Data Structures and Algorithms

Week-2

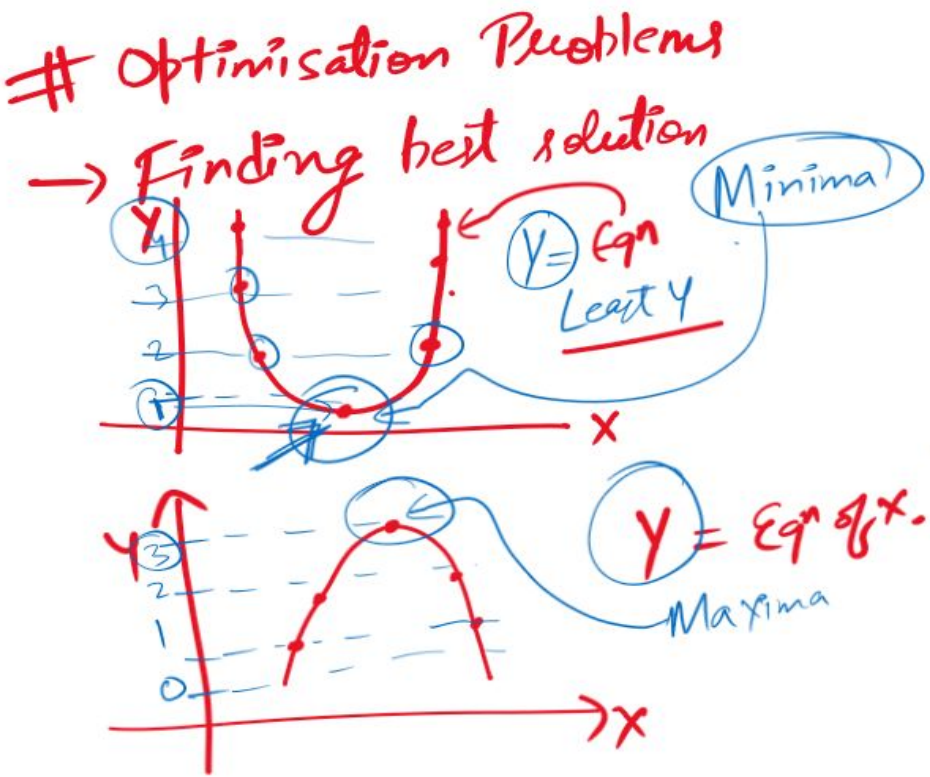
Greedy Algorithms

Greedy is an algorithmic paradigm that builds up a solution piece by piece, always choosing the next piece that offers the most obvious and immediate benefit.

Used to solve Optimisation Problems

Examples: Fractional Knapsack, Maximum Number Problem, Car Fueling , etc

Optimisation Problems and the ways to solve them:



