# Tutorial - Discrete optimization

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# 1 TSP

Consider the Travelling SalesPerson (note the politically correct denomination), with the following cost matrix :

|        | city 1 | city 2 | city 3 | city 4 | city 5 |
|--------|--------|--------|--------|--------|--------|
| city 1 | 0      | 132    | 217    | 164    | 58     |
| city 2 | 132    | 0      | 290    | 201    | 79     |
| city 3 | 217    | 290    | 0      | 113    | 303    |
| city 4 | 164    | 201    | 113    | 0      | 196    |
| city 5 | 58     | 79     | 303    | 196    | 0      |

We would like to visit the 5 cities coming back to the starting point, and do so by minimizing travel costs.

1. Propose a relaxation formulation of the problem as an assignment problem.

2. Solve the actual TSP by branch-and-bound *by hand*

3. Write a Python + cvxopt program to solve this TSP.