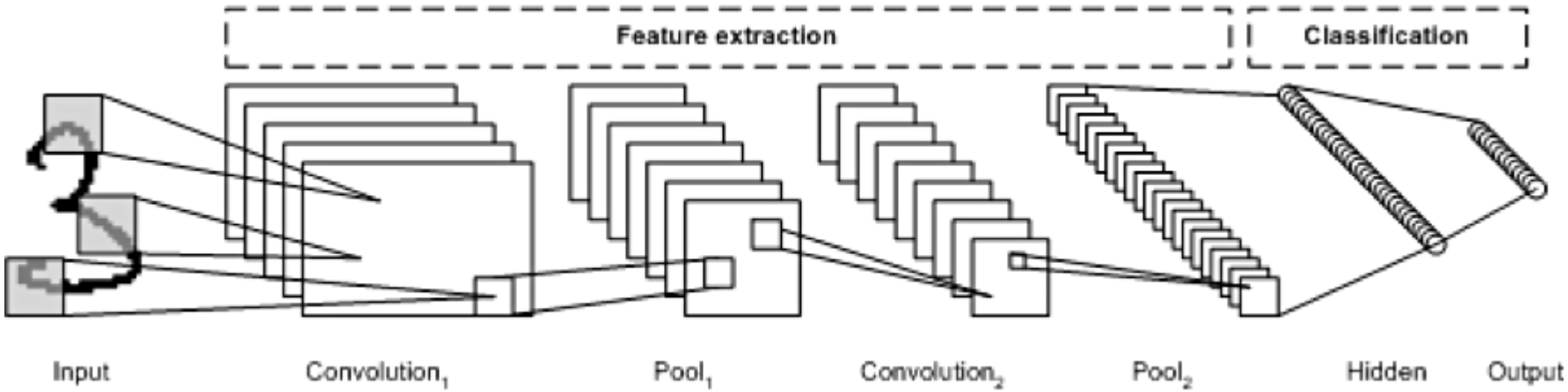
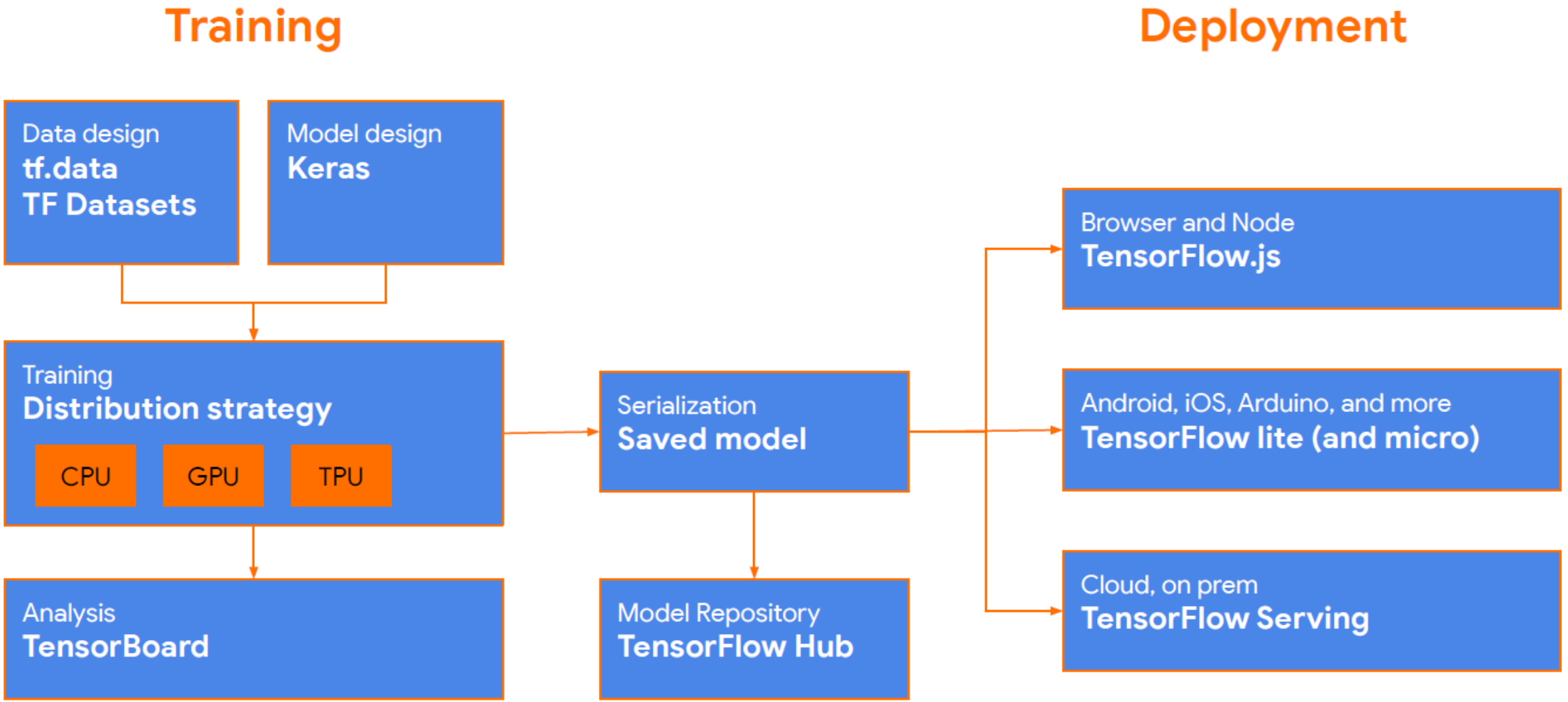
모델 서브클래싱

