Large-scale classification

Denninger Maximilian, Lucas Peer

Technische Universität München
Department of Informatics
Computer Vision Group

August 3, 2016

Outline

Outline

Introduction

Combination of Random Forests with Gaussian Processes

- Speed of Random Forests
- Precision of Gaussian Processes

Pipeline

Outline

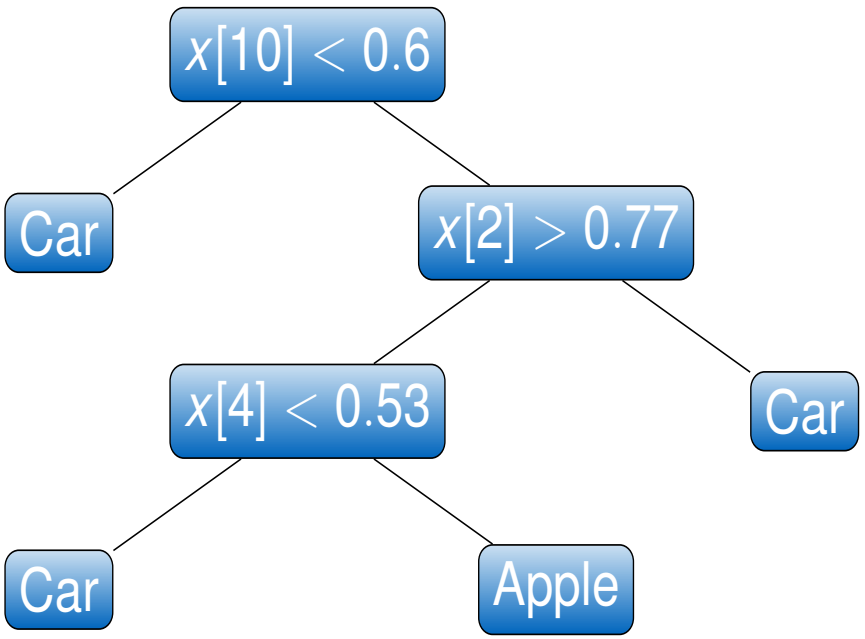
Related work

- Large-Scale Gaussian Process Classification Using Random Decision Forests [Fröhlich et al., 2012]
  - B. Fröhlich, E. Rodner
  - Random Forests with Gaussian Processes
- Gaussian Processes for Machine Learning [Rasmussen, 2006]
  - C. E. Rasmussen
  - Bible of GPs

Outline

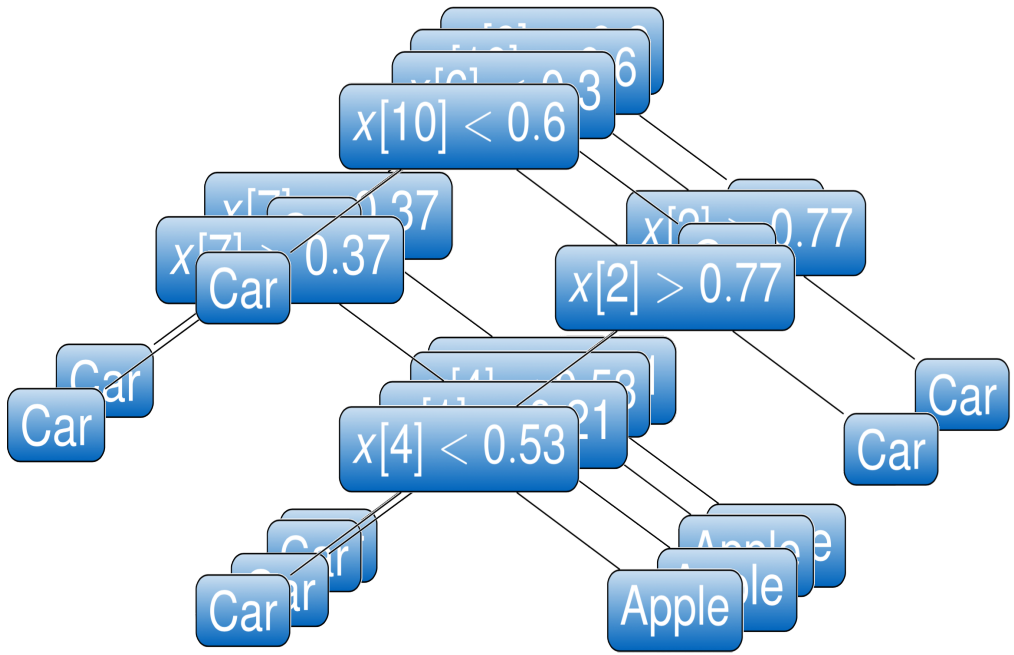
Decision Trees

- Hyper parameters:
  - Height
  - Amount of used data
- Greedy approach without pruning
- Selection criteria: entropy

