1. my CNN model

   epochs = 20

   training time = 20 min

   accuracy = 0.7833333333333333

   # of parameters = 7153

   Conv(filter_size=3, input_channel=1, output_channel=16)

   ⇨ W + b = 3*3*1*16 + 1*1*1*16 = 160

   Conv(filter_size=3, input_channel=16, output_channel=16)

   ⇨ W + b = 3*3*16*16 + 1*1*1*16 = 2320

   Dense(144, 32) => W + b = 32*144 + 32*1 = 4640

   Dense(32, 1) => W + b = 1*32 + 1*1 = 33

   160 + 2320 + 4640 + 33 = 7153

   training loss curve =
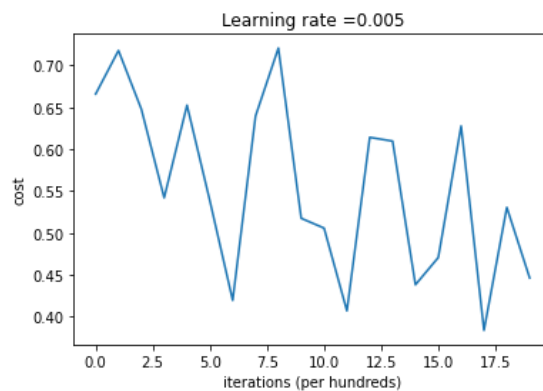
2. Tensorflow CNN model
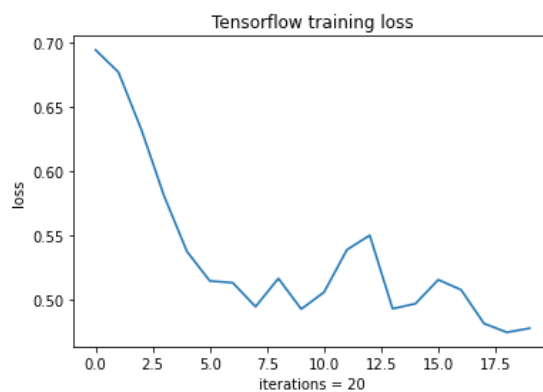
   epochs = 20

   training time = 22 sec

   accuracy = 0.8

   # of parameters = 121474

   training loss curve =

3. Advance part

   (1) Model structure

```python
model = models.Sequential()
model.add(data_augmentation)
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(32, 32, 1)))
model.add(layers.MaxPooling2D((2, 2)))  # pool_size
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))  # units: dim of output space
model.add(layers.Dense(2))
```

   Data augmentation layer 做了水平翻轉, rotation(factor=0.1)

   (2) Loss function

   tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True)

   (3) Optimizer: ADAM