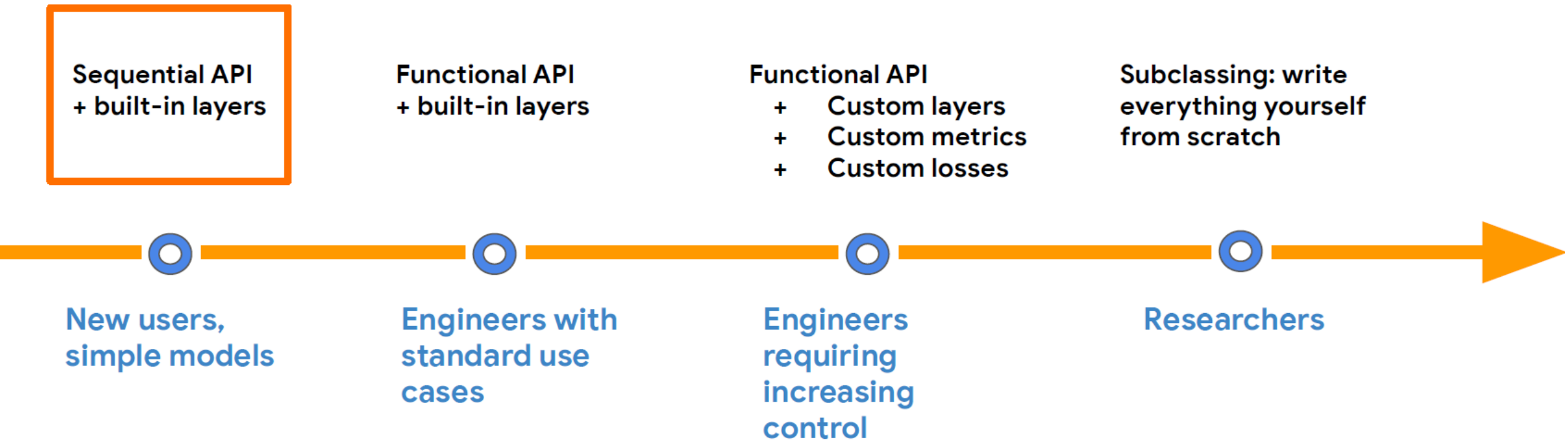

Feature extraction
Classification
Input
Convolution1
Pool1
Convolution2
Pool2
Hidden
Output

박경규



https://www.youtube.com/watch?v=5ECD8J3dvDQ

Model building

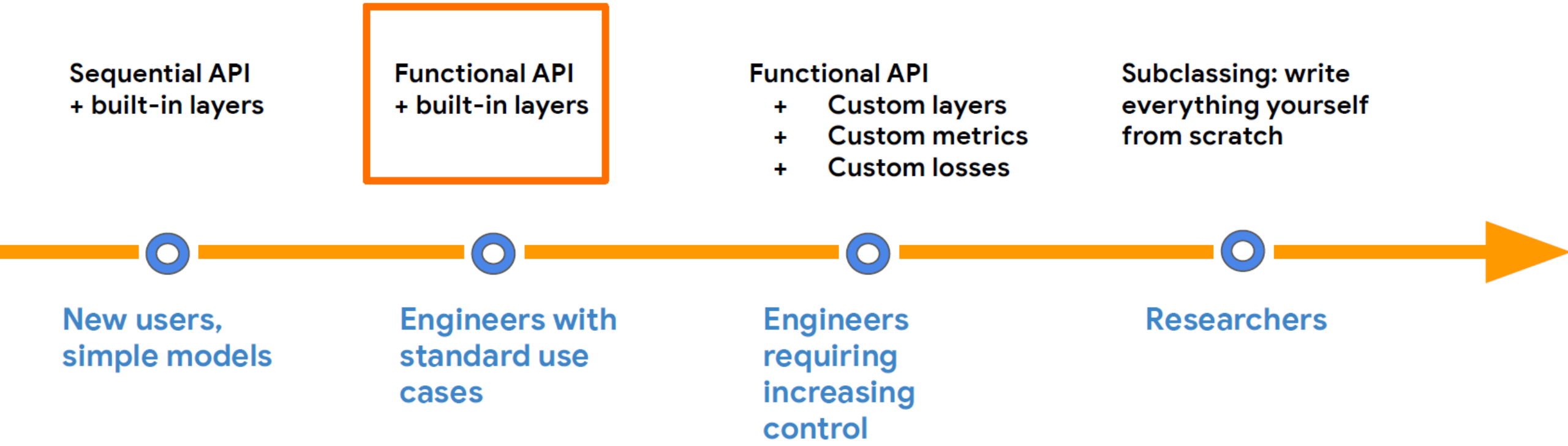


https://www.youtube.com/watch?v=5ECD8J3dvDQ

```
model = keras.Sequential()
model.add(layers.Dense(32, activation='relu', input_shape=(784,)))
model.add(layers.Dense(32, activation='relu'))
model.add(layers.Dense(32, activation='softmax'))
```

https://www.youtube.com/watch?v=5ECD8J3dvDQ

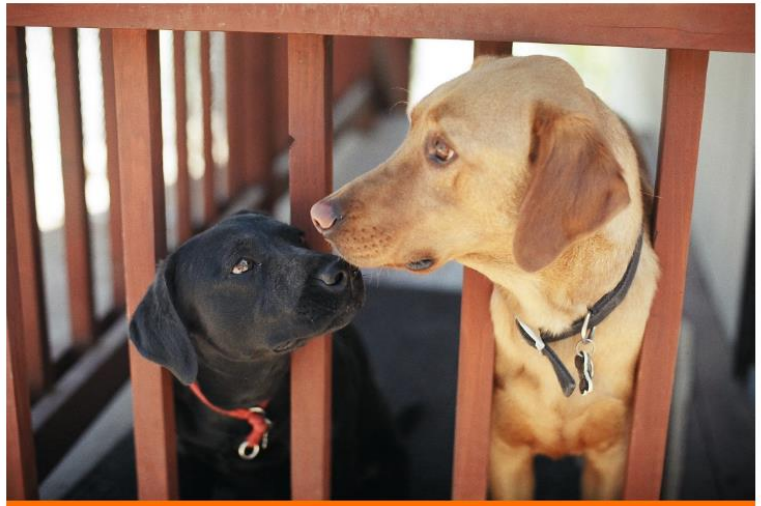
Model building



https://www.youtube.com/watch?v=5ECD8J3dvDQ

Model building

Visual Question Answering



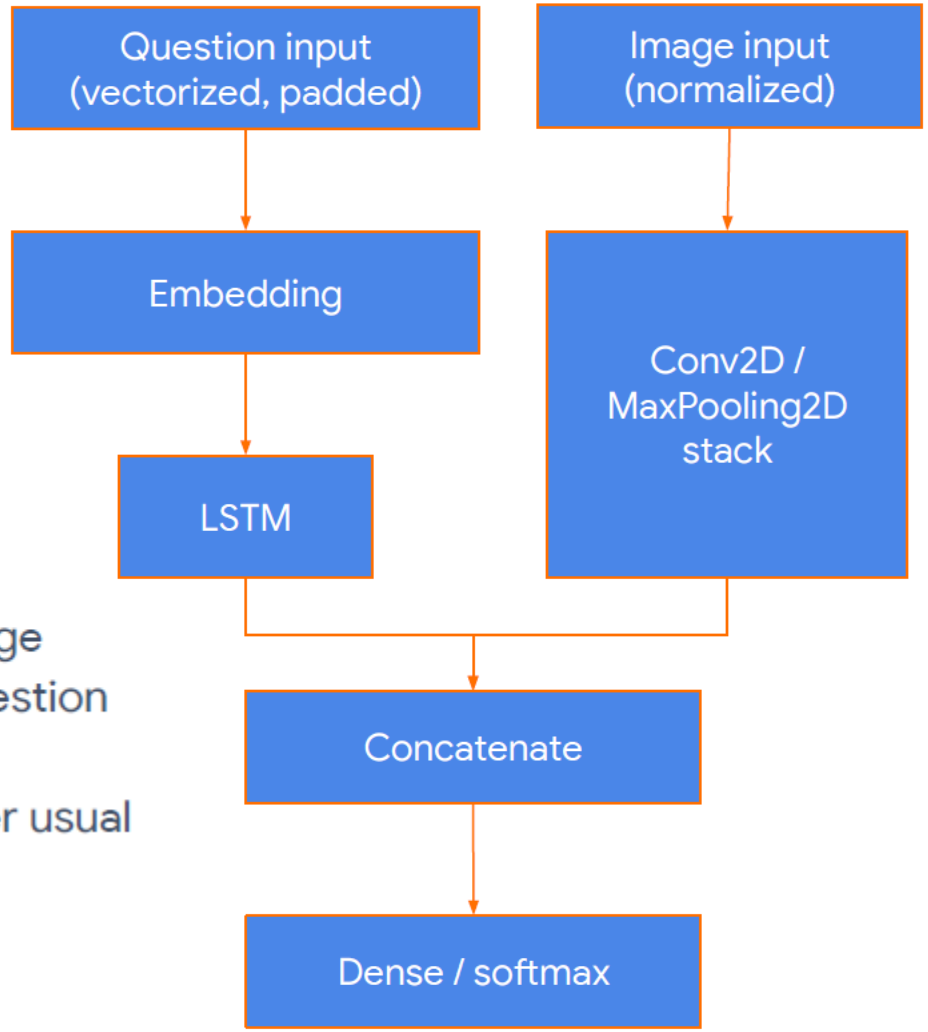
Question: What color is the dog on the right?

Answer: Golden

Workflow

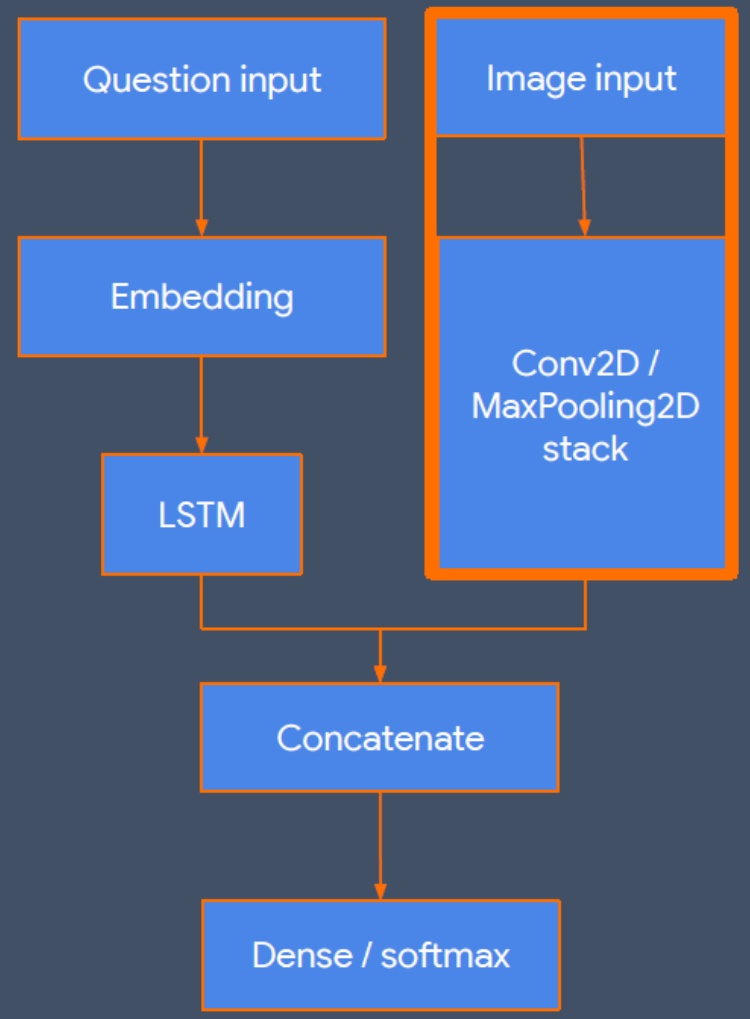
A multi-input model

1. Use a CNN to embed the image
2. Use a LSTM to embed the question
3. **Concatenate**
4. Classify with Dense layers, per usual



