

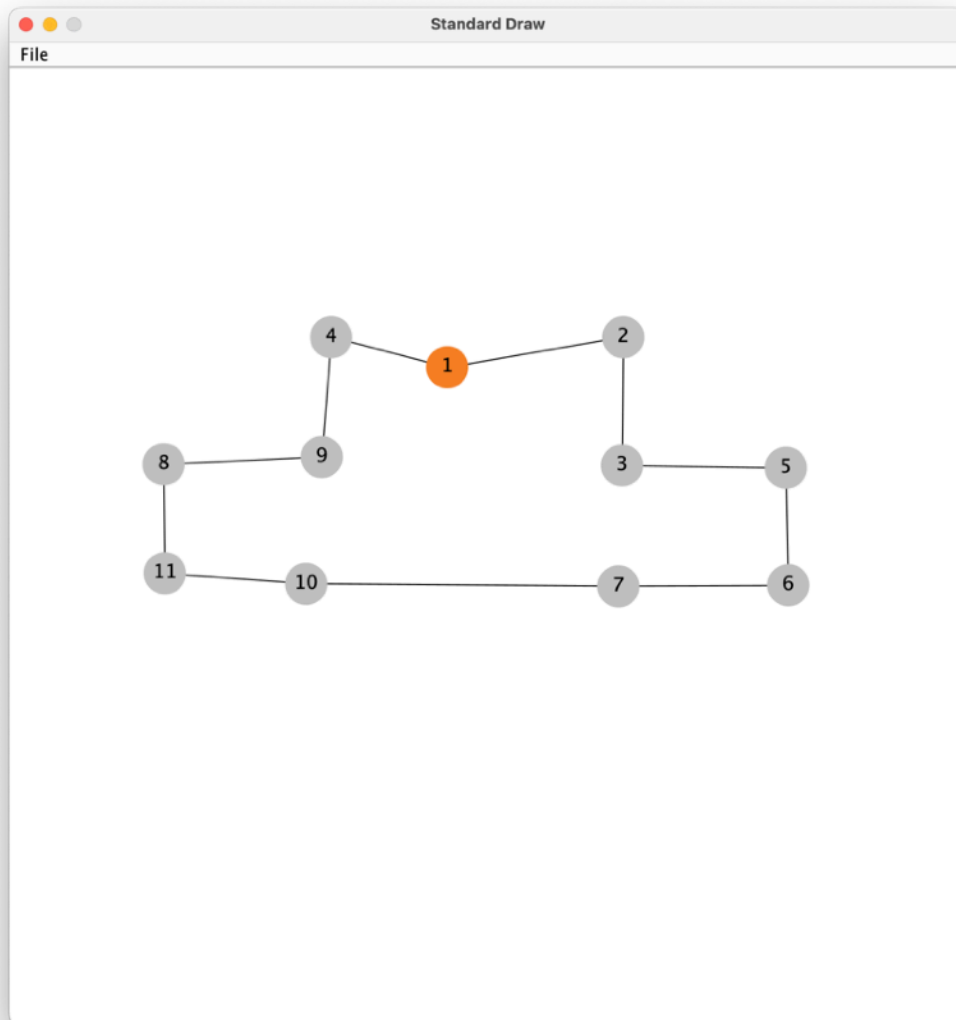
# ASSIGNMENT 3

## ANT-COLONY OPTIMIZATION

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# Brute-Force Method

Input File 1:



