Greedy Algorithms

Sam McCauley

February 22, 2024

Welcome Back!

- Assignment 1 back
- Optional Assignment out
  - Gives *proof-based* practice with greedy algorithms
  - I believe that proof-based questions give a much deeper understanding of the algorithm
  - I *do not* think that such a question would be appropriate on a 75 minute midterm
- Submit optional assignment by end of Monday and I will give you feedback. You can also discuss in office hours, or just create a study group and do it together. (Or look it over/not do it at all.)

Practice Midterm Posted

- On GLOW. Please don’t distribute it
- Gives a *rough* idea of what the midterm will look like
- Not as polished!

What the Midterm Will Look Like

- An assignment-style very open-ended proof will not be on the midterm (it is too long)
    - Shorter proofs from assignments that follow more directly are possible (think Problem 1 from Assignment 2)
    - perhaps 1-2 “justify your algorithm” or similar short proofs
- Some true/false, some short answer
- 1-2 questions with longer answers (i.e. asking to give an algorithm)

Midterm Topics

- Basics of running time, correctness, big-O/Ω/Θ notation
- Gale-Shapley and stable matchings
- BFS/DFS and properties (incl. Topological sort)
- Greedy algorithms
- Minimum spanning trees
- *Not Dijkstra's Algorithm itself* (which we'll likely start on Monday)
- I'll leave some time for review on Monday

Wrapping up Greedy

Earliest Finish Time Proof

- This is called an *Exchange Argument*: we repeatedly alter (exchange) an optimal solution, without increasing cost, until we get the greedy solution
- Proves that greedy is one of the optimal solutions!
- Let's do an example of how this proof works [On Board #1]

Greedy Proof Techniques

1. Greedy stays ahead
2. Exchange argument

Both are good ways to analyze a greedy algorithm! Oftentimes, both actually work—but sometimes one is easier than the other.

- If one is proving very difficult, try the other
- Can look quite similar

Greedy Algorithms Takeaway

- Greedy algorithms are a *sometimes* thing
- Usually fast; *Correctness* is the main question!
- Only use a greedy algorithm when you can show that it is correct
  - Starting in March we'll look at more sophisticated problem-solving techniques