Traveling Salesperson

Lecture 17
CS 312

Traveling Salesperson Problem (TSP)

- Given a set of $n$ cities with a cost of traveling between cities.
- Find a tour of all $n$ cities with minimal cost.
- NP-Complete
  - don’t expect an efficient algorithm

Project 1 Report

- 20: representation of data
- 20: explanation of data
- 10: general presentation
- 10: summary
- 20: conclusion and reasoning
- 20: clarity and style

Comment encoding:
- 1 - Don’t use first person singular
- 3 - Awkward

Optimality

- $g(n,S) = \text{length of the shortest path starting at } n, \text{ ending at } 1 \text{ and passing through all vertices in } S$
- $g(1, V - \{1\})$ is the optimal tour
- $g(1, V - \{1\}) = \min \{c_{ik} + g(k, V - \{1, k\})\}$ for every $k$ between 2 and $n$.
- $g(i, s) = \min \{c_{ij} + g(j, S - \{j\})\}$ for every $j$ in $S$

Building the algorithm

- Get $g(1, V - \{1\})$ if know $g(k, V - \{1, k\})$ for every value of $k$.
- Get $g(i, \emptyset)$ easily
- Build $g(i, \{j\}) = \{c_{ij} + g(j, \emptyset)\}$ from $g(j, \emptyset)$.
- Top-down or bottom-up?
Complexity

- Enumerate all tours?
- Use this DP solution?

Complexity

- Enumerate all tours?
  - $O(n!)$ time
- Use this DP solution?
  - $O(n^2 2^n)$ time and $O(n^2 2^n)$ space