

# Convex Optimization Project

Please send your report and code by email to `aspremon@ens.fr`

## 1 Semidefinite programming solver

Consider the following semidefinite program

$$\begin{aligned} & \text{minimize} && \mathbf{Tr} CX \\ & \text{subject to} && \mathbf{Tr} A_i X = b_i, \quad i = 1, \dots, m \\ & && X \succeq 0 \end{aligned} \tag{1}$$

- Use the barrier method to write a simple MATLAB solver for this problem (it should solve a phase one problem first to get a feasible starting point). Test it on randomly generated problem instances.

*Hint : Focus on solving the dual. The Hessian for  $\log \det(X)$  can be found in Appendix A.4.3 of the “Convex Optimization” textbook.*

- (Optional) One can show that a semidefinite program such as (1) with only one constraint ( $m = 1$ ) always has a solution of rank one. Use the algorithm described in the reader (Appendix B.3) to extract a solution  $xx^T$  from any solution  $X$  to problem (1). Try your code on some random examples.

**NOTE :** Please use *graphics and tables* to illustrate your results as much as possible. You can use MATLAB/OCTAVE or general purpose languages such as PYTHON or JULIA.