

## Homework 4 (計算方法設計 · Design and Analysis of Algorithms)

註: 請在截止日期以前透過 eeclass 線上繳交作業, 請注意不接受遲交。Please submit your assignment online through eeclass before the due date. Note that late submissions will not be accepted.

**Due date: May 14, 2025**

Given  $n$  cities and the costs of traveling from one to the other, the traveling salesperson problem (TSP) is to find a shortest Hamiltonian cycle (i.e., the cheapest round-trip route that visits each city exactly once and then returns to the starting city). The formats of the input and output files, as well as the constraints for the number of cities and the cost of each edge, are described as follows.

**Input:** The first line of the input is the number  $n$  of cities and the following  $n$  lines represent an  $n \times n$  cost matrix  $C$ , in which an entry  $C(i, j)$  is the cost of a directed edge from city  $i$  to city  $j$ , where  $1 \leq i, j \leq n$ . The following is an example of an input.

```
4
100 1 3 1
1 100 1 3
3 1 100 1
1 3 1 100
```

**Output:** A shortest Hamiltonian cycle and its total cost.

**Constraints:**

$$5 \leq n \leq 15$$

$$1 \leq C(i, j) \leq 99 \text{ if } i \neq j \text{ and } C(i, j) = 100 \text{ if } i = j$$

Use a programming language you familiar with to implement the brute force method and the branch and bound algorithm, both of which were already introduced in the class, for solving the traveling salesperson problem. Also compare their performance by plotting their running times as curves of the city number  $n$ , when  $n$  is from 5 to 15 in steps of 1 (i.e.,  $n = 5, 6, \dots, 15$ ). Note that for each  $n$ , you should generate three problem instances and average the running time of your branch and bound program for solving these three instances. Also note that you should submit the pseudocode of your branch and bound algorithm, its program, and the figure showing the running time curves of both your brute force program and your branch and bound program via the eeclass system. You do not need to submit your brute force program.