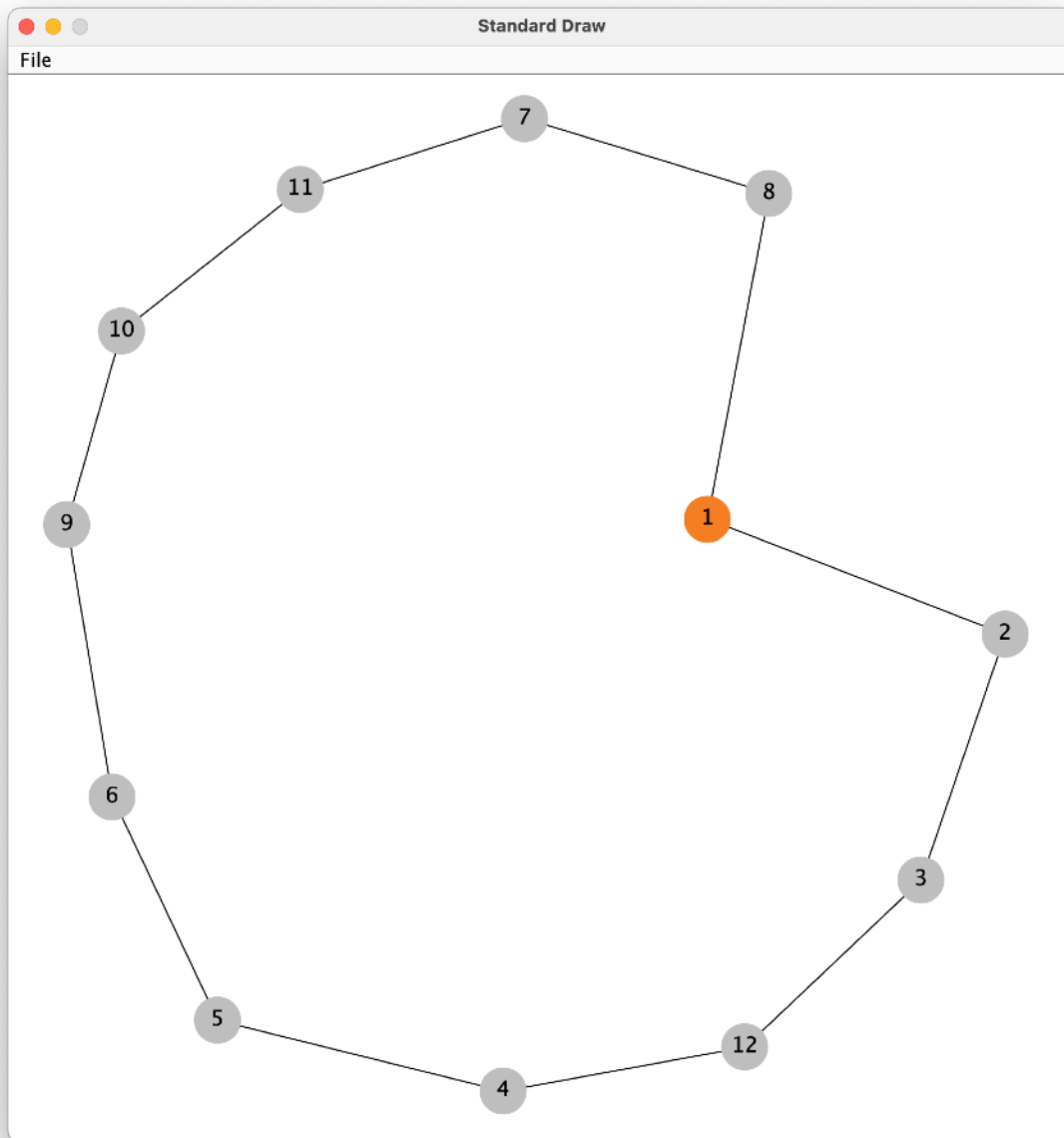
Method: Brute-Force Method

Shortest Distance: 1.79529

Shortest Path: [1, 4, 9, 8, 11, 10, 7, 6, 5, 3, 2, 1]

Time it takes to find the shortest path: 0.208 seconds.

## Input File 2:



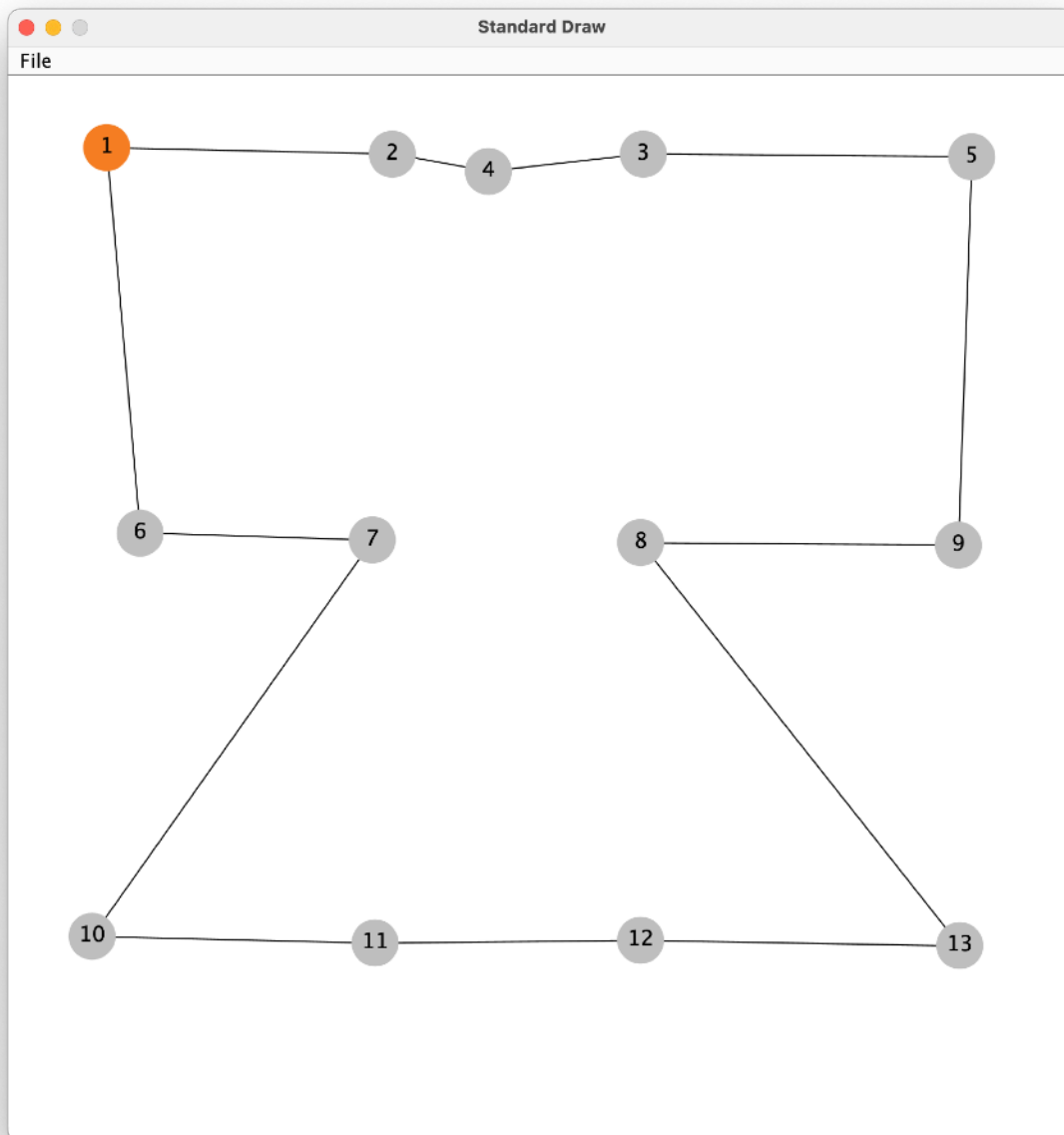
Method: Brute-Force Method

Shortest Distance: 2.93588

Shortest Path: [1, 8, 7, 11, 10, 9, 6, 5, 4, 12, 3, 2, 1]

