- Basic graph algorithms
  - directed and undirected graphs
  - DFS (depth-first search)
  - reachability
  - connectedness
- Connected components
  - union-find
  - optimizations
  - running time
- Matching and flow optimization
  - Flow networks
  - The Min-cut-max-flow theorem
  - How to compute optimal flows
  - Application to the marriage problem
- Stable marriage problem (Not examinable)
  - Gale-Shapley algorithm (Not examinable)
  - running-time
  - correctness
  - optimality (for boys!)
• String matching
  • Rabin-Karp
  • Knuth-Morris-Pratt
  • Boyer-Moore

• Linear programming
  • Problem definition
  • Geometrical analysis
  • The simplex method (bounded cases, feasible)
  • The integer-case (ILP)
• Turing machines and complexity
  • Definition of Turing machines
  • Definitions of recursive, recursively enumerable (r.e.)
  • The existence of a universal TM and simulations
  • Undecidability of the halting problem
  • Time and space complexity (deterministic, non-deterministic)
  • Complement classes
  • The time-bounded halting problem and $\text{PTime} \neq \text{ExpTime}$

• Propositional satisfiability
  • Basic propositional logic
  • The problem SAT
  • The Davis-Putnam algorithm
  • The problem $k$-SAT
  • The problem Horn-SAT
  • Phase-transition phenomena (high-level description only)
• Reductions, completeness and hardness
  • Many-one polynomial-time/log-space reductions
  • Transitivity of many-one log-space reductions
  • Cook’s Theorem (Cook-Levin Theorem)
  • 3-SAT is NP-hard

• Hard graph-theoretic problems
  • 3-colourability is $\text{NPTime}$-hard
  • Hamiltonian and Eulerian circuits
  • The travelling salesman problem
• Two important theorems
  • Savitch’s Theorem (both forms)
  • The Immerman-Szelepcsényi Theorem (both forms)
  • Configuration graphs for Turing machines

• The standard complexity hierarchy:

\[ \text{LogSpace} \subseteq \text{NLogSpace} \subseteq \text{PTime} \subseteq \cdots \]

• Complexity of satisfiability: two well-known problems
  • Krom-clauses (2-SAT)
  • QBF
• Reading:
  http://studentnet.cs.manchester.ac.uk/ugt/2016/COMP36111/syllabus/

• Past exam papers:
  http://studentnet.cs.manchester.ac.uk/assessment/exam_papers/index.php

Note that the syllabus may vary slightly from year to year.