Artificial Intelligence Homework

Archer Problem Experimental Data

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1 Experimental data

In this section it is presented how the experimental values are generated for our problem.

To test our problem we need to generate multiple data sets which are meaningful to our goals in finding how does our algorithm behave.

In order to achieve this we need to make use of the random input data generator located in the main file,which will be our data input reference.

The algorithm for the generator has been presented in the report under the Apllication outline when I presented how the main.py module works and what it contains.

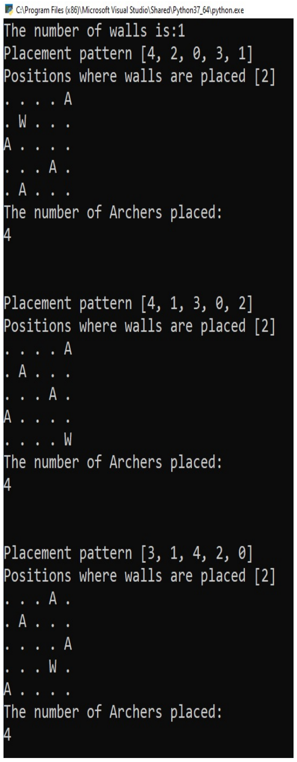
In order to test our input data generator I ran the algorithm 10 times to get multiple data outputs which I will compare down below.

The output data consists of getting all the possible arrangements for the archers and the walls visualised both in original form(a list of elements which tell the position of each archer on the board) and in form of a grid which helps both me and the reader to understand how the algorithm works.

1.1 Results and Conclusions

In this section we will conduct a set of tests to observe how the algorithm behaves. Here we have all 10 inputs tests made on different sizes of input data:small,medium,large.
In most of these tests I will show the first couple of arrangements found,and then the last ones together with the number of solutions found and the running time of the algorithm.

1. first test(small test size:grid size:5,walls placed on position:2)



```
C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe
The number of walls is:1
Placement pattern [4, 2, 0, 3, 1]
Positions where walls are placed [2]
. . . . A
. W . . .
A . . . .
. . . A .
. A . . .
The number of Archers placed:
4


Placement pattern [4, 1, 3, 0, 2]
Positions where walls are placed [2]
. . . . A
. A . . .
. . . A .
A . . . .
. . . . W
The number of Archers placed:
4


Placement pattern [3, 1, 4, 2, 0]
Positions where walls are placed [2]
. . . A .
. A . . .
. . . . A
. . . W .
A . . . .
The number of Archers placed:
4
```

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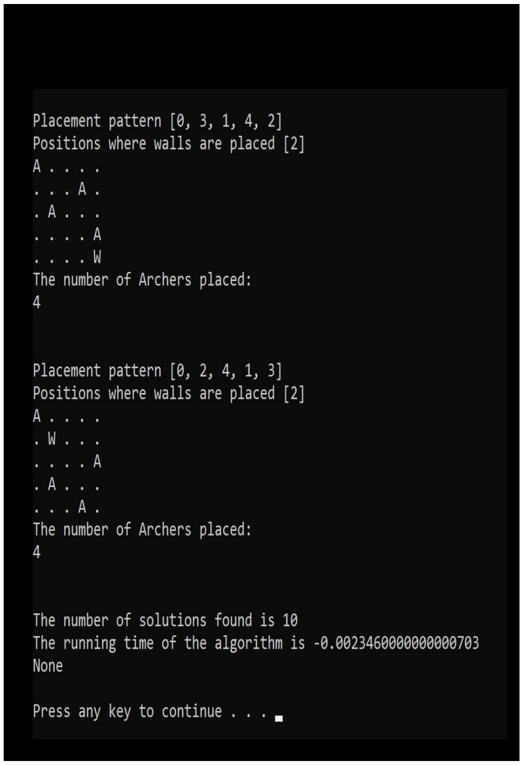