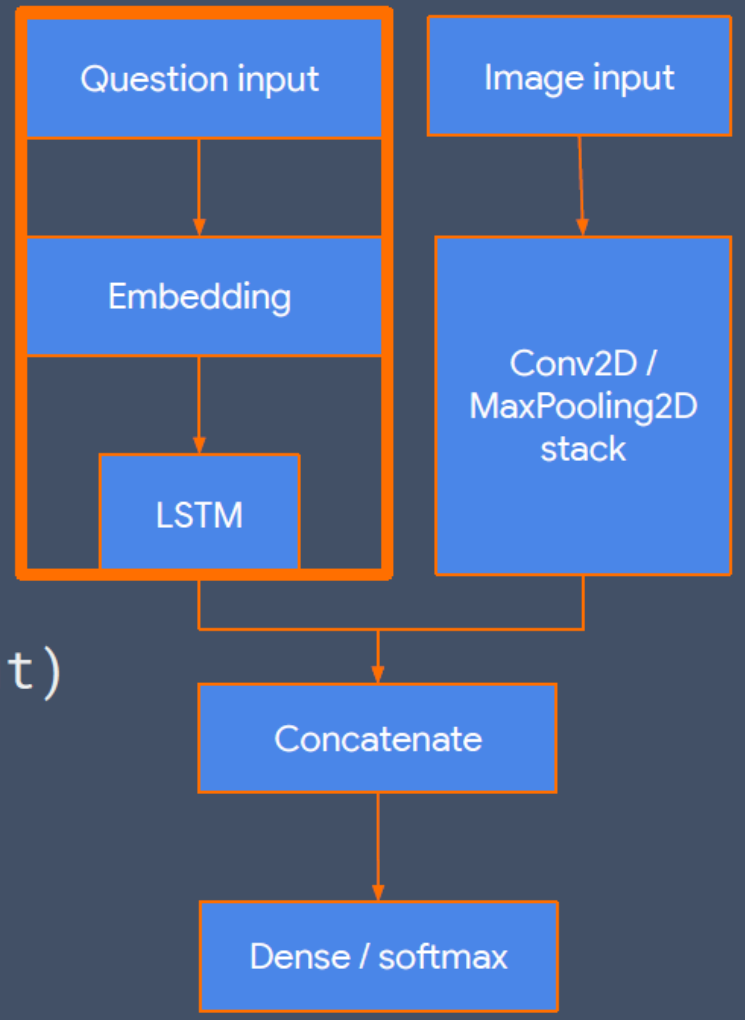
https://www.youtube.com/watch?v=5ECD8J3dvDQ

```
# A vision model.
# Encode an image into a vector.
vision_model = Sequential()
vision_model.add(Conv2D(64, (3, 3),
                        activation='relu',
                        input_shape=(224, 224, 3)))
vision_model.add(MaxPooling2D())
vision_model.add(Flatten())

# Get a tensor with the output of your vision model
image_input = Input(shape=(224, 224, 3))
encoded_image = vision_model(image_input)
```



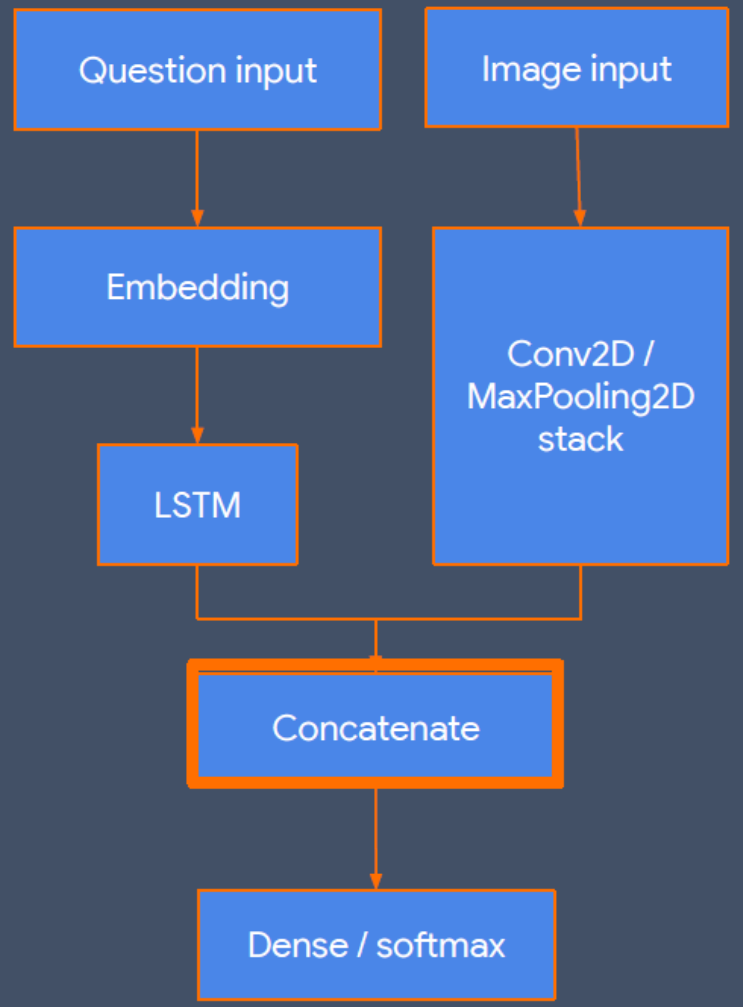
https://www.youtube.com/watch?v=5ECD8J3dvDQ

```
# A language model.
# Encode the question into a vector.
question_input = Input(shape=(100,),
                       dtype='int32',
                       name="Question")

embedded = Embedding(input_dim=10000,
                     output_dim=256,
                     input_length=100)(question_input)

encoded_question = LSTM(256)(embedded_question)
```



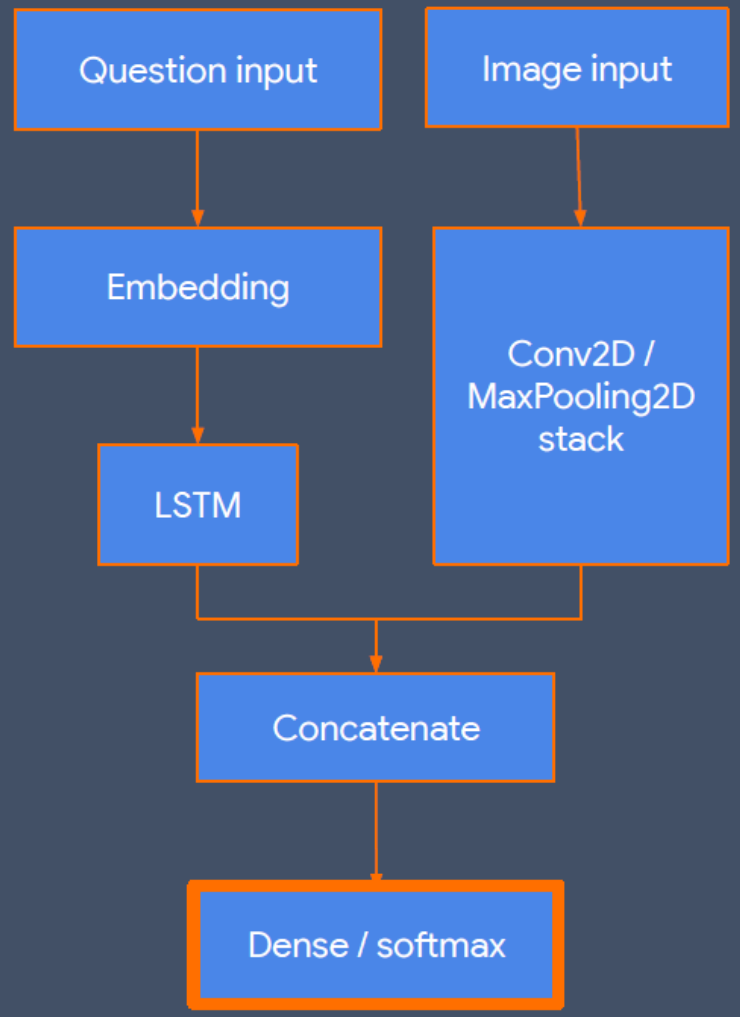
https://www.youtube.com/watch?v=5ECD8J3dvDQ

```
# Concatenate the encoded image and question
merged = layers.concatenate([encoded_image,
                             encoded_question])
```



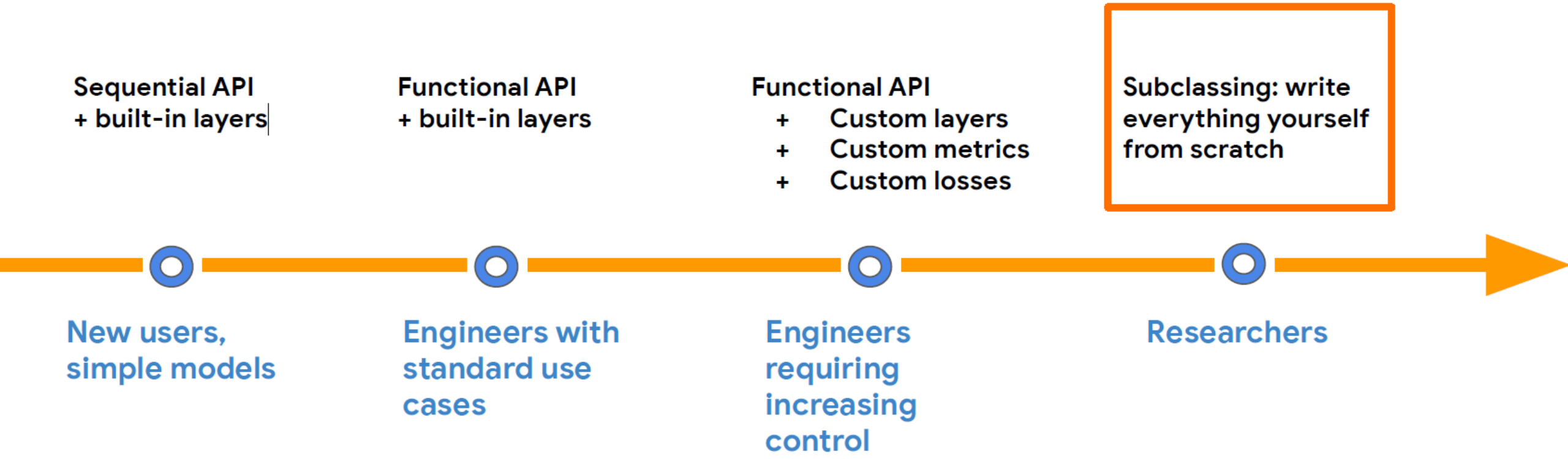
https://www.youtube.com/watch?v=5ECD8J3dvDQ

```
# Train a classifier on top.
output = Dense(1000,
               activation='softmax')(merged)


# You can train w/ .fit, .train_on_batch,
# or with a GradientTape.
vqa_model = Model(inputs=[image_input,
                          question_input],
                  outputs=output)
```



