アルゴリズムの設計と解析

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Contents (L15 – TSP problem)

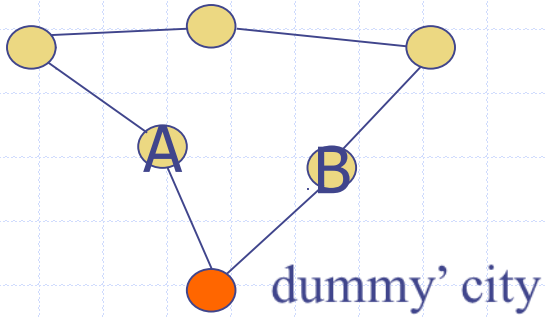
- TSP problem
- Nearest Neighbor Method
- APPROX-TSP-TOUR methon
- Review

https://www.cs.usfca.edu/~galles/visualization/Algorithms.html

What is travel salesman problem?

TSP:

A Salesman wishes to travel around a given set of cities, and return to the beginning, covering the smallest total distance.



➔Create a TSP Tour around all cities

(1) Return to the beginning

(2) No condition to return to the beginning.

It can still be regarded as a TSP by connecting the beginning city and the end city to a 'dummy' city at zero distance

Two classifications of TSP

A route returning to the beginning is known as a

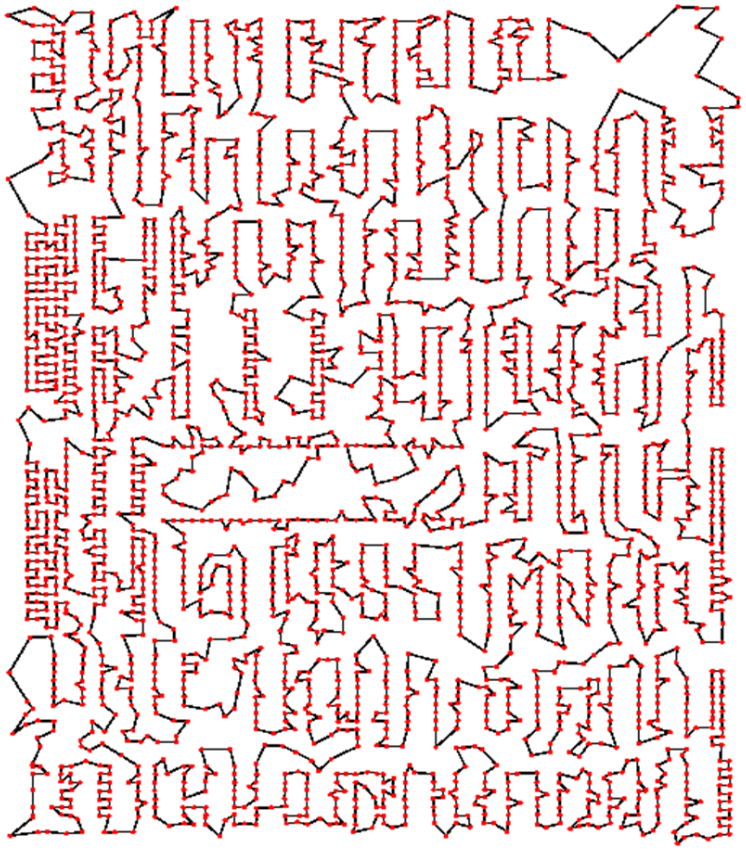
→**Hamiltonian Circuit**

A route not returning to the beginning is known as a

→**Hamiltonian Path**

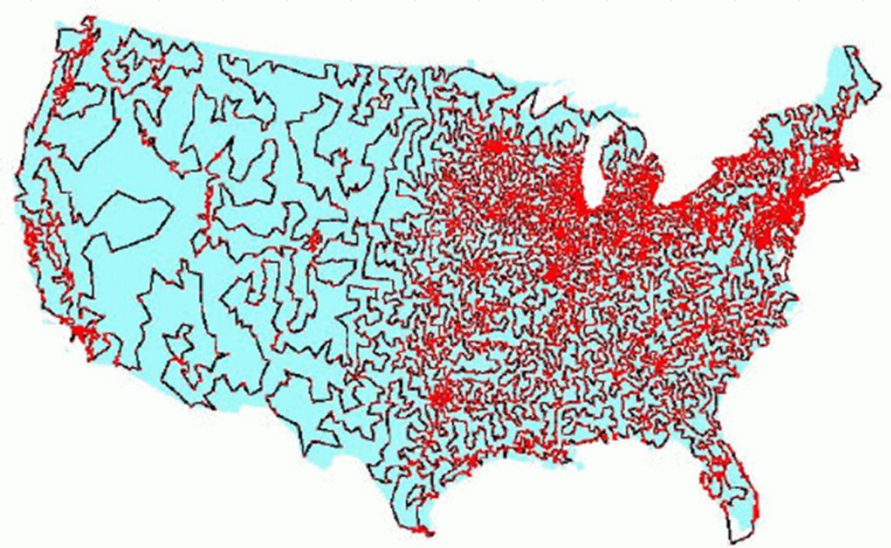
Some cases

Printed Circuit Board 2392 cities
1987 Padberg and Rinaldi

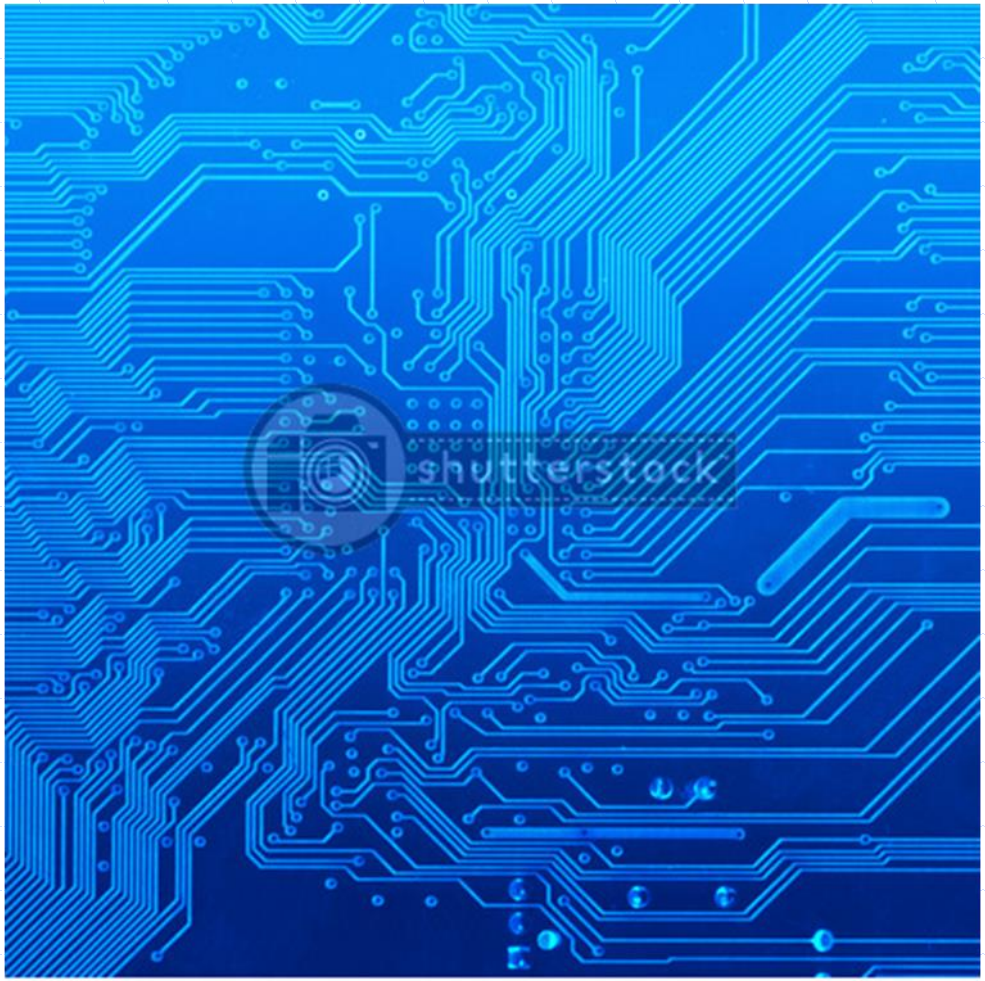


USA Towns of 500 or more population
13509 cities
1998 Applegate, Bixby, Chvátal and Cook

