

# ITP4510 Data Structure and Algorithms ASSIGNMENT

Deadline: 13 Apr 2025

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## Test Case 1

Here is a sample of one simulation  
- 2 Teller, Using waitingLine

Input Name	User Input
Simulation Length	7
Number of Counter	2
Iteration 1 - Serving time:	7
Iteration 2 - Serving time:	3
Iteration 3 - Serving time:	4
Iteration 4 - Serving time:	1
Iteration 5 - Serving time:	0
Iteration 6 - Serving time:	2
Iteration 7 - Serving time:	1

## Output:

Total minute simulated: 7 minutes  
Number of Tellers: 2  
Number of customer served: 3  
Average number of customers in the queue 1.2857143  
Max queue length 3

```
(base) MacBook-Air-6:DSA Assignment whitneywhalley$ javac Main.java
(base) MacBook-Air-6:DSA Assignment whitneywhalley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): 7
Input number of counter: 2

-----START SIMULATION -----

At the beginning of iteration 1 ...
Input serving time for a new customer: 7
After 1 minute ##

    Teller_1 [8]    Teller_2 [0]    Waiting Queue: [ ]

At the beginning of iteration 2 ...
Input serving time for a new customer: 3
After 2 minute ##

    Teller_1 [8]    Teller_2 [5]    Waiting Queue: [ ]

At the beginning of iteration 3 ...
Input serving time for a new customer: 4
After 3 minute ##

    Teller_1 [8]    Teller_2 [5]    Waiting Queue: [ 4 ]

At the beginning of iteration 4 ...
Input serving time for a new customer: 1
After 4 minute ##

    Teller_1 [8]    Teller_2 [5]    Waiting Queue: [ 4 1 ]

At the beginning of iteration 5 ...
Input serving time for a new customer: 0
After 5 minute ##

    Teller_1 [8]    Teller_2 [9]    Waiting Queue: [ 1 ]

At the beginning of iteration 6 ...
Input serving time for a new customer: 2
After 6 minute ##

    Teller_1 [8]    Teller_2 [9]    Waiting Queue: [ 1 2 ]

At the beginning of iteration 7 ...
Input serving time for a new customer: 1
After 7 minute ##

    Teller_1 [8]    Teller_2 [9]    Waiting Queue: [ 1 2 1 ]

-----END OF SIMULATION -----
Total minute simulated: 7 minutes
Number of Tellers: 2
Number of customer served: 3
Average number of customers in the queue 1.2857143
Max queue length 3
```

## Test Case 2

Here is a sample of one simulation  
– Never need waitingLine

Input Name	User Input
Simulation Length	9
Number of Counter	3
Iteration 1 - Serving time:	3
Iteration 2 - Serving time:	4
Iteration 3 - Serving time:	5
Iteration 4 - Serving time:	3
Iteration 5 - Serving time:	0
Iteration 6 - Serving time:	1
Iteration 7 - Serving time:	1
Iteration 8 - Serving time:	1
Iteration 9 - Serving time:	1

### Output:

Total minute simulated: 9 minutes  
Number of Tellers: 3  
Number of customer served: 7  
Average number of customers in the queue: 0.0  
Max queue length: 0

```
(base) MacBook-Air-0:DSA Assignment whitneywhitley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): 9
Input number of counter: 3

-----START SIMULATION -----

At the beginning of iteration 1 ...
Input serving time for a new customer: 3
After 1 minute ##

    Teller_1 [4]    Teller_2 [0]    Teller_3 [0]    Waiting Queue: [ ]

At the beginning of iteration 2 ...
Input serving time for a new customer: 4
After 2 minute ##

    Teller_1 [4]    Teller_2 [6]    Teller_3 [0]    Waiting Queue: [ ]

At the beginning of iteration 3 ...
Input serving time for a new customer: 5
After 3 minute ##

    Teller_1 [4]    Teller_2 [6]    Teller_3 [8]    Waiting Queue: [ ]

At the beginning of iteration 4 ...
Input serving time for a new customer: 3
After 4 minute ##

    Teller_1 [7]    Teller_2 [6]    Teller_3 [8]    Waiting Queue: [ ]

At the beginning of iteration 5 ...
Input serving time for a new customer: 0
After 5 minute ##

    Teller_1 [7]    Teller_2 [6]    Teller_3 [8]    Waiting Queue: [ ]

At the beginning of iteration 6 ...
Input serving time for a new customer: 0
After 6 minute ##

    Teller_1 [7]    Teller_2 [6]    Teller_3 [8]    Waiting Queue: [ ]

At the beginning of iteration 7 ...
Input serving time for a new customer: 1
After 7 minute ##

    Teller_1 [8]    Teller_2 [6]    Teller_3 [8]    Waiting Queue: [ ]

At the beginning of iteration 8 ...
Input serving time for a new customer: 1
After 8 minute ##

    Teller_1 [9]    Teller_2 [6]    Teller_3 [8]    Waiting Queue: [ ]

At the beginning of iteration 9 ...
Input serving time for a new customer: 2
After 9 minute ##

    Teller_1 [11]   Teller_2 [6]    Teller_3 [8]    Waiting Queue: [ ]

-----END OF SIMULATION -----
Total minute simulated: 9 minutes
Number of Tellers: 3
Number of customer served: 7
Average number of customers in the queue: 0.0
Max queue length: 0
```