Ways of Solving

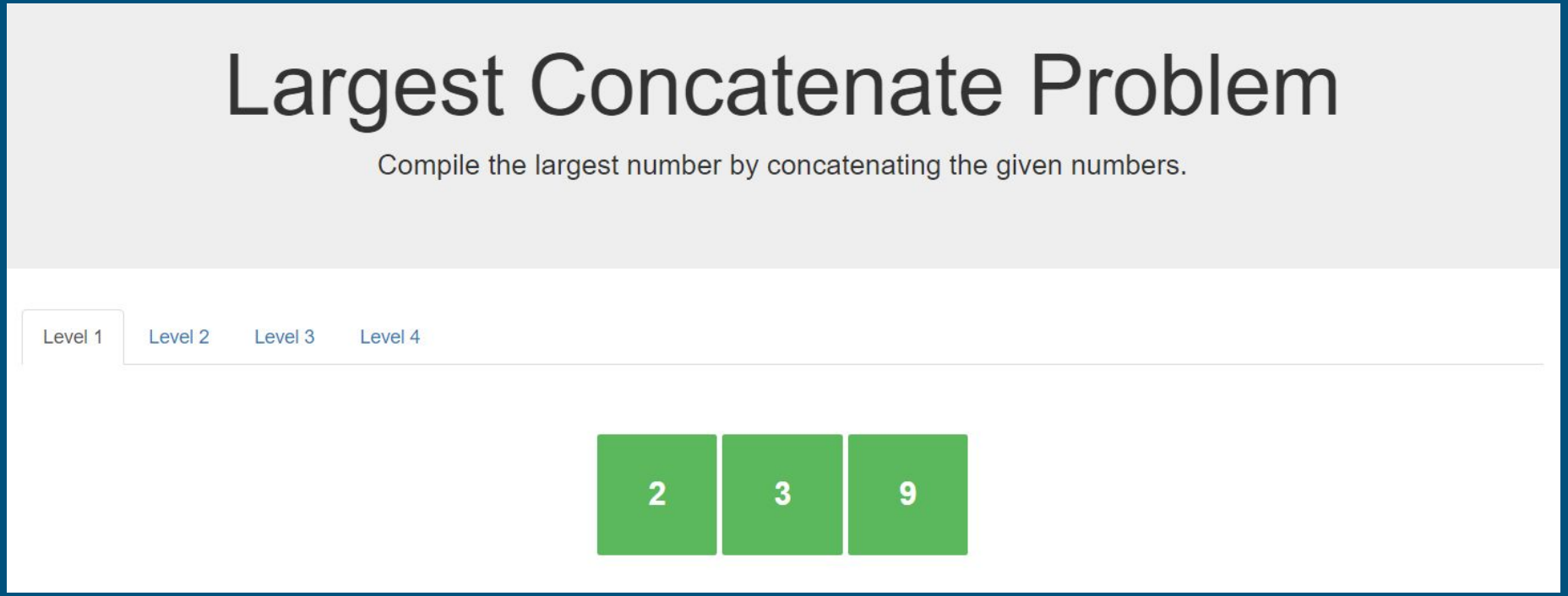
1. Greedy Algo (Method)
2. Branch & Bound
3. Dynamic Programming

Greedy Strategy:

- ➔ Make a Greedy choice
- ➔ Reduce to a subproblem
- ➔ Iterate

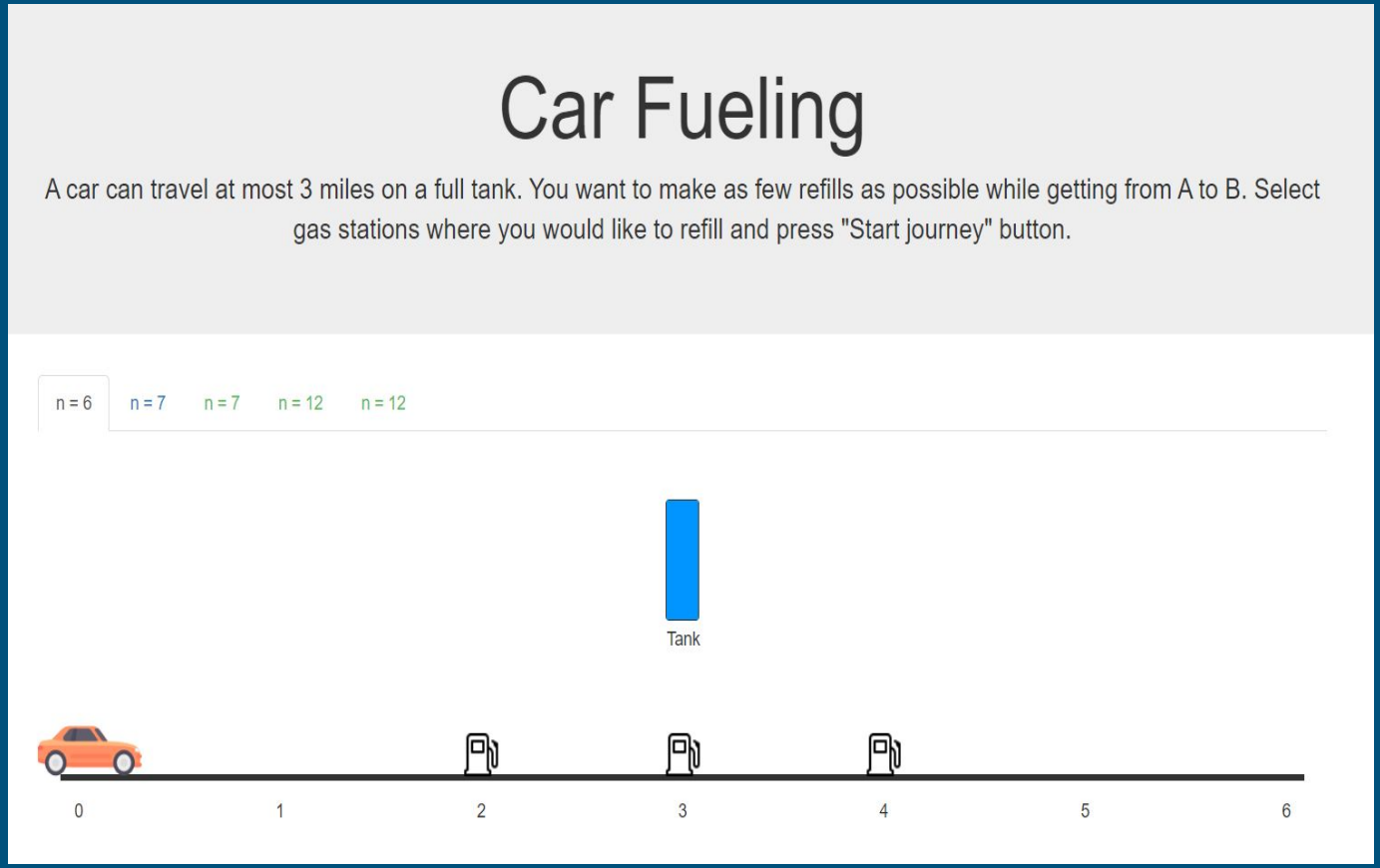
Links to develop Intuition: http://dm.compsciclub.ru/app/quiz-largest-number

