DD2434 Projects

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Abstract

The task of the project is to reproduce the results presented in a published scientific article, describe the article orally and in written form to your peer students, and argue for and against the method presented in the article. From this you will learn how to read scientific articles, how to implement and use a particular method, how to argue for and against a method, and how to adapt the presentation of a method to different target groups (i.e., adapt the presentation of the method in the article - targeted to active researchers in Machine Learning - so that it is understandable to first year Master students in Machine Learning).

The below 7 papers represent a range of different topics in Machine Learning, and have been selected by Hedvig, who will be the supervisor of these projects.

Some of the papers are more theoretical and while others are of a more practical nature. The requirements will change accordingly, so if you pick a more practical paper you will need to perform more experiments while a more theoretical paper requires you to show a more thorough analysis of the paper.

Detailed instructions about the project can be found on the course home page, Project in the menu to the left.

1 Graphical Models

L. Breiman. "Random Forests". In: *Machine Learning* 45.1 (2001), pp. 5–32

The original Random Forests paper. Random Forests are used in diversity of applications; a recent application is the Microsoft person tracker. For this project, it is an advantage that some group members have taken a Machine Learning basic course.

2 Particle Filters

R. Van Der Merwe *et al.* "The unscented particle filter". In: *Advances in Neural Information Processing Systems* 12. 2000

The unscented particle filter is an improvement of the regular particle filter that uses an unscented Kalman filter (UKF) to generate the importance proposal distribution. For this project, it is an advantage that some group members have taken an Estimation or Signal Processing course.

3 Approximative Nearest Neighbor

A. Gionis *et al.* "Similarity search in high dimensions via hashing". In: *VLDB Conference*. 1999

Exakt kNN becomes intractable for very large N. Locality Sensitive Hashing is a principled approximation to exact kNN, which pre-organizes the state space so as to restricting the neighbor search to a small subset of the space.

4 Representation Learning

S. Mika *et al.* "Kernel PCA and de-noising in feature spaces". In: *Advances in Neural Information Processing Systems* 10. 1998

The original Kernel PCA paper. Kernel PCA is a widely used non-linear extension of PCA, also briefly covered in the course book by Bishop.

5 Computer Vision applications

Y. Boykov and M.-P. Jolly. "Interactive Graph Cuts for Optimal Boundary & Region Segmentation of Objects in ND Images". In: *International Conference on Computer Vision*. 2001

This paper is about image segmentation, and is extremely influential in Computer Vision. It treats an image as a Markov Random Field, optimizing segmentation boundaries using the Graph Cuts algorithm, also developed by Boykov. It is ok to use an existing implementation of the Graph Cuts algorithm, as an exception to the general demand of implementing from "scratch". For this project, it is an advantage that some group members have taken a Image Processing and Computer Vision course.

K. Grauman and T. Darrell. "The pyramid match kernel: discriminative classification with sets of image features". In: *IEEE International Conference on Computer Vision*. 2005

Pyramid kernels are designed for very efficient comparison of sets of features, a common task in Computer Vision. The algorithm is widely used in, e.g., large-scale retrieval applications, where computational efficiency is crucial.

T. Malisiewicz *et al.* "Ensemble of exemplar-SVMs for object detection and beyond". In: *IEEE International Conference on Computer Vision*. 2011

Large intra-class variation is a ubiquitous problem in Computer Vision. The method in this paper addresses this by splitting up the representation of a class into a large number of "exemplars", typical class members. For this project, it is an advantage that some group members have taken a Machine Learning basic course and a Image Processing and Computer Vision course.

References

- L. Breiman. “Random Forests”. In: *Machine Learning* 45.1 (2001), pp. 5–32.
- R. Van Der Merwe *et al.* “The unscented particle filter”. In: *Advances in Neural Information Processing Systems* 12. 2000.
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- S. Mika *et al.* “Kernel PCA and de-noising in feature spaces”. In: *Advances in Neural Information Processing Systems* 10. 1998.
- Y. Boykov and M.-P. Jolly. “Interactive Graph Cuts for Optimal Boundary & Region Segmentation of Objects in ND Images”. In: *International Conference on Computer Vision*. 2001.
- K. Grauman and T. Darrell. “The pyramid match kernel: discriminative classification with sets of image features”. In: *IEEE International Conference on Computer Vision*. 2005.
- T. Malisiewicz *et al.* “Ensemble of exemplar-SVMs for object detection and beyond”. In: *IEEE International Conference on Computer Vision*. 2011.