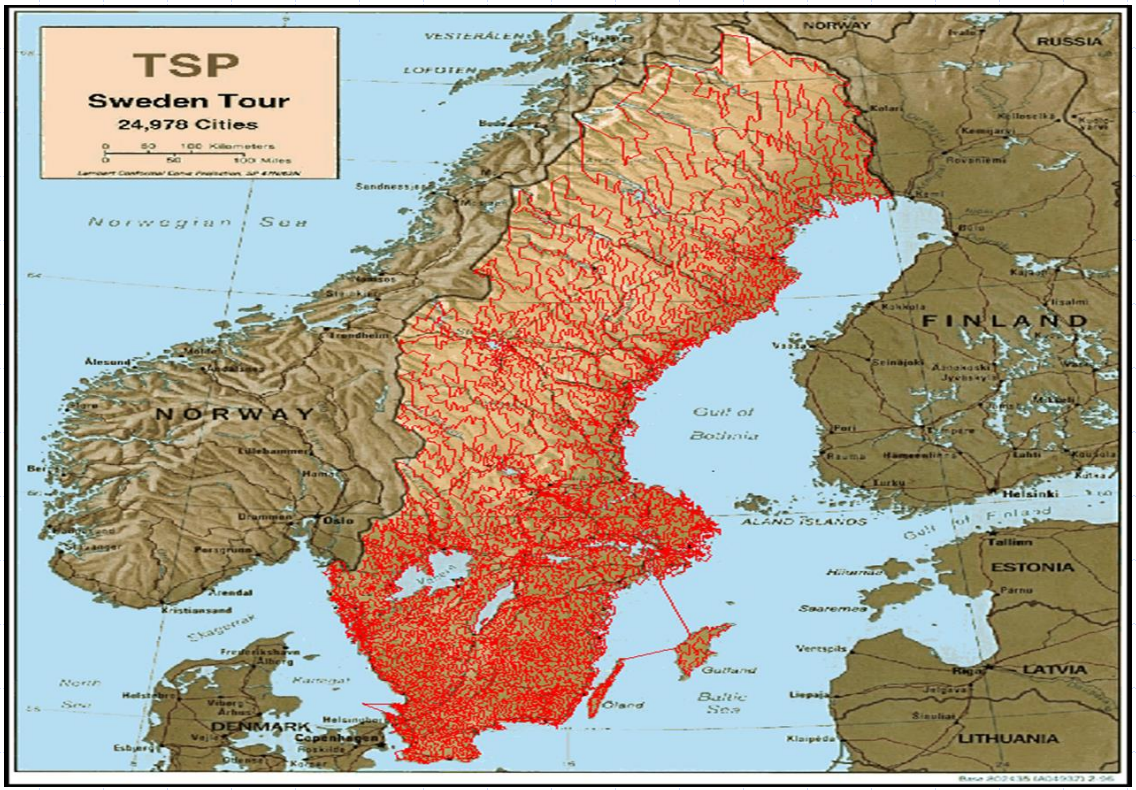
TSP Tour in USA



Electronic Circuits:



The smallest total distance?



Sweden 24978 Cities
2004 Applegate, Bixby, Chvátal, Cook and Helsgaun

Solutions:

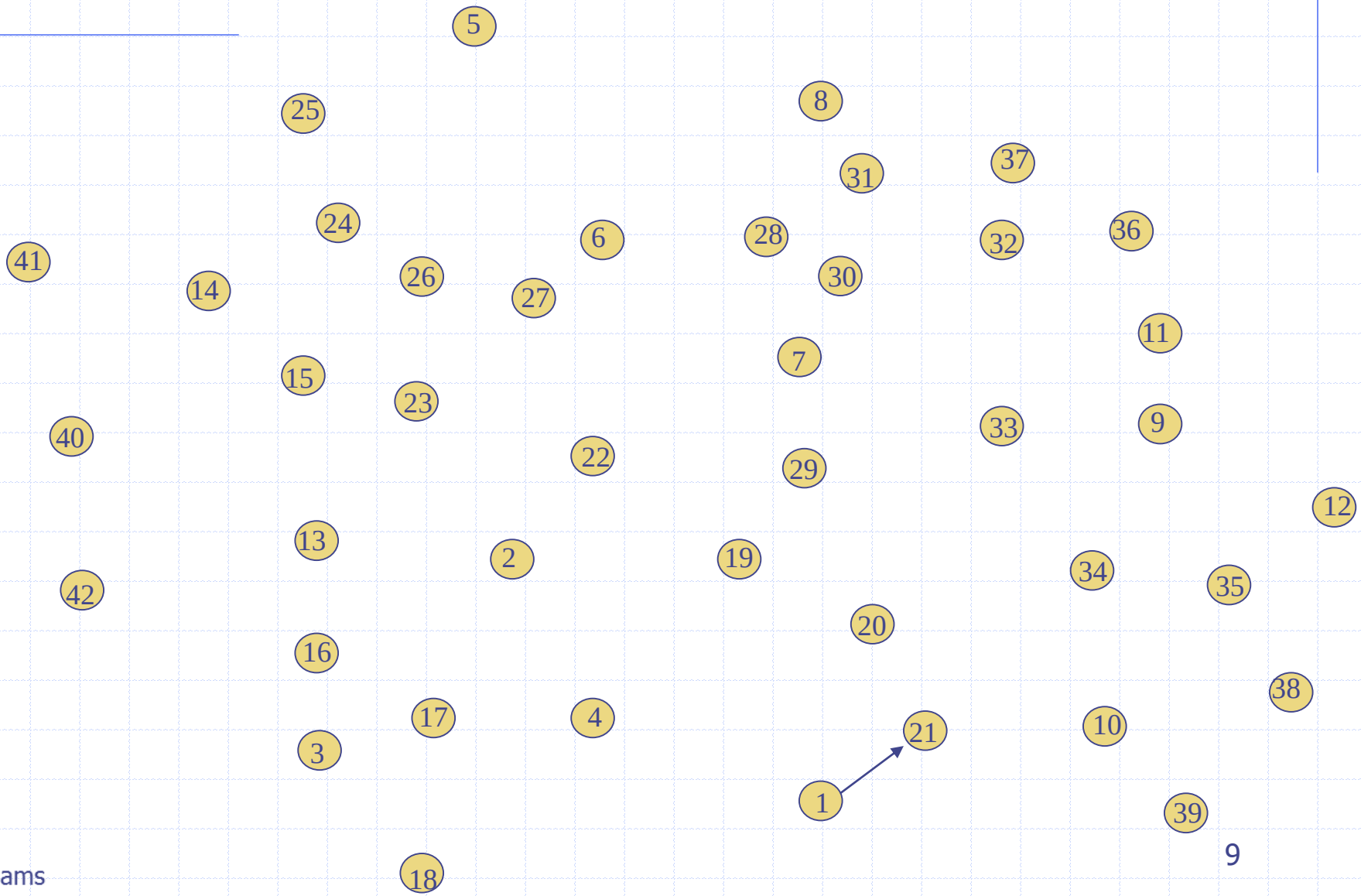
(1) Try every possibility? → (n-1)!, 24977 possibilities
(2) Optimizing Methods → take very long time
(3) Heuristic Methods → may not optimal

