Review Questions for EE364a – Convex Optimization I at Stanford

Pranay Pasula

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Chapter 2 – Convex Sets

Affine Set

1. What is an affine set?
2. Describe an affine set using set notation.
3. What are some examples of affine sets?
4. Is any affine set the solution to a linear system of equations?

Convex Set

5. What is a convex set?
6. Describe a convex set using set notation.
7. Are affine sets also convex sets? Why or why not?
8. Are null sets also convex sets? Why or why not?
9. What do convex sets look like in $\mathbb{R}^n$?
10. How does the definition of convexity apply to a set $S \not\subseteq \mathbb{R}^n$? Say, for $S = \boldsymbol{S}^n_{++}$?
11. What is the interior of a set?
12. Give examples of convex sets with an interior equal to the empty set.

Convex Combination

13. What is a convex combination?
14. What is a convex hull?
15. What is the convex hull of a convex set?
16. How do convex combinations differ from affine combinations?

Convex Cone

17. What is a cone?
18. What is a convex cone?
19. Why is a convex cone considered to be convex even though the constraints on weights are different than what is required by the definition of convexity?
20. What is a conic combination?
21. What is a conic hull? 22. What convex cone that contains a set is bigger than the conic hull of that set?

Hyperplane

23. What is a hyperplane?
24. Describe a hyperplane using set notation.
25. Describe how the variables in the definition of a hyperplane determine the hyperplane.
26. Is a hyperplane a vector space?
27. Is a hyperplane a subspace?
28. Is a hyperplane an affine subspace?
29. How does the definition of an affine subspace differ from the definition of a vector space? How do the relate?
30. Does every affine subspace contain a vector space?
31. Does every vector space contain an affine subspace?
32. What is the dimension of a hyperplane?
33. What is the codimension of a hyperplane?
34. What is meant by codimension in this context? When does is the codimension defined in this context?
35. Is a hyperplane convex? Affine?

Halfspace

36. What is a halfspace?
37. If a halfspace contains the origin, is it a vector space?
38. Is a halfspace convex?
39. Is a halfspace affine?
40. How does the definition of a halfspace relate to the definition of a hyperplane?

Euclidean Ball and Ellipsoid