https://www.youtube.com/watch?v=5ECD8J3dvDQ

Model building



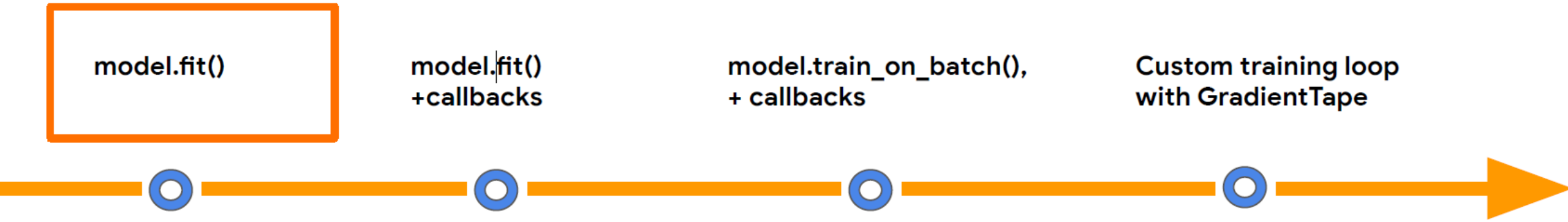
https://www.youtube.com/watch?v=5ECD8J3dvDQ

```python
class MyModel(tf.keras.Model):
  def __init__(self, num_classes=10):
    super(MyModel, self).__init__(name='my_model')
    self.dense_1 = layers.Dense(32, activation='relu')
    self.dense_2 = layers.Dense(num_classes,activation='softmax')

  def call(self, inputs):
    # Define your forward pass here
    x = self.dense_1(inputs)
    return self.dense_2(x)
```


https://www.youtube.com/watch?v=5ECD8J3dvDQ

```python
class MyModel(tf.keras.Model):
  def __init__(self, num_classes=10):
    super(MyModel, self).__init__(name='my_model')
    self.dense_1 = layers.Dense(32)
    self.dense_2 = layers.Dense(num_classes,activation='softmax')

  def call(self, inputs):
    # Define your forward pass here
    x = self.dense_1(inputs)
    x = tf.nn.relu(x)
    return self.dense_2(x)
```

Model training



Quick experiment

Customize your training loop
Add checkpointing, early stopping, TensorBoard monitoring, send Slack notifications...

Custom training loop using built-in optimizers and losses
e.g. GANs

Complete control
e.g. new optimization algorithm; easily modify gradients as you go.

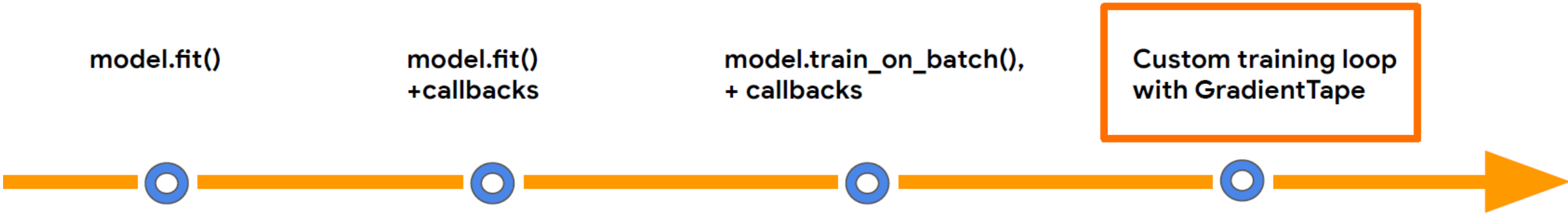
https://www.youtube.com/watch?v=5ECD8J3dvDQ

```
model.compile(optimizer=Adam(),
              loss=BinaryCrossentropy(),
              metrics=[AUC(), Precision(), Recall()])

model.fit(data,
          epochs=10,
          validation_data=val_data,
          callbacks=[EarlyStopping(),
                     TensorBoard(),
                     ModelCheckpoint()])
```

...or write your own callbacks!

https://www.youtube.com/watch?v=5ECD8J3dvDQ

Model training



Quick experiment

Customize your training loop
Add checkpointing, early stopping, TensorBoard monitoring, ...

Custom training loop using built-in optimizers and losses
e.g. GANs

Complete control
e.g. new optimization algorithm; easily modify gradients as you go.

https://www.youtube.com/watch?v=5ECD8J3dvDQ

Graphs with one LOC

```
@tf.function
def train_step(features, labels):
  with tf.GradientTape() as tape:
    logits = model(features, training=True)
    loss = loss_fn(labels, logits)

  grads = tape.gradient(loss, model.trainable_variables)
  optimizer.apply_gradients(zip(grads, model.trainable_variables))
  return loss
```

Gradients

```
x = tf.constant(3.0)
with tf.GradientTape() as g:
  g.watch(x)
  y = x * x
dy_dx = g.gradient(y, x) # 6.0
```

