

Greedy Algorithms

Lecture 15

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CS3000 Algorithms and Data

Making change

Fractional Knapsack

Graph Coloring

Practice Problems

1. Making change

“Only thing bigger than greed.. is bigger greed.” – Vincenzo Cassano

Making Change

- Given a set of coin denominations $c_1 < c_2 < \dots < c_n$, find the smallest number of coins needed to make change for some amount x .
- Case 1: Let denominations be: 1, 5, 10, 25, 100 (US coins)
- Case 2: Let denominations be: 1, 2, 4, 8, 16 (powers of 2)
- Case 3: Let denominations be: $b^0, b^1, b^2, \dots, b^{n-1}$ (consecutive powers, $b \geq 2$)
- General case: $2 \cdot c_i \leq c_{i+1}$ for all $1 \leq i < n$.

2. Fractional Knapsack

Fractional Knapsack

- Consider the Knapsack problem we've seen in the past.
- Knapsack with capacity W , items with value v_i and weight w_i .
- In this case, the items can be broken into smaller parts.
- Example: Grains, various liquids, etc.
- What's the most value you can carry around in the Knapsack?
- How will you find the best things to carry?

3. Graph Coloring

“Although greed is considered one of the seven deadly sins, it turns out that greedy algorithms often perform quite well.”

– Stuart Russell, Artificial Intelligence: A Modern Approach

Graph Coloring

- Given a graph $G = (V, E)$, color the vertices V using as few colors as possible.
- Constraint: For a coloring $c : V \rightarrow \mathbb{N}$, if $\{u, v\} \in E$ then $c(u) \neq c(v)$.
- In general this problem is hard. What's a way to get some coloring going?

4. Practice Problems

Practice Problems

- These are all greedy programming problems I found on a quick search on leetcode.
- We'll solve these now.
- 409. Longest Palindrome
<https://leetcode.com/problems/longest-palindrome/>
- 1221. Split a String in Balanced Strings
<https://leetcode.com/problems/split-a-string-in-balanced-strings/>
- 1323. Maximum 69 Number
<https://leetcode.com/problems/maximum-69-number/>
- 1827. Minimum Operations to Make the Array Increasing
<https://leetcode.com/problems/minimum-operations-to-make-the-array-increasing/>
- 2656. Maximum Sum With Exactly K Elements
<https://leetcode.com/problems/maximum-sum-with-exactly-k-elements/>