Optimisation for Data Analysis **CS7DS2/CS4405**

Lecture 2: 24, 30 Jan

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2.1 Convex Sets

Read Chapter 2 from [BV04], focusing on the following sections:

- 2.1.1, 2.1.2, 2.1.4, 2.1.5;
- 2.2.1, 2.2.2, 2.2.4 (not simplexes);
- 2.3.1, 2.3.2, 2.3.3 (only linear fractional functions);
- 2.5.1, 2.5.2,
  read also chapter 4 from Chong/Zak; nice figures for geometry

Also, it is suggested to read Appendix A (Math Background) from [BV04].

2.2 Questions for Practice

- How do we prove that a set is convex?
- Prove that any Euclidean ball is a convex set.
- What is the difference between l_1, l_2 and l_∞ norms? Draw them in 2 dimensions.
- Prove that set $\mathcal{S} = \{x \,|\, Ax = b\}$ is affine.
- Exercise 2.12 from [BV04].

2.3 Notes about Matlab Scripts

- Examples provided for creating and plotting affine sets, convex hulls, a cone, a hyperplane and a hyperspace.
- Can you write a script that finds the conic hull of a random set of points?

References

[BV04] S. Boyd, L. Vandenberghe, "Convex Optimization", *Cambridge University Press*, 2004.