Time it takes to find the shortest path: 1.734 seconds.

### Input File 3:



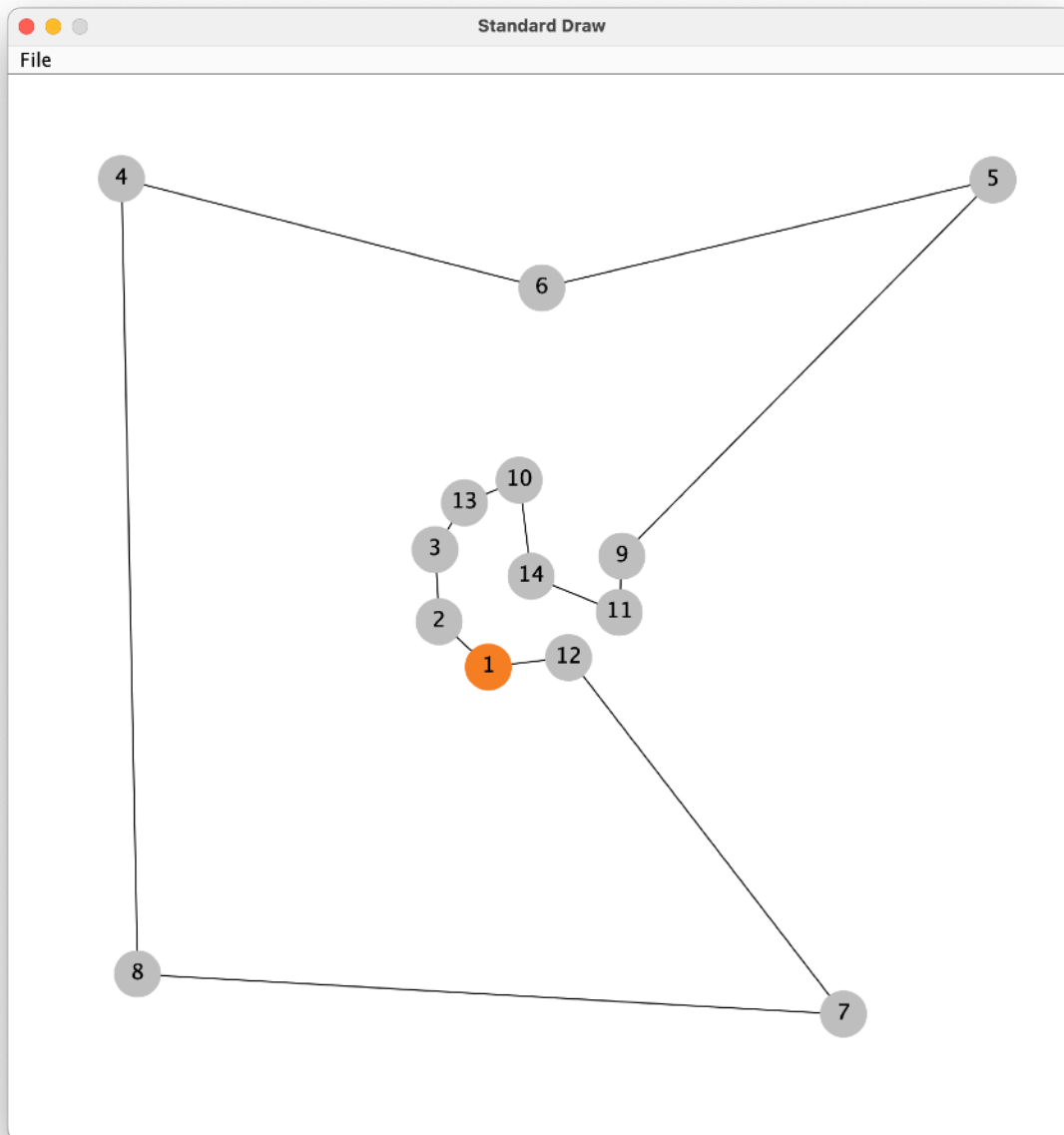
Method: Brute-Force Method

Shortest Distance: 3.80292

Shortest Path: [1, 2, 4, 3, 5, 9, 8, 13, 12, 11, 10, 7, 6, 1]

Time it takes to find the shortest path: 19.422 seconds.

## Input File 4:



Method: Brute-Force Method

Shortest Distance: 3.71091

Shortest Path: [1, 2, 3, 13, 10, 14, 11, 9, 5, 6, 4, 8, 7, 12, 1]

Time it takes to find the shortest path: 309.507 seconds.

Input File 5:

Too takes time to compute by using Brute-Force Method.

