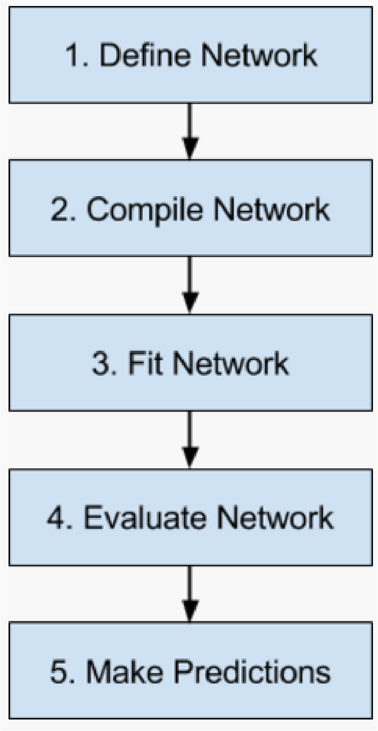
Keras: A high level API with best practice defaults

Keras workflow



1. Define Network

2. Compile Network

3. Fit Network

4. Evaluate Network

5. Make Predictions

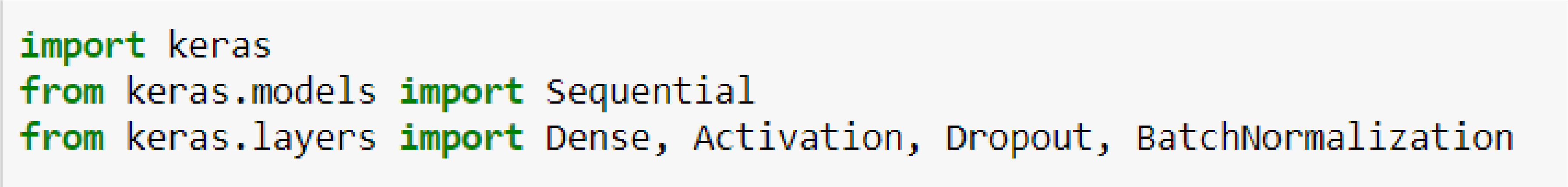
- Keras is a high-level NN API for TensorFlow and Theano.
- Is now shipped with TF (or can be imported as python library)
- Can be mixed with TF code
- Offers many predefined layers
- Each layer has a default "best practice choices of parameters"
- Allows for easy and fast prototyping (define only key parameters)
- Supports fcNN, CNNs, RNNs ...
- Supports arbitrary connectivity schemes and NN architectures

Keras: import keras and the required layers

Keras provides two ways to define a model:

1) Sequential API: simple, good for linear stack of layers

2) Functional API: flexible, required for complicated architectures



```
import keras
from keras.models import Sequential
from keras.layers import Dense, Activation, Dropout, BatchNormalization
```

For documentation see:

https://keras.io/

Remark: Keras can be used as API for theano and tf and which differ in the shape of expectedtensors – i.e. #channels is in tf at last position and in theano not.

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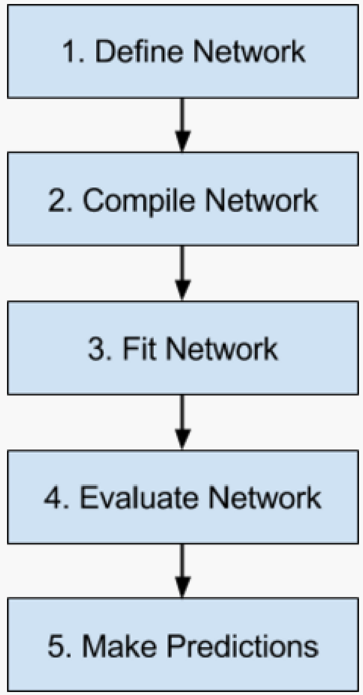