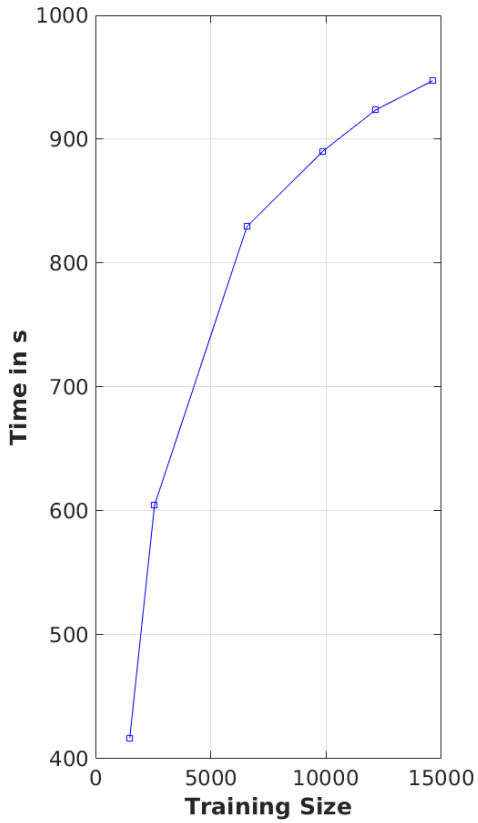


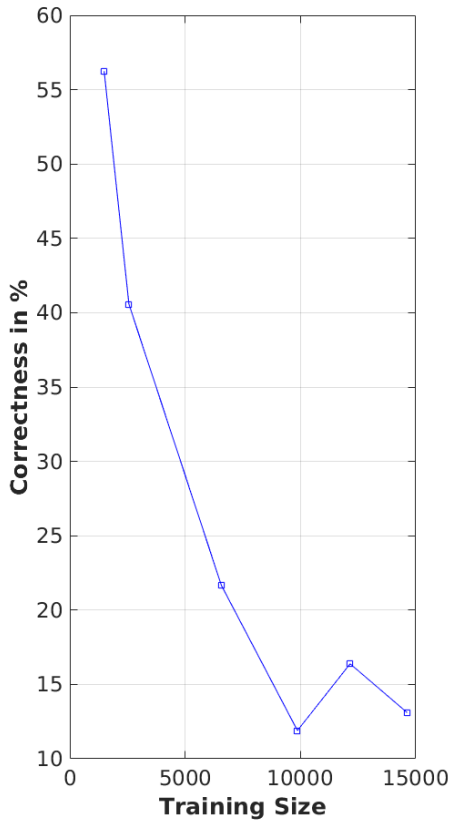
Random Forest

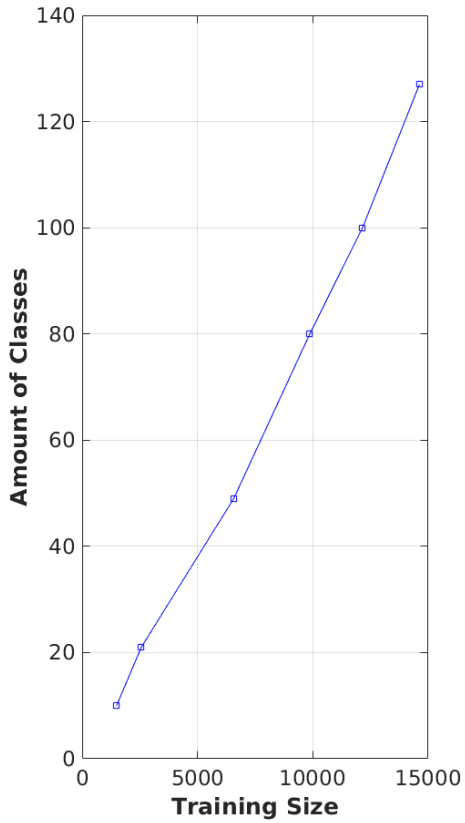
- Linear scalable
- Train trees in parallel
- Save and load trained forests as binary