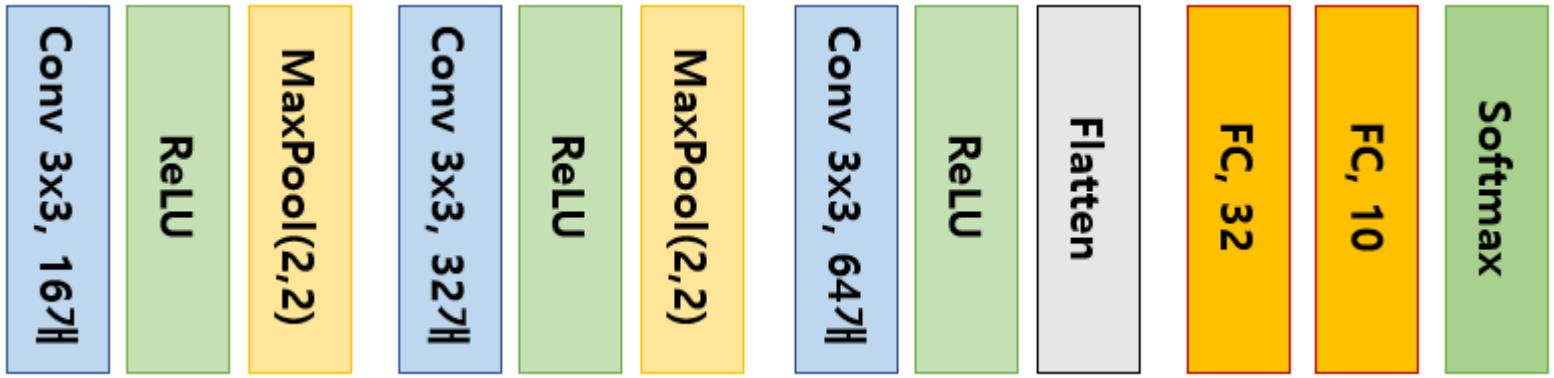
Variables are automatically tracked

```
dense1 = tf.keras.layers.Dense(32)
dense2 = tf.keras.layers.Dense(32)



with tf.GradientTape() as tape:
  result = dense2(dense1(tf.zeros([1, 10])))
  tape.gradient(result, dense1.variables)
```

As we saw previously, you can get the gradients for model.trainable_variables as well in one go.

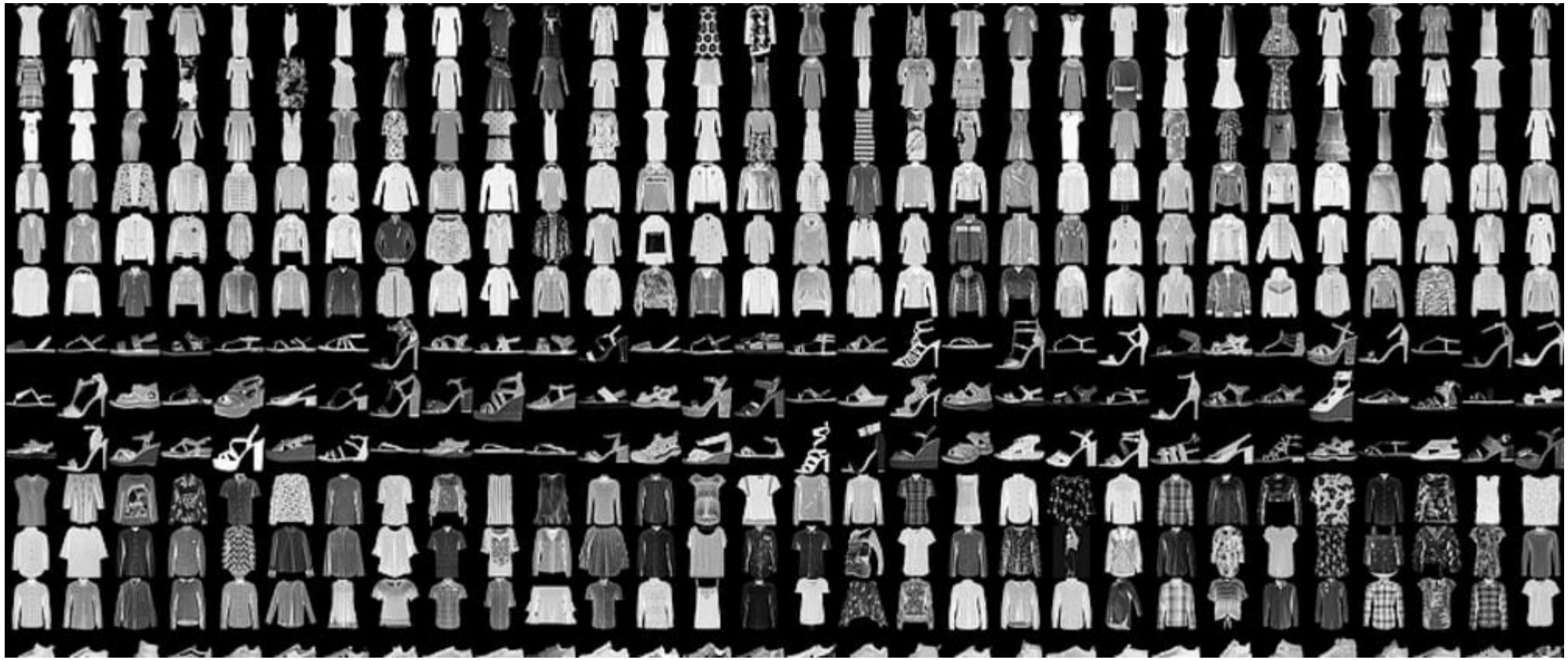
Model Subclassing 실습

model_subclassing.ipynb



Model Subclassing 실습

- Fashion MNIST 데이터셋은 운동화, 셔츠, 샌들과 같은 작은 이미지들의 모음입니다.
- 기본 MNIST 데이터셋과 같이 열 가지로 분류될 수 있는 28×28 픽셀의 이미지 70,000개로 이루어져 있습니다.

