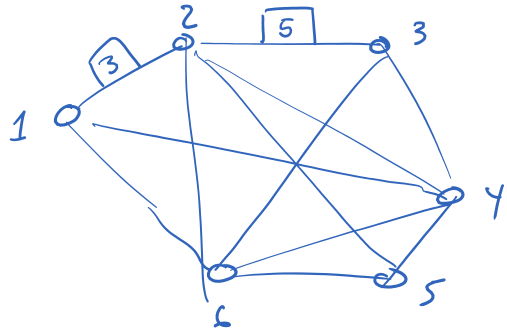
Travelling Salesperson

Monday, 11 April 2022 12:33

First: Projects Time!



Euclidean TSP

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\min\left(\sum_i d\right)$$

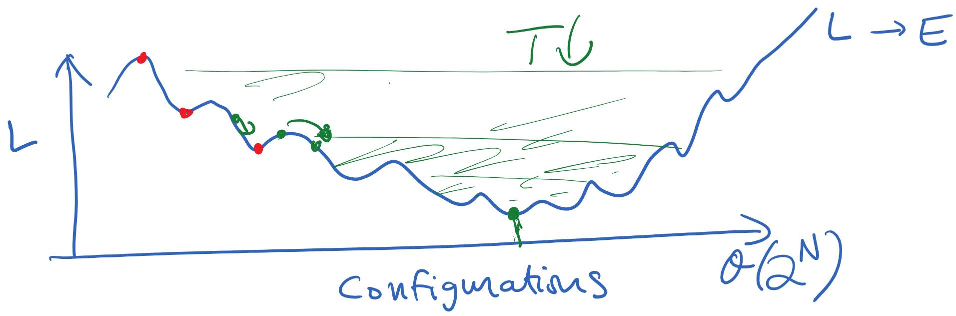
NP-complete — Magic involved.

non-deterministic polynomial — Check the answer in polynomial time.

TSP: Given L there is a tour with length at most L.

$$P \neq NP \,?$$

Optimization Problem



$$E = L_{tour} = \sum_{i=1}^{N} \sqrt{(x_i - x_{i-1})^2 + (y_i - y_{i-1})^2}$$

$$x_0 = x_N$$
$$y_0 = y_N$$

Global minimum energy (or minimum path length)

Moves:
- ISING → Spin flips randomly
- SWAP - 2 random cities (nodes)

~~randomly~~

randomly

- Choose a random segment eg. (b,e)

reverse order
or
randomly reinsert at a random position in the tour

$$P(E,E',T) = \begin{cases} 1 & \text{if } E' < E \\ \exp\left(\frac{(E-E')}{T}\right), & E' \geq E \end{cases}$$

☆ Metropolis method.

How to set the initial T_0:
use ~100 Random moves and take the largest ΔE → and make this the initial temperature ($k_B = 1$).

Make $\mathcal{O}(1000)$ moves at T_0, keep the best configuration (lowest E) tour

$T_{n+1} = 0.98\, T_n$

$\underset{\text{any}}{C_i} \longrightarrow \underset{\text{any}}{C_j}$ in $\mathcal{O}(N^k)$ moves

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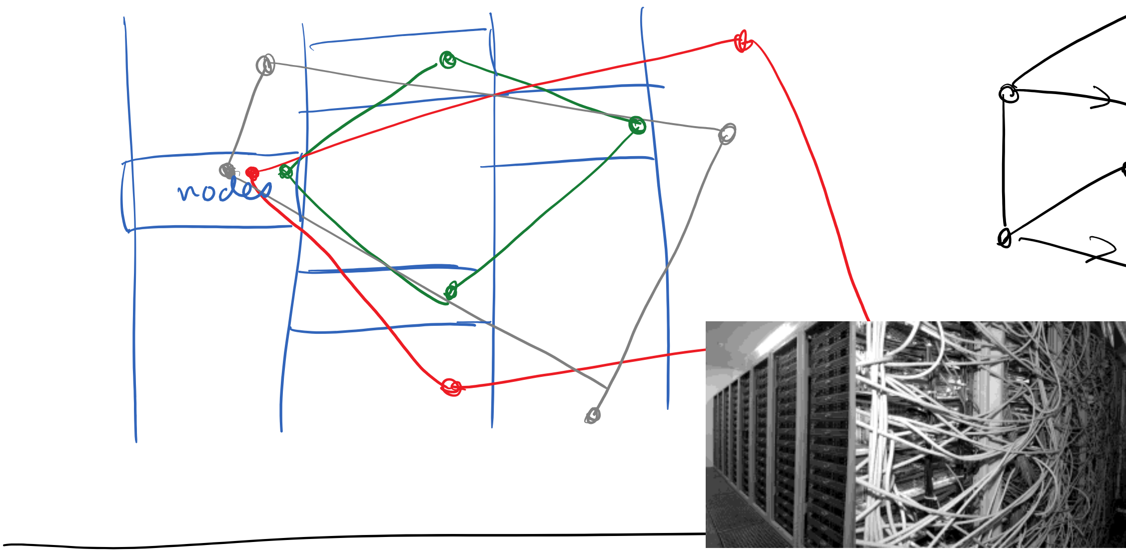
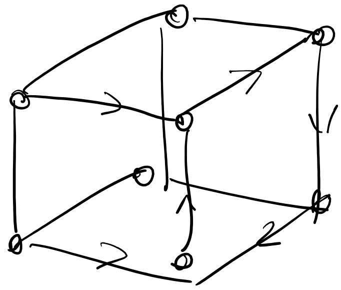
Euclidean TSP has a lot of clever heuristics, can dramatically improve the speed.

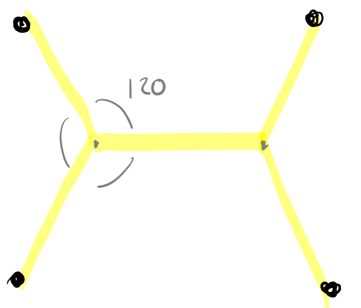
PTAS $\quad (1+\varepsilon)L \quad \mathcal{O}(N^{(\frac{1}{\varepsilon})})$

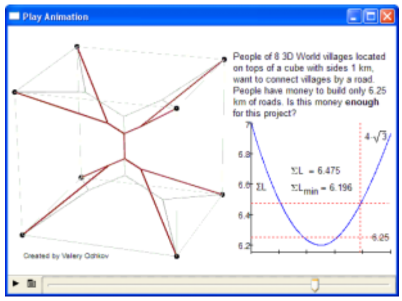
http://www.math.uwaterloo.ca/tsp/

http://comopt.ifi.uni-heidelberg.de/software/TSPLIB95



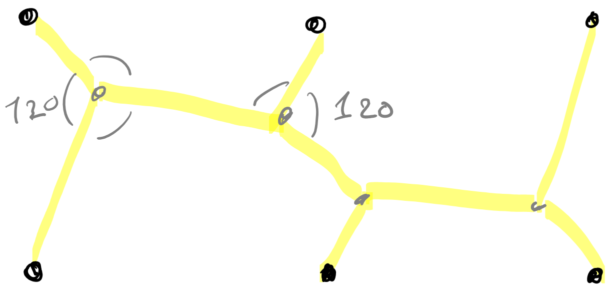


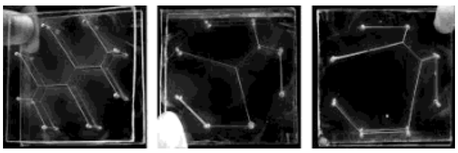




In 3-D, Steiner trees are also interesting!

VLSI Routing





Soap film computers!