Fri, Feb 9, 2024
Greedy Algorithms (continued)

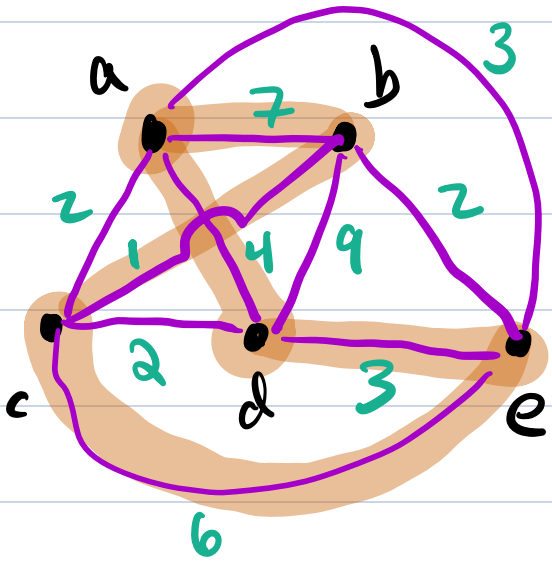
Announcements

→ HW 1 due tonight
→ HW 2 assigned today (D2L)
due Fri, Feb 23

Problem #5: Traveling Salesman Problem (TSP)

There are n cities that a salesman needs to visit, and return home. What is the shortest route to visit each city once and return home?

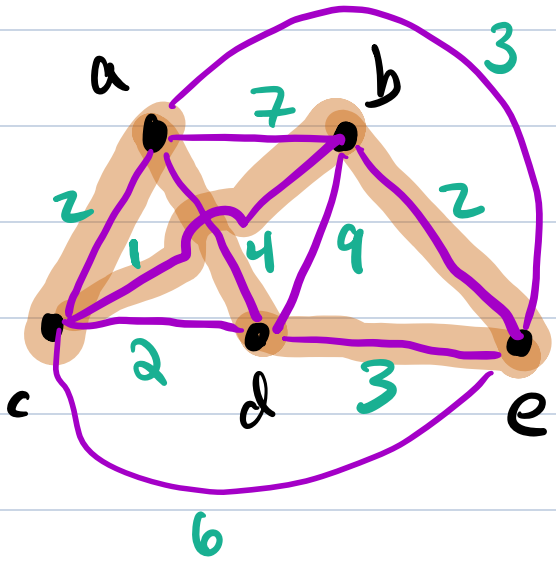
More formally: Consider a weighted graph G. Which ordering of the vertices gives you smallest sum of the edge weights?



$a \to d \to e \to c \to b \to a$

$4 + 3 + 6 + 1 + 7$

$= 21$



$a \to c \to b \to e \to d \to a$

$2 + 1 + 2 + 3 + 4$

$= 12$

this is the shortest path

$d \to a \to c \to b \to e \to d$ is the same set of edges (start city is kind of irrelevant)

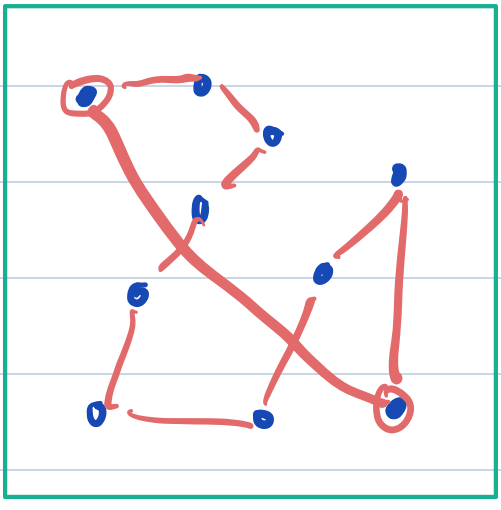
Greedy Algo:

* pick a random start vertex v_1
* pick v_2 to be the "closest" vertex to v_1

"closest" = the edge from v_1 → something with the lowest weight

* pick v_3 to be the "closest" to v_2 that we haven't visited
* repeat until the last vertex is picked, then go back to v_1.

- does okay in general but tends to pick a few dumb edges.



Brute force: Try every possible solution

n cities $\Rightarrow$ $(n-1)!$ possible solutions

$$(n-1)! = (n-1)(n-2)(n-3)\ldots 4\cdot 3\cdot 2\cdot 1$$

This is big, even bigger than exponential.

$$n! \approx n^n$$

Better than brute force:

Dynamic Programming: $\approx n^2 \cdot 2^n$ things to check

There is no known way to find optimal solutions to TSP, in less than exponential time.

Lecture 4 – using the Unix command line

Unix was an O.S. framework in the 70s that is a precursor to every current OS (except Windows)

Mac + Linux have terminals where you can use Unix commands and "Git for Windows" is a Unix emulator for Windows.

Goal: Cover some basic commands to navigate and manipulate files and run python code.

Useful because:

- On your computer there are some things you can't do easily with the GUI.
- Ex: View the first 10 lines of a 1GB text file.
- The only way to interact with

remote computers (SSH)

Website: "Software Carpentry"
deeper dive than this lecture

File System

On my mac: