Lec00-intro

KT Ch. 1

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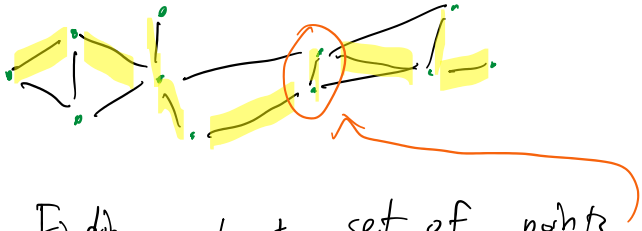
Objectives: to study general computational problems and their algorithms, with a focus on the principles used to design those algorithms.

Learning goals:

1. Design algorithms using common techniques
2. Prove worst-case runtime
3. Prove a problem is NP-hard

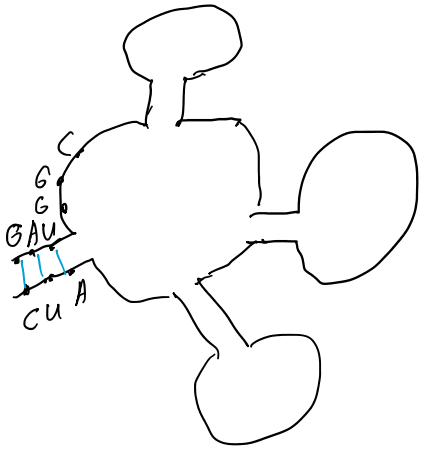
Example 1: Low-cost network design



Example 2: Finding closest set of points

Example 3: RNA folding

GAUGG C AAAU GC UA A GGCCU ...



Example 4: Genomic alignment

ACCGGTTAA
ACGATTCAA

ACCGGTT-AA
A-CGATTCAA

General techniques

Book: Algorithm Design by Jon Kleinberg & Éva Tardos

- Ch 4: Greedy — easy local optimization at every step
- Ch 5: Divide & Conquer — break problem into subproblems
- Ch 6: Dynamic programming — overlapping subproblems
- Ch 7: Network Flow — transportation networks → general problem
- Sec 11.6-11.7: Linear & integer programming — constraint satisfaction

Analysis of Algorithms

- Correctness — alg always returns right answer
- Implementation — what data structures are needed
- Worst-case runtime — speed guarantees
- Computational complexity — prove no alg can do better