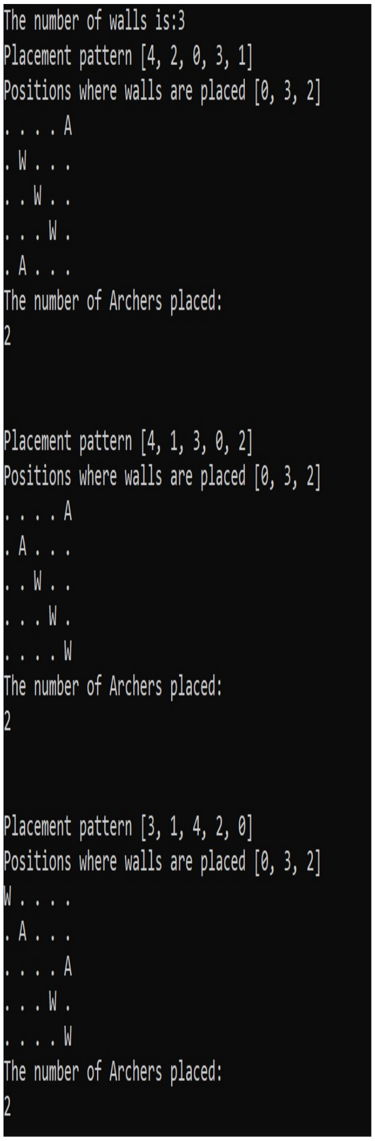
```
Placement pattern [0, 3, 1, 4, 2]
Positions where walls are placed [2]
A . . . .
. . . A .
. A . . .
. . . . A
. . . . W
The number of Archers placed:
4


Placement pattern [0, 2, 4, 1, 3]
Positions where walls are placed [2]
A . . . .
. W . . .
. . . . A
. A . . .
. . . A .
The number of Archers placed:
4


The number of solutions found is 10
The running time of the algorithm is -0.0023460000000000703
None

Press any key to continue . . .
```

2. second test(small test size,grid size:5,walls placed on positions:0,3,2)



```
The number of walls is:3
Placement pattern [4, 2, 0, 3, 1]
Positions where walls are placed [0, 3, 2]
. . . . A
. W . . .
. . W . .
. . . W .
. A . . .
The number of Archers placed:
2


Placement pattern [4, 1, 3, 0, 2]
Positions where walls are placed [0, 3, 2]
. . . . A
. A . . .
. . W . .
. . . W .
. . . . W
The number of Archers placed:
2


Placement pattern [3, 1, 4, 2, 0]
Positions where walls are placed [0, 3, 2]
W . . . .
. A . . .
. . . . A
. . . W .
. . . . W
The number of Archers placed:
2
```

