Introduction to Deep Learning (I2DL)

Exercise 4: Linear and logistic regression

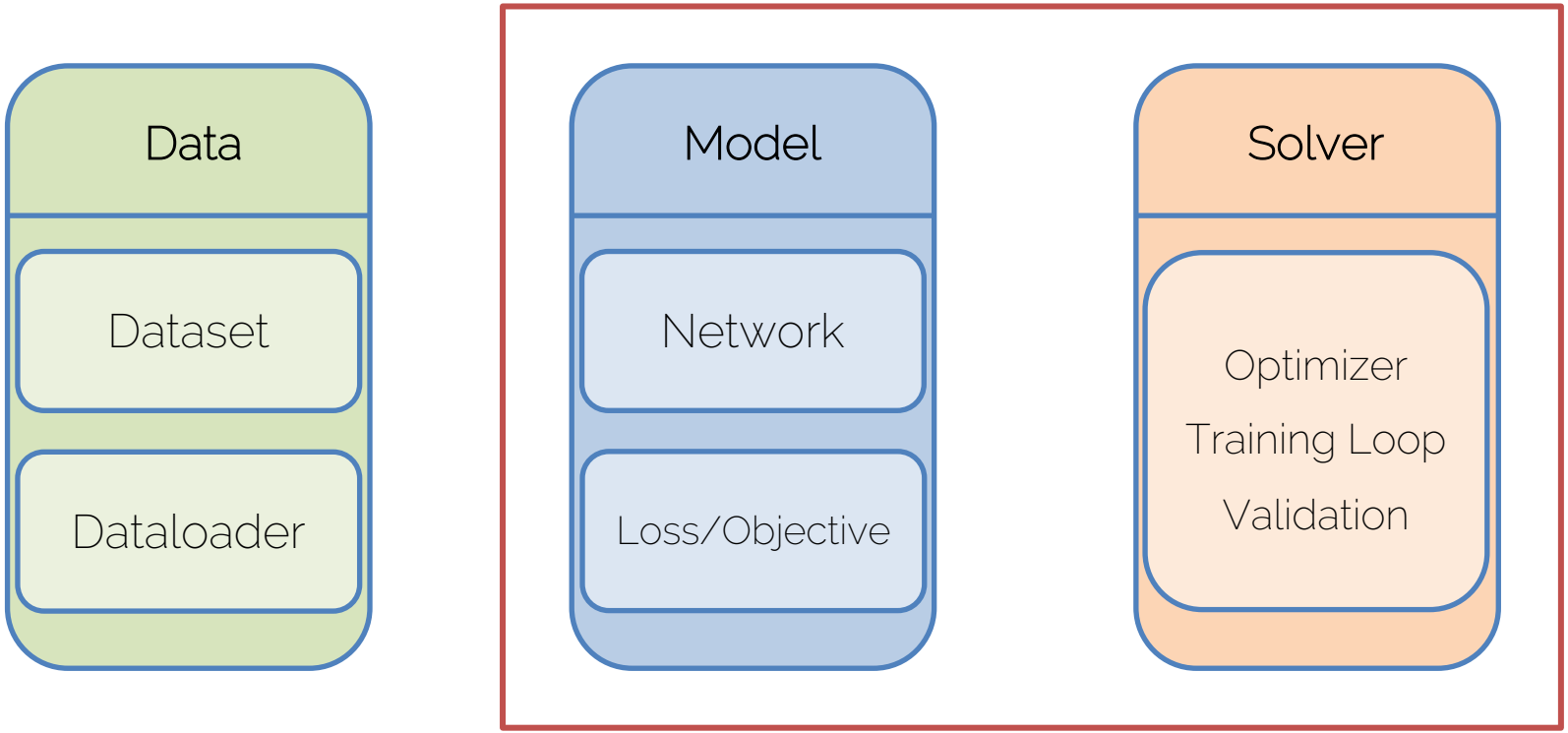
Today's Outline

- Submission System
- Linear Regression
  - Model
  - Loss Function
  - Optimization (Gradient Descent)
  - Solver
- Submission 4: Logistic Regression
  - Start: **May 14, 2020 12.00**
  - End: **May 20, 2020 23.59**