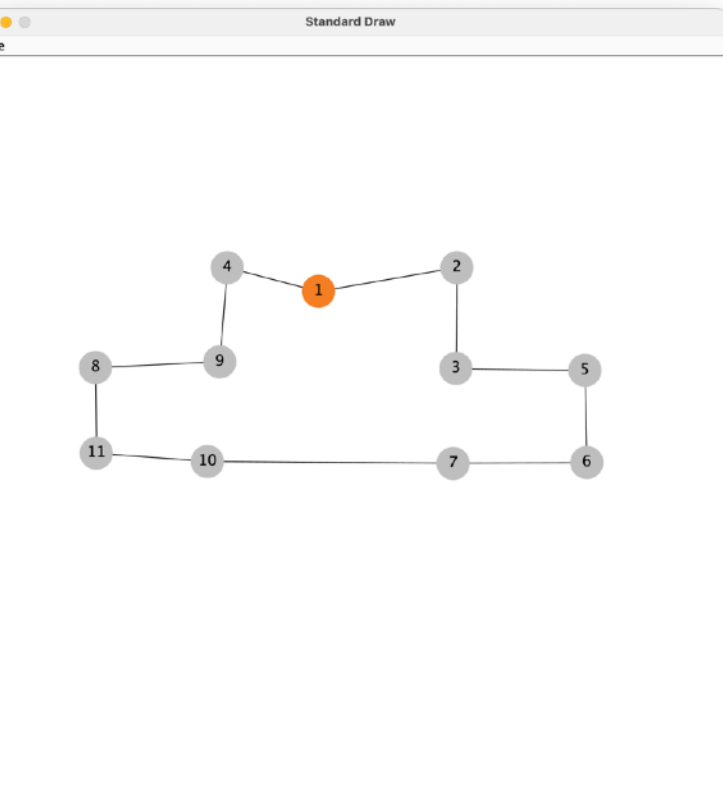
## Ant-Colony Optimization

### Ant-Colony Hyperparameters

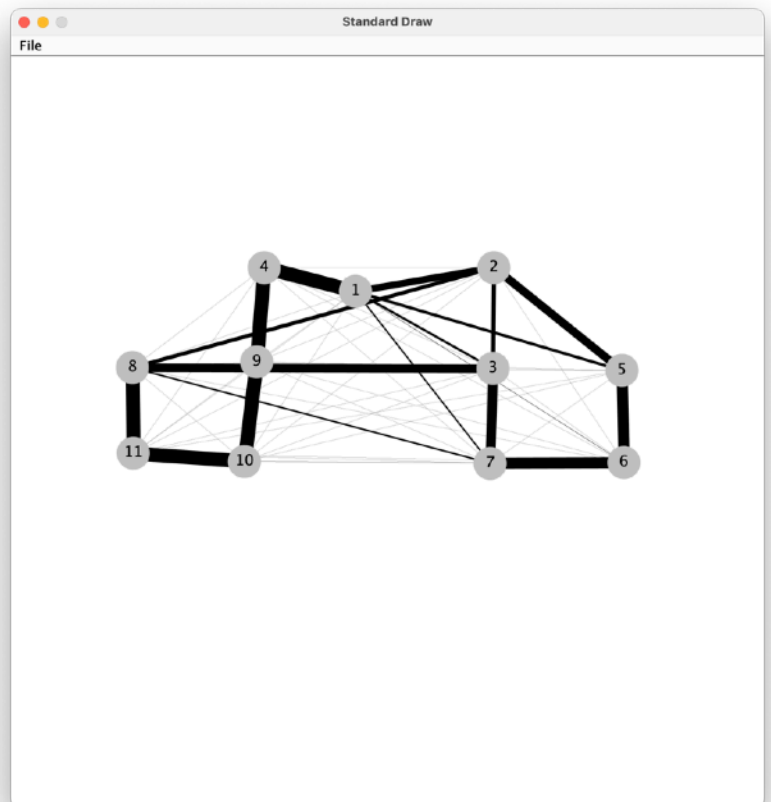
- Alpha: 1.0
- Beta: 1.6
- The number of ant for each iteration: 50
- The number of iteration: 100
- Q: 0.0001
- Degradation constant: 0.7
- Initial pheromone intensity: 1.2

## Input File 1:

### Shortest Path



### Pheromone Lines



Method: Ant Colony Optimization

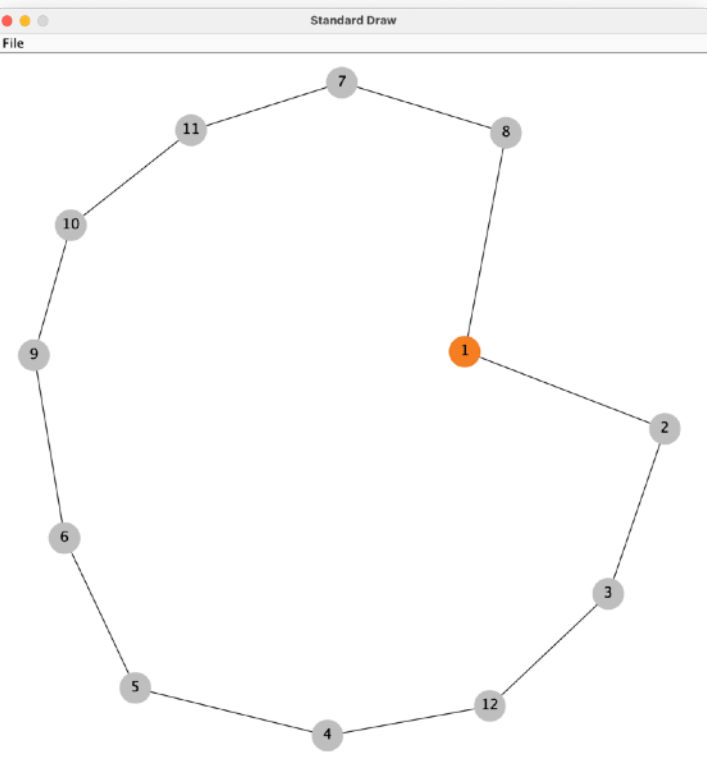
Shortest Distance: 1.79529

Shortest Path: [1, 4, 9, 8, 11, 10, 7, 6, 5, 3, 2, 1]

