Batch training

Puteaux, Fall/Winter 2020-2021

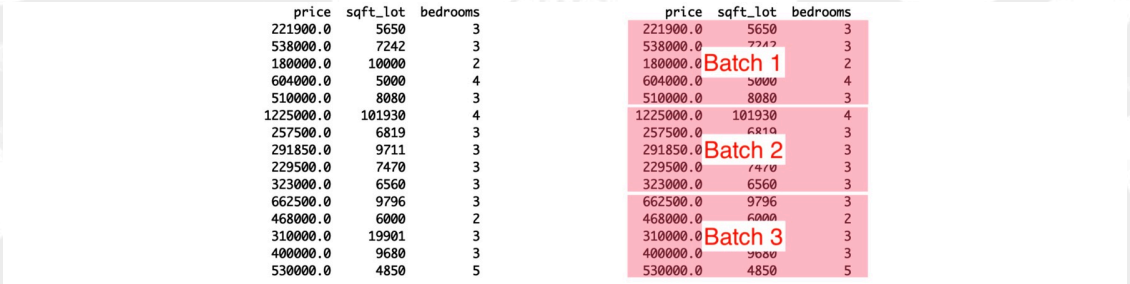
```
################################
##                            ##
##  Deep Learning in Python   ##
##                            ##
################################
```

§2 Introduction to TensorFlow in Python

§2.2 Linear models

1 Linear regression

1.1 What is batch training?



1.2 What is the `chunksize` parameter?

- `pandas.read_csv()` allows to load data in batches:
  - avoid loading entire dataset
  - `chunksize` parameter provides batch size

1.3 Code of the `chunksize` parameter:

[1]:
```
# Import pandas and numpy
import pandas as pd
import numpy as np

# Load data in batches
for batch in pd.read_csv('ref1. King county house sales.csv', chunksize=100):
```

```
    # Extract price column
    price = np.array(batch['price'], np.float32)

    # Extract size column
    size = np.array(batch['sqft_living'], np.float32)
```

1.4 Code of training a linear model in batches:

[2]:
```
# Import tensorflow, pandas, and numpy
import tensorflow as tf
import pandas as pd
import numpy as np
```

[3]:
```
# Define trainable variables
intercept = tf.Variable(0.1, tf.float32)
slope = tf.Variable(0.1, tf.float32)
```

[4]:
```
# Define the model
def linear_regression(intercept, slope, features):
    return intercept + features * slope
```

[5]:
```
# Compute predicted values and return loss function
def loss_function(intercept, slope, targets, features):
    predictions = linear_regression(intercept, slope, features)
    return tf.keras.losses.mse(targets, predictions)
```

[6]:
```
# Define optimization operation
opt = tf.keras.optimizers.Adam()
```

[7]:
```
# Load the data in batches from pandas
for batch in pd.read_csv('ref1. King county house sales.csv', chunksize=100):
    # Extract the target and feature columns
    price_batch = np.array(batch['price'], np.float32)
    size_batch = np.array(batch['sqft_lot'], np.float32)

    # Minimize the loss function
    opt.minimize(
        lambda: loss_function(intercept, slope, price_batch, size_batch),
        var_list=[intercept, slope])
```

[8]:
```
# Print parameter values
print(intercept.numpy(), slope.numpy())
```

```
0.31781912 0.29831016
```

1.5 Compare full sample versus batch training, what are the differences?

- Full Sample
  1. One update per epoch
  2. Accepts dataset without modification
  3. Limited by memory
- Batch Training
  1. Multiple updates per epoch
  2. Requires the division of dataset
  3. No limit on dataset size

1.6 Practice exercises for batch training:

▶ Package pre-loading:

[9]:
```
from tensorflow import Variable, keras, float32
```

▶ Batch train preparing practice:

[10]:
```
# Define the intercept and slope
intercept = Variable(10.0, float32)
slope = Variable(0.5, float32)


# Define the model
def linear_regression(intercept, slope, features):
    # Define the predicted values
    return intercept + features * slope


# Define the loss function
def loss_function(intercept, slope, targets, features):
    # Define the predicted values
    predictions = linear_regression(intercept, slope, features)

    # Define the MSE loss
    return keras.losses.mse(targets, predictions)
```

▶ Package re-pre-loading:

[11]:
```
import pandas as pd
import numpy as np
```

▶ Linear model batches training practice:

[12]:
```
# Initialize adam optimizer
opt = keras.optimizers.Adam()

# Load data in batches
for batch in pd.read_csv('ref1. King county house sales.csv', chunksize=100):
    size_batch = np.array(batch['sqft_lot'], np.float32)

    # Extract the price values for the current batch
    price_batch = np.array(batch['price'], np.float32)

    # Complete the loss, fill in the variable list, and minimize
    opt.minimize(
        lambda: loss_function(intercept, slope, price_batch, size_batch),
        var_list=[intercept, slope])

# Print trained parameters
print(intercept.numpy(), slope.numpy())
```

```
10.217888 0.7016
```