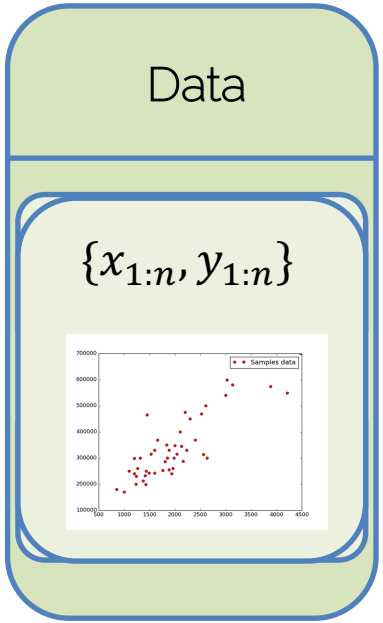
Submission Rules

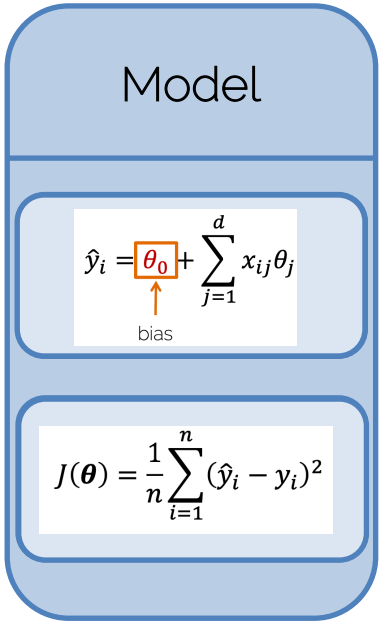
- Submission Regulations:
  - No submission after deadline
  - Submission Limit: max. 5 successful submissions

