Exam questions on the course "Optimization methods"
Fall 2020

1. Optimization problem statement, local and global minimum
2. Convex sets and their properties, cones. Examples
3. Convex functions and their properties. Jensen inequality. Criteria of the function convexity
4. Subgradient and its existance. Subdifferential of maximum of convex functions. Subdifferential of sum of convex functions.
5. Main principles of autodiff technique
6. L-smooth functions, descent lemma
7. Optimality conditions: unconstrained problems, constrained problems. KKT conditions. Slater regularity condition. Convex vs. non-convex problems.
8. Dual function and its properties. Dual problem. Weak and strong duality.
9. Basic principles of convex calculus. DCP
10. Convergence speed of optimization methods. Stopping criteria. How to compare optimization methods? Step size selection.
11. Gradient descent and its convergence.
12. How gradient descent can be accelerated? Main ideas, methods and use cases
13. Stochastic gradient descent and its convergence. Vartiance reduction approach and examples of its usage.
14. Adaptive step size stochastic gradient-based methods
15. Newton method and its convergence.
16. Quasi-Newton methods: main idea and examples (Barzilai-Borwein, BFGS and L-BFGS)
17. Semidefinite programming problems. Convex relaxations of combinatorial quadratic problems. MAXCUT problem and Goemans-Williamson's algorithm