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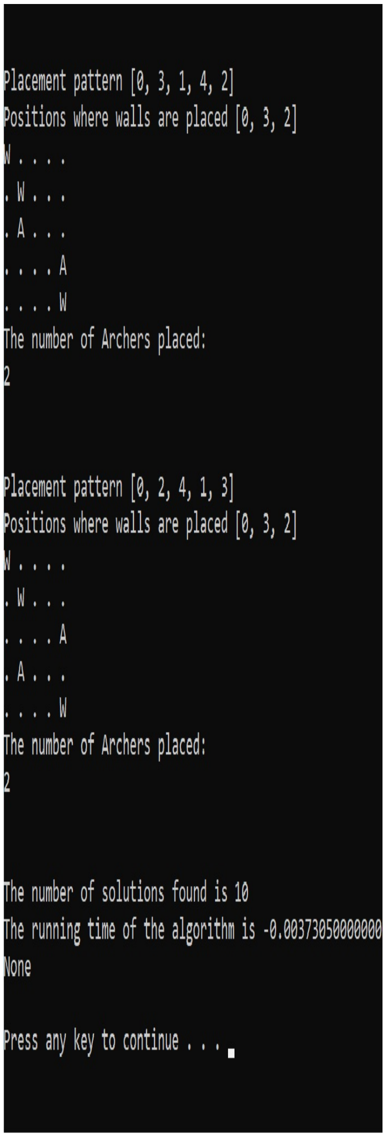
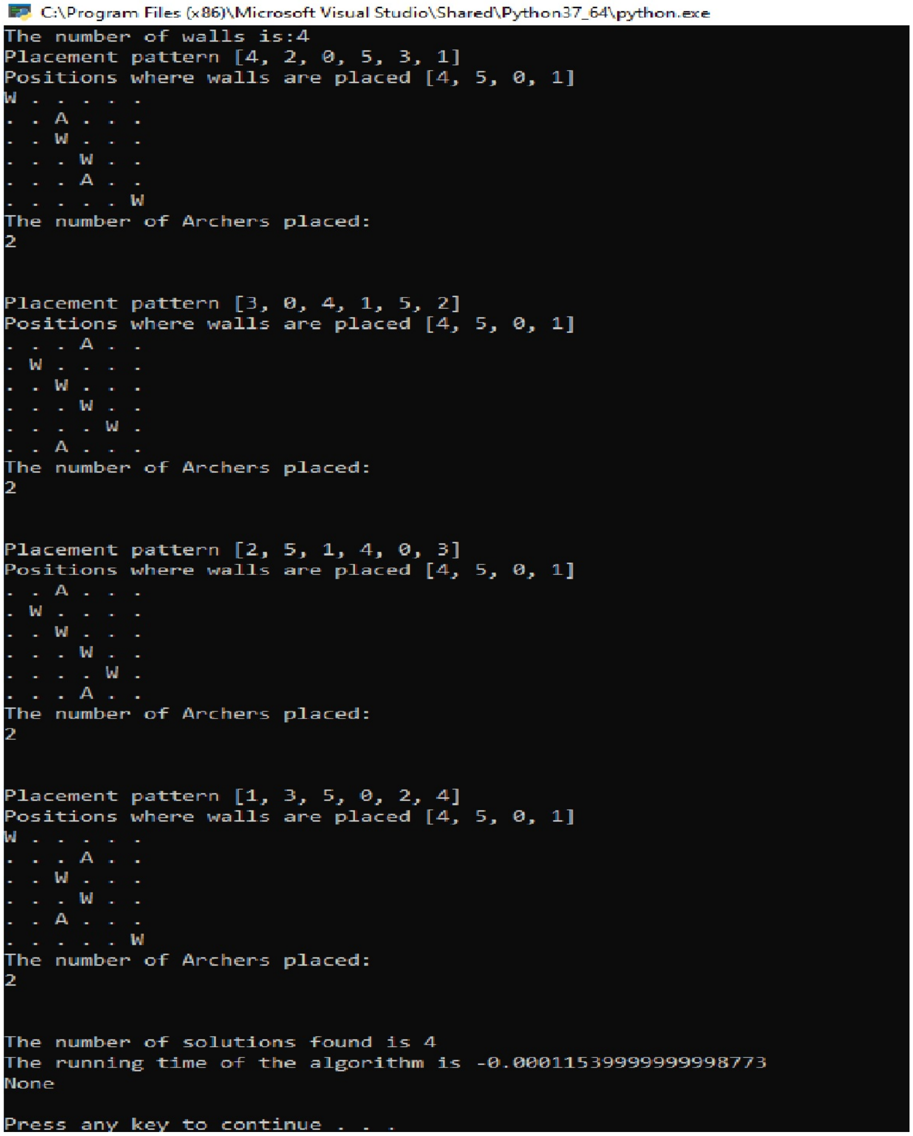


```
Placement pattern [0, 3, 1, 4, 2]
Positions where walls are placed [0, 3, 2]
W . . . .
. W . . .
. A . . .
. . . . A
. . . . W
The number of Archers placed:
2


Placement pattern [0, 2, 4, 1, 3]
Positions where walls are placed [0, 3, 2]
W . . . .
. W . . .
. . . . A
. A . . .
. . . . W
The number of Archers placed:
2


The number of solutions found is 10
The running time of the algorithm is -0.00373050000000
None

Press any key to continue . . .
```

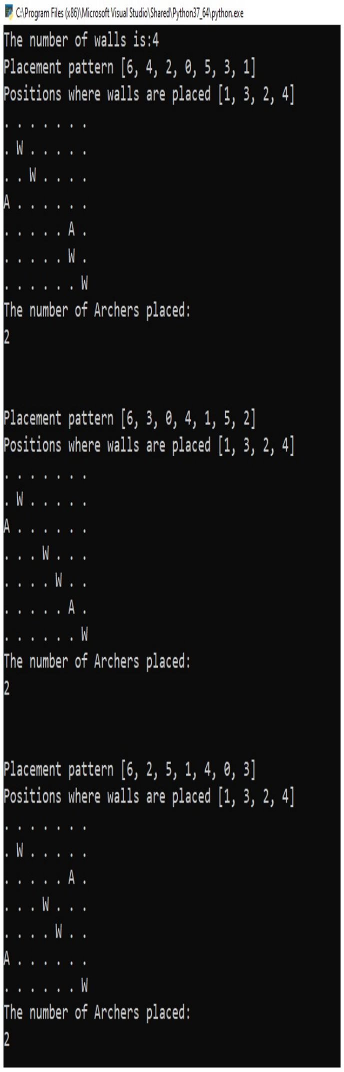
3. third test(small test size,grid size:6,walls placed on positions:4,5,0,1)



