# PFP Project proposal - TSP (Travelling Salesman Problem)

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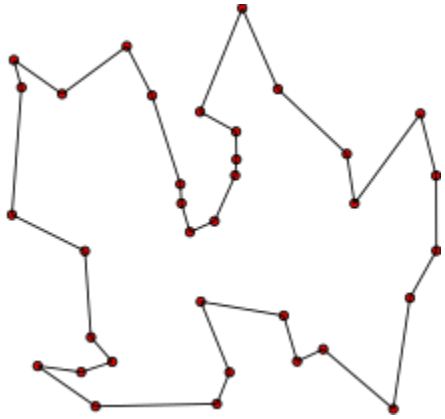
## The Problem

The traveling salesman problem (also called the travelling salesperson problem or TSP) asks the following question: "Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly once and returns to the origin city?" It is an NP-hard problem in combinatorial optimization, important in theoretical computer science and operations research. - Wikipedia

Example solution of a travelling salesman problem - the black line shows the shortest possible loop that connects every red dot:



Therefore our goal is to, for any given list of points (coordinates in 2D space), determine an order of visits such that the sum of the euclidean distances between consecutive points (and the distance between the last and first point in the order) is minimized.

## Possible Algorithms:

Bruteforce: try all possible orders lexicographically. This can be parallelized by calculating the total distance for multiple orders at the same time.

Genetic algorithm (approximation): treat each order of visits as a gene. Make offspring genes by crossover between two orders that generate a new valid order. Also make possible random mutations in the orders. Fitness of each gene is inversely proportional to the total path distance for that order.