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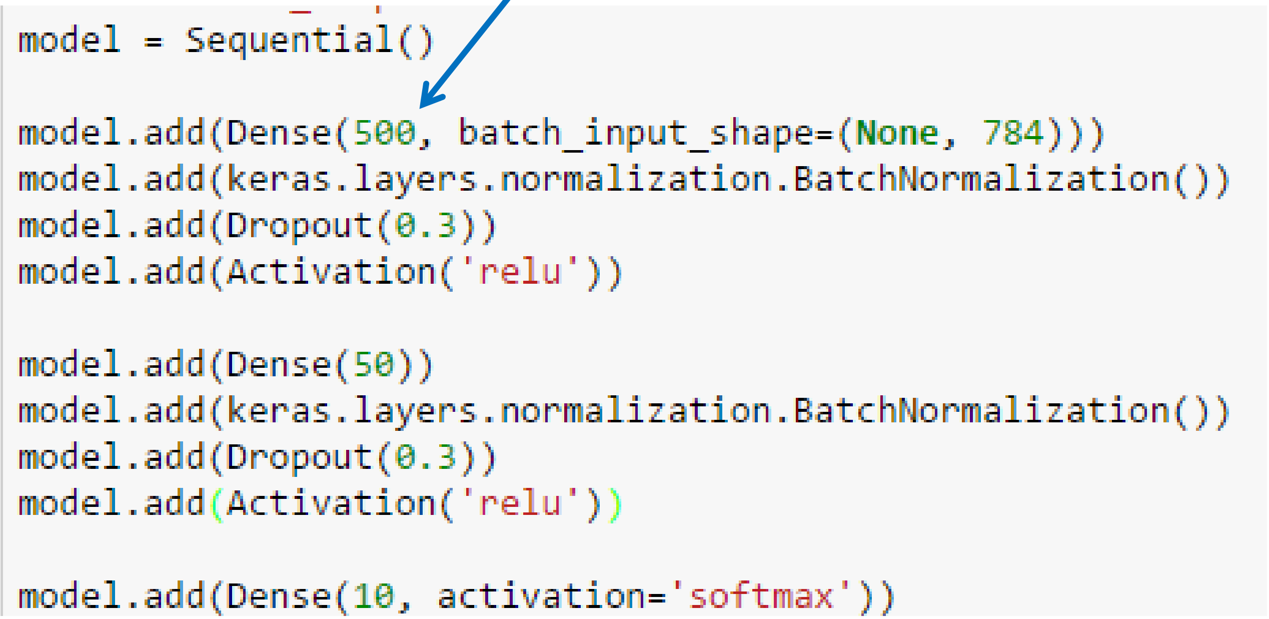
Number of neurons in (first) hidden dense layers (will be input to next layer)



```
model = Sequential()

model.add(Dense(500, batch_input_shape=(None, 784)))
model.add(keras.layers.normalization.BatchNormalization())
model.add(Dropout(0.3))
model.add(Activation('relu'))

model.add(Dense(50))
model.add(keras.layers.normalization.BatchNormalization())
model.add(Dropout(0.3))
model.add(Activation('relu'))

model.add(Dense(10, activation='softmax'))
```

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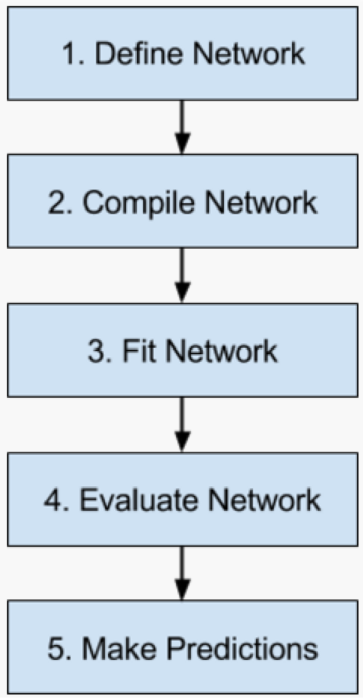

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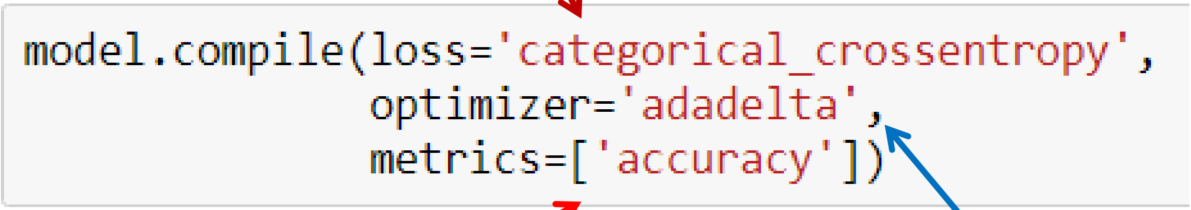
loss function that will be minimized



```
model.compile(loss='categorical_crossentropy',
              optimizer='adadelta',
              metrics=['accuracy'])
```

easiest optimizer is SGD (stochastic gradient descent)