C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
The number of walls is:4
Placement pattern [4, 2, 0, 5, 3, 1]
Positions where walls are placed [4, 5, 0, 1]
W . . . . .
. . A . . .
. . W . . .
. . . W . .
. . . A . .
. . . . . W
The number of Archers placed:
2


Placement pattern [3, 0, 4, 1, 5, 2]
Positions where walls are placed [4, 5, 0, 1]
. . . A . .
. W . . . .
. . W . . .
. . . W . .
. . . . W .
. . A . . .
The number of Archers placed:
2


Placement pattern [2, 5, 1, 4, 0, 3]
Positions where walls are placed [4, 5, 0, 1]
. . A . . .
. W . . . .
. . W . . .
. . . W . .
. . . . W .
. . . A . .
The number of Archers placed:
2


Placement pattern [1, 3, 5, 0, 2, 4]
Positions where walls are placed [4, 5, 0, 1]
W . . . . .
. . . A . .
. . W . . .
. . . W . .
. . A . . .
. . . . . W
The number of Archers placed:
2


The number of solutions found is 4
The running time of the algorithm is -0.00011539999999998773
None

Press any key to continue . . .
```

4. fourth test(medium test size,grid size:7,walls placed on positions:1,3,2,4,max number of archers is 2(chaged the max to see how it affects the solutions))


C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
The number of walls is:4
Placement pattern [6, 4, 2, 0, 5, 3, 1]
Positions where walls are placed [1, 3, 2, 4]
. . . . . . .
. W . . . . .
. . W . . . .
A . . . . . .
. . . . . A .
. . . . . W .
. . . . . . W
The number of Archers placed:
2


Placement pattern [6, 3, 0, 4, 1, 5, 2]
Positions where walls are placed [1, 3, 2, 4]
. . . . . . .
. W . . . . .
A . . . . . .
. . . W . . .
. . . . W . .
. . . . . A .
. . . . . . W
The number of Archers placed:
2


Placement pattern [6, 2, 5, 1, 4, 0, 3]
Positions where walls are placed [1, 3, 2, 4]
. . . . . . .
. W . . . . .
. . . . . A .
. . . W . . .
. . . . W . .
A . . . . . .
. . . . . . W
The number of Archers placed:
2
```

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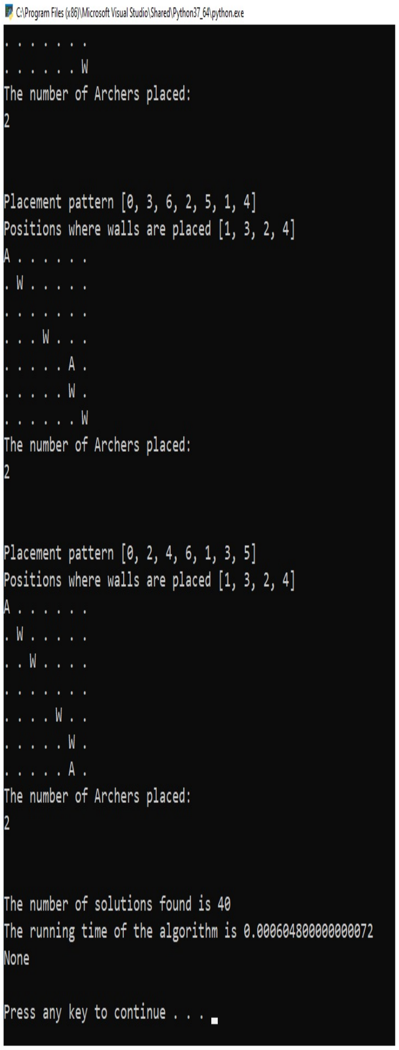
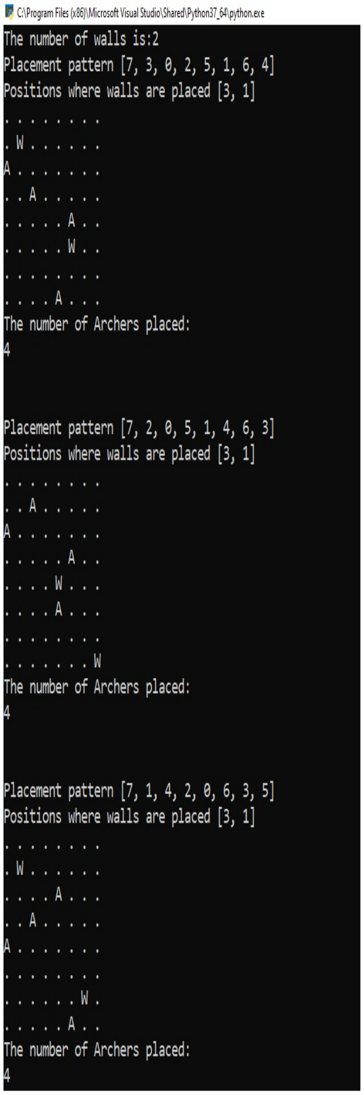

