

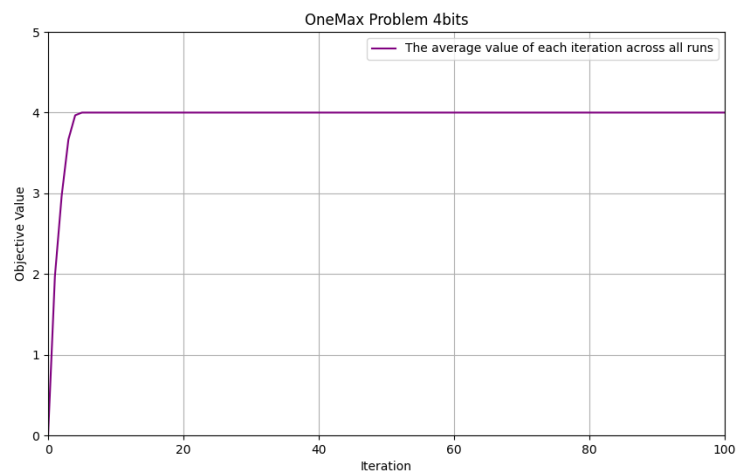
## (1)Tabu Search

### A. OneMax Problem

#### I. 4bits, 30runs, 5000evaluations

```
allen@DESKTOP-TKIN1M5:/mnt/c/Users/User/Desktop/Lab/Week4$ ./main 4 30 5000 OneMax
```

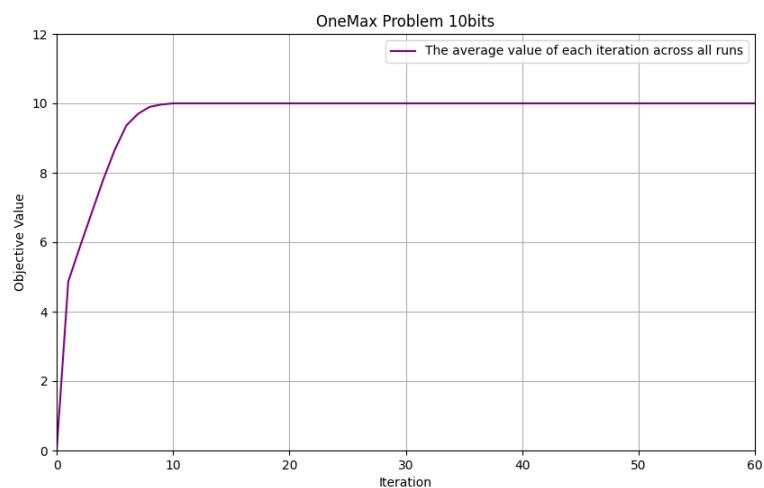
```
Run: 30, NFES: 50, Best Value: 4, Best Solution: 1111
Run: 30, NFES: 50, Best Value: 4, Best Solution: 1111
Run: 30, NFES: 50, Best Value: 4, Best Solution: 1111
```



#### II. 10bits, 30runs, 5000evaluations

```
allen@DESKTOP-TKIN1M5:/mnt/c/Users/User/Desktop/Lab/Week4$ ./main 10 30 5000 OneMax
```

```
Run: 30, NFES: 49, Best Value: 10, Best Solution: 1111111111
Run: 30, NFES: 50, Best Value: 10, Best Solution: 1111111111
Run: 30, NFES: 51, Best Value: 10, Best Solution: 1111111111
```