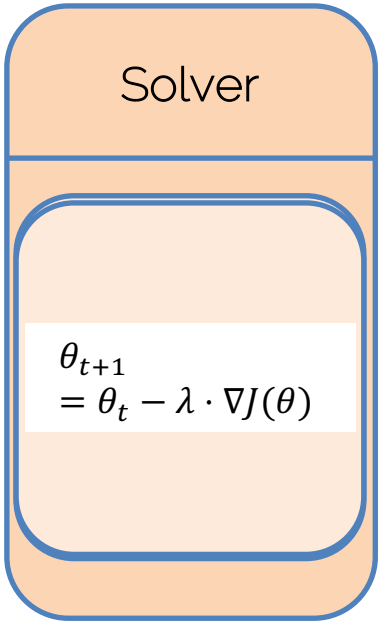
The Pillars of Deep Learning



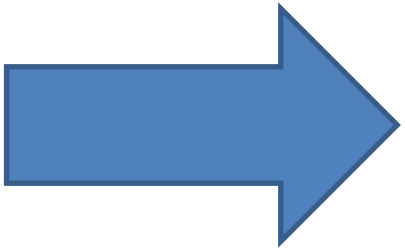
The Pillars of Deep Learning

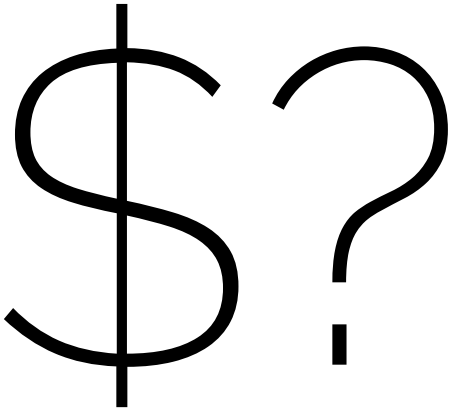






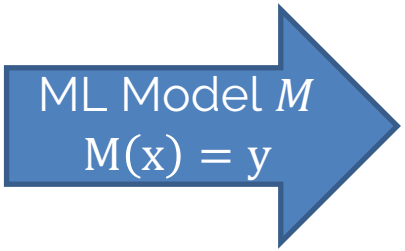
Linear Regression for House Prices

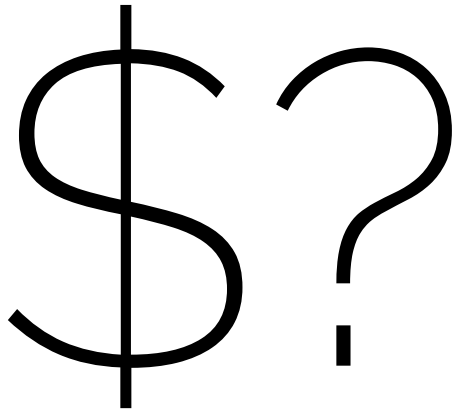




Linear Regression for House Prices

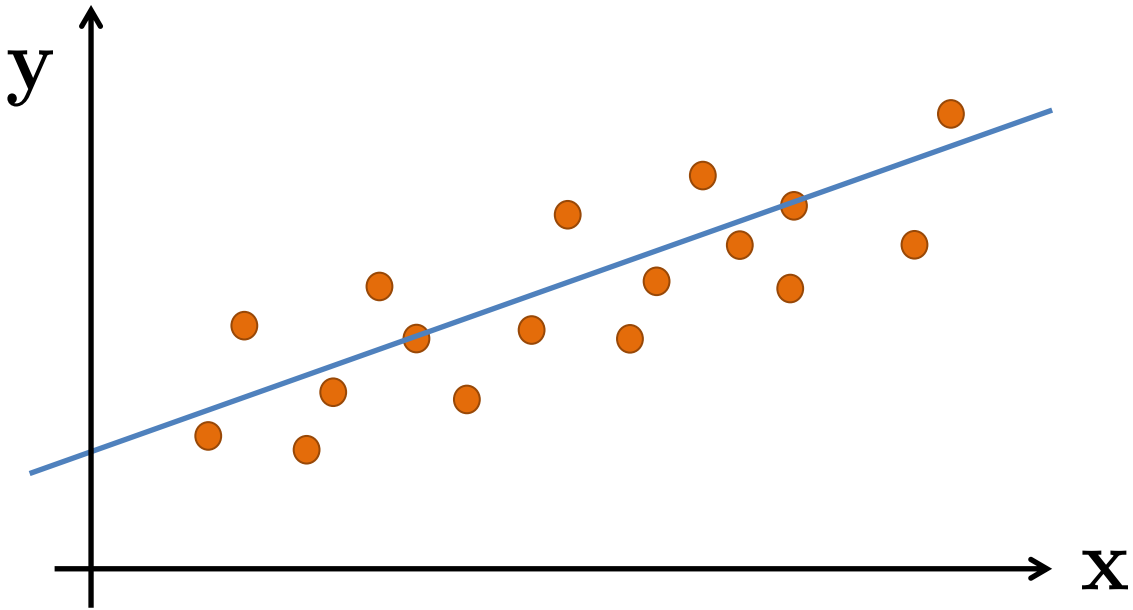
$$\begin{pmatrix} \text{LivingArea} \\ \text{YearBuilt} \\ \text{OutdoorArea} \\ \dots \end{pmatrix}$$