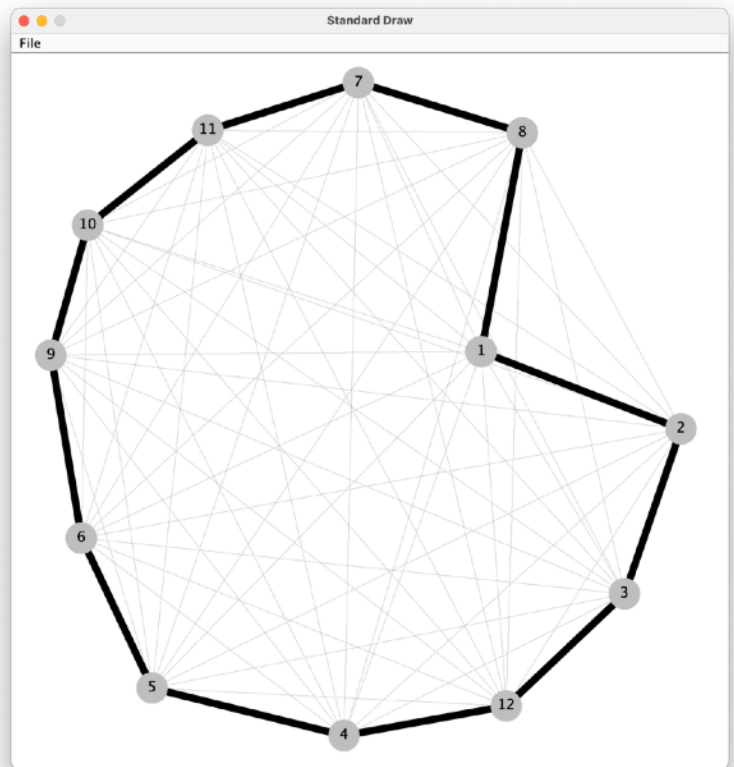
Time it takes to find the shortest path: 0.112 seconds.

## Input File 2:

### Shortest Path



### Pheromone Lines



Method: Ant Colony Optimization

Shortest Distance: 2.93588

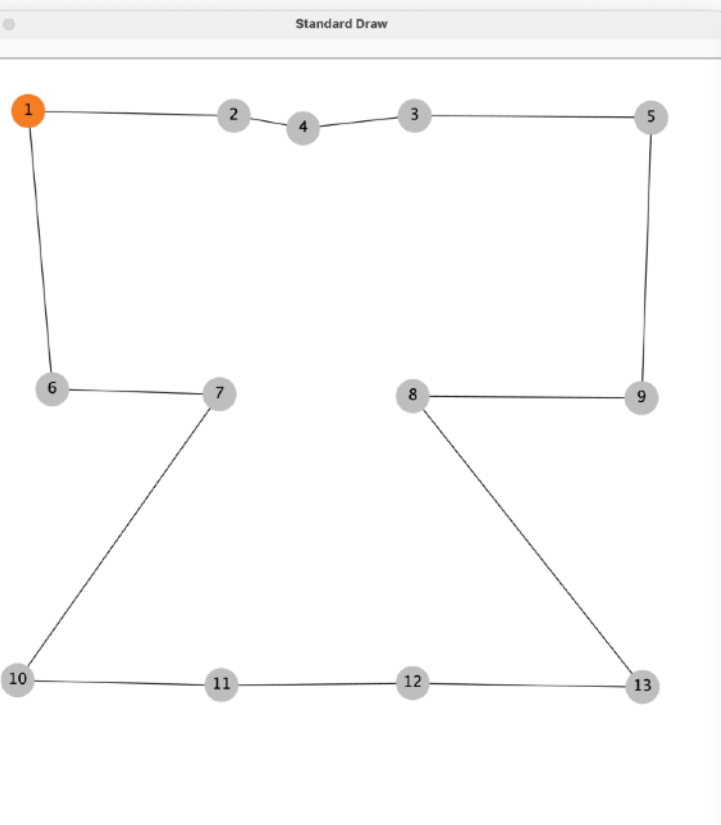
Shortest Path: [1, 8, 7, 11, 10, 9, 6, 5, 4, 12, 3, 2, 1]

Time it takes to find the shortest path: 0.115 seconds.

