You need to choose one topic from the list and prepare a project on it (a presentation including a worked-out computational example). This project is equivalent to the final exam and will determine your grade for it. Prepare a high-quality presentation. Of course, you cannot use printed materials with text during your presentation. The defense of your projects will take place during the last two class sessions of the semester. I and your fellow students will ask you questions — be prepared to answer all of them. Prepare a presentation lasting 20 minutes, and we will leave 5 minutes for questions following your presentation. The project defense will take place on May 21 and May 28. By May 14, I will need a list of who has chosen which topic and your schedule — who will present on May 21 and who will present on May 28.

List of topics:

1. Penalty Function Method (External Point) for Solving Constrained Optimization Problems

2. Barrier Function Method (Logarithmic Barrier) for Inequality-Constrained Problems

3. Online Gradient Descent (OGD) and Its Application to Time Series Prediction

4. Comparison of Optimization Methods for Training Small-Size Neural Networks

5. Genetic Algorithm for Minimizing Multimodal Functions (e.g., Rastrigin or Ackley)

6. Simulated Annealing Algorithm for the Traveling Salesman Problem

7. Gradient Optimization Using the Rprop (Resilient Backpropagation) Algorithm

8. Gradient Optimization Using Differentiation Along Trajectories (Gradient Flows)

9. Knapsack Problem: Solving via Dynamic Programming and Greedy Algorithm

10. Differential Evolution Method for Global Optimization

11. Cuckoo Search Method

12. Hyperparameter Optimization Using Bayesian Optimization (From-Scratch Implementation with GPyTorch or scikit-optimize)

13. Recurrent Backpropagation for Training Models with Echo States

14. Stochastic Programming with Recourse (Two-Stage Problem) on the Example of Production Planning

15. Game-Theoretic Optimization: Finding Nash Equilibrium via Gradient Descent

16. Parallel Optimization: Implementing Parallel Gradient Descent with MPI or multiprocessing

17. Impact of Rounding Errors and Computational Precision on the Convergence of Gradient Methods

18. Job Shop Scheduling Optimization Using a Genetic Algorithm

19. Energy Minimization in the Ising Model Using Graph-Based Optimization (Max-Cut Reduction)

20. Firefly Algorithm for Global Optimization

21. Comparison of Gradient-Based and Gradient-Free Methods on Ridge Functions

22. Vertex Cover Problem: Exact Method (Branch and Bound) vs. Greedy Algorithm

23. Multidimensional Knapsack Problem with Dynamic Programming

24. Genetic Algorithm for the Cutting Stock Problem

25. Multi-Criteria Optimization Using Geometric Weighting with Nonlinear Normalization of Criteria

26. Comparison of Robust and Stochastic Optimization on the Inventory Management Problem (Newsvendor Problem)

27. LLM Optimization (LLMO): Query and Generation Optimization Methods for Large Language Models

28. Physics-Inspired Optimization for Deep Learning: Dynamic Fractional Generalized Deterministic Annealing (DF-GDA)

29. Quantum Interior Point Method (QIPM) for Linear Optimization

30. Energy-Efficient Task Offloading Optimization in Cooperative Edge Computing (IoV)