1. Introduction
    - What is an algorithm?
    - What is a data structure?
    - Inductive reasoning
    - Inductive proof
    - Complexity of an algorithm
    - Sorting by insertion
    - Analysis of sorting by insertion
    - Asymptotic notations
2. Sorting, Heap, Recursion
    - Divide-and-conquer method.
    - Sorting by merging - MergeSort.
    - Complexity of merge sorting.
    - Recursion, computing recursive complexity, solving recursion, the universal recursion theorem.
    - Heap, heap property, restoring heap property, building a heap.
    - Analysis of heap algorithms
    - Heap Sorting, Priority Queues, Priority Sorting, Quicksort.
3. Priority queues, Quicksort, Linear time sorting.
    - Priority queues
    - Heap operations
    - Implementation of priority queues
    - Quicksort
        - Algorithm
        - Quicksort analysis
    - Decision Tree Model alg. Sorting
    - Sorting by counting, positional sorting, bucket sort.
    - Dynamic Sorts, Stack, List
4. Data structures, Stack, Queue, List, BST and RB Trees.
    - Dynamic Sets
    - Stack
    - Queue
    - List
    - BST tree
        - browse, search, delete operations
        - complexity of BST tree operations
    - Well-balanced trees
        - Red-Black Tree (RB-Tree)
            - inserting into RB-tree
5. Skip lists, hash tables, positional statistics
    - Skip lists
    - hash tables
        - direct addressing
        - open addressing
            - linear, square, double addressing
    - List implementation, collision resolution
    - Hashing function
    - positional statistics
        - selection problem, selection in pessimistic linear time
        - dynamic positional statistics
6. Dynamic positional statistics, interval trees, graphs.

- dynamic positional statistics
  - determination of an element of a given rank
  - rotation in a tree of dynamic positional statistics
- Interval trees
  - rotation in an interval tree
  - searching for an interval in an interval tree
- Graphs
  - graph representation, neighborhood matrix, neighborhood lists
  - graph search, BFS algorithm

7. Graphs, DFS, graph spanning tree, topological sorting.
   - Graph algorithms
     - Graph Searching
       - BFS, DFS
       - spanning tree creation
       - edge classification
         - forward edge, traversal edge, backward edge, spanning tree edge.
   - directed acyclic graph
     - topological sorting
       - properties of topological sorting
8. Graph algorithms, search for minimal paths.
   - Minimum spanning tree
   - Observation, optimal structure consists of optimal substructures.
   - Prim algorithm for searching a minimal spanning tree * Prima algorithm for searching a minimal spanning tree
   - Searching for minimal paths in any directed graph, Ford Bellman algorithm.
   - A version of the Ford Bellman algorithm for directed acyclic graphs.
   - Searching for shortest paths in a graph with nonnegative edge weights, Dijkstra's algorithm.
9. Graph algorithms, amortised cost method.
   - Dijkstra's algorithm
     - operation, complexity, correctness
   - Spanning trees
     - Kruskal algorithm
     - Kruskal algorithm correctness
   - The problem of shortest paths between each pair of vertices in a graph.
     - Warshal Floyd algorithm
   - Amortised cost analysis
     - dynamic arrays
     - analysis by the summary cost method
     - analysis by accounting method
10. Flow networks, pattern finding algorithms
    - Flow networks
      - Ford-Fulkerson algorithm, residual network, augmented path, flow function.
      - minimum crosssection, maximum flow.
    - Maximal associations in bipartite graphs.
      - reduction to a flow network problem
    - pattern search in text
      - „naive” algorithm, Rabin Karp algorithm,
      - Finite state automata, introduction to KMP
11. Text algorithms

    - Pattern search
        - finite automata
        - searching for a pattern in a text using automata
        - KMP algorithm (reduction of transition functions to an array)
        - Boyer-Moore algorithm
            - heuristics
                - inconsistencies
                - good suffix
12. Text compression, Parallel algorithms
    - text compression
        - Information theory, Shannon's entropy measure
        - Huffman coding
            - Huffman coding algorithm
        - LZW compression
    - Parallel algorithms
        - Flynn's taxonomy of parallel systems
        - parallel architectures
    - PRAM model
        - EREW, CREW, ERCW, CRCW
    - examples of parallel algorithms
        - Pascal's triangle, minimum search, positional statistics, determining the rank of an element in a list.
13. Geometric algorithms
    - basic concepts
    - determining the position of points relative to each other
    - the problem of intersection of two segments.
    - construction techniques for geometric algorithms
    - the problem of finding the convex envelope of a set of points
    - Graham's algorithm for finding the convex envelope of a set of points.
    - Finding intersecting segments in a set of segments.
    - algorithm for finding intersecting segments by the sweeping method
    - problem of finding the least distant pair of points in a point set
        - the divide and conquer algorithm
14. Summary lecture