r/ThingsYouDidntKnow • 2 mo. ago
TheStocksGuy

Traveling Salesperson Problem (Explained)

Traveling Salesperson Problem (TSP)

The Traveling Salesperson Problem (TSP) involves finding the shortest possible route that visits each city exactly once and returns to the starting city. Here’s a detailed breakdown of how to solve this using basic and advanced math operations:

Key Concepts and Steps

1. **Distance Calculation between Cities**
   - **Formula:** distance = sqrt((x2 - x1)^2 + (y2 - y1)^2)
   - **Explanation:** This formula calculates the straight-line (Euclidean) distance between two points in a 2D space. Here, (x1, y1) and (x2, y2) are the coordinates of two cities. "sqrt" stands for square root, "" stands for exponentiation (raising to a power), and "*" stands for multiplication.
2. **Total Distance of a Path**
   - **Formula:** D = sum(distance(pi, p(i+1) % n)) for i in range(0, n)
   - **Explanation:** To calculate the total distance (D) of a path that visits (n) cities in sequence and returns to the starting city, we use this summation formula. "sum" means adding all the values inside the parentheses. "range(0, n)" indicates that (i) goes from 0 to (n-1). "pi" represents the position of the (i)-th city in the path, and "(i+1) % n" ensures the path wraps back to the starting city by using the modulo operation.
3. **Morton Order (Z-order Curve)**
   - **Concept:** Morton ordering helps in spatially ordering cities by interleaving the bits of their x and y coordinates.
   - **Steps:**
     1. Scale each x and y coordinate by a factor (e.g., 10000) to avoid floating-point issues.
     2. Interleave bits to create a Morton code that ensures spatial locality.
4. **Nearest Neighbor Heuristic**
   - **Approach:** Start at the first city, then select the closest unvisited city at each step until all cities are visited.
   - **Formula:** Minimize distance(current_city, next_city)
   - **Explanation:** At each step, you choose the city that has the smallest distance from the current city, ensuring a quick way to generate a path by always picking the nearest unvisited city.
5. **2-Opt Optimization**
   - **Optimization:** Improve the path by iteratively swapping two edges if it reduces the total path length.
   - **Formulas:** before_swap = distance(p(i-1), pi) + distance(pj, p(j+1)) after_swap = distance(p(i-1), pj) + distance(pi, p(j+1))

Detailed Mathematical Spreadsheet Example

1. **Cities and Coordinates:**

City	x	y
City0	0	0
City1	737	137
City2	761	101
City3	661	125
City4	707	185
City5	612	126
City6	682	198
City7	829	137
City8	673	190
City9	567	156

2 Distance Calculation Example:

- **Formula:** distance = sqrt$((761 - 737)^2 + (101 - 137)^2)$
- **Calculation:** distance = sqrt$((24)^2 + (-36)^2) \approx 44.72$
- **Explanation:** Calculate the difference in the x-coordinates (761 - 737) and y-coordinates (101 - 137), square both differences, sum them, and then take the square root of the result to get the Euclidean distance.

3. Total Distance Calculation:

1. **Nearest Neighbor Heuristic:**
   - **Starting Point:** Start at City0.
   - **First Step:** Find the nearest city to City0.
   - **Calculation:** distance(City0, City1) = 750.00
   - **Next Steps:** Continue finding the nearest unvisited city until all cities are visited.
2. **2-Opt Optimization:**
   - **Identify Swap:** Identify any two edges in the path that can be swapped.
   - **Before Swap Calculation:** before_swap = distance(City2, City3) + distance(City7, City8)

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Create

Got it? It's simpler than finding a needle in a haystack if you just follow the trail of breadcrumbs!

Visit the code here: https://github.com/BadNintendo/tsp/blob/main/instant/noproblem.py

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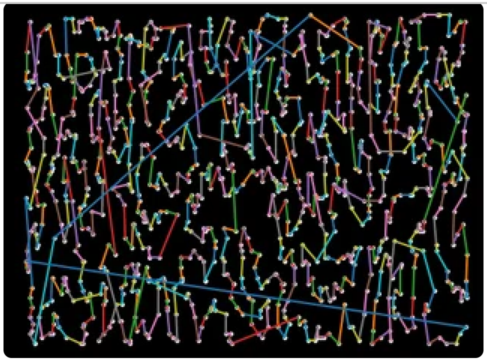
TheStocksGuy OP • 2mo ago

Feelings - With great sorrow, I reflect on the state of our "math" communities. Despite the vast potential in the field of math, it seems that no one has engaged with me on these critical topics. This particular problem, among others, appears to intimidate rather than inspire examination. It feels as if there is a preference for someone with a high reputation, regardless of their actual skill in mathematics, to validate ideas. Only one person, named Zed, has shown a willingness to delve into the code and help improve it. He may be the only true math expert who cared enough to assist in an area unrelated to his own, and for that, I thank zedAshaw on Twitch for offering to review and improve the code.

1 ... Approved 2 months ago

TheStocksGuy OP • 1mo ago

Create



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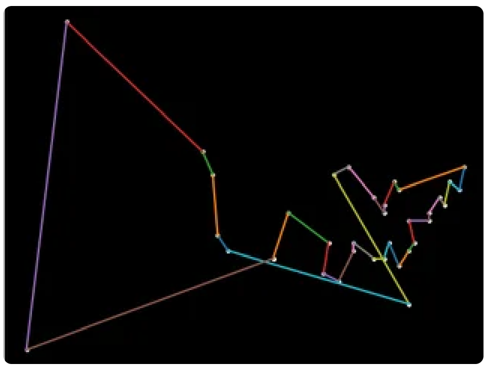

The USA visitor only sitied a state once and returned home.

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