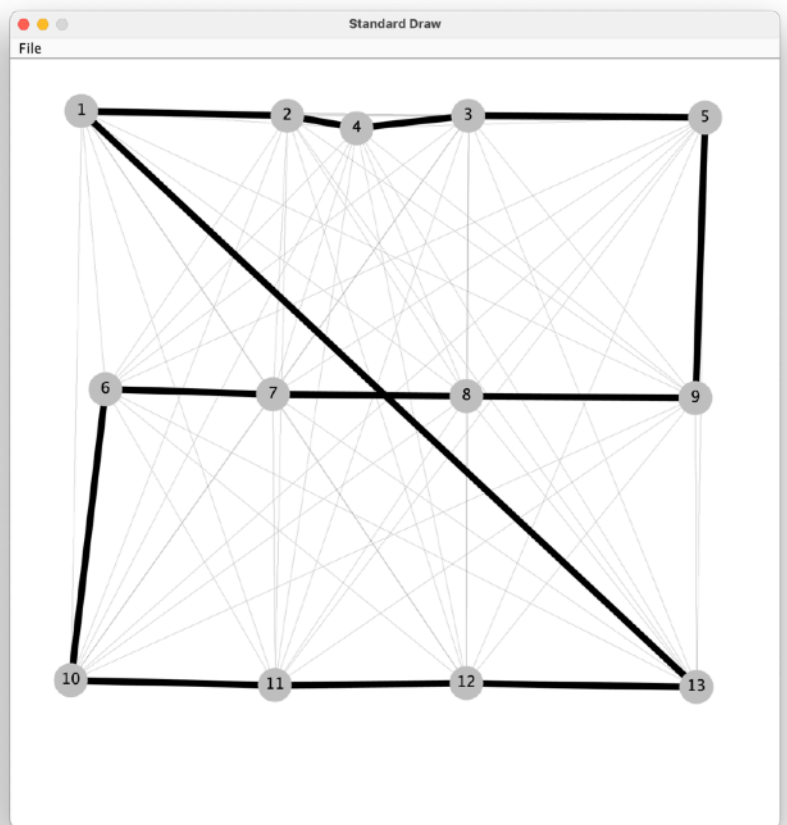


## Input File 3:

### Shortest Path



### Pheromone Lines



Method: Ant Colony Optimization

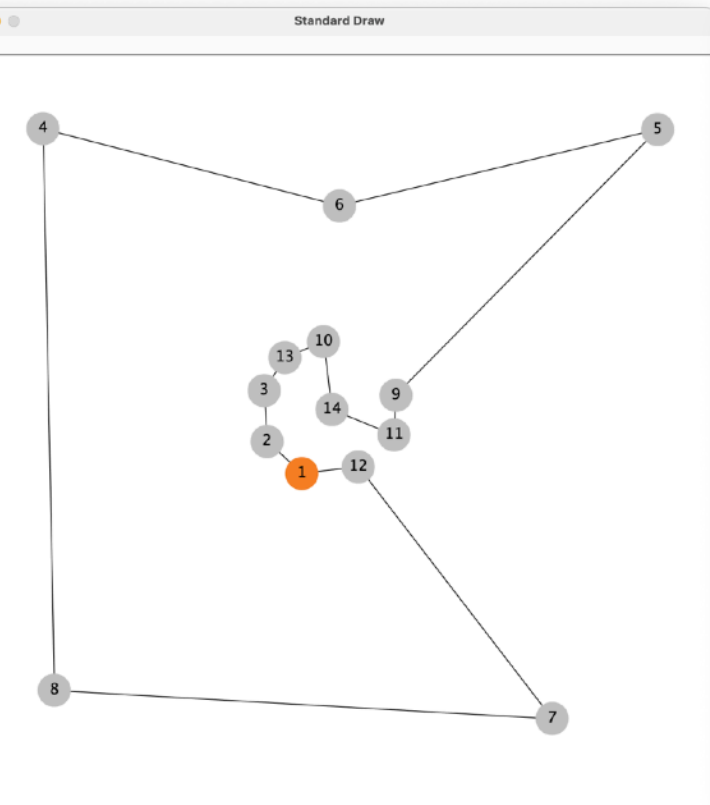
Shortest Distance: 3.80972

Shortest Path: [1, 2, 4, 3, 5, 9, 8, 13, 12, 11, 10, 6, 7, 1]

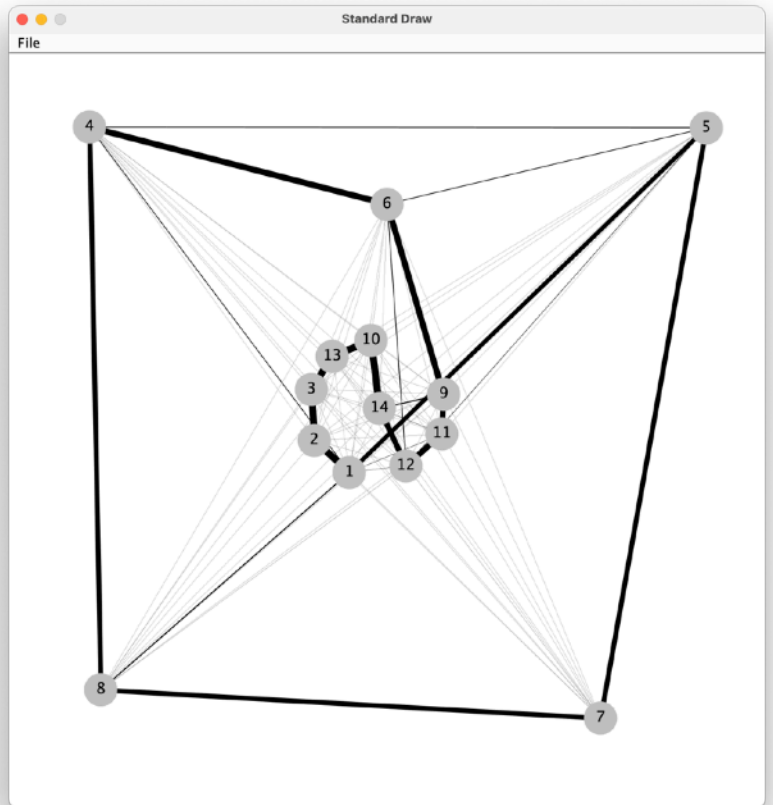
Time it takes to find the shortest path: 0.12 seconds.