Which metrics besides ‘loss’ do we want to collect during training

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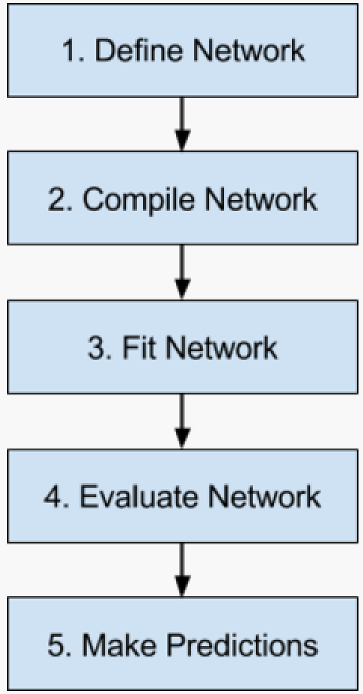

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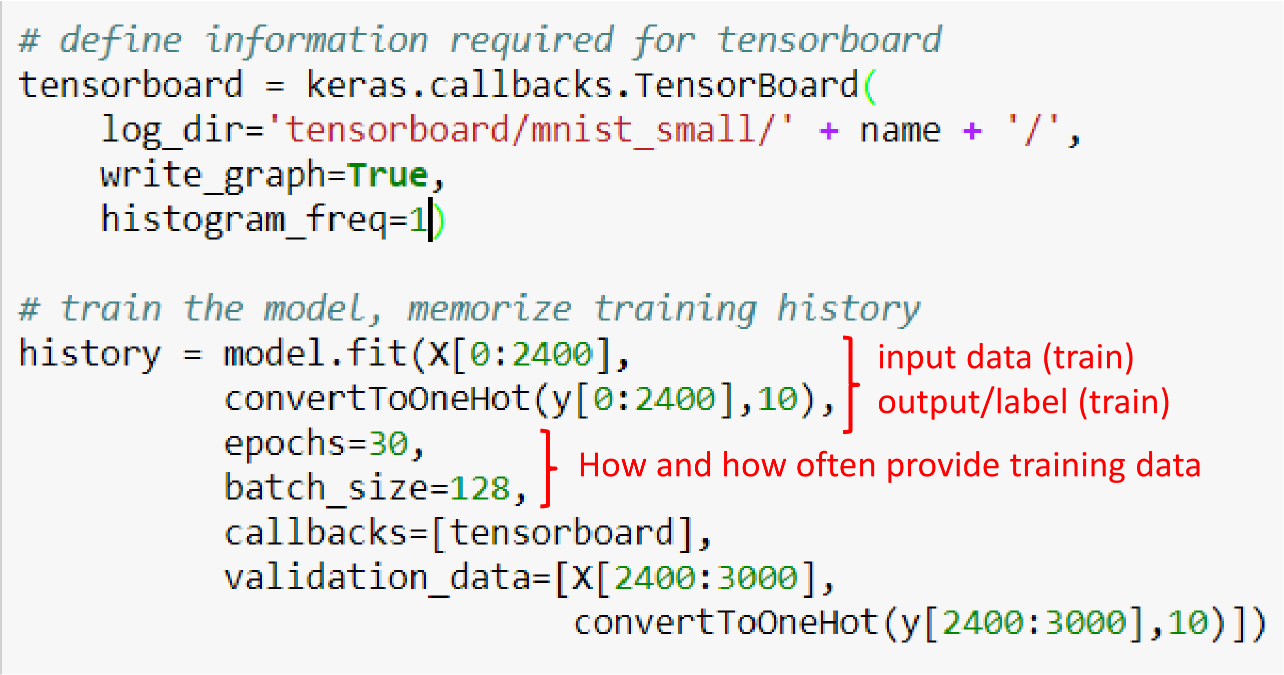

```
# define information required for tensorboard
tensorboard = keras.callbacks.TensorBoard(
    log_dir='tensorboard/mnist_small/' + name + '/',
    write_graph=True,
    histogram_freq=1)

# train the model, memorize training history
history = model.fit(X[0:2400],
          convertToOneHot(y[0:2400],10),
          epochs=30,
          batch_size=128,
          callbacks=[tensorboard],
          validation_data=[X[2400:3000],
                           convertToOneHot(y[2400:3000],10)])
```

input data (train)

output/label (train)

