squared loss (regression)

Example : sentence classification

Preparing dataset

```
# example data
sentences = ['What I cannot create, I do not understand.',
             'Intellecuals solve problems, geniuses prevent them',
             'A person who never made a mistake never tied anything new.',
             'The same equations have the same solutions.']
y_data = [1,0,0,1] # 1: richard feynman, 0: albert einstein
```

```
# creating a token dictionary
char_set = ['<pad>'] + sorted(list(set(''.join(sentences))))
idx2char = {idx : char for idx, char in enumerate(char_set)}
char2idx = {char : idx for idx, char in enumerate(char_set)}

print(char_set)
print(idx2char)
print(char2idx)
```

```
['<pad>', ' ', ',', '.', 'A', 'I', 'T', 'W', 'a',
'b', 'c', 'd', 'e', 'g', 'h', 'i', 'k', 'l', 'm',
'n', 'o', 'p', 'q', 'r', 's', 't', 'u', 'v', 'w',
'y']
{0: '<pad>', 1: ' ', 2: ',', 3: '.', 4: 'A', 5: 'I',
6: 'T', 7: 'W', 8: 'a', 9: 'b', 10: 'c', 11: 'd', 12:
'e', 13: 'g', 14: 'h', 15: 'i', 16: 'k', 17: 'l', 18:
'm', 19: 'n', 20: 'o', 21: 'p', 22: 'q', 23: 'r', 24:
's', 25: 't', 26: 'u', 27: 'v', 28: 'w', 29: 'y'}
{'<pad>': 0, ' ': 1, ',': 2, '.': 3, 'A': 4, 'I': 5,
'T': 6, 'W': 7, 'a': 8, 'b': 9, 'c': 10, 'd': 11,
'e': 12, 'g': 13, 'h': 14, 'i': 15, 'k': 16, 'l': 17,
'm': 18, 'n': 19, 'o': 20, 'p': 21, 'q': 22, 'r': 23,
's': 24, 't': 25, 'u': 26, 'v': 27, 'w': 28, 'y': 29}
```

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-2-many-to-one-stacking-keras-eager.ipynb

Example : sentence classification

Preparing dataset

```
# converting sequence of tokens to sequence of indices
x_data = list(map(lambda sentence : [char2idx.get(char) for char in sentence], sentences))
x_data_len = list(map(lambda sentence : len(sentence), sentences))

print(x_data)
print(x_data_len)
print(y_data)
```

```
[[7, 14, 8, 25, 1, 5, 1, 10, 8, 19, 19, 20, 25, 1, 10, 23, 12, 8, 25, 12, 2, 1, 5, 1, 11, 20, 1, 19, 20, 25, 1, 26, 19,
11, 12, 23, 24, 25, 8, 19, 11, 3], [5, 19, 25, 12, 17, 17, 12, 10, 26, 8, 17, 24, 1, 24, 20, 17, 27, 12, 1, 21, 23, 20, 9,
17, 12, 18, 24, 2, 1, 13, 12, 19, 15, 26, 24, 12, 24, 1, 21, 23, 12, 27, 12, 19, 25, 1, 25, 14, 12, 18], [4, 1, 21, 12,
23, 24, 20, 19, 1, 28, 14, 20, 1, 19, 12, 27, 12, 23, 1, 18, 8, 11, 12, 1, 8, 1, 18, 15, 24, 25, 8, 16, 12, 1, 19, 12, 27,
12, 23, 1, 25, 15, 12, 11, 1, 8, 19, 29, 25, 14, 15, 19, 13, 1, 19, 12, 28, 3], [6, 14, 12, 1, 24, 8, 18, 12, 1, 12, 22,
26, 8, 25, 15, 20, 19, 24, 1, 14, 8, 27, 12, 1, 25, 14, 12, 1, 24, 8, 18, 12, 1, 24, 20, 17, 26, 25, 15, 20, 19, 24, 3]]
[42, 50, 58, 43]
[1, 0, 0, 1]
```

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-2-many-to-one-stacking-keras-eager.ipynb

Example : sentence classification

Preparing dataset

```
# padding the sequence of indices
max_sequence = 55
x_data = pad_sequences(sequences = x_data, maxlen = max_sequence,
                      padding = 'post', truncating = 'post')

# checking data
print(x_data)
print(x_data_len)
print(y_data)
```

```
[[ 7 14  8 25  1  5  1 10  8 19 19 20 25  1 10 23 12  8 25 12  2  1  5  1
  11 20  1 19 20 25  1 26 19 11 12 23 24 25  8 19 11  3  0  0  0  0  0  0
                                                     0  0  0  0  0  0  0]
 [ 5 19 25 12 17 17 12 10 26  8 17 24  1 24 20 17 27 12  1 21 23 20  9 17
  12 18 24  2  1 13 12 19 15 26 24 12 24  1 21 23 12 27 12 19 25  1 25 14
                                                    12 18  0  0  0  0  0]
 [ 4  1 21 12 23 24 20 19  1 28 14 20  1 19 12 27 12 23  1 18  8 11 12  1
   8  1 18 15 24 25  8 16 12  1 19 12 27 12 23  1 25 15 12 11  1  8 19 29
                                                    25 14 15 19 13  1 19]
 [ 6 14 12  1 24  8 18 12  1 12 22 26  8 25 15 20 19 24  1 14  8 27 12  1
  25 14 12  1 24  8 18 12  1 24 20 17 26 25 15 20 19 24  3  0  0  0  0  0
                                                    0  0  0  0  0  0  0]]
                                                          [42, 50, 58, 43]
                                                              [1, 0, 0, 1]
```

