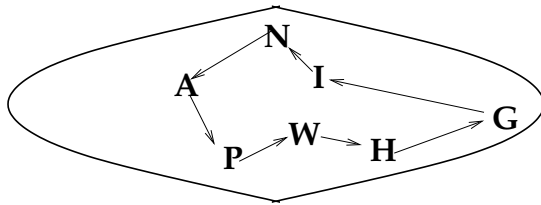


Sections 6.1 to 6.3

Traveling Salesman Problems

- Traveling Salesman
- Mars Rover visiting sites



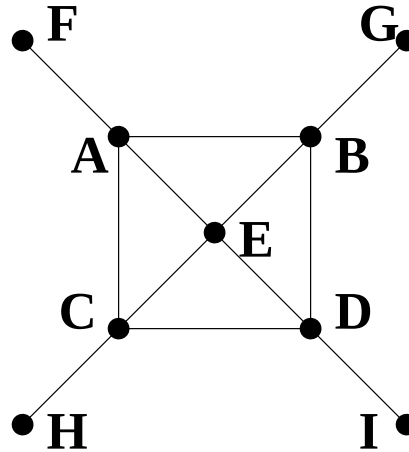
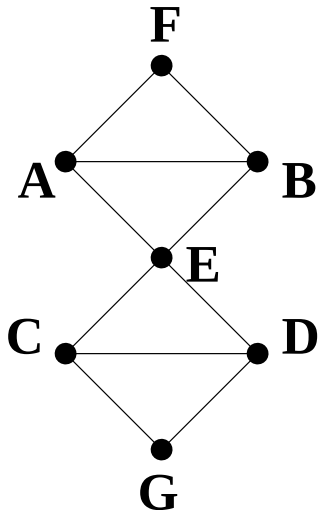
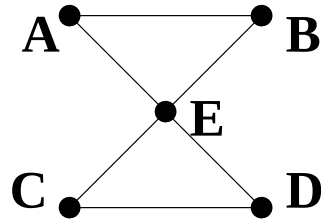
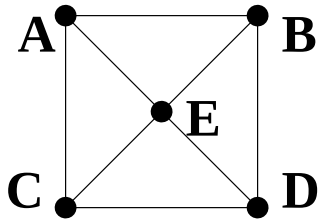
- UPS Driver

Differ from other routing problems:

Interested in *vertices* rather than *edges*.

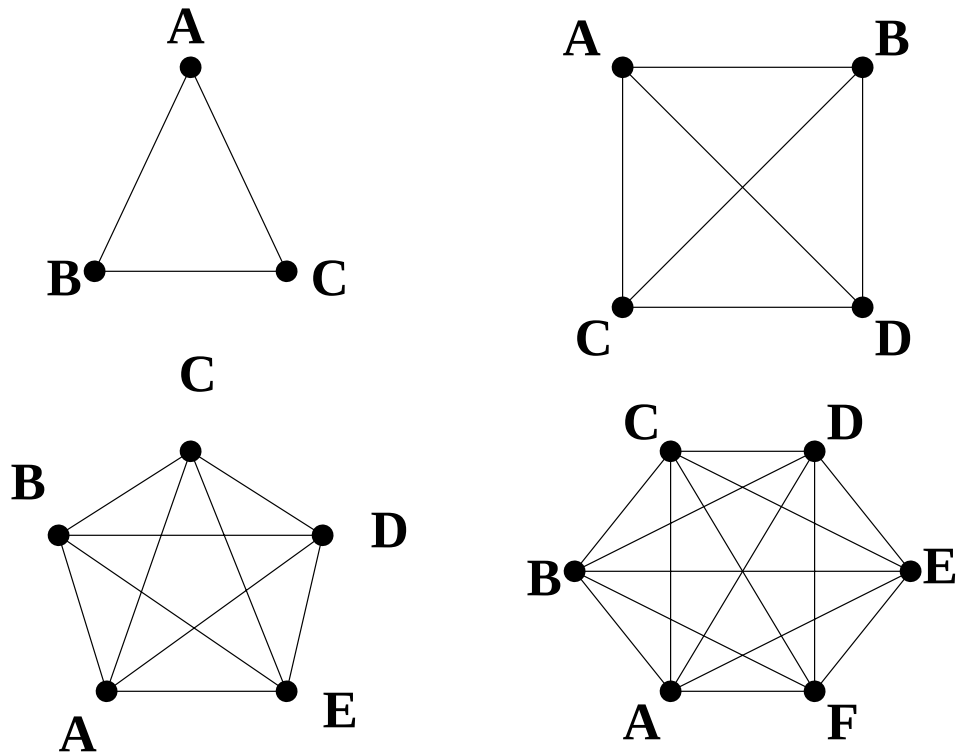
Hamilton Circuit a circuit that passes through every *vertex* once and only once.

Hamilton Path a path that passes through every *vertex* once and only once.



Consider graphs in which every possible sequence of vertices produces a Hamilton Circuit.

Complete Graph (K_N)- a graph with N vertices in which every pair of vertices is joined by exactly one edge.