How and how often provide training data

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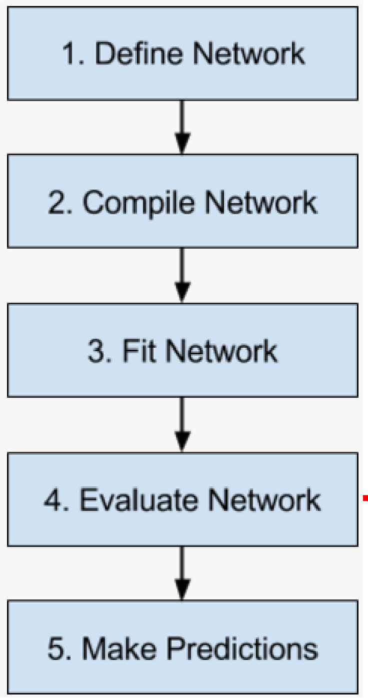
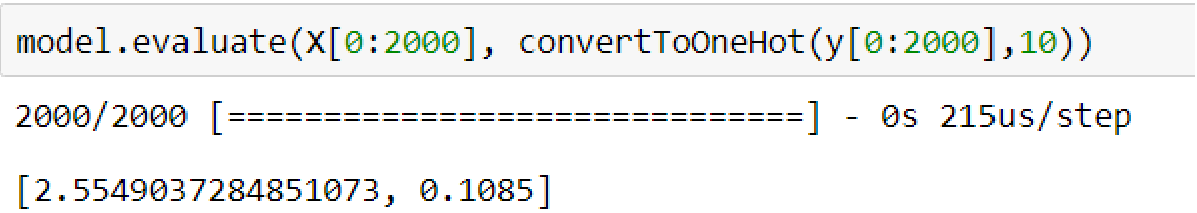




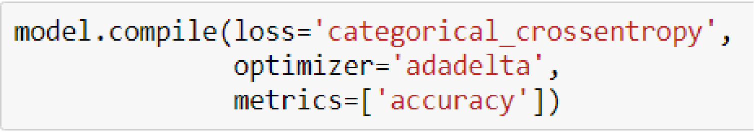
```
model.evaluate(X[0:2000], convertToOneHot(y[0:2000],10))

2000/2000 [==============================] - 0s 215us/step

[2.5549037284851073, 0.1085]
```

loss

metrics: accuracy



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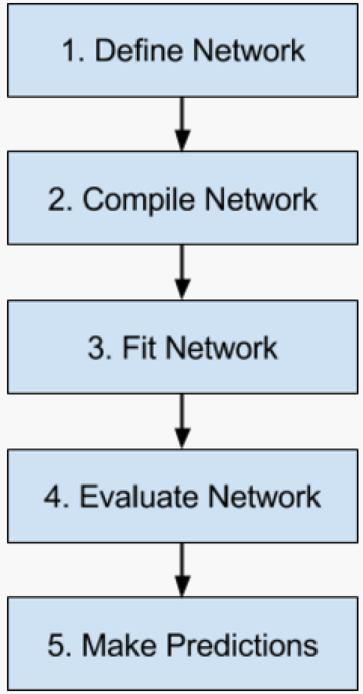

