CompSci 260P
Spring 2023 Lecture :
Review of Diagnostic Exams

Diagnostic 1, Dynamic Programming

- Word Segmentation: Maximize sum of quality
- English definition then clear recursive formula

Segment(0) = 0

def Segment(i) as highest quality break-up for s[1 ... i]

$\sum_{i=1}^{n} i$

//j = 1st char of last word

// s[1 ... j-1] and word: s[j ... i]

$$\max_{1 \le j \le i} \{ \text{Segment}(j-1) + \text{quality}(s, j, i) \}$$

$O(n)$ work/case x $O(n)$ cases: $O(n^2)$

memoize vector [0 .. n], increasing index

Diagnostic 2, Dynamic Programming

- Candy Jar
  - n office hours
  - Jar holds C pieces of candy
  - Costs $\$P$ to refill jar
  - Costs $\$d$ per piece after each office hour
  - Office hour i expects s_i students
- Be sure to understand the problem!

Diagnostic 2, Dynamic Programming

vector[0...n, 0...C], $O(nC)$ cases, $O(1)$ time each, $O(nC)$ total

- Candy Jar incr both dims Goal: Candy(n, 0)
- English definition then clear recursive formula

Let Candy(i, j) be least expensive way for OHs 1...i w/ j leftover after i^{th}.

// do I order candy for i^{th} OH?

// If $j + s_i > C$, I must order

when choice take min

yes order = Candy(i-1, 0) + P

no order = Candy(i-1, $j + s_i$) + d($j + s_i$)

base? Candy(0, *) = 0

Diagnostic 1, Complexity

"no" certifiable

- Trucks! Version One:
  - Constraints are canister to truck.
  - Each truck has max carrying capacity
  - Load all trucks?
- Version Two
  - Constraints are canister to canister
  - Each truck has max carrying capacity
  - Load all trucks
- Polynomial time Solvable?

Diagnostic 1, Complexity

Partitioning

- Version Two is $\mathcal{NP}$-complete.
  - Constraints are canister to canister
  - Each truck has max carrying capacity
  - Load all trucks

3-COLOR (G)

{ for each vertex i
def canister i

for each edge (i,j)
constrain truck (i) ≠ truck (j)

V2 (canisters, 3 trucks, |V| capacity)

3 trucks
|V| capacity

Diagnostic 2, Complexity

- *Spacing*: min dist btwn vertices in diff sets
- *Diameter*: max dist btwn vertices in same set
- Polynomial time Solvable?

Diagnostic 2, Complexity

- *Spacing*: min dist btwn vertices in diff sets
- *Diameter*: max dist btwn vertices in same set
- $\mathcal{NP}$-complete?

3-COLOR(G)

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