Regression + Assignments 1, 2

(Neural Networks Implementation and Application Tutorial)

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Overview

- Assignment 1
- Regression
- Assignment 2

Update

Up to 2 points for participation.

Assignment 1

Organization

- Late submissions (>10mins) will not be accepted unless previously agreed upon
- Other questions?

Notes

- Very nice solutions!
- Reconstruction error on original space, not standardized (we did the same mistake 🙃)

Assignment 1

- *Tutor cue:* go through the assignment
- Questions?
- Did it work?
- Were you able to collaborate?

Regression

- What is the difference between classification and regression? 🧐
- What is regression in terms of functions? 🧐
  - Any function $f : F \to \mathbb{R}$ (from joint feature space to numbers)
- What is *linear* regression? 🧐
  - $\hat{y} = x^T \cdot \beta + \beta_c$ (parameters β, β_c)

Which of the following are regression (and linear/polynomial) models? 🧐 1. 5

2. $4 \cdot x_1 + 5$
3. $4 \cdot x_1 + 3 \cdot x_2^2 + 5$
4. $4 \cdot x_1 + 3 \cdot x_1 \cdot x_2 + 5$
5. $4 \cdot x_1 + 3 \cdot \sin(x_2^2) + 5$
6. $\begin{cases} 4 \cdot x_1 + 5 & \text{if } x_2 \geq 10 \\ 3 \cdot x_1 + 4 & \text{if } x_2 < 10 \end{cases}$

Regression

Regression to Classification 🤔 🤔

Assume that we have a function that outputs a score for every class, e.g. *Predict sentiment into (positive, negative, neutral)*:

$$(15.0, -2.3, 4.1)$$

- How do we use this for classification?
  - Argmax
- Can we get a probability distribution?
  - Softmax: $\frac{\exp x_i}{\sum_k \exp x_k}$

Loss & Regularization

Loss

- Why L_2 and not L_1?
  - We care about points that are drastially mispredicted, e.g. $L_2(-1, 10)$ and not about almost correctly predicted instances $L_2(-1, -1.1)$
  - In L_1, these would have the same weight (gradient)
  - L_1 leads to some parameters being 0 (sometimes a good thing)

Regularization

- Why do we want to regularize?
  - Prevent overfitting, prevent reliance on noise
- Ridge regression uses L_2 penalty: *minimize* $\arg\min L_2^2(\hat{Y}, Y) + \lambda||\beta||_2^2$
- Lasso regression uses L_1 penalty: *minimize* $\arg\min L_2^2(\hat{Y}, Y) + \lambda||\beta||_1$
- ElasticNet regression uses both: *minimize* $\arg\min L_2^2(\hat{Y}, Y) + \lambda_1||\beta||_1 + \lambda_2||\beta||_2^2$

Model Capacity

- What contributes to overfitting?
  - Overfitting: little data, large model capacity, too many optimization steps
  - Underfitting: not enough optimization steps, too strict regularization

Bias-variance tradeoff

- Large bias corresponds to ...?
  - Underfitting/small model capacity
- Large variance corresponds to ...?
  - Overfitting

Assignment 2

- Any questions?