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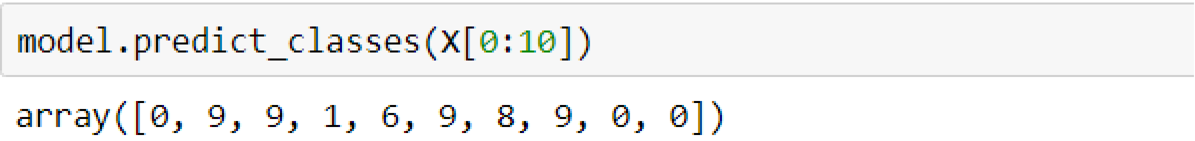
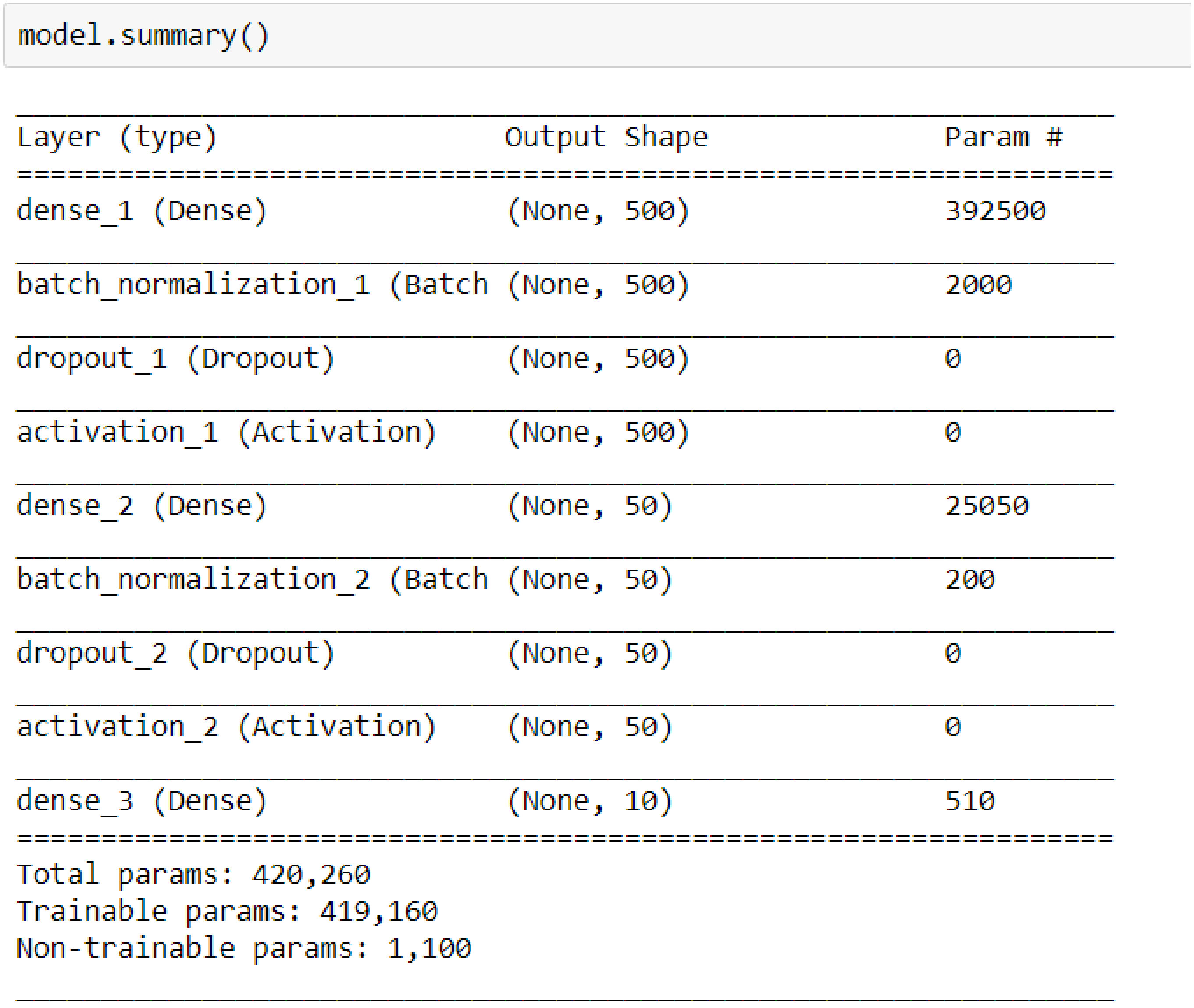


```
model.predict_classes(X[0:10])
```

```
array([0, 9, 9, 1, 6, 9, 8, 9, 0, 0])
```