What is the Greedy Choice here? Choosing the largest number OR choosing the number such that leftmost position should be the greatest one possible?



Links to develop Intuition:

http://dm.compsciclub.ru/app/quiz-car-fueling



Greedy Choice here?

1. Refill at the closest gas station.
2. Refill at the farthest reachable gas station
3. Go untill there is no fuel.

So option 2 is correct.

Problem in the code format

Car Fueling

Input: A car which can travel at most L kilometers with full tank, a source point A, a destination point B and n gas stations at distances $x_1 \leq x_2 \leq x_3 \leq \cdots \leq x_n$ in kilometers from A along the path from A to B.

Output: The minimum number of refills to get from A to B, besides refill at A.

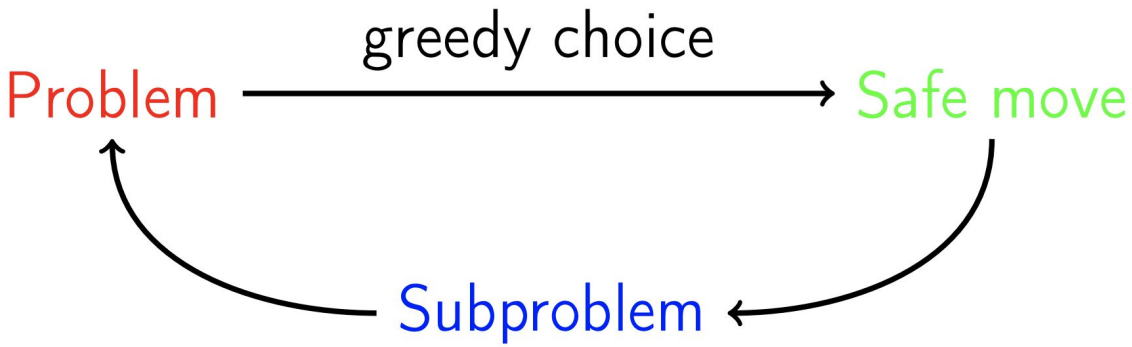
PSEUDOCODE

$A = x_0 \le x_1 \le x_2 \le \cdots \le x_n \le x_{n+1} = B$

MinRefills(x, n, L)

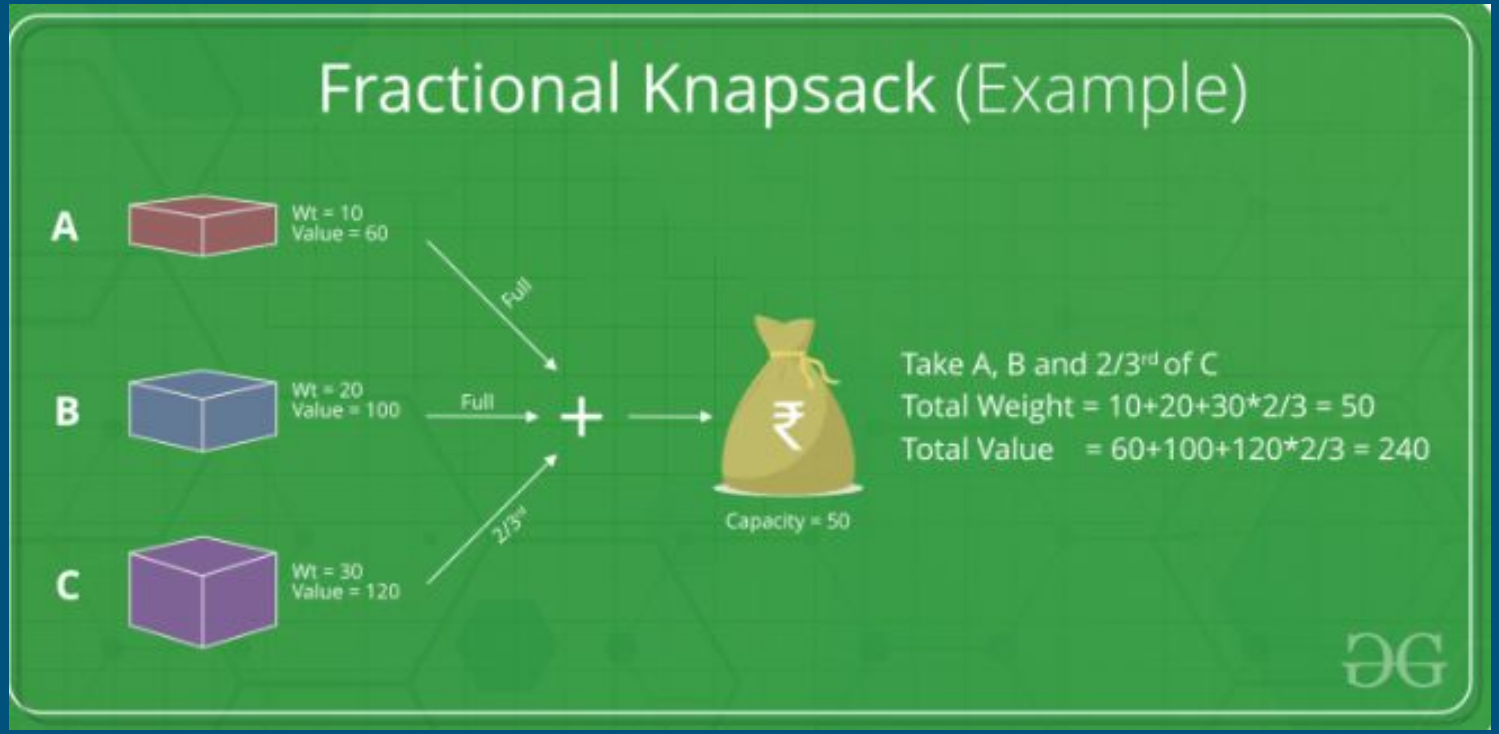
```
numRefills ← 0, currentRefill ← 0
while currentRefill ≤ n:
  lastRefill ← currentRefill
  while (currentRefill ≤ n and
         x[currentRefill + 1] − x[lastRefill] ≤ L):
    currentRefill ← currentRefill + 1
  if currentRefill == lastRefill:
    return IMPOSSIBLE
  if currentRefill ≤ n:
    numRefills ← numRefills + 1
return numRefills
```

General Strategy



- Make a greedy choice
- Prove that it is a safe move
- Reduce to a subproblem
- Solve the subproblem

Fractional Knapsack



Source:gfg