Random Forest

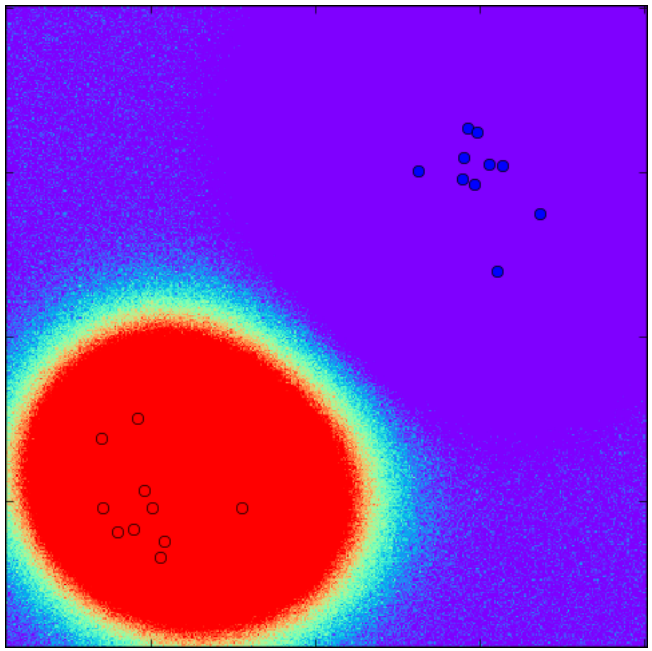






Gaussian Processes

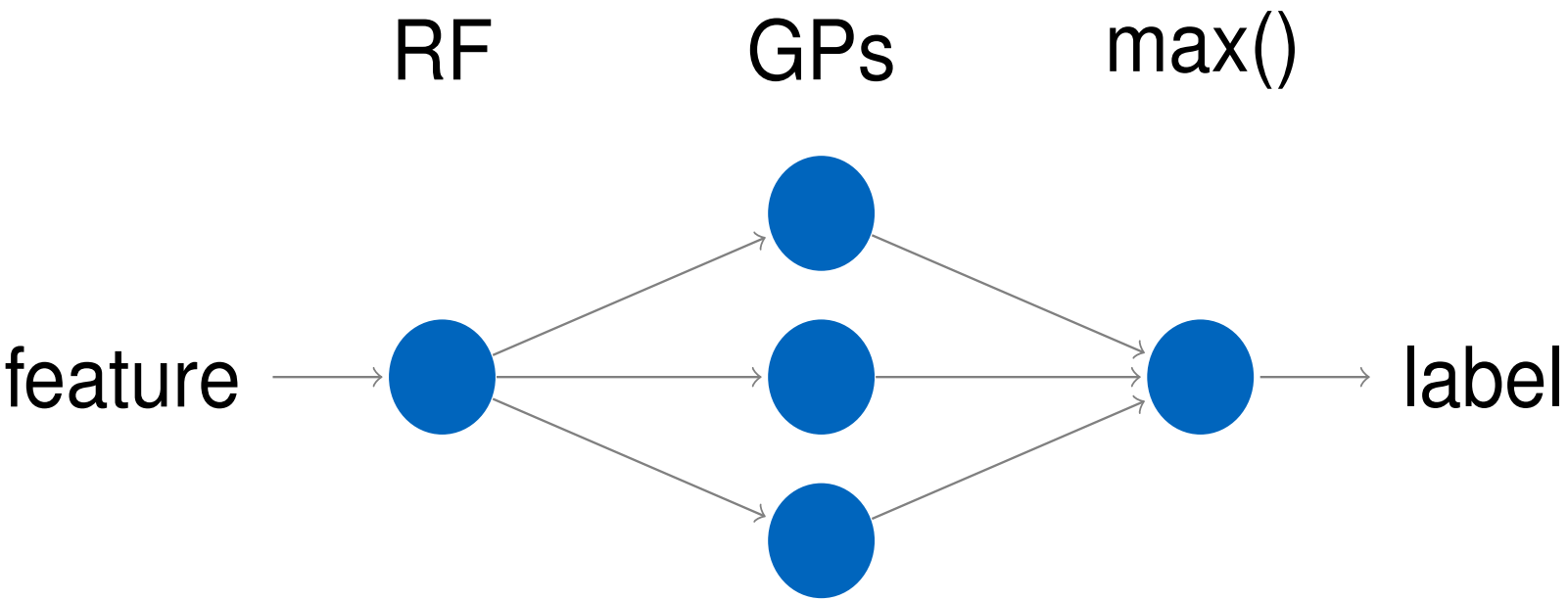
- Binary classification
- Nearly dimension independent
- Convex calculation of the latent variables
- Gaussian kernel parameters with BayesOpt



$$k(x_p, x_q) = {\sigma_f}^2 \exp(-\frac{1}{2l^2}(x_p - x_q)^2) + {\sigma_n}^2 \delta_{pq}$$

Random Forests with Gaussian Processes

- Combination of both approaches
- For each data point:



Outline

Evaluation and Conclusion

- Trained on 5822 images of 22 different classes
- Tests on 3656 images:
  - The RF: 67.53 % images correct classified
  - The RFGP: 93.71 % images correct classifed
- The concept works for this one case

Outline

Future Work

- Speed improvements
- More tests
- Multiclass Gaussian Processes
- Online learning for Random Forests and Gaussian Processes

Bibliography I

[Fröhlich et al., 2012] Fröhlich, B., Rodner, E., Kemmler, M., and Denzler, J. (2012).
Large-scale gaussian process classification using random decision forests.
Pattern Recognition and Image Analysis, 22(1):113–120.

[Rasmussen, 2006] Rasmussen, C. E. (2006).
Gaussian processes for machine learning.