Lec00-intro

KT Chapter 1

Sunday, August 27, 2023 8:01 PM

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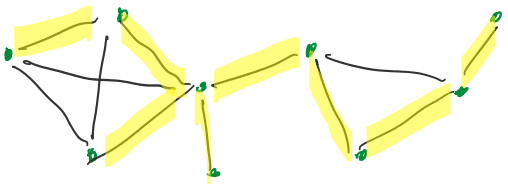
Objectives: to study general computational problems and their algorithms, with a focus on the principles used to design those algorithms.

Learning goals:

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

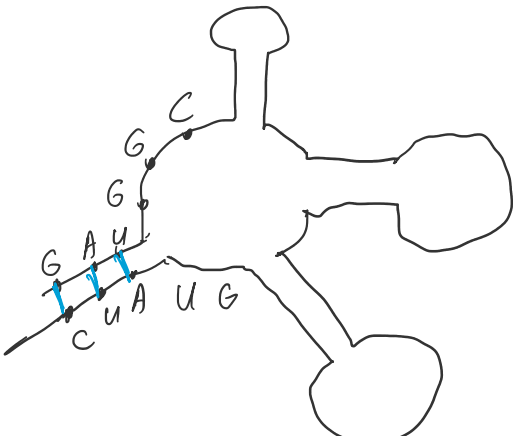
Example 1: Low-cost network design



Example 2: Finding closest set of points

Example 3: RNA folding

GAUGGCAAAUGCUAAGGCCU...



Example 4: Genomic alignment

```
ACCGGTTAA          ACCGGTT-AA
          }        |  ||  ||  |
ACGATTCAA          A-CGATTCAA
```

General techniques

Book: Algorithm Design by Jon Kleinberg and 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 do we need to implement the algorithm
- Worst-case runtime — guarantees of speed
- Computational complexity — prove no algorithm can do better

Syllabus