## Input File 4:

Shortest Path



Pheromone Lines



Method: Ant Colony Optimization

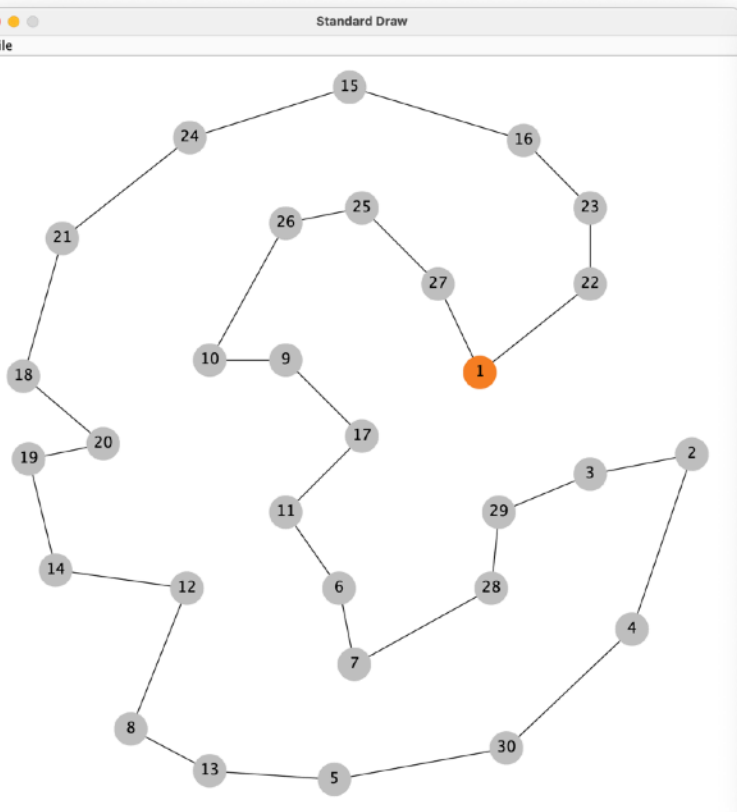
Shortest Distance: 3.71091

Shortest Path: [1, 2, 3, 13, 10, 14, 11, 9, 5, 6, 4, 8, 7, 12, 1]

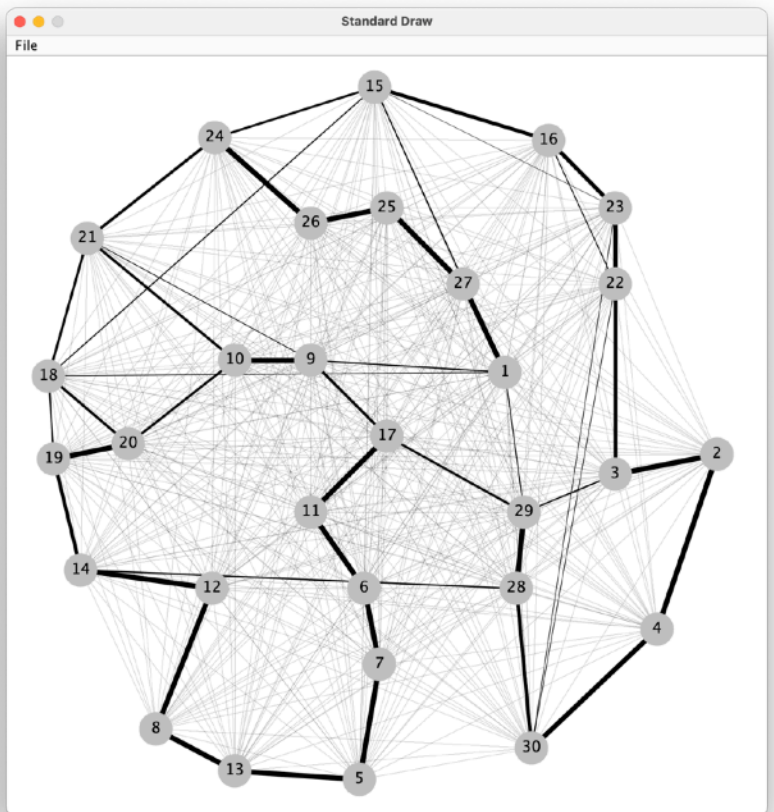
Time it takes to find the shortest path: 0.161 seconds.