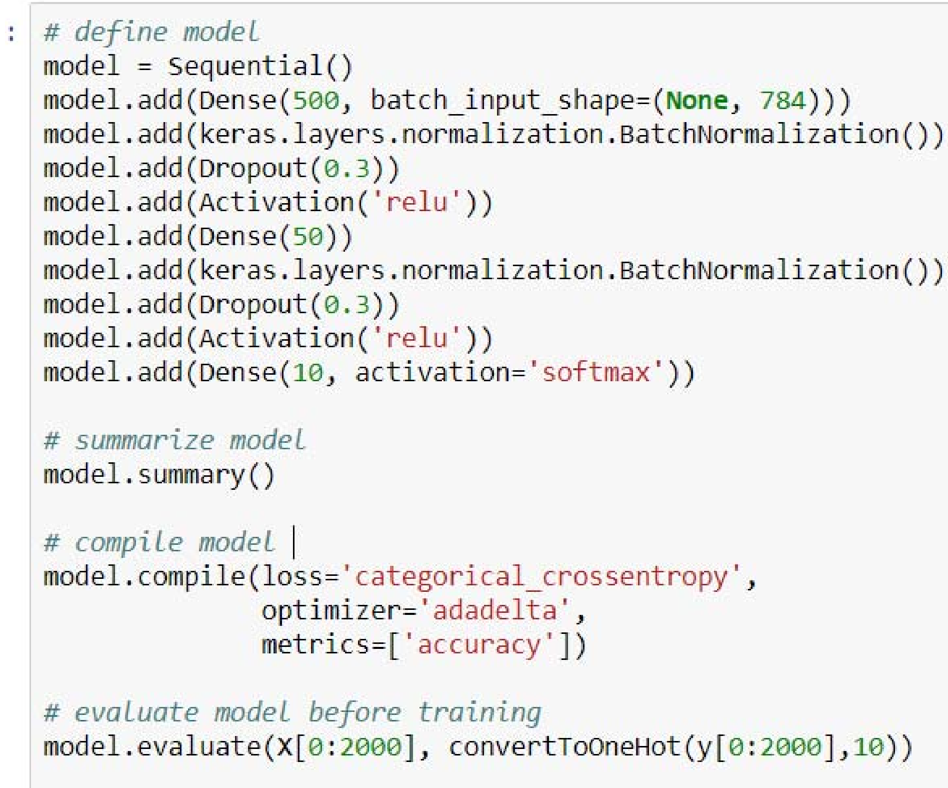
Keras: gives nice summary of model architecture



```
model.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 500)               392500

_________________________________________________________________
batch_normalization_1 (Batch (None, 500)               2000

_________________________________________________________________
dropout_1 (Dropout)          (None, 500)               0

_________________________________________________________________
activation_1 (Activation)    (None, 500)               0

_________________________________________________________________
dense_2 (Dense)              (None, 50)                25050

_________________________________________________________________
batch_normalization_2 (Batch (None, 50)                200

_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0

_________________________________________________________________
activation_2 (Activation)    (None, 50)                0

_________________________________________________________________
dense_3 (Dense)              (None, 10)                510
=================================================================
Total params: 420,260
Trainable params: 419,160
Non-trainable params: 1,100

_________________________________________________________________
```

Keras: put the code together



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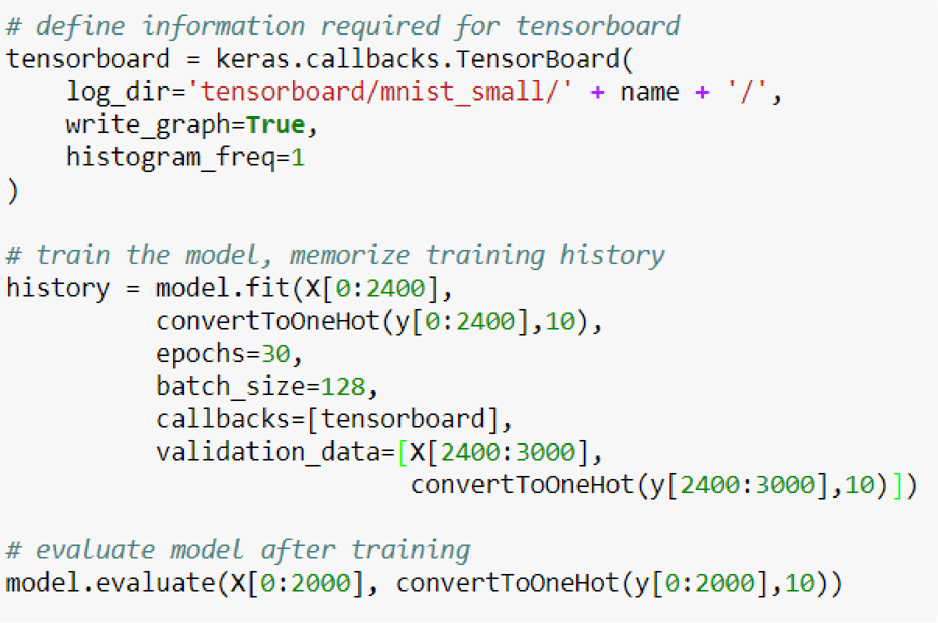
model.add(Activation('relu'))
model.add(Dense(10, activation='softmax'))

# summarize model
model.summary()

# compile model
model.compile(loss='categorical_crossentropy',
              optimizer='adadelta',
              metrics=['accuracy'])

# evaluate model before training
model.evaluate(X[0:2000], convertToOneHot(y[0:2000],10))
```



```
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