Theoretical minimum

1. General concept of matrix calculus. Gradient, Hessian, Jacobian, their connection.
2. Affine set. Convex set. Conic set.
3. Interior, relative interior of a set.
4. Affine, convex, conic combinations.
5. Affine, convex, conic hulls of the set.
6. Projection. Existense and uniqeness conditions.
7. Convex function. Criterias of convexity. Strictly convex function.
8. Strongly convex function. Criterias of strong convexity.
9. Conjugate set. Conjugate cone. Properties of conjugate set.
10. Conjugate functions. Conjugate cone. Properties of conjugate functions. Fenchel - Moreau theorem.
11. Subgradient. Subdifferential.
12. Moreau - Rockafellar theorem. Dubovitsky - Milutin theorem. Subdifferential calculus.
13. Extreme value (Weierstrass) theorem. Necessary and sufficient conditions of the local minimum in unconstrained minimization.
14. General mathematical optimization problem. Convex optimization problem. Lagrange function.
15. Karush-Kuhn-Tucker theorem. Slater's condition.
16. Dual problem. Dual function. Duality gap. Weak duality. Strong duality.
17. Fenchel - Rockafellar theorem.
18. Conjugate (dual) norm. Dual function to the norm.
19. Linear programming problem and its dual.
20. Quadratic programming problem and its dual.
21. Logistic regression problem and its dual.

- Materials