Note:

- degree of every vertex = $N-1$
- total number of edges = $N(N-1)/2$
- Total # of Hamilton Circuits = $(N-1)!$

Describing Hamilton Circuits

if 4 vertices, consider:

A,B,C,D,A and B,C,D,A,B

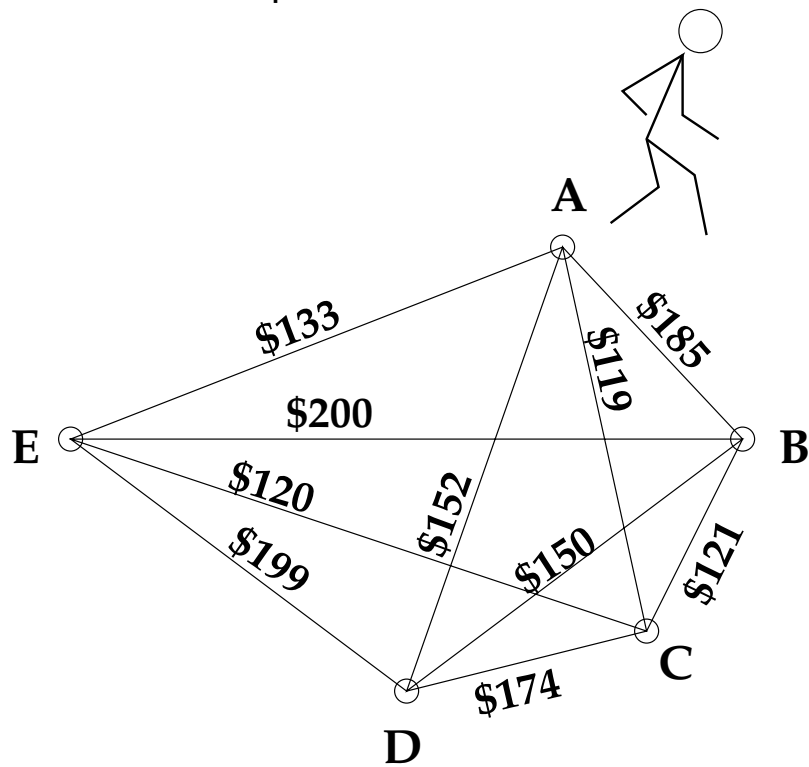
The 24 Hamilton Circuits of K_5

1	A,B,C,D,E,A	13	A,E,D,C,B,A
2	A,B,C,E,D,A	14	A,D,E,C,B,A
3	A,B,D,C,E,A	15	A,E,C,D,B,A
4	A,B,D,E,C,A	16	A,C,E,D,B,A
5	A,B,E,C,D,A	17	A,D,C,E,B,A
6	A,B,E,D,C,A	18	A,C,D,E,B,A
7	A,C,B,D,E,A	19	A,E,D,B,C,A
8	A,C,B,E,D,A	20	A,D,E,B,C,A
9	A,C,D,B,E,A	21	A,E,B,D,C,A
10	A,C,E,B,D,A	22	A,D,B,E,C,A
11	A,D,B,C,E,A	23	A,E,C,B,D,A
12	A,D,C,B,E,A	24	A,E,B,C,D,A

Number of circuits is $N!$, so the list will grow very quickly.

Example, if $N=18$ vertices, there will be 6,402,373,705,728,000 possible circuits.

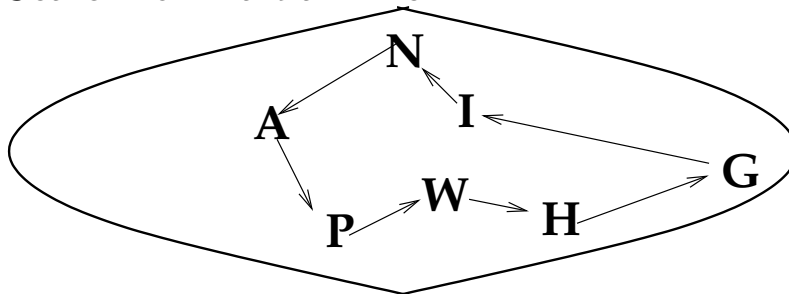
Kinds of TSP problems



Traveling Salesman

Note the Airplane Costs

Search for Martian Life



	A	G	H	I	N	P	W
A	-	7500	5000	2800	3500	1500	2200
G	7500	-	3000	6000	8000	6500	5000
H	5000	3000	-	4000	4800	3500	2800
I	2800	6000	4000	-	2000	3000	2900
N	3500	8000	4800	2000	-	4000	3200
P	1500	6500	3500	3000	4000	-	1300
W	2200	5000	2800	2900	3200	1300	-

Weighted Graph any graph whose edges have values attached to them

Weight the value attached to an edge of a weighted graph

Complete Weighted Graph a complete graph that is also weighted.

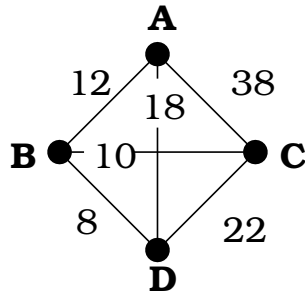
Optimal Hamilton Circuit a Hamilton Circuit on a complete weighted graph with the least total weight.

So, Traveling Salesman Problem is essentially looking for the smallest cost of travel, or the Optimal Hamilton Circuit.

Brute Force Algorithm- check all circuits and select the one with the least total weight (cost)

1. Make a list of all possible Hamilton circuits of the graph
2. For each Hamilton circuit, calculate its total weight by adding the weights of all the edges in the circuit.
3. Find the circuit(s) with the least total weight.

Consider the route ABCDA. What is the weight of this route?



Fill out the chart:

Route	Mirror Route	Weight
ABCD	ADCBA	$12+10+22+18 = 62$
ABDCA		