### Test Case 3

Here is a sample of one simulation  
– One Teller, long waitingLine

Input Name	User Input
Simulation Length	6
Number of Counter	1
Iteration 1 - Serving time:	6
Iteration 2 - Serving time:	1
Iteration 3 - Serving time:	2
Iteration 4 - Serving time:	3
Iteration 5 - Serving time:	4
Iteration 6 - Serving time:	5

#### Output:

Total minute simulated: 6 minutes  
Number of Tellers: 1  
Number of customer served: 1  
Average number of customers in the queue: 2.5  
Max queue length: 5

```
(base) MacBook-Air-6:DSA Assignment whitneywhalley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): 6
Input number of counter: 1

-----START SIMULATION -----

At the beginning of iteration 1 ...
Input serving time for a new customer: 6
After 1 minute ##

    Teller_1 [7]    Waiting Queue: [ ]

At the beginning of iteration 2 ...
Input serving time for a new customer: 1
After 2 minute ##

    Teller_1 [7]    Waiting Queue: [ 1 ]

At the beginning of iteration 3 ...
Input serving time for a new customer: 2
After 3 minute ##

    Teller_1 [7]    Waiting Queue: [ 1 2 ]

At the beginning of iteration 4 ...
Input serving time for a new customer: 3
After 4 minute ##

    Teller_1 [7]    Waiting Queue: [ 1 2 3 ]

At the beginning of iteration 5 ...
Input serving time for a new customer: 4
After 5 minute ##

    Teller_1 [7]    Waiting Queue: [ 1 2 3 4 ]

At the beginning of iteration 6 ...
Input serving time for a new customer: 5
After 6 minute ##

    Teller_1 [7]    Waiting Queue: [ 1 2 3 4 5 ]

-----END OF SIMULATION -----
Total minute simulated: 6 minutes
Number of Tellers: 1
Number of customer served: 1
Average number of customers in the queue: 2.5
Max queue length: 5
(base) MacBook-Air-6:DSA Assignment whitneywhalley$
```

## Test Case 4

Here is a sample of one simulation

– No teller, all in waitingLine

Input Name	User Input
Simulation Length	5
Number of Counter	0
Iteration 1 - Serving time:	1
Iteration 2 - Serving time:	1
Iteration 3 - Serving time:	3
Iteration 4 - Serving time:	4
Iteration 5 - Serving time:	5

### Output:

Total minute simulated: 5 minutes

Number of Tellers: 0

Number of customer served: 0

Average number of customers in the queue: 3.0

Max queue length: 5

```
(base) MacBook-Air-6:DSA Assignment whitneywhalley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): 5
Input number of counter: 0

-----START SIMULATION -----

At the beginning of iteration 1 ...
Input serving time for a new customer: 1
After 1 minute ##

    Waiting Queue: [ 1 ]

At the beginning of iteration 2 ...
Input serving time for a new customer: 2
After 2 minute ##

    Waiting Queue: [ 1 2 ]

At the beginning of iteration 3 ...
Input serving time for a new customer: 3
After 3 minute ##

    Waiting Queue: [ 1 2 3 ]

At the beginning of iteration 4 ...
Input serving time for a new customer: 4
After 4 minute ##

    Waiting Queue: [ 1 2 3 4 ]

At the beginning of iteration 5 ...
Input serving time for a new customer: 5
After 5 minute ##

    Waiting Queue: [ 1 2 3 4 5 ]

-----END OF SIMULATION -----
Total minute simulated: 5 minutes
Number of Tellers: 0
Number of customer served: 0
Average number of customers in the queue: 3.0
Max queue length: 5
(base) MacBook-Air-6:DSA Assignment whitneywhalley$
```

## Test Case 5

Here is a sample of one simulation

– User enters any input other than an integer for any of the user input

Input Name	User Input
Simulation Length	5
Number of Counter	2
Iteration 1 - Serving time:	1
Iteration 2 - Serving time:	s

### Output:

Exception in thread "main" InvalidInputException: Please enter an integer  
at Main.main(Main.java:67)

```
ⓧ (base) MacBook-Air-6:DSA Assignment whitneywhalley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): 5
Input number of counter: 2

-----START SIMULATION -----

At the beginning of iteration 1 ...
Input serving time for a new customer: 1
After 1 minute ##

    Teller_1 [2]    Teller_2 [0]    Waiting Queue: [ ]

At the beginning of iteration 2 ...
Input serving time for a new customer: s
Exception in thread "main" InvalidInputException: Please enter an integer
at Main.main(Main.java:67)
(base) MacBook-Air-6:DSA Assignment whitneywhalley$
```

