# Assignment: NP-Completeness and Heuristic Algorithms

*Note: You will discuss Question 1 as part of the Group Assignment. (Check this week's Group Assignment on Canvas for details).*

1. **NP-Completeness:** Consider the Travelling Salesperson (TSP) problem that was covered in the exploration.
   Problem: Given a graph G with V vertices and E edges, determine if the graph has a TSP solution with a cost of at most k.
   Prove that the above stated problem is NP-Complete.

2. **Implement Heuristic Algorithm:**
   a. Below matrix represents the distance of 5 cities from each other. Represent it in the form of a graph

| | A | B | C | D | E |
|---|---|---|---|---|---|
| A | 0 | 2 | 3 | 20 | 1 |
| B | 2 | 0 | 15 | 2 | 20 |
| C | 3 | 15 | 0 | 20 | 13 |
| D | 20 | 2 | 20 | 0 | 9 |
| E | 1 | 20 | 13 | 9 | 0 |

   b. Apply Nearest-neighbor heuristic to this matrix and find the approximate solution for this matrix if it were for TSP problem.
   c. What is the approximation ratio of your approximate solution?
   d. Implement the nearest neighbor heuristic for TSP problem. Consider the first node as the starting point. The input Graph is provided in the form of a 2-D matrix. Name your function **solve_tsp(G)**. Name your file **TSP.py**

      Sample input
      G: [[0,1,3,7], [1,0,2,3],[3,2,0,1], [7,3,1,0]]
      Output: 11