Dijkstra’s Algorithm

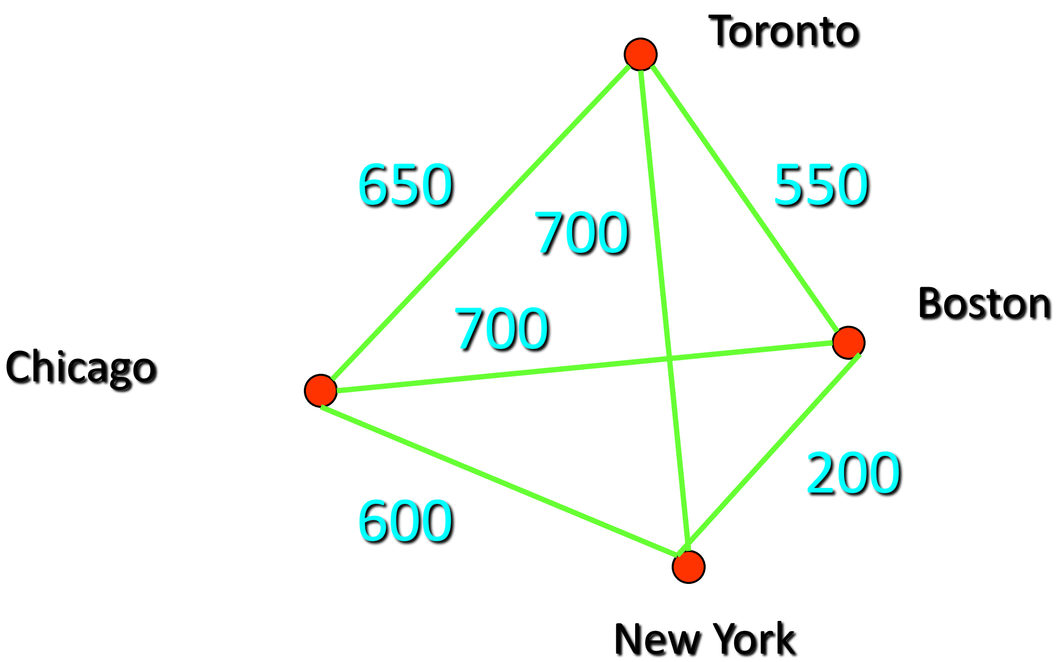
- Dijkstra’s algorithm is an iterative procedure that finds the shortest path between to vertices a and z in a weighted graph.
- It proceeds by finding the length of the shortest path from a to successive vertices and adding these vertices to a distinguished set of vertices S.
- The algorithm terminates once it reaches the vertex z.

The Traveling Salesman Problem

- The **traveling salesman problem** is one of the classical problems in computer science.
- A traveling salesman wants to visit a number of cities and then return to his starting point. Of course he wants to save time and energy, so he wants to determine the **shortest path** for his trip.
- We can represent the cities and the distances between them by a weighted, complete, undirected graph.
- The problem then is to find the **circuit of minimum total weight that visits each vertex exactly one**.

The Traveling Salesman Problem

- **Example:** What path would the traveling salesman take to visit the following cities?



Solution: The shortest path is Boston, New York, Chicago, Toronto, Boston (2,000 miles).

The Traveling Salesman Problem

- **Question:** Given n vertices, how many different cycles C_n can we form by connecting these vertices with edges?
- **Solution:** We first choose a starting point. Then we have (n – 1) choices for the second vertex in the cycle, (n – 2) for the third one, and so on, so there are (n – 1)! choices for the whole cycle.
- However, this number includes identical cycles that were constructed in **opposite directions**. Therefore, the actual number of different cycles C_n is **(n – 1)!/2**.

The Traveling Salesman Problem

- Unfortunately, no algorithm solving the traveling salesman problem with polynomial worst-case time complexity has been devised yet.
- This means that for large numbers of vertices, solving the traveling salesman problem is impractical.
- In these cases, we can use efficient **approximation algorithms** that determine a path whose length may be slightly larger than the traveling salesman's path, but

The End