C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
. . . . . . .
. . . . . . W
The number of Archers placed:
2


Placement pattern [0, 3, 6, 2, 5, 1, 4]
Positions where walls are placed [1, 3, 2, 4]
A . . . . . .
. W . . . . .
. . . . . . .
. . . W . . .
. . . . . A .
. . . . . W .
. . . . . . W
The number of Archers placed:
2


Placement pattern [0, 2, 4, 6, 1, 3, 5]
Positions where walls are placed [1, 3, 2, 4]
A . . . . . .
. W . . . . .
. . W . . . .
. . . . . . .
. . . . W . .
. . . . . W .
. . . . . A .
The number of Archers placed:
2


The number of solutions found is 40
The running time of the algorithm is 0.000604800000000072
None

Press any key to continue . . .
```

5. fifth test(medium test size,grid size:8,walls placed on positions:3,1,,max number of archers is 4(chaged the max to see how it affects the solutions))


C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
The number of walls is:2
Placement pattern [7, 3, 0, 2, 5, 1, 6, 4]
Positions where walls are placed [3, 1]
. . . . . . . .
. W . . . . . .
A . . . . . . .
. . A . . . . .
. . . . . A . .
. . . . . W . .
. . . . . . . .
. . . . A . . .
The number of Archers placed:
4


Placement pattern [7, 2, 0, 5, 1, 4, 6, 3]
Positions where walls are placed [3, 1]
. . . . . . . .
. . A . . . . .
A . . . . . . .
. . . . . A . .
. . . . W . . .
. . . . A . . .
. . . . . . . .
. . . . . . . W
The number of Archers placed:
4


Placement pattern [7, 1, 4, 2, 0, 6, 3, 5]
Positions where walls are placed [3, 1]
. . . . . . . .
. W . . . . . .
. . . . A . . .
. . A . . . . .
A . . . . . . .
. . . . . . . .
. . . . . . W .
. . . . . A . .
The number of Archers placed:
4
```

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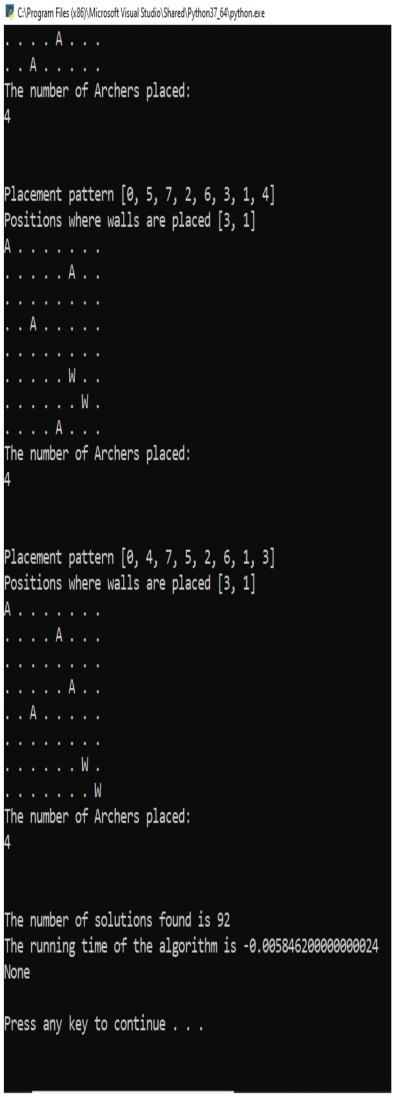
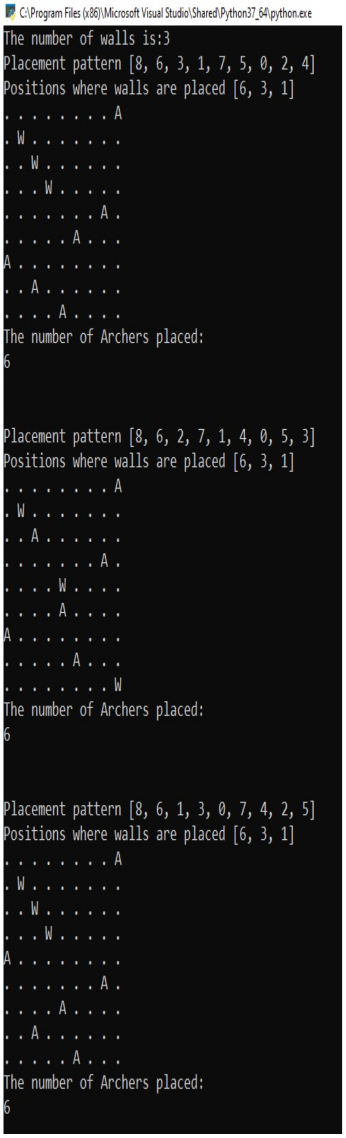