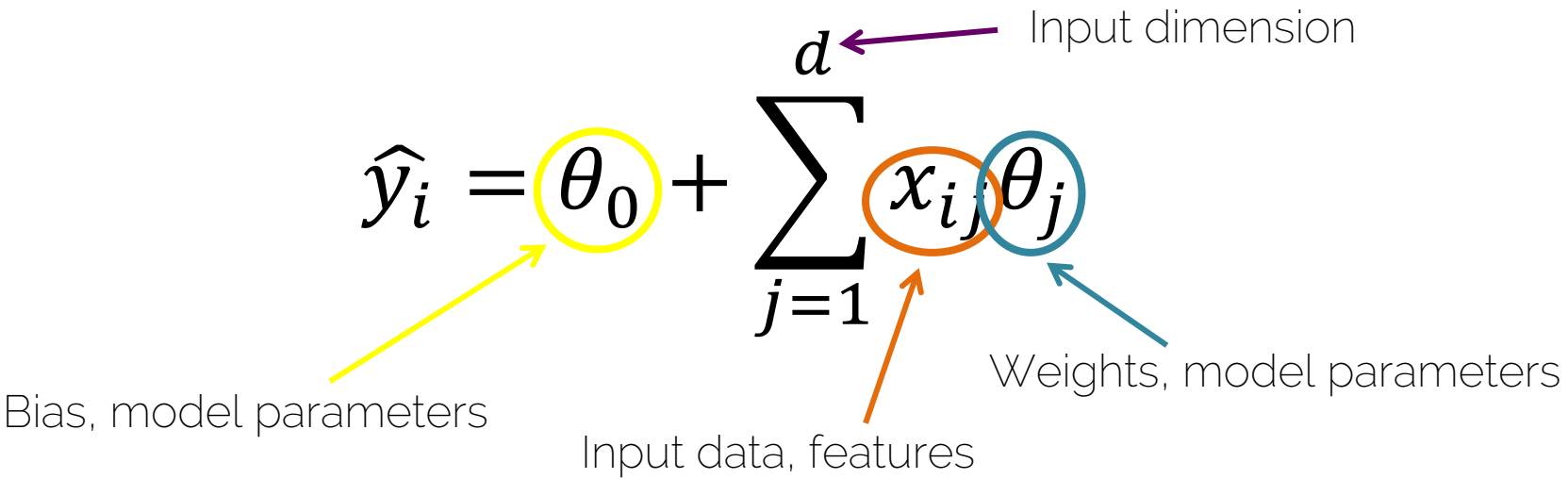
Linear Regression for House Prices

- Find a linear model that explains a target $\mathbf{y}$ given the inputs $\mathbf{X}$