## Input File 5:

### Shortest Path



### Pheromone Lines



Method: Ant Colony Optimization

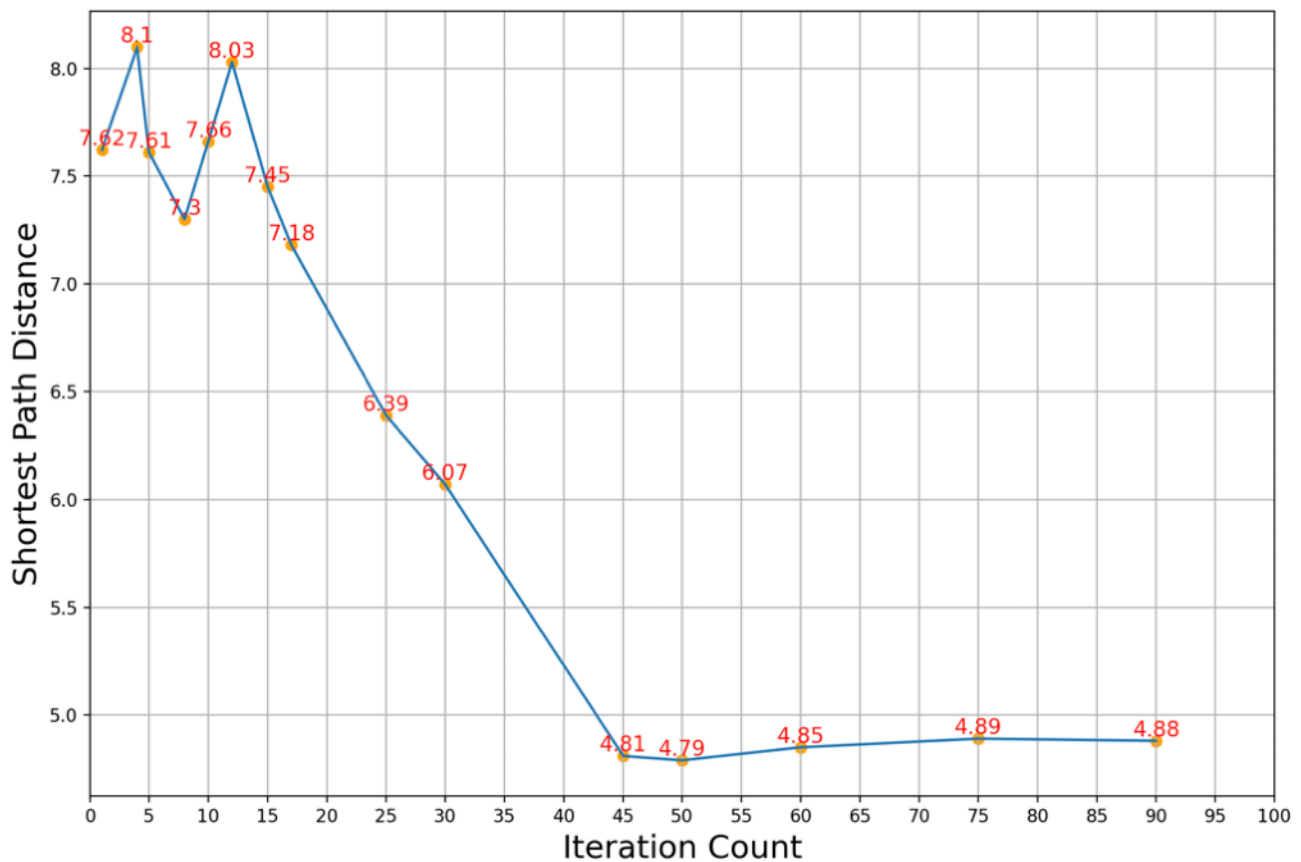
Shortest Distance: 4.77238

Shortest Path: [1, 27, 25, 26, 10, 9, 17, 11, 6, 7, 28, 29, 3, 2, 4, 30, 5, 13, 8, 12, 14, 19, 20, 18, 21, 24, 15, 16, 23, 22, 1]

Time it takes to find the shortest path: 0.45 seconds.

# Comparison of Methods

Input File	Number of Houses + Migros	Brute-Force Time (seconds)	Ant Colony Time (seconds)	Speed Up Factor
Input1	11	0.208	0.112	1.86
Input2	12	1.734	0.115	15.1
Input3	13	19.422	0.120	162
Input4	14	309.507	0.161	1922
Input5	30	-	0.450	>1922



## References:

-[chatgpt.com](https://chatgpt.com)

-<https://github.com/ecada/cmpe160spr24/blob/main/lab4/MigrosDeliveryLab.java>

## Advantages of Ant Colony Optimization:

1. **Efficient Solution:** ACO is more efficient than Brute Force, especially for large-scale problems. ACO uses a heuristic search to find good solutions, whereas Brute Force exhaustively searches all possible solutions.
2. **Flexibility:** ACO can be applied to a wide range of optimization problems, including those with non-linear constraints. Brute Force, on the other hand, is limited to problems with a small solution space.
3. **Scalability:** ACO can handle large problem sizes, whereas Brute Force becomes impractical for large problems due to its exponential time complexity.
4. **Robustness:** ACO is more robust than Brute Force, as it can adapt to changes in the problem environment.

1.

## Disadvantages of Ant Colony Optimization:

1. **Complexity:** ACO is a more complex algorithm than Brute Force, requiring a deeper understanding of the problem domain and the ACO algorithm itself.
2. **Tuning Parameters:** ACO requires tuning of parameters, such as the number of ants, pheromone evaporation rate, and iteration count, which can be time-consuming.
3. **Convergence:** ACO may not always converge to the optimal solution, whereas Brute Force is guaranteed to find the optimal solution (although it may take an impractically long time).
4. **Implementation:** ACO requires a more sophisticated implementation than Brute Force, involving data structures and algorithms to manage the ant colony and pheromone trails.

