Randomised Algorithms:
Past Papers by topic

This classification includes past papers from the Advanced Algorithms and Mathematical Methods courses. Keep in mind that the Advanced Algorithms course places more emphasis on the approximation aspect of the algorithms rather than the randomised aspect. The past papers from the Mathematical Methods course place less emphasis on the algorithms side.

Concentration Inequalities:

- **[2022P9Q12]** Compare Chernoff bounds to Markov's and Chebyshev's inequalities, Derive Chernoff bounds (general and specific to schedulling)

- **[2016P6Q8]** Chernoff bound for the binomial distribution, application to load balancing

- **[2015P6Q8]** Prove Chebyshev's inequality, apply Chebyshev's inequality for estimation

- **[2014P6Q8]** Derive the general Chernoff bound, apply for i.i.d., Normal random variables

- **[2013P6Q8]** Prove Chebyshev's inequality, use Jensen's inequality, apply Chebyshev's inequality, investigate how the bounds change with parameters

- **[2011P6Q7]** Prove Markov's for X and X^2, apply Markov's inequality

Markov Chains:

- **[2021P6Q4 (a), (b)]** Irreducible, aperiodic, unique stationary distribution, power of matrix, mixing time

- **[2017P6Q8]** State diagram, irreducible, recurrent, aperiodic, stationary distribution

- **[2012P6Q8]** Irreducible, aperiodic, positive recurrence, PageRank

- **[2010P6Q8]** Derive expected number of returns, Stationary distribution

- **[2009P4Q10]** Irreducible, aperiodic, positive recurrence, stationary distribution, PageRank

- **[2008P4Q4]** Simple random walk, CLT, gambler ruin problem

- **[2007P4Q4]** Detailed balance equations, stationary distribution, simple random walk, proportion of time

Linear Programming:

- **[2021P8Q1 (b)(i)]** Weighted vertex cover

- **[2020P8Q1]** Fundamental theorem of LP, slack form, (non-)feasible solutions, Application to classifying points

- **[2019P8Q1]** Worst-case, convex set, initialise simplex, Vertex cover

- **[2018P7Q1]** Three cases for the solutions of an LP, Solve an LP, LP duality

- **[2017P7Q1 (a),(b)]** Three cases for the solutions of an LP, Vertex cover

- **[2016P9Q1 (b)]** Randomised rounding for MAX-CNF

- **[2015P7Q2 (a),(b)]** Three cases for the solutions of an LP, Solve an LP

Approximation Algorithms:

- **[2022P9Q12]** Max-Cut for directed graph, balanced partitions (Max-Bisection), Integer Program, Randomised Rounding

- **[2021P8Q1 (b)(ii)]** Weighted vertex cover

- **[2021P9Q1]** Expectation bound using Jensen's inequality, Max-k-Cut

- **[2020P9Q1 (a)(i),(b),(c)]** Define approximation ratio, Vertex Cover

- **[2019P9Q1 (a),(c)]** Approximation ratio, Maximum clique problem

- **[2018P9Q1]** Vertex-Cover via Set-Cover, Unweighted vertex cover using DFS

- **[2017P7Q1 (c)]** Randomised algorithm for Vertex-Cover

- **[2017P9Q1]** State two approximation algorithms and their guarantees, k-Clustering

- **[2015P7Q2 (c)]** Approximation algorithm for the Steiner tree problem

Spectral Graph Theory:

- **[2022P8Q12]** Conductance (connected/disconnected graph), Laplacian for hypercube