House price prediction using linear regression (minimal)

Using the boston housing dataset: https://www.kaggle.com/c/boston-housing/

```
# Uncomment and run the commands below if imports fail
# !conda install numpy pytorch torchvision cpuonly -c pytorch -y
# !pip install matplotlib --upgrade --quiet
!pip install jovian --upgrade --quiet
```

```
WARNING: You are using pip version 20.1; however, version 20.1.1 is available.
You should consider upgrading via the '/opt/conda/bin/python3.7 -m pip install --upgrade pip' command.
```

```
# Imports
import torch
import jovian
import torchvision
import torch.nn as nn
import pandas as pd
import matplotlib.pyplot as plt
import torch.nn.functional as F
from torchvision.datasets.utils import download_url
from torch.utils.data import DataLoader, TensorDataset, random_split
```

```
# Hyperparameters
batch_size=64
learning_rate=5e-7


# Other constants
DATASET_URL = "https://raw.githubusercontent.com/selva86/datasets/master/BostonHousing.csv"
DATA_FILENAME = "BostonHousing.csv"
TARGET_COLUMN = 'medv'
input_size=13
output_size=1
```

Dataset & Data loaders

```
# Download the data
download_url(DATASET_URL, '.')
dataframe = pd.read_csv(DATA_FILENAME)
dataframe.head()
```

Using downloaded and verified file: ./BostonHousing.csv

	crim	zn	indus	chas	nox	rm	age	dis	rad	tax	ptratio	b	lstat	medv
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.98	24.0
1	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.14	21.6
2	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03	34.7
3	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94	33.4
4	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	5.33	36.2

```
# Convert from Pandas dataframe to numpy arrays
inputs = dataframe.drop('medv', axis=1).values
targets = dataframe[['medv']].values
inputs.shape, targets.shape
```

```
((506, 13), (506, 1))
```

```
# Convert to PyTorch dataset
dataset = TensorDataset(torch.tensor(inputs, dtype=torch.float32), torch.tensor(targets, dtype=torch.float32))
train_ds, val_ds = random_split(dataset, [406, 100])

train_loader = DataLoader(train_ds, batch_size, shuffle=True)
val_loader = DataLoader(val_ds, batch_size*2)
```

Model

```
class HousingModel(nn.Module):
    def __init__(self):
        super().__init__()
        self.linear = nn.Linear(input_size, output_size)

    def forward(self, xb):
        out = self.linear(xb)
        return out

    def training_step(self, batch):
        inputs, targets = batch
        out = self(inputs)                 # Generate predictions
        loss = F.mse_loss(out, targets)    # Calculate loss
        return loss

    def validation_step(self, batch):
        inputs, targets = batch
        out = self(inputs)                 # Generate predictions
        loss = F.mse_loss(out, targets)    # Calculate loss
        return {'val_loss': loss.detach()}

    def validation_epoch_end(self, outputs):
        batch_losses = [x['val_loss'] for x in outputs]
        epoch_loss = torch.stack(batch_losses).mean()   # Combine losses
        return {'val_loss': epoch_loss.item()}

    def epoch_end(self, epoch, result):
        print("Epoch [{}], val_loss: {:.4f}".format(epoch, result['val_loss']))

model = HousingModel()
```

Training

```
def evaluate(model, val_loader):
    outputs = [model.validation_step(batch) for batch in val_loader]
    return model.validation_epoch_end(outputs)

def fit(epochs, lr, model, train_loader, val_loader, opt_func=torch.optim.SGD):
    history = []
    optimizer = opt_func(model.parameters(), lr)
    for epoch in range(epochs):
        # Training Phase
        for batch in train_loader:
            loss = model.training_step(batch)
            loss.backward()
            optimizer.step()
            optimizer.zero_grad()
        # Validation phase
        result = evaluate(model, val_loader)
        model.epoch_end(epoch, result)
        history.append(result)
    return history
```

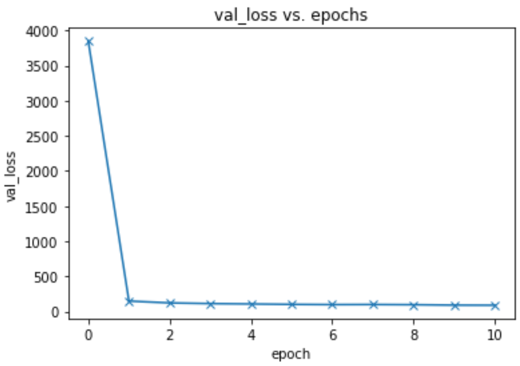
```
result = evaluate(model, val_loader)
result
```

```
{'val_loss': 3850.06103515625}
```

```
history = fit(10, learning_rate, model, train_loader, val_loader)
```

```
Epoch [0], val_loss: 147.9092
Epoch [1], val_loss: 121.6677
Epoch [2], val_loss: 112.0455
Epoch [3], val_loss: 106.7845
Epoch [4], val_loss: 100.6463
Epoch [5], val_loss: 97.4375
Epoch [6], val_loss: 98.7278
Epoch [7], val_loss: 95.8225
Epoch [8], val_loss: 89.9052
Epoch [9], val_loss: 88.4346
```

```
losses = [r['val_loss'] for r in [result] + history]
plt.plot(losses, '-x')
plt.xlabel('epoch')
plt.ylabel('val_loss')
plt.title('val_loss vs. epochs');
```



Prediction

```
def predict_single(x, model):
    xb = x.unsqueeze(0)
    return model(x).item()
```

```
x, target = val_ds[10]
pred = predict_single(x, model)
print("Input: ", x)
print("Target: ", target.item())
print("Prediction:", pred)
```

```
Input:  tensor([4.6469e+00, 0.0000e+00, 1.8100e+01, 0.0000e+00, 6.1400e-01, 6.9800e+00,
        6.7600e+01, 2.5329e+00, 2.4000e+01, 6.6600e+02, 2.0200e+01, 3.7468e+02,
        1.1660e+01])
Target:  29.799999237060547
Prediction: 25.074195861816406
```

Save and upload

```
torch.save(model.state_dict(), 'housing-linear.pth')
```

```
jovian.commit(project='housing-linear-minimal', environment=None, outputs=['housing-linear.pth'])
jovian.commit(project='housing-linear-minimal', environment=None, outputs=['housing-linear.pth']) # Kaggle commit fails sometime
```

```
[jovian] Attempting to save notebook..
```

Start coding or generate with AI.