## Test Case 6

Here is a sample of one simulation

– User enters 0 simulation minutes

Input Name	User Input
Simulation Length	0

### Output:

Exception in thread "main" InvalidSimulationMinutesException: Simulation minutes must be more than or equal to zero

at Main.main(Main.java:30)

```
● (base) MacBook-Air-6:DSA Assignment whitneywhalley$ javac Main.java
⊗ (base) MacBook-Air-6:DSA Assignment whitneywhalley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): 0
Exception in thread "main" InvalidSimulationMinutesException: Simulation minutes must be more than or equal to zero
    at Main.main(Main.java:30)
○ (base) MacBook-Air-6:DSA Assignment whitneywhalley$ █
```

## Test Case 7

Here is a sample of one simulation

– User enters -1 simulation minutes

Input Name	User Input
Simulation Length	-1

### Output:

Exception in thread "main" InvalidSimulationMinutesException: Simulation minutes must be more than or equal to zero

at Main.main(Main.java:30)

```
(base) MacBook-Air-6:DSA Assignment whitneywhalley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): -1
Exception in thread "main" InvalidSimulationMinutesException: Simulation minutes must be more than or equal to zero
at Main.main(Main.java:30)
(base) MacBook-Air-6:DSA Assignment whitneywhalley$
```

## Test Case 8

Here is a sample of one simulation  
– Longer test case, more tellers,  
showing queue is working

Input Name	User Input
Simulation Length	10
Number of Counter	4
Iteration 1 - Serving time:	10
Iteration 2 - Serving time:	5
Iteration 3 - Serving time:	6
Iteration 4 - Serving time:	3
Iteration 5 - Serving time:	1
Iteration 6 - Serving time:	3
Iteration 7 - Serving time:	0
Iteration 8 - Serving time:	2
Iteration 9 - Serving time:	1
Iteration 10 - Serving time:	1

### Output:

Total minute simulated: 10 minutes  
Number of Tellers: 4  
Number of customer served: 8  
Average number of customers in  
the queue: 0.7  
Max queue length: 2

```
(base) MacBook-Air-6:DSA Assignment whitneyhalley$ java Main
-----START SIMULATION ENVIRONMENT -----
Input simulation length (min): 10
Input number of counter: 4

-----START SIMULATION -----

At the beginning of iteration 1 ...
Input serving time for a new customer: 10
After 1 minute ##

Teller_1 [11] Teller_2 [0] Teller_3 [0] Teller_4 [0] Waiting Queue: [ ]

At the beginning of iteration 2 ...
Input serving time for a new customer: 5
After 2 minute ##

Teller_1 [11] Teller_2 [7] Teller_3 [0] Teller_4 [0] Waiting Queue: [ ]

At the beginning of iteration 3 ...
Input serving time for a new customer: 6
After 3 minute ##

Teller_1 [11] Teller_2 [7] Teller_3 [9] Teller_4 [0] Waiting Queue: [ ]

At the beginning of iteration 4 ...
Input serving time for a new customer: 3
After 4 minute ##

Teller_1 [11] Teller_2 [7] Teller_3 [9] Teller_4 [7] Waiting Queue: [ ]

At the beginning of iteration 5 ...
Input serving time for a new customer: 1
After 5 minute ##

Teller_1 [11] Teller_2 [7] Teller_3 [9] Teller_4 [7] Waiting Queue: [ 1 ]

At the beginning of iteration 6 ...
Input serving time for a new customer: 3
After 6 minute ##

Teller_1 [11] Teller_2 [7] Teller_3 [9] Teller_4 [7] Waiting Queue: [ 1 3 ]

At the beginning of iteration 7 ...
Input serving time for a new customer: 0
After 7 minute ##

Teller_1 [11] Teller_2 [8] Teller_3 [9] Teller_4 [7] Waiting Queue: [ 3 ]

At the beginning of iteration 8 ...
Input serving time for a new customer: 2
After 8 minute ##

Teller_1 [11] Teller_2 [11] Teller_3 [9] Teller_4 [7] Waiting Queue: [ 2 ]

At the beginning of iteration 9 ...
Input serving time for a new customer: 1
After 9 minute ##

Teller_1 [11] Teller_2 [11] Teller_3 [11] Teller_4 [7] Waiting Queue: [ 1 ]

At the beginning of iteration 10 ...
Input serving time for a new customer: 1
After 10 minute ##

Teller_1 [11] Teller_2 [11] Teller_3 [11] Teller_4 [11] Waiting Queue: [ 1 ]

-----END OF SIMULATION -----
Total minute simulated: 10 minutes
Number of Tellers: 4
Number of customer served: 8
Average number of customers in the queue: 0.7
Max queue length: 2
(base) MacBook-Air-6:DSA Assignment whitneyhalley$
```