mlbd2022fall-logistic-regression

Machine Learning & Big Data 2022 Fall homework 2: logistic regression

https://github.com/keyork/mlbd2022fall-logistic-regression

Task

See task.md.

Usage

```
pip install matplotlib numpy pandas colorlog tqdm
python train.py -h
python train.py --args ARGS
```

Model

Log-likelihood

$$\mathcal{L}(\beta) = \sum_{i=1}^{m} y_i \log\left(\frac{1}{1+e^{-\beta^T \mathbf{x}}}\right) + (1-y_i)\log\left(1-\frac{1}{1+e^{-\beta^T \mathbf{x}}}\right)$$

$\beta = [\beta_0, \beta_1, \beta_2]^T$

$\mathbf{x} = [x_0, x_1, x_2]^T \quad (x_0 = 1)$

Regression

$$\beta^{(k+1)} = \beta^{(k)} + \alpha\left[y_i - g(\beta^{(k)^T})\mathbf{x}_i\right]\mathbf{x}_i$$

$$f_\beta(\mathbf{x}) = \frac{1}{1+e^{-\beta^T \mathbf{x}}}$$

Find boundary pseudi-code

```
procedure LOGISTICREGRESSION(dataset, beta)
  for data, label in dataset
    beta += alpha*(label-data/(1+exp(-beta*data)))*data
  end for
end procedure
```

5-fold

Split all data into 5 parts, each part is used as val-set, and the rest is used as train-set, compare the MSE-Loss of 5 times train and select the smallest as the best model.

Norm

$$x = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Back Line Search

See [hw1: minibatch-sgd](#).

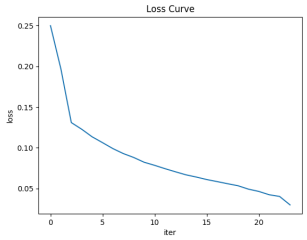
Experiments

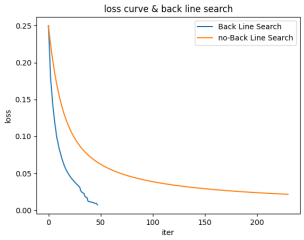
logistic regression

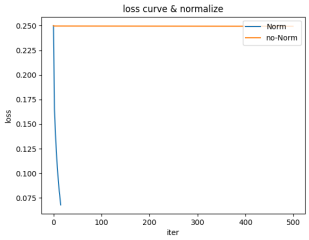
Using normalize, 5-fold and back line search, we get the boundary by logistic regression and plot it in 3D, plot its loss curve(Fig. Left).

Ablation Experiment

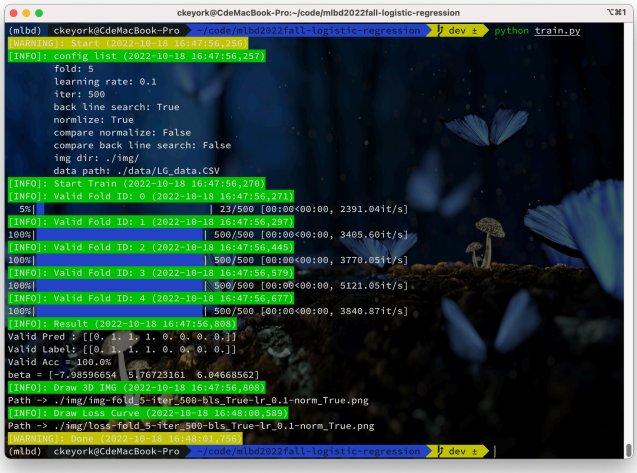
Remove back line search(Fig. Middle), normalize(Fig. Right) and compare them with initial experiment.

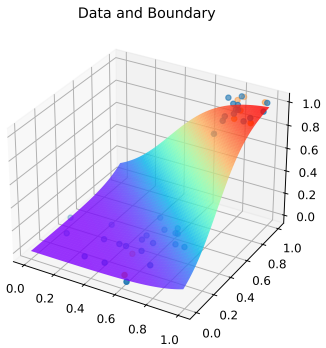






Result





$$\beta = [\beta_0, \beta_1, \beta_2]^T = [-7.98596654, 5.76723161, 6.04668562]^T$$