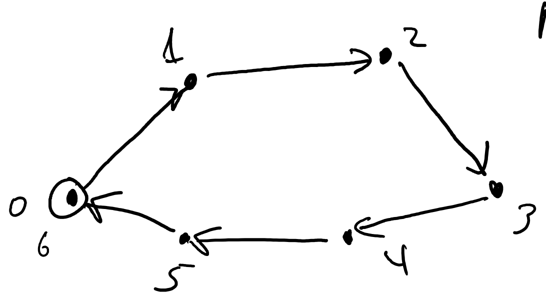
Traveling salesperson

26 April 2021 10:51



N cities

Gets very hard as the number of cities increases.

$\mathcal{O}(2^N)$, $\mathcal{O}(N^k)$ NP-complete

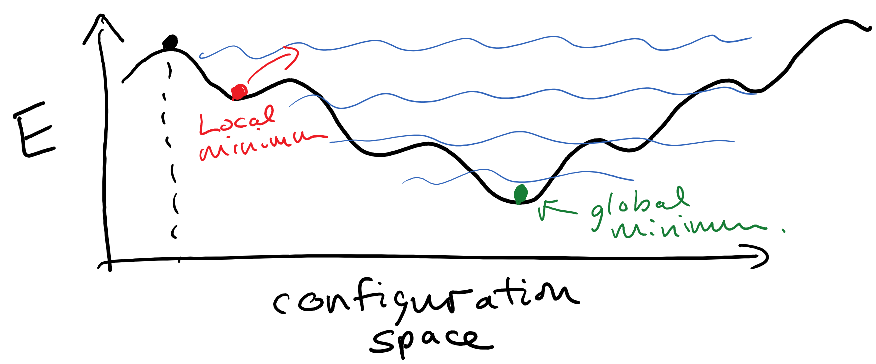
P = NP ?

Optimize the path length

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

$x_0 = x_N$, $y_0 = y_N$ to make it a cycle.

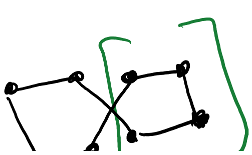
Want the global minimum Energy (or path length in this case).

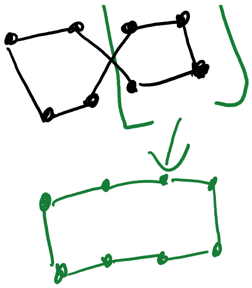


Moves: Ising → Flip one random spin

- Swap 2 random cities ("random spin flip")

- Choose a random segment of the tour → cut it out this





reverse the segment

cut it out this segment and reinsert it at a random position.

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

☆ Metropolis Method

How to set initial T_0 :

use 100 Random Moves and take the largest ΔE → make this our initial temperature ($k_B = 1$).

Make $O(1000)$ Moves at T_0 keep the best (lowest E) tour

$T_{n+1} = 0.9\, T_n$

C_i (any) ⟶ C_j (any) in $O(N^k)$ Moves

Euclidean Traveling salesperson problem is a special case which allows a lot of heuristics to improve the speed.

True optimum can be found for this case up to about 100'000 cities up to about 100'000 cities

TSPLIB web link: http://www.math.uwaterloo.ca/tsp/

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