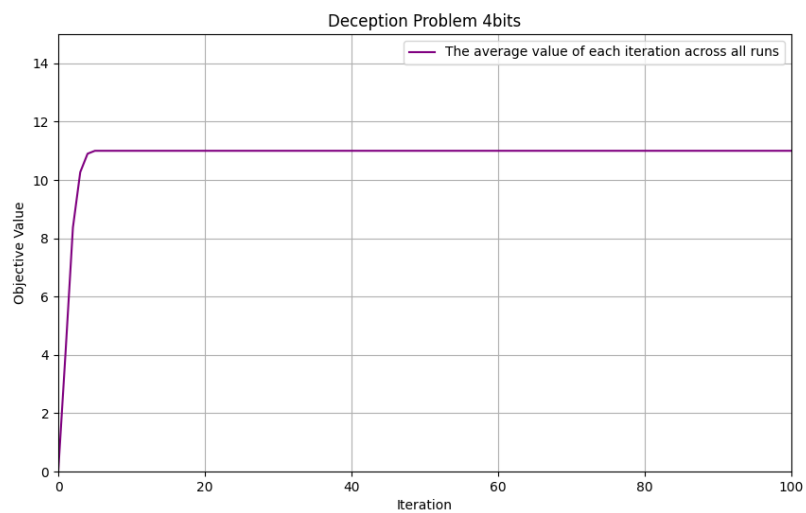


## B. Deception Problem

### I. 4bits, 30runs, 5000evaluations

```
allen@DESKTOP-TKIN1M5:/mnt/c/Users/User/Desktop/Lab/Week4$ ./main 4 30 5000 Deception
```

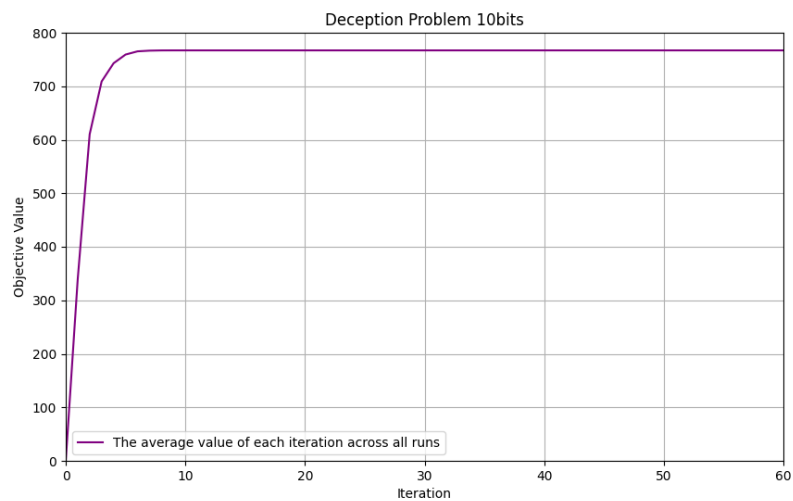
```
Run: 30, NFES: 50, Best Value: 11, Best Solution: 1111
Run: 30, NFES: 50, Best Value: 11, Best Solution: 1111
Run: 30, NFES: 50, Best Value: 11, Best Solution: 1111
```



### II. 10bits, 30runs, 5000evaluations

```
allen@DESKTOP-TKIN1M5:/mnt/c/Users/User/Desktop/Lab/Week4$ ./main 10 30 5000 Deception
```

```
Run: 30, NFES: 49, Best Value: 767, Best Solution: 111111111
Run: 30, NFES: 50, Best Value: 767, Best Solution: 111111111
Run: 30, NFES: 50, Best Value: 767, Best Solution: 111111111
```