C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
. . . . A . . .
. . A . . . . .
The number of Archers placed:
4


Placement pattern [0, 5, 7, 2, 6, 3, 1, 4]
Positions where walls are placed [3, 1]
A . . . . . . .
. . . . . A . .
. . . . . . . .
. . A . . . . .
. . . . . . . .
. . . . . W . .
. . . . . . W .
. . . . A . . .
The number of Archers placed:
4


Placement pattern [0, 4, 7, 5, 2, 6, 1, 3]
Positions where walls are placed [3, 1]
A . . . . . . .
. . . . A . . .
. . . . . . . .
. . . . . A . .
. . A . . . . .
. . . . . . . .
. . . . . . W .
. . . . . . . W
The number of Archers placed:
4


The number of solutions found is 92
The running time of the algorithm is -0.005846200000000024
None

Press any key to continue . . .
```

6. sixth test(medium test size,grid size:9,walls placed on positions:6,3,1,from here I changed the maximum number of archers to match the size of the grid)



```
C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe
The number of walls is:3
Placement pattern [8, 6, 3, 1, 7, 5, 0, 2, 4]
Positions where walls are placed [6, 3, 1]
. . . . . . . . A
. W . . . . . . .
. . W . . . . . .
. . . W . . . . .
. . . . . . . A .
. . . . . A . . .
A . . . . . . . .
. . A . . . . . .
. . . . A . . . .
The number of Archers placed:
6


Placement pattern [8, 6, 2, 7, 1, 4, 0, 5, 3]
Positions where walls are placed [6, 3, 1]
. . . . . . . . A
. W . . . . . . .
. . A . . . . . .
. . . . . . . A .
. . . . W . . . .
. . . . A . . . .
A . . . . . . . .
. . . . . A . . .
. . . . . . . . W
The number of Archers placed:
6


