Computational Complexity

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1 Languages and Problems

- 1. Alphabet.
- 2. Strings, empty string.
- 3. Length of a string.
- 4. Powers of an alphabet.
- 5. Kleene Closure.
- 6. Language.
- 7. Problem, e.g. primality.

Asymptotics and Inequalities $\mathbf{2}$

- 1. Tool for comparing functions.
- 2. The O, Ω, Θ , and o notations.
- 3. The limit test.
- 4. Some relationships.
- 5. Summation through integration.

Probability and expectation 3

- 1. Axiomatic definition of probability spaces.
- 2. Random variables.
- 3. Probability mass function of a random variable.
- 4. Cumulative Distribution function of a random variable.
- 5. Expectation and Variance.
- 6. The Binomial, Bernoulli and Geometric random variables.
- 7. Independent Random variables.
- 8. Linearity of expectation.
- 9. Conditional linearity of variance.
- 10. Concentration inequalities.

4 Abstract Algebra

- 1. Groups.
- 2. Rings.
- 3. Fields.

$\mathbf{5}$ Upper and Lower bounds

- 1. Finding the maximum/minimum.
- 2. Finding the maximum and minimum.
- 3. Sorting an array of integers.
- 4. Matrix multiplication.

Problem paradigms 6

- 1. The Konigsberg bridge problem.
- 2. The Hamilton Circuit problem.
- 3. The Chess problem.
- 4. Roadmap.