## (2)Ant Colony Optimization

1 run

200 iterations

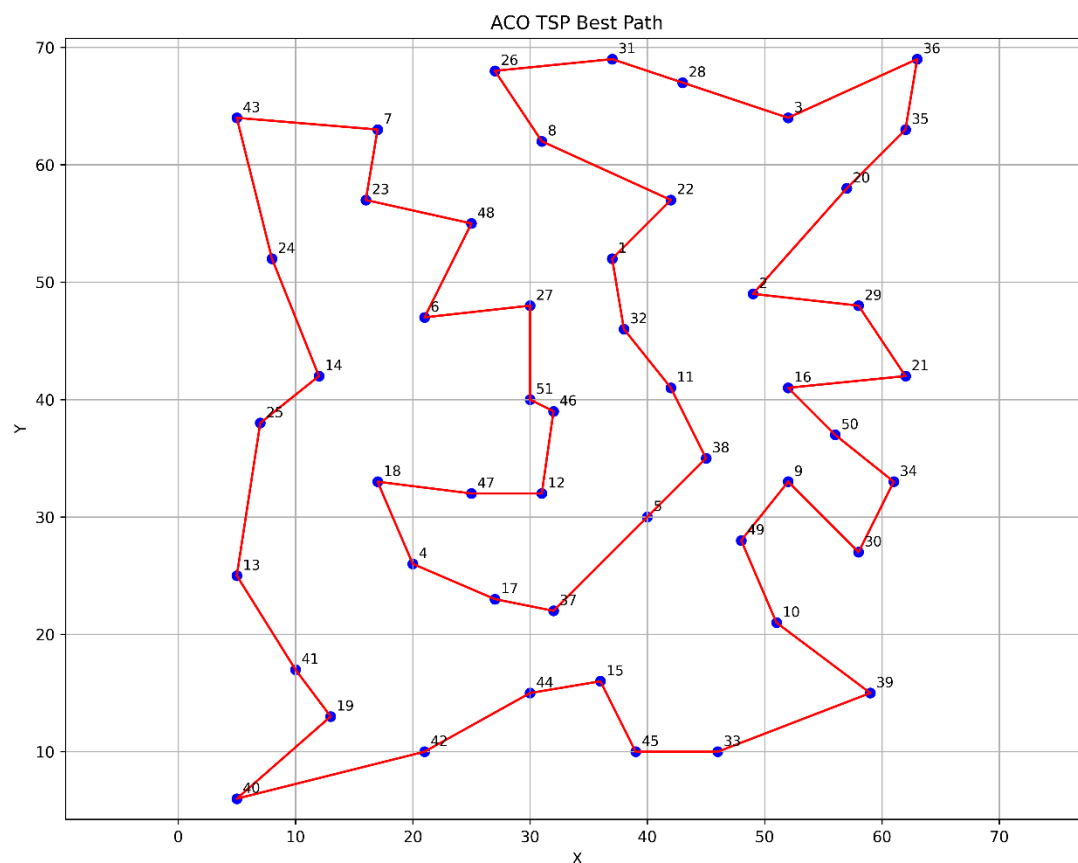
100 ants

Alpha = 2.3, beta = 4.5, evaporation rate = 0.05, Q = 1, default pheromone on path = 0.5,  $\tau_{\min} = 0.3$ ,  $\tau_{\max} = 5$

```
allen@DESKTOP-TKIN1M5:/mnt/c/Users/User/Desktop/Lab/Week4/Ant Colony Optimization$ make
g++ -std=c++17 -Wall -O2 -c main.cpp -o main.o
g++ -std=c++17 -Wall -O2 -c Alg.cpp -o Alg.o
g++ -std=c++17 -Wall -O2 -o main main.o Alg.o
```

```
allen@DESKTOP-TKIN1M5:/mnt/c/Users/User/Desktop/Lab/Week4/Ant Colony Optimization$ ./main 1 200 100 2.3 4.5 0.05 1
```

```
Iteration 198 Best length: 426
Iteration 199 Best length: 426
Iteration 200 Best length: 426
Final best tour length: 426
Tour: 9 49 18 39 33 45 15 44 42 40 19 41 13 25 14 24 43 7 23 48 6 27 51 46 12 47 18 4 17 37 5 38 11 32 1 22 8 26 31 28 3 35 36 20 2 29 21 16 50 34 30
```



## Discussion:

根據網路上找的資料，426 的確為 `eil51` 之最佳解，只是我發現長度 426 不是只有唯一的一條路徑，我一開始在算兩點距離時沒有四捨五入，後來把不同 426 之路徑算法改成不四捨五入長度大概 429.多，但我在跑沒有四捨五入的時候基本上都有 428.多的，將 428.多的幾條路徑換成要四捨五入的話，他們的長度會變 427，但基於網路上給出的最佳解答案看起來都是用四捨五入，所以本次作業我最後是用四捨五入。

## Method:

### 1. Construct Ant Solutions:

螞蟻選擇下一步採用的是輪盤法

突變交換兩點(可選可不選)，本次作業產生的結果我沒選

### 2. Apply Local Search:

採用 2-OPT

### 3. Update Pheromones:

$$\tau_{ij} \leftarrow (1 - \rho) \cdot \tau_{ij} + \sum_{k=1}^m \Delta \tau_{ij}^k$$

蒸發率

所有Ant於Edge(i, j)上留下的費洛蒙

除了原本基礎的公式外，我還加入以下其他方法：

(a) 設定路徑上費洛蒙上下限

(b) 獎勵最優之路徑額外費洛蒙

(c) 每循環 N 次（例如 10），就對非最優路徑的費洛蒙進行重置。

參考來源：[ACO 優化策略](#)

## Conclusion:

上述參數基本上在 200 次迭代內都能找到最優解 426 或次優解 427。