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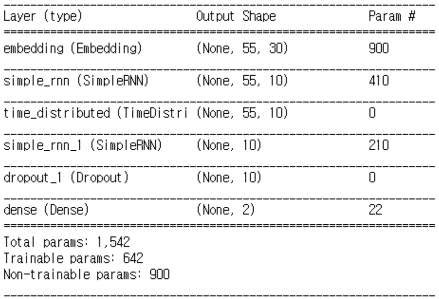
Example : sentence classification

Creating and training model

```
# creating stacked rnn for "many to one" classification with dropout
num_classes = 2
hidden_dims = [10,10]

input_dim = len(char2idx)
output_dim = len(char2idx)
one_hot = np.eye(len(char2idx))

model = Sequential()
model.add(layers.Embedding(input_dim=input_dim, output_dim=output_dim,
                           trainable=False, mask_zero=True, input_length=max_sequence,
                           embeddings_initializer=keras.initializers.Constant(one_hot)))
model.add(layers.SimpleRNN(units=hidden_dims[0], return_sequences=True))
model.add(layers.TimeDistributed(layers.Dropout(rate = .2)))
model.add(layers.SimpleRNN(units=hidden_dims[1]))
model.add(layers.Dropout(rate = .2))
model.add(layers.Dense(units=num_classes))
model.summary()
```



```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 55, 30)            900
_________________________________________________________________
simple_rnn (SimpleRNN)       (None, 55, 10)            410
_________________________________________________________________
time_distributed (TimeDistri (None, 55, 10)            0
_________________________________________________________________
simple_rnn_1 (SimpleRNN)     (None, 10)                210
_________________________________________________________________
dropout_1 (Dropout)          (None, 10)                0
_________________________________________________________________
dense (Dense)                (None, 2)                 22
=================================================================
Total params: 1,542
Trainable params: 642
Non-trainable params: 900
_________________________________________________________________
```

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-2-many-to-one-stacking-keras-eager.ipynb

Example : sentence classification

Creating and training model

```python
# creating loss function
def loss_fn(model, x, y, training):
   return tf.losses.sparse_softmax_cross_entropy(labels=y, logits=model(x, training))

# creating and optimizer
lr = .01
epochs = 30
batch_size = 2
opt = tf.train.AdamOptimizer(learning_rate = lr)


# generating data pipeline
tr_dataset = tf.data.Dataset.from_tensor_slices((x_data, y_data))
tr_dataset = tr_dataset.shuffle(buffer_size=4)
tr_dataset = tr_dataset.batch(batch_size=batch_size)

print(tr_dataset)
```

```
<BatchDataset shapes: ((?, 55), (?,)), types: (tf.int32, tf.int32)>
```

https://github.com/deeplearningzerotoall/TensorFlow/blob/master/lab-12-2-many-to-one-stacking-keras-eager.ipynb

Example : sentence classification

Creating and training model

```
# training
tr_loss_hist = []

for epoch in range(epochs):
    avg_tr_loss = 0
    tr_step = 0

    for x_mb, y_mb in tr_dataset:
        with tf.GradientTape() as tape:
            tr_loss = loss_fn(model, x=x_mb, y=y_mb, training=True)
        grads = tape.gradient(target=tr_loss, sources=model.variables)
        opt.apply_gradients(grads_and_vars=zip(grads, model.variables))
        avg_tr_loss += tr_loss
        tr_step += 1
    else:
        avg_tr_loss /= tr_step
        tr_loss_hist.append(avg_tr_loss)

    if (epoch + 1) % 5 ==0:
        print('epoch : {:3}, tr_loss : {:.3f}'.format(epoch + 1, avg_tr_loss))
```

```
epoch :   5, tr_loss : 0.319
epoch :  10, tr_loss : 0.084
epoch :  15, tr_loss : 0.038
epoch :  20, tr_loss : 0.015
epoch :  25, tr_loss : 0.016
epoch :  30, tr_loss : 0.010
```

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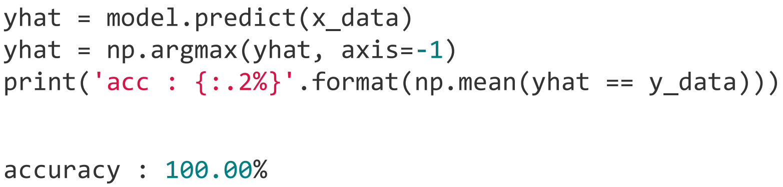
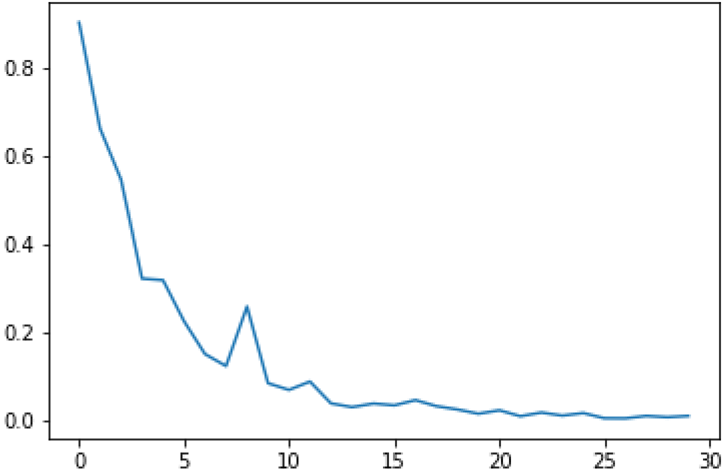
Example : sentence classification

Checking performance



```
yhat = model.predict(x_data)
yhat = np.argmax(yhat, axis=-1)
print('acc : {:.2%}'.format(np.mean(yhat == y_data)))
```

```
accuracy : 100.00%
```



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What’s Next?

- many to many