Course Summary

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Modeling

mathematical optimization

- problems in engineering design, data analysis and statistics, economics, management, ..., can often be expressed as mathematical optimization problems
- techniques exist to take into account multiple objectives or uncertainty in the data

tractability

- roughly speaking, tractability in optimization requires convexity
- algorithms for non-convex optimization find local (suboptimal) solutions, or are very expensive
- surprisingly many applications can be formulated as convex problems

Convexity

theoretical consequences

- local optima are global
- extensive duality theory (systematic way of deriving lower bounds on optimal value, necessary and sufficient optimality conditions, certificates of infeasibility, sensitivity analysis)
- solution methods with polynomial worst-case complexity theory (with self-concordance)

practical consequences (convex problems can be solved globally and efficiently)

- interior-point methods require $20 - 80$ steps in practice
- basic algorithms (e.g. Newton, barrier method, . . .) are easy to implement and work well for small and medium size problems (larger problems if structure is exploited)
- more and more high-quality implementations of advanced algorithms and modeling tools

Using convex optimization

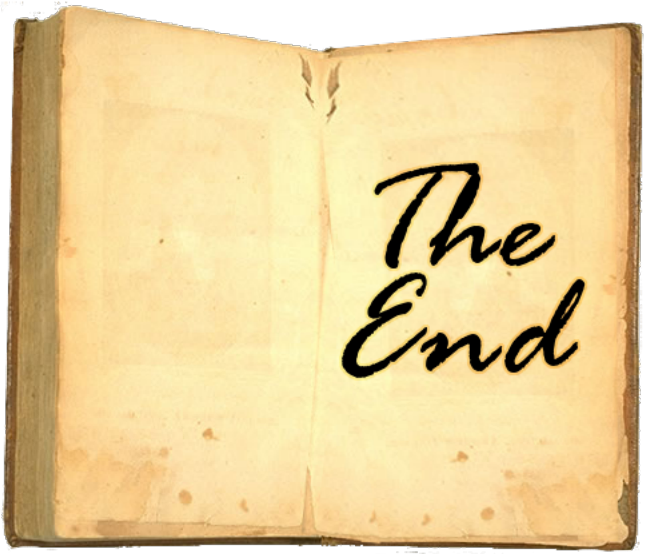
areas of applications

- approximation and fitting
- statistical estimation
- geometric problems
- . . . and many more

general guidance for using convex optimization

- use rapid prototyping, approximate modeling
- work out, simplify, and interpret optimality conditions and dual
- even if the problem is quite non-convex, convex optimization can still be helpful

Feedback or Suggestions?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