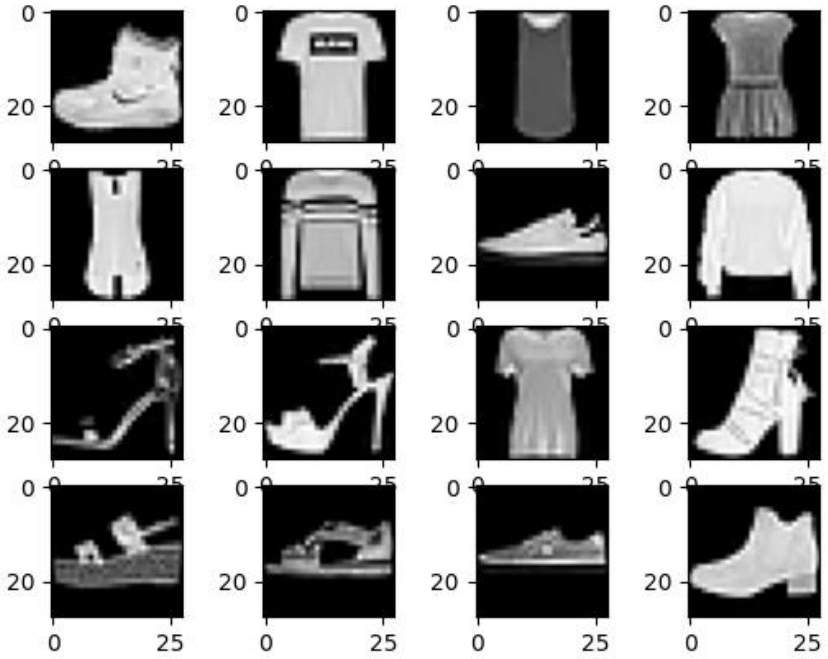


Model Subclassing 실습

```
import matplotlib.pyplot as plt

import tensorflow as tf
from tensorflow.keras.datasets import fashion_mnist
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense

# load fashion_mnist data
(x_train, y_train), (x_test, y_test) = fashion_mnist.load_data()


# adjusting to 0 ~ 1.0
x_train = x_train / 255.0
x_test = x_test / 255.0

print(x_train.shape, x_test.shape)
```

Model Subclassing 실습

```
17  # reshaping
18  x_train = x_train.reshape(-1,28,28,1)
19  x_test = x_test.reshape(-1,28,28,1)
20
21  # plotting
22  plt.figure()
23  for c in range(16):
24      plt.subplot(4,4,c+1)
25      plt.imshow(x_train[c].reshape(28,28), cmap='gray')
26  plt.show()
```



Model Subclassing 실습

```
28  class MyModel(tf.keras.Model):
29      def __init__(self):
30          super(MyModel, self).__init__()
31          self.conv1 = Conv2D(kernel_size=(3,3), filters=16, activation='relu')
32          self.conv2 = Conv2D(kernel_size=(3,3), filters=32, activation='relu')
33          self.conv3 = Conv2D(kernel_size=(3,3), filters=64, activation='relu')
34          self.pool = MaxPooling2D((2, 2))
35          self.flatten = Flatten()
36          self.d1 = Dense(32, activation='relu')
37          self.d2 = Dense(10, activation='softmax')
38
39      def call(self, x):
40          x = self.conv1(x)
41          x = self.pool(x)
42          x = self.conv2(x)
43          x = self.pool(x)
44          x = self.conv3(x)
45          x = self.flatten(x)
46          x = self.d1(x)
47          return self.d2(x)
```

Model Subclassing 실습

```
model = MyModel()

# compile and train
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])


history = model.fit(x_train, y_train,
    epochs=10, validation_split=0.25)

plt.figure(figsize=(10,4))
plt.subplot(1,2,1)
plt.plot(history.history['loss'], 'b-', label='loss')
plt.plot(history.history['val_loss'], 'r-', label='val_loss')
plt.xlabel('epoch')
plt.legend()
```

Gradient 및 자동 미분 실습

https://www.tensorflow.org/guide/autodiff?hl=ko

GradientTape 실습

model_subclassing_gt.ipynb

GradientTape 실습

Loss Function 정의

```
[12]  loss_function = SparseCategoricalCrossentropy()
```

Optimizer 정의

```
[13]  optimizer = Adam()
```

Metric 정의

```
[14]  train_loss = Mean()
      train_acc = SparseCategoricalAccuracy()
      test_loss = Mean()
      test_acc = SparseCategoricalAccuracy()
```

GradientTape 실습

Train step 함수

```
[15]  @tf.function
      def train_step(images, labels):
          with tf.GradientTape() as tape:
              # 1. 예측(Prediction)
              predictions = model(images)
              # 2. Loss 계산
              loss = loss_function(labels, predictions)

          # 3. Gradients 계산
          gradients = tape.gradient(loss, model.trainable_variables)

          # 4. 오차역전파(Backpropagation) - weight 업데이트
          optimizer.apply_gradients(zip(gradients, model.trainable_variables))

          # loss와 accuracy를 업데이트 합니다.
          train_loss(loss)
          train_acc(labels, predictions)
```

GradientTape 실습

Test step 함수

```
[16]  @tf.function
      def test_step(images, labels):
          # 1. 예측(Prediction)
          predictions = model(images)
          # 2. Loss 계산
          loss = loss_function(labels, predictions)

          # Test셋에 대해서는 gradient를 계산 및 backpropagation 하지 않습니다.

          # loss와 accuracy를 업데이트
          test_loss(loss)
          test_acc(labels, predictions)
```

GradientTape 실습

모델 훈련

```
[17] EPOCHS = 10

     for epoch in range(EPOCHS):
         for train_images, train_labels in train_ds:
             train_step(train_images, train_labels)

         for test_images, test_labels in test_ds:
             test_step(test_images, test_labels)

         template = 'Epoch : {}, Train Loss : {:.5f}, 정확도: {:.2f}%, 테스트 손실: {:.5f}, 테스트
         print (template.format(epoch+1,
                                train_loss.result(),
                                train_acc.result()*100,
                                test_loss.result(),
                                test_acc.result()*100))
```

```
Epoch : 1, Train Loss : 0.57843, 정확도: 78.79%, 테스트 손실: 0.42673, 테스트 정확도: 84.77%
Epoch : 2, Train Loss : 0.46914, 정확도: 82.85%, 테스트 손실: 0.39928, 테스트 정확도: 85.69%
```

Thank you

kgpark88@gmail.com