The Nearest Neighbor Method (Heuristic)

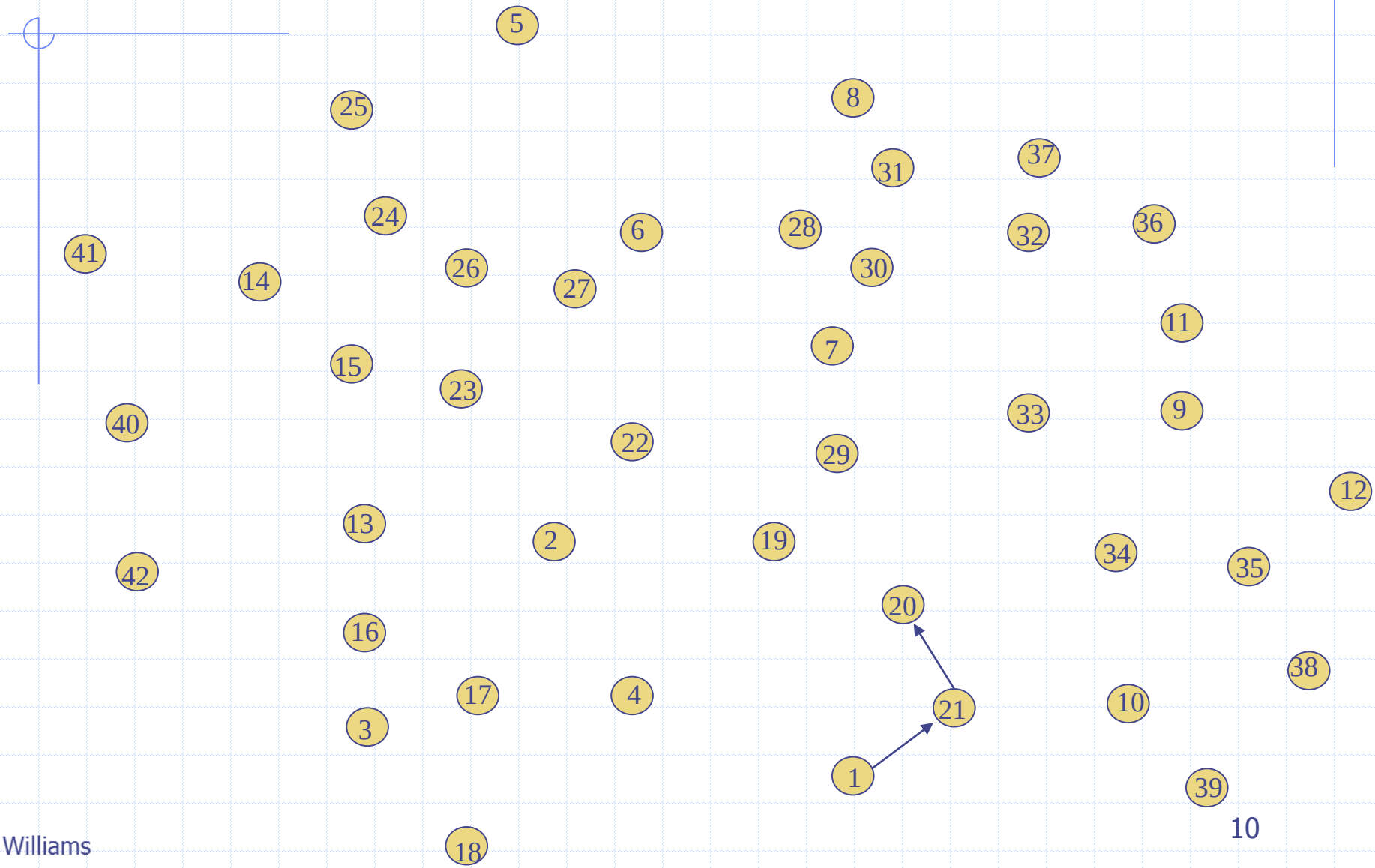
- A Greedy method

1. Start Anywhere
2. Go to Nearest Unvisited City
3. Continue until all Cities visited
4. Return to Beginning

A 42-City Problem The Nearest Neighbour Method (Starting at City 1)

