Convex Optimization – Questions for the Exam
Fall Semester 2021/2022

1. Linear and affine subspaces, convex sets and cones in linear spaces. Set theoretic operations and algebraic operations with such sets.
2. Linear, affine, cone and convex combinations, The characterization of the linear, affine, convex cone and convex hull of sets.
3. The generalized drop theorem for the computation of the convex hull of the union of convex sets. Half spaces and the Stone separation theorem.
4. Linear and affine functions, convex and sublinear functions and their characterizations. Implications among these properties.
5. The core (algebraic interior) of convex sets and its properties. Hyperplanes and the halfspaces determinded by hyperplanes.
6. Separation of disjoint convex sets by hyperplanes or affine functions.
7. The sandwich theorem for convex-concave pairs of functions.
8. Topological vector spaces. The connection between the core and the topological interior of sets. The interior and the closure of convex sets and convex cones.
9. Characterization of continuity of convex functions. Local Lipschitz property of regular convex functions. The continuity of convex functions over finite dimensional spaces.
10. Directional derivative of convex functions and its basic properties. Global Lipschitz property the directional derivative of regular convex functions.
11. The subgradient of convex functions. Connection between the subgradient and the directional derivative.
12. The sum rule for the directional derivative and for the subgradient of convex functions.
13. The maximum theorem. The directional derivative and the subgradient of the maximum of convex functions.
14. Local and global minimum point for convex functions. The Fermat principle.
15. Minimum problems with convex inequality constraints. Necessary and sufficient conditions: The Karush–Kuhn–Tucker multiplier theorem.