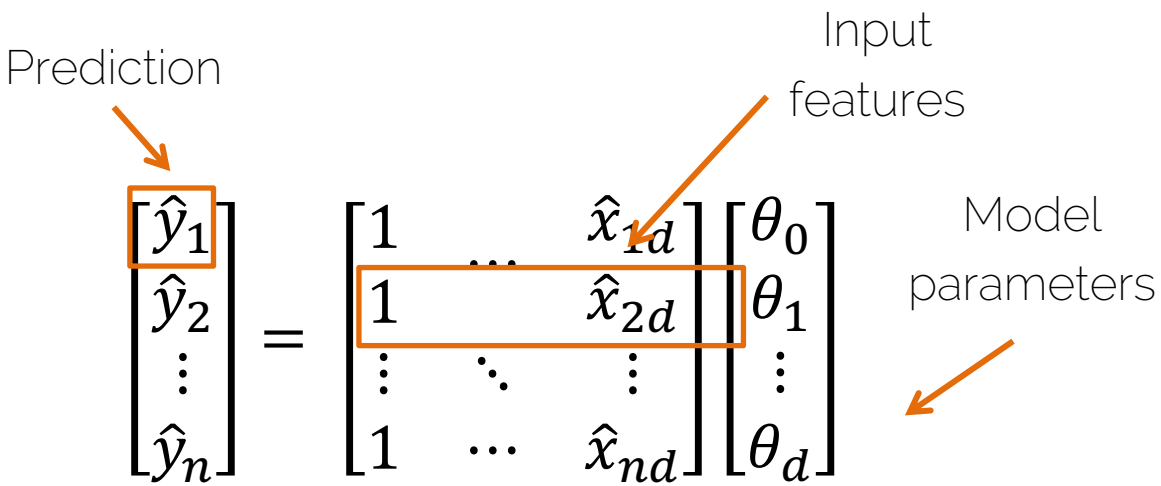
Linear Regression for House Prices

- A linear model is expressed in the form

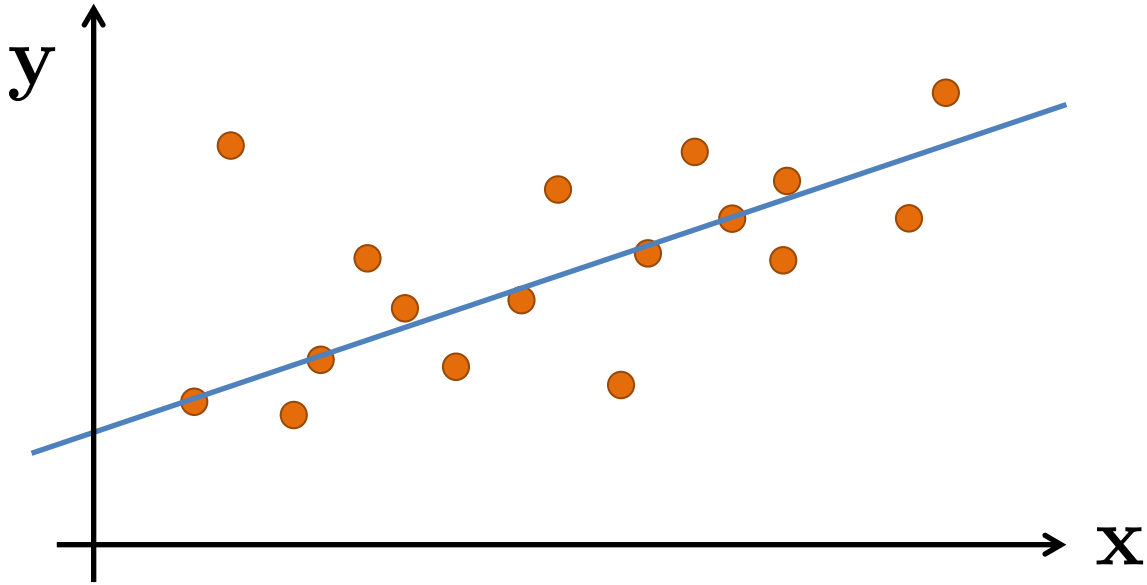


Linear Regression for House Prices

Matrix Notation: $\hat{y} = \mathrm{X}\theta$



Linear regression: loss function



Minimizing

$$J(\boldsymbol{\theta}) = \frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2$$

Objective function
Energy
Cost function

Solution for Linear Regression

Analytic

$$\boldsymbol{\theta} = (\boldsymbol{X}^T \boldsymbol{X})^{-1} \boldsymbol{X}^T \mathbf{y}$$

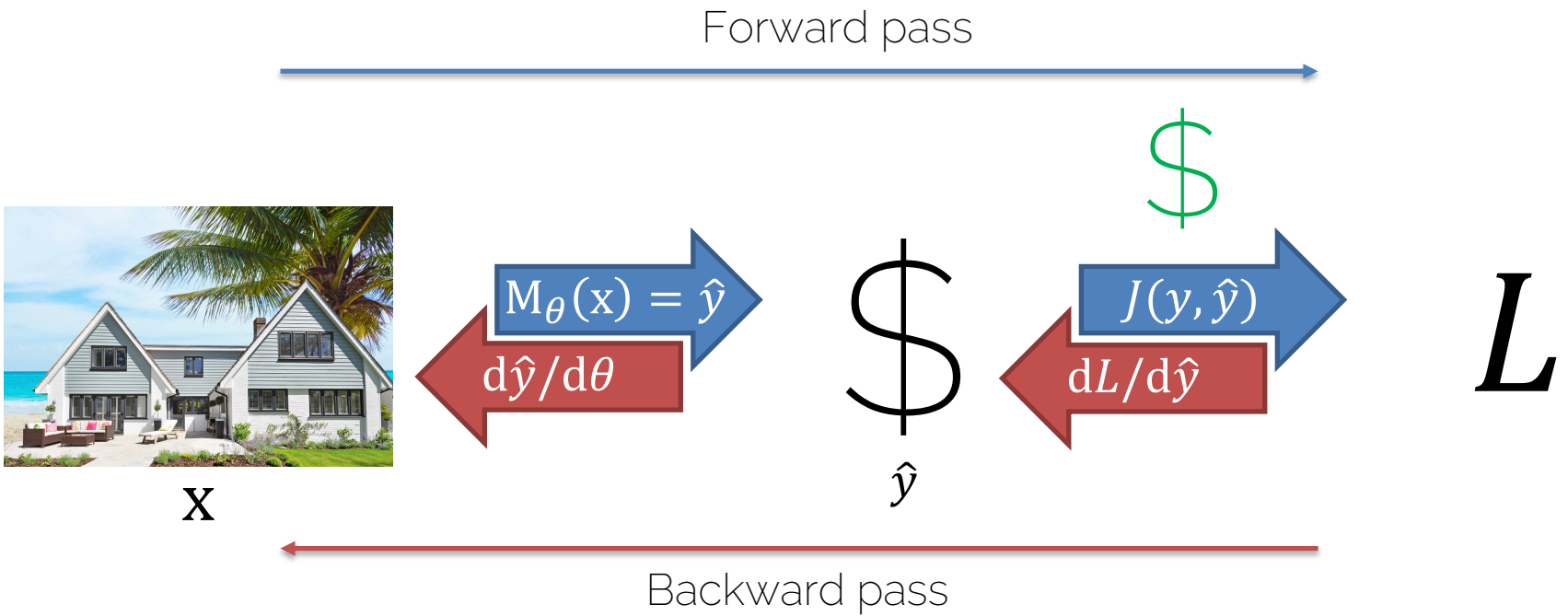
Derivation in additional exercise slides