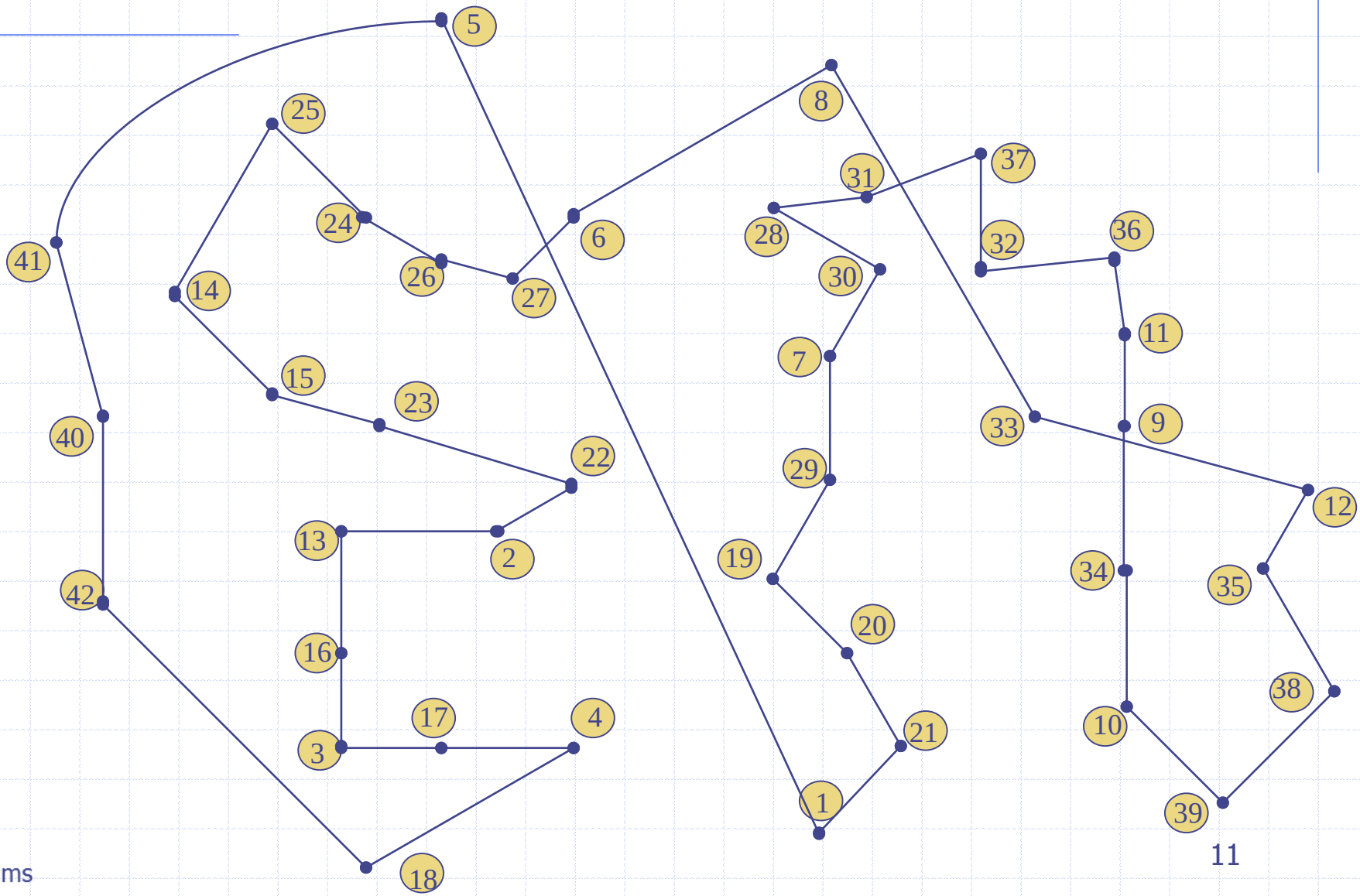


The Nearest Neighbour Method (Starting at City 1)

