

# Convex Optimization Projects

May 26, 2020

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The goal of the project is to become an „expert“ in one of the following topics („expert“ means, you know the theory („how the algorithm works and why it is correct“), you know how to implement (a version of) the algorithm, you know the advantages, disadvantages and applications of the algorithm):

## List of Topics

Group 1) Simplex Algorithms (and Linear Programming)

Group 2) Interior Point Algorithms (and Quadratic Programming)

Group 3) Alternating Direction Method of Multipliers (Convex Objective + Linear Constraints)

Group 4) Proximal Point Algorithms (Convex Objective + Linear Constraints)

Group 5) Active Set Algorithms (and Quadratic Programming)

Group 6) Own Topic (if the proposed topic fits to Convex Optimization)



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## Literature

Group 1) Plenty of material online, many books, e.g. Understanding and Using Linear Programming (Matousek, Gärtner), Introduction to Linear Optimization (Bertsimas, Tsitsiklis)

Group 2) Plenty of material online, Convex Optimization (Boyd, Vadenberghe)

Group 3) Survey Paper: Distributed Optimization and Statistical Learning via the Alternating Direction Method of Multipliers (Boyd et.al.)

Group 4) Survey Paper: Proximal Algorithms (Parikh, Boyd)

Group 5) Numerical Optimization (Nocedal, Wright), An online active set strategy to overcome the limitations of explicit MPC (Ferreau et. al.)

Group 6)



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- Group size = up to two students
- Project reviews start at June 15 (via WebEx, at usual lecture hours, timetable will be soon available on ILIAS, sign in for project until June 2)
- Handout has to contain
  - (Short Introduction, Goal of the Project)
  - Mathematical **problem formulation**
  - **Algorithm (pseudo code**, what are the input/output variables etc.)  
(including a description of the main ideas and main features of the algorithm and how it works)
  - **Convergence theorem/rates + proof** (if proof is not too complicated)
  - **Application or numerical/academic example**
  - **Matlab code**: ML function algorithm.m for the algorithm and demo.m for the demonstration of the example
  - **Bibliography**  
The handouts/Matlab code should be written in a way, so that your fellow students can quickly become experts in your topic and that they can easily use the Matlab code
- Submission deadline for handouts and Matlab files: **July 17** (via Email: [ce@ist.uni-stuttgart.de](mailto:ce@ist.uni-stuttgart.de), [meriem.gharbi@ist.uni-stuttgart.de](mailto:meriem.gharbi@ist.uni-stuttgart.de) , Subject: „Convex Optimization Project Group X“ X=group number)
- Use latex.zip for handout (ILIAS), handouts: about 4-6 pages (double column)



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- Exam
  - Written or oral exam
  - Questions to lectures and projects
  - *Handouts*, *ML code* are taken into account in the grade
  - (Oral) exam dates will be finalized in July
- Questions: Meriem Gharbi ([meriem.gharbi@ist.uni-stuttgart.de](mailto:meriem.gharbi@ist.uni-stuttgart.de)),  
Christian Ebenbauer ([ce@ist.uni-stuttgart.de](mailto:ce@ist.uni-stuttgart.de))