Numeric

Gradient Descent

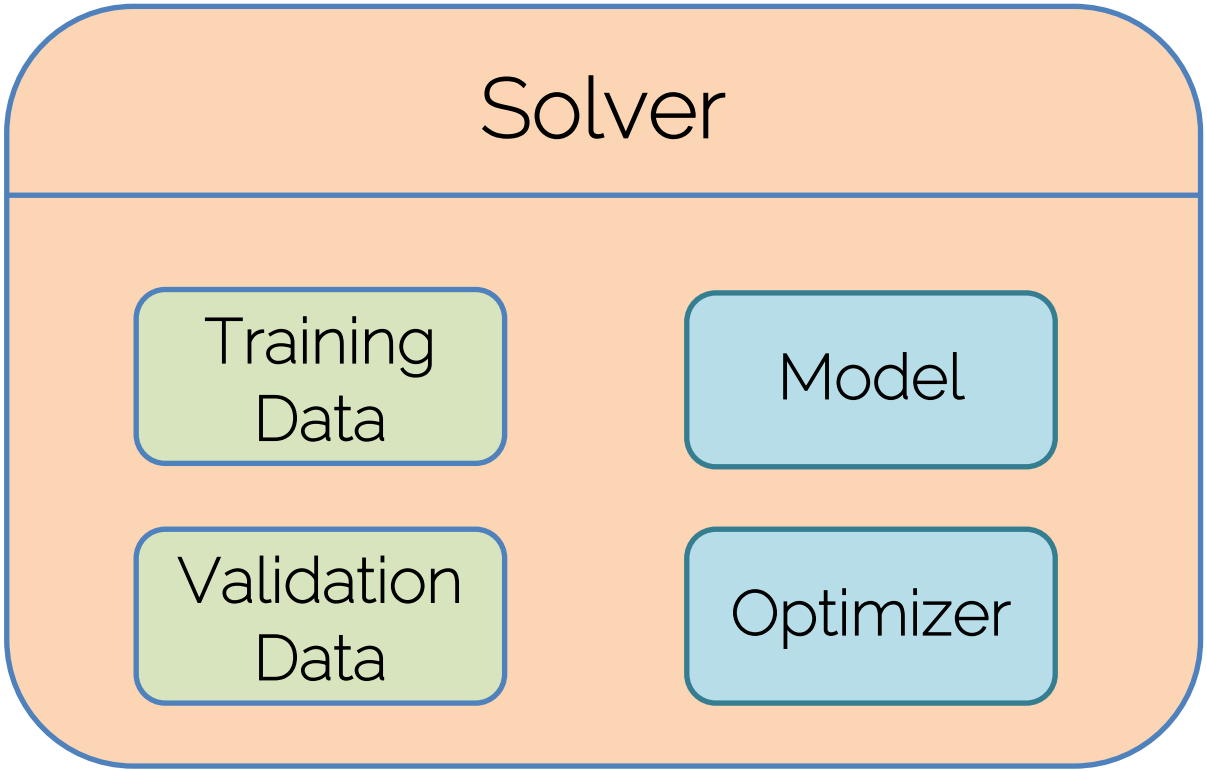
$$\theta_{t+1} = \theta_t - \lambda \cdot \nabla_\theta J(\theta)$$

Solution for Linear Regression

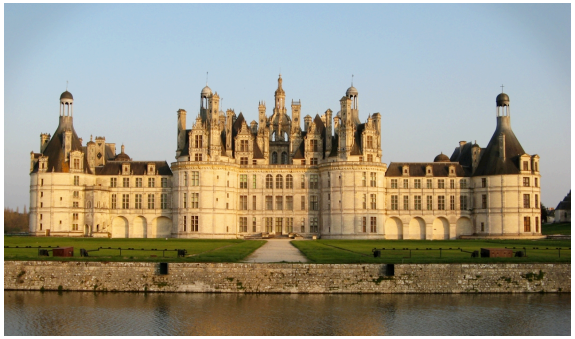


Optimization with gradient descent: $\theta_{t+1} = \theta_t - \lambda \cdot \nabla_\theta \mathrm{L}$