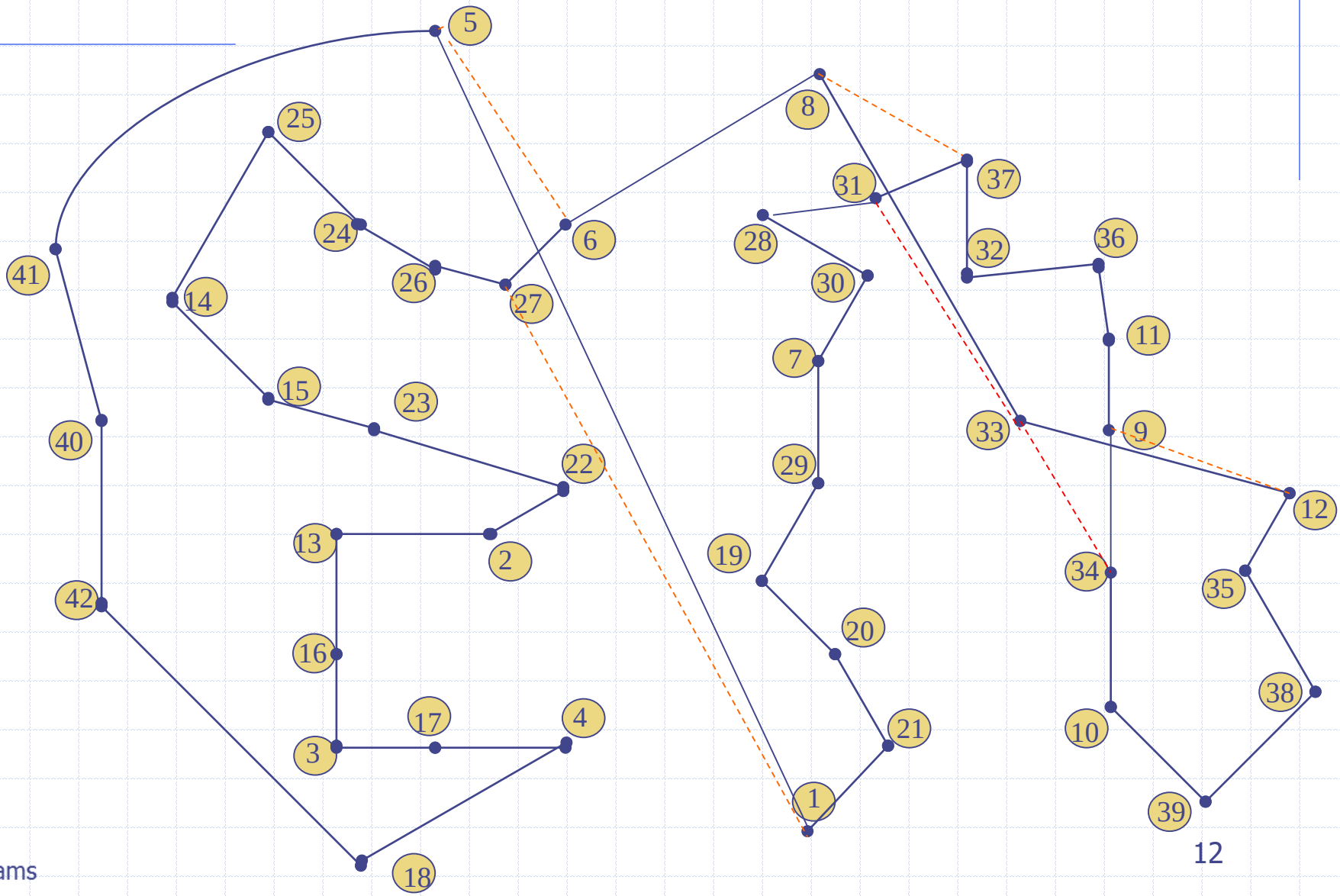


The Nearest Neighbour Method (Starting at City 1)

