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Practical 4: Difference between brute force and nearest neighbor method.

Code: **Brute Force Method**

```
import time
from itertools import permutations

import numpy as np
import pandas as pd
from tabulate import tabulate


def runM1():
    mat = pd.read_csv("6citytsp.csv", header=None).values
    table_data = {}

    for row in range(mat.shape[0]):
        startCity = row
        mat = pd.read_csv("6citytsp.csv", header=None).values
        cityNames = list(range(mat.shape[0]))
        cityNames.remove(startCity)
        per = list(permutations(cityNames))
        st = time.process_time()
        bestTourLength = np.inf
        bestTour = []
        for tour in per:
            tourLength = 0
            for i in range(len(tour) - 1):
                tourLength += mat[tour[i], tour[i + 1]]
                tourLength += mat[tour[i + 1], startCity]
                tourLength += mat[startCity, tour[0]]
            if tourLength < bestTourLength:
                bestTourLength = tourLength
                bestTour = list(tour)
        et = time.process_time()
        time_taken_ms = (et - st) * 1000
        table_data[row] = [bestTourLength, bestTour, time_taken_ms]

    print(tabulate(pd.DataFrame(table_data).T, tablefmt="pretty", headers=["Path
Length", "Tour", "Elapsed Time"]))


if __name__ == '__main__':
    runM1()
```

Output:

```
PS C:\Users\JaySs\OneDrive\Desktop\Lab Works\AI ML Classs\Lab4> & "C:/Program Files/Python310/python.exe" "c:/Users/JaySs/OneDrive/Desktop/Lab Works/AI ML
  Classs/Lab4/main.py"
+---+-------------+----------------+--------------+
|   | Path Length |      Tour      | Elapsed Time |
+---+-------------+----------------+--------------+
| 0 |    2617     | [1, 5, 4, 3, 2] |     0.0      |
| 1 |    2434     | [0, 5, 4, 3, 2] |     0.0      |
| 2 |    2709     | [3, 4, 5, 1, 0] |     0.0      |
| 3 |    3071     | [2, 4, 5, 1, 0] |     0.0      |
| 4 |    2981     | [3, 2, 5, 1, 0] |     0.0      |
| 5 |    2736     | [1, 0, 2, 3, 4] |     0.0      |
+---+-------------+----------------+--------------+
PS C:\Users\JaySs\OneDrive\Desktop\Lab Works\AI ML Classs\Lab4>
```

Code: **Nearest Neighbor Method**

```python
import time
import numpy as np
import pandas as pd
from tabulate import tabulate
def runM2():
    df = pd.read_csv('6citytsp.csv', header=None).values.astype(float)
    table_data = {}
    for row in range(df.shape[0]):
        df = pd.read_csv('6citytsp.csv', header=None).values.astype(float)
        stCity = row
        nextBestCity = 0
        tourLength = 0
        tour = [stCity]
        df[df == 0] = np.inf
        df1 = df.copy()
        st = time.process_time()
        for i in range(df.shape[0] - 1):
            if i == 0:
                tourLength += min(df[stCity, :])
                nextBestCity = np.argmin(df[stCity, :])
                tour.append(nextBestCity)
                df[:, stCity] = np.inf
                df[:, nextBestCity] = np.inf
            else:
                tourLength += min(df[nextBestCity, :])
                nextBestCity = np.argmin(df[nextBestCity, :])
                tour.append(nextBestCity)
                # df[:, nextBestCity] = np.inf
        tourLength += df1[nextBestCity, stCity]
        et = time.process_time()
        table_data[row] = [tourLength, tour, et - st]

    print(tabulate(pd.DataFrame(table_data).T, tablefmt="pretty", headers=["Path
Length", "Tour", "Elapsed Time"]))


if __name__ == '__main__':
    runM2()
```

Output:

```
PS C:\Users\JaySs\OneDrive\Desktop\Lab Works\AI ML Classs\Lab4> & "C:/Program Files/Python310/python.exe" "c:/Users/JaySs/OneDrive/Desktop/Lab Works/AI ML Classs/Lab4/main2.py"
+---+-------------+--------------------+--------------+
|   | Path Length |        Tour        | Elapsed Time |
+---+-------------+--------------------+--------------+
| 0 |   1272.0    | [0, 1, 5, 4, 3, 2] |     0.0      |
| 1 |   1248.0    | [1, 0, 5, 4, 3, 2] |     0.0      |
| 2 |   1272.0    | [2, 3, 4, 5, 1, 0] |     0.0      |
| 3 |   1455.0    | [3, 2, 4, 5, 1, 0] |     0.0      |
| 4 |   1214.0    | [4, 3, 2, 1, 0, 1] |     0.0      |
| 5 |   1290.0    | [5, 1, 0, 2, 3, 2] |     0.0      |
+---+-------------+--------------------+--------------+
PS C:\Users\JaySs\OneDrive\Desktop\Lab Works\AI ML Classs\Lab4>
```

Both Tables:

```
PS C:\Users\JaySs\OneDrive\Desktop\Lab Works\AI ML Classs\Lab4> & "C:/Program Files/Python310/python.exe" "c:/Users/JaySs/OneDrive/Desktop/Lab Works/AI ML Classs/Lab4/runBoth.py"

====   Brute Force Approach   ====
+---+-------------+-----------------+--------------+
|   | Path Length |      Tour       | Elapsed Time |
+---+-------------+-----------------+--------------+
| 0 |    2617     | [1, 5, 4, 3, 2] |     0.0      |
| 1 |    2434     | [0, 5, 4, 3, 2] |     0.0      |
| 2 |    2709     | [3, 4, 5, 1, 0] |     0.0      |
| 3 |    3071     | [2, 4, 5, 1, 0] |     0.0      |
| 4 |    2981     | [3, 2, 5, 1, 0] |     0.0      |
| 5 |    2736     | [1, 0, 2, 3, 4] |     0.0      |
+---+-------------+-----------------+--------------+

====   Nearest Neighbour Approach   ====
+---+-------------+--------------------+--------------+
|   | Path Length |        Tour        | Elapsed Time |
+---+-------------+--------------------+--------------+
| 0 |   1272.0    | [0, 1, 5, 4, 3, 2] |     0.0      |
| 1 |   1248.0    | [1, 0, 5, 4, 3, 2] |     0.0      |
| 2 |   1272.0    | [2, 3, 4, 5, 1, 0] |     0.0      |
| 3 |   1455.0    | [3, 2, 4, 5, 1, 0] |     0.0      |
| 4 |   1214.0    | [4, 3, 2, 1, 0, 1] |     0.0      |
| 5 |   1290.0    | [5, 1, 0, 2, 3, 2] |     0.0      |
+---+-------------+--------------------+--------------+
PS C:\Users\JaySs\OneDrive\Desktop\Lab Works\AI ML Classs\Lab4>
```