

# Introduction to Computer Science 2

## Syllabus 2024 Spring

1. (February 12.) Fundamental notions of graph theory: graph, simple graph, degree, subgraph, complement, isomorphism, directed graph.
2. (February 19.) Fundamental notions of graph theory, cont'd: walk, trail, path, circuit, cycle, connected graph, (connected) component, tree, spanning tree.
3. (February 26.) BFS. Minimum weight spanning trees, Kruskal's algorithm.
4. (March 4.) Euler trails and circuits, necessary and sufficient condition for their existence. Hamilton paths and cycles, necessary and (separate) sufficient conditions for their existence.
5. (March 11.) Bipartite graphs, their characterisation. Vertex coloring, lower and upper bounds on the chromatic number, greedy coloring.
6. (March 18.) Zykov's construction. Interval graphs, their coloring.
7. (March 25.) Matchings, independent verices, vertex- and edge cover, their relations. Gallai's theorems. Augmenting path algorithm in bipartite graphs.  
**No class on April 1.**
8. (April 8.) Matchings (cont'd): Theorems of König, Hall and Frobenius.
9. (April 15.) Edge-chromatic number, theorems of Vizing, König and Shannon.
10. (April 22.) Flows in networks,  $st$ -cut, augmenting path algorithm. Max flow-mincut theorem.
11. (April 29.) Flows (cont'd): Edmonds-Karp theorem, integrality lemma. Generalisations of flows. Menger's theorems.
12. (May 6.) Menger's theorems (cont'd). Higher connectivity of graphs.  
**The midterm is on May 9th, up to the end of flows.**
13. (May 13.) Shortest paths, the Bellman-Ford algorithm.