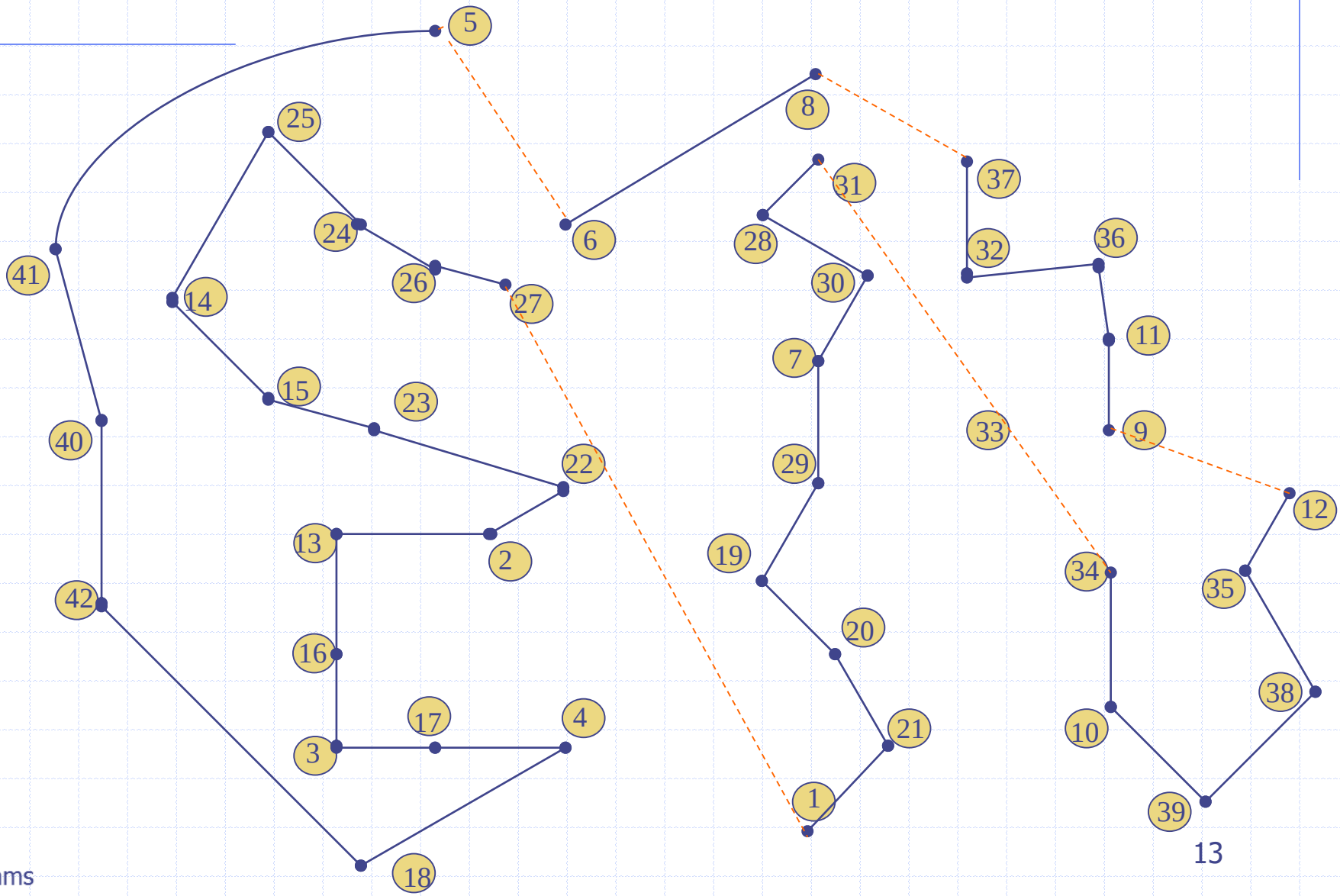
Length 1498



Remove Crossovers

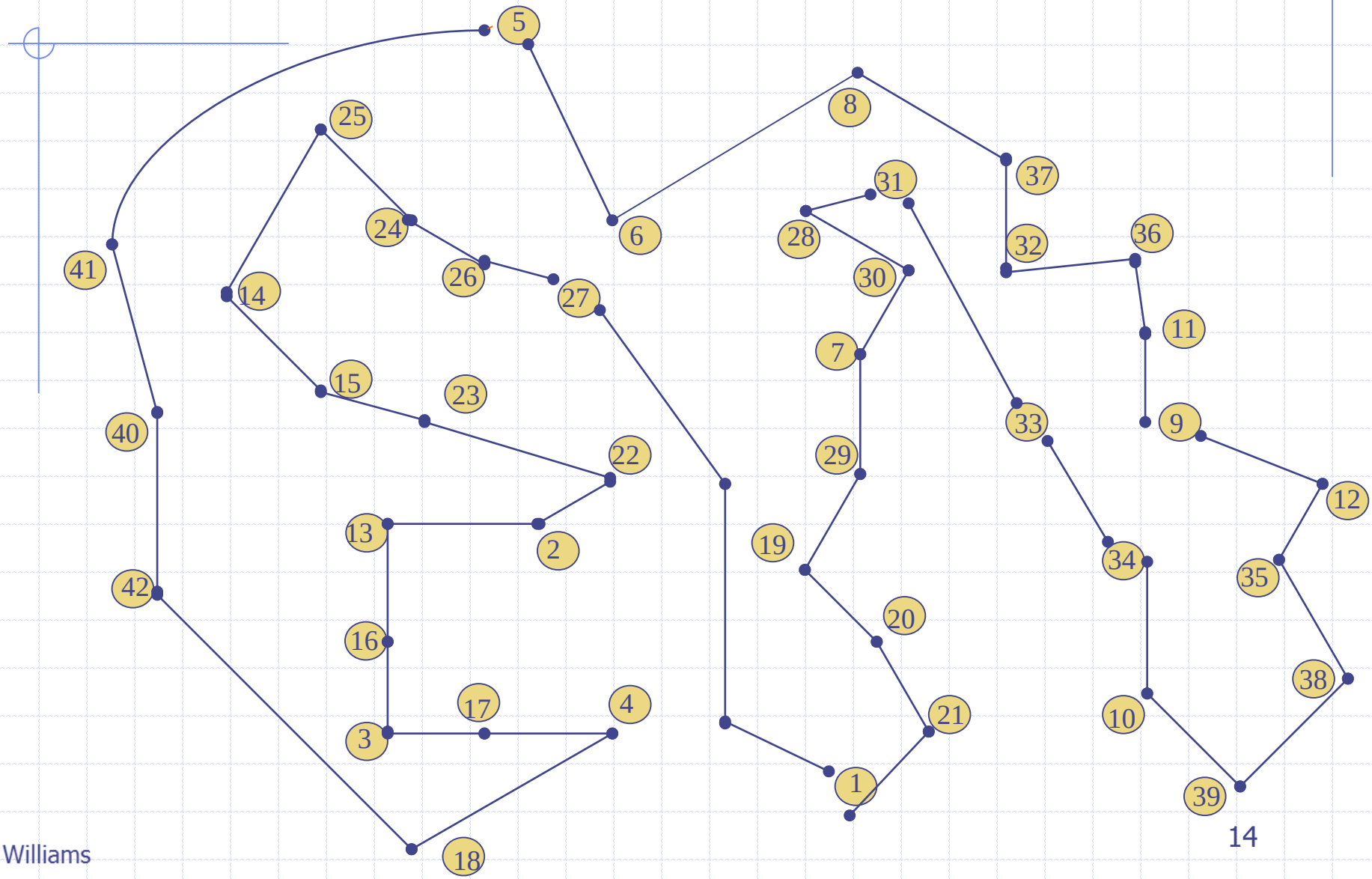


Remove Crossovers



Remove Crossovers

Length 1453



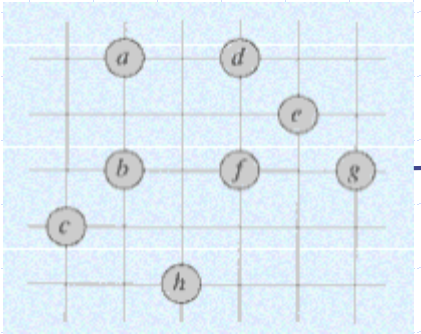
Outline of an APPROX-TSP-TOUR

(1)
compute a MST (minimum spanning tree)
whose weight is a lower bound
on the length of an optimal TSP tour.

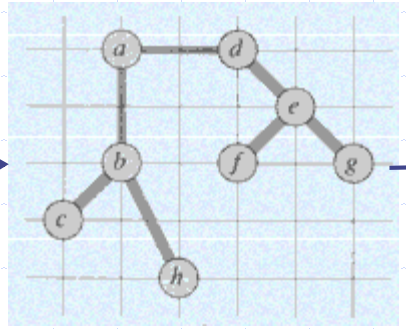
(2)
use MST to build a tour
whose cost is no more than twice that of
MST's weight as long as the cost function satisfies triangle inequality.

Operation of APPROX-TSP-TOUR