Solution for Linear Regression



Submission 4 - Classifying House Prices



ML Model M
$M(\mathbf{x}) = \mathbf{y}$

Expensive $y = 1$

ML Model M
$M(\mathbf{x}) = \mathbf{y}$

Low-priced $y = 0$

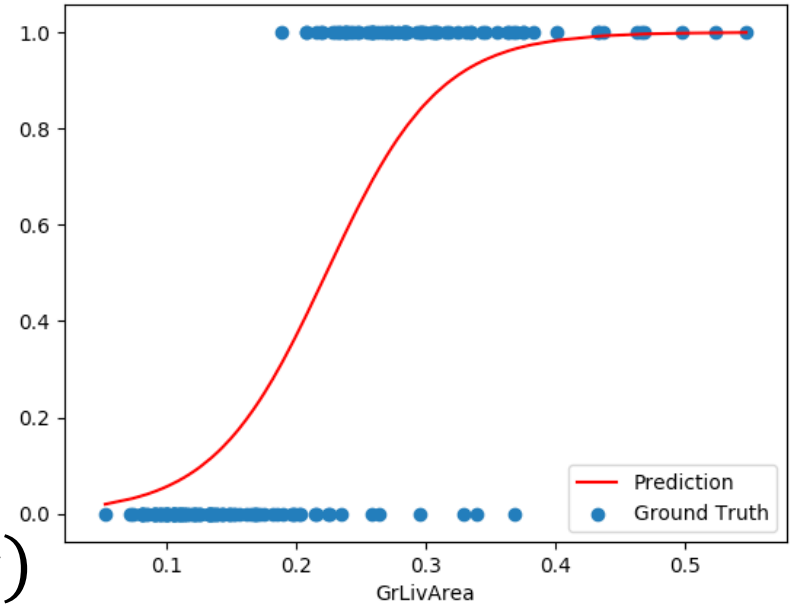
Submission 4 - Classifying House Prices

Logistic Regression:

$$y_i = \frac{1}{1 + \exp\left(-\theta_0 - \sum_{j=1}^{d} x_{ij}\theta_j\right)}$$

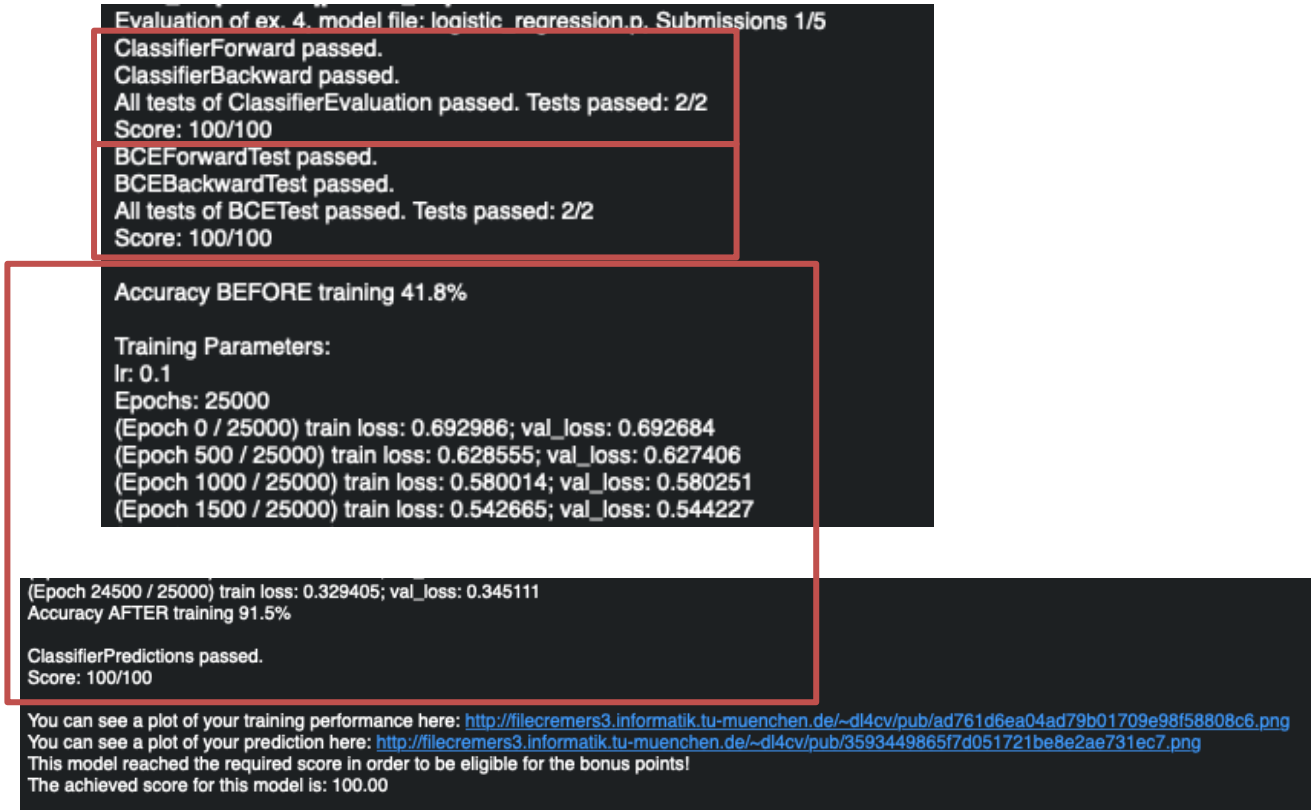
Cross Entropy Loss:

$$-\hat{y}\log(y) - (1-\hat{y})\log(1-y)$$

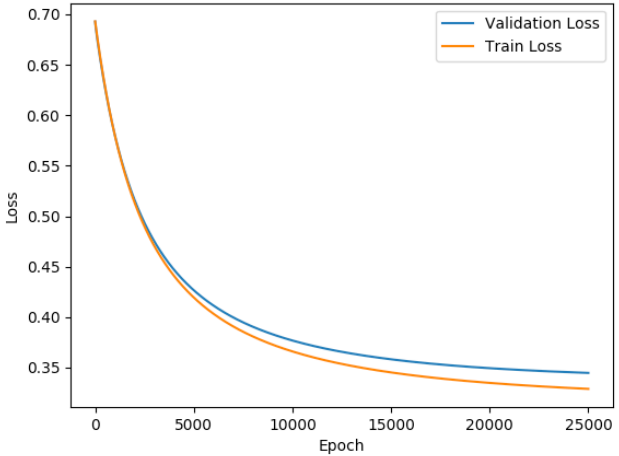


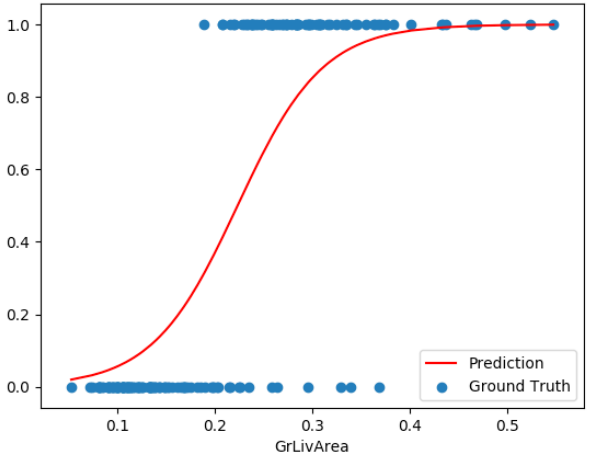
Submission 4 - Classifying House Prices

1. Classifier: Forward and Backward Pass
2. BCE Loss: Forward and Backward Pass
3. Training with Solver Test Accuracy > 85%



Submission 4 - Classifying House Prices



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(Epoch 24500 / 25000) train loss: 0.329405; val_loss: 0.345111
Accuracy AFTER training 91.5%

ClassifierPredictions passed.
Score: 100/100

You can see a plot of your training performance here: http://filecremers3.informatik.tu-muenchen.de/~dl4cv/pub/ad761d6ea04ad79b01709e98f58808c6.png
You can see a plot of your prediction here: http://filecremers3.informatik.tu-muenchen.de/~dl4cv/pub/3593449865f7d051721be8e2ae731ec7.png
This model reached the required score in order to be eligible for the bonus points!
The achieved score for this model is: 100.00
```

Submission 4: Logistic Regression

Start: May 14, 2020 12.00

End: May 20, 2020 23.59

See you next week