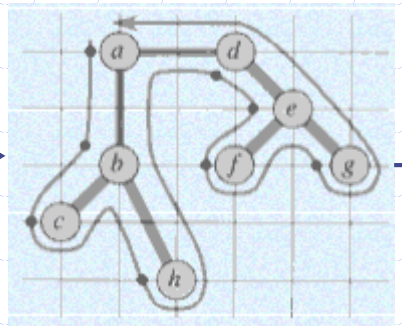
Let root be a in following given set of points (graph)



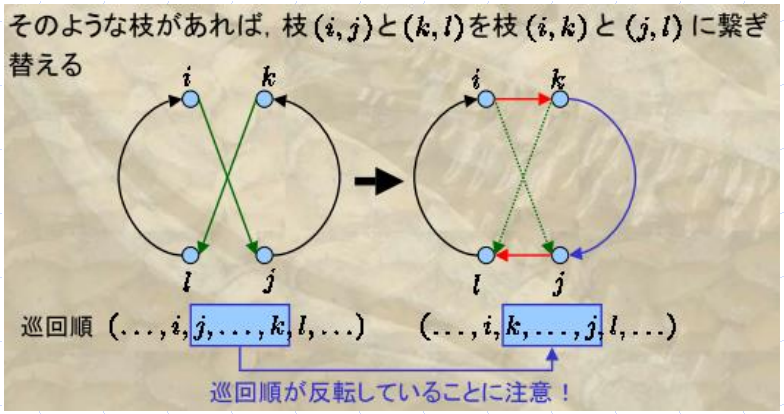
MST-PRIM

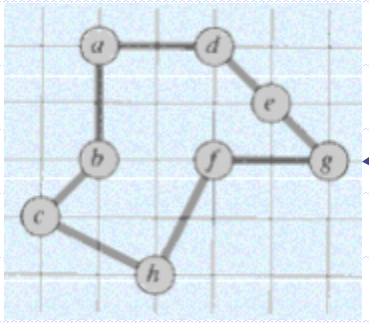


Preorder

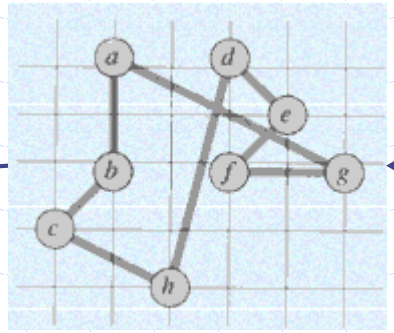


List vertices visited in preorder walk.
L = {*a, b, c, h, d, e, f, g*}





optimal TSP tour



Hamiltonian cycle

Exercises 13

EX 13

(1) What is a TSP problem?

(2) Refer the city connection graph in Fig 1, start from the node A,

- to draw a MST
- to an optimal TSP tour

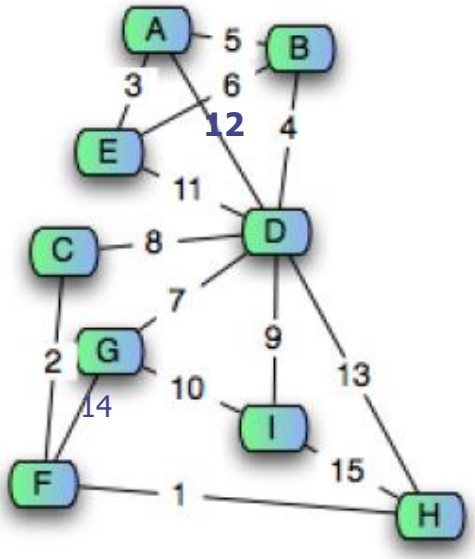


Fig1. City connection graph

Review