Placement pattern [8, 6, 1, 3, 0, 7, 4, 2, 5]
Positions where walls are placed [6, 3, 1]
. . . . . . . . A
. W . . . . . . .
. . W . . . . . .
. . . W . . . . .
A . . . . . . . .
. . . . . . . A .
. . . . A . . . .
. . A . . . . . .
. . . . . A . . .
The number of Archers placed:
6
```

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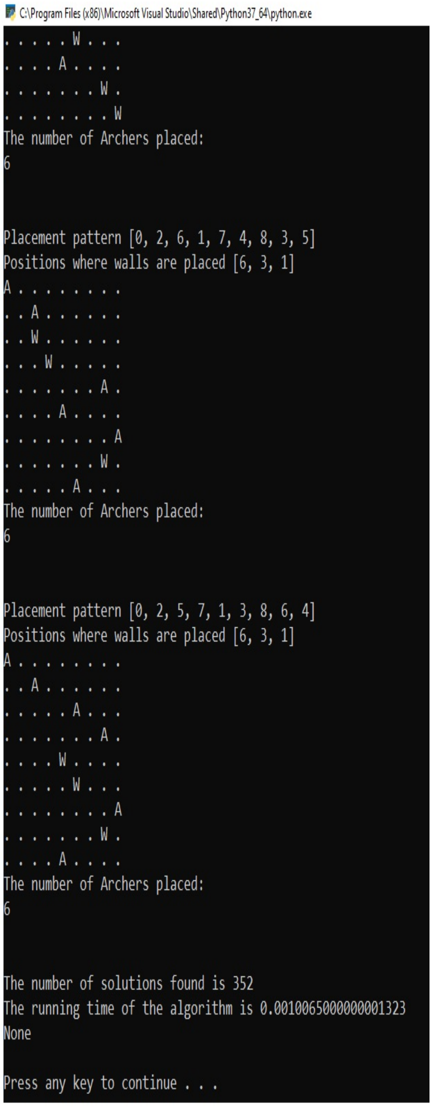
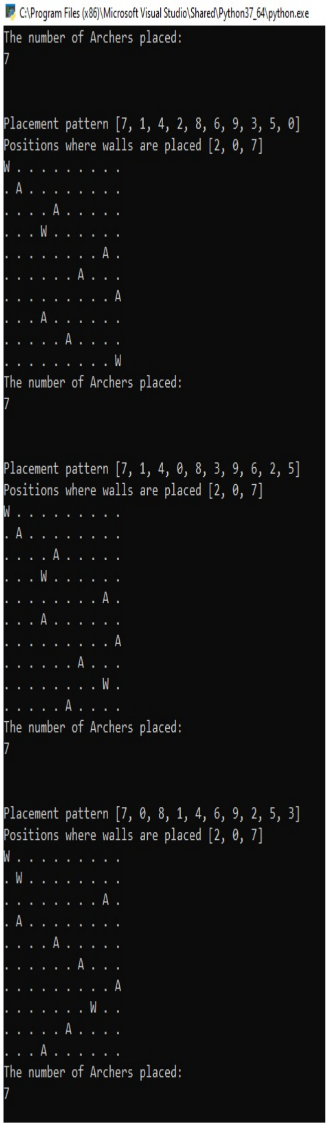


```
C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe
. . . . . W . . .
. . . . A . . . .
. . . . . . . W .
. . . . . . . . W
The number of Archers placed:
6


Placement pattern [0, 2, 6, 1, 7, 4, 8, 3, 5]
Positions where walls are placed [6, 3, 1]
A . . . . . . . .
. . A . . . . . .
. . W . . . . . .
. . . W . . . . .
. . . . . . . A .
. . . . A . . . .
. . . . . . . . A
. . . . . . . W .
. . . . . A . . .
The number of Archers placed:
6


Placement pattern [0, 2, 5, 7, 1, 3, 8, 6, 4]
Positions where walls are placed [6, 3, 1]
A . . . . . . . .
. . A . . . . . .
. . . . . A . . .
. . . . . . . A .
. . . . W . . . .
. . . . . W . . .
. . . . . . . . A
. . . . . . . W .
. . . . A . . . .
The number of Archers placed:
6


The number of solutions found is 352
The running time of the algorithm is 0.0010065000000001323
None

Press any key to continue . . .
```

7. seventh test(large test size,grid size:10,walls placed on positions:2,0,7,from here the running time begins to increase)


C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
The number of Archers placed:
7


Placement pattern [7, 1, 4, 2, 8, 6, 9, 3, 5, 0]
Positions where walls are placed [2, 0, 7]
W . . . . . . . . .
. A . . . . . . . .
. . . . A . . . . .
. . . W . . . . . .
. . . . . . . . A .
. . . . . . A . . .
. . . . . . . . . A
. . . A . . . . . .
. . . . . A . . . .
. . . . . . . . . W
The number of Archers placed:
7


Placement pattern [7, 1, 4, 0, 8, 3, 9, 6, 2, 5]
Positions where walls are placed [2, 0, 7]
W . . . . . . . . .
. A . . . . . . . .
. . . . A . . . . .
. . . W . . . . . .
. . . . . . . . A .
. . . A . . . . . .
. . . . . . . . . A
. . . . . . A . . .
. . . . . . . . W .
. . . . . A . . . .
The number of Archers placed:
7


Placement pattern [7, 0, 8, 1, 4, 6, 9, 2, 5, 3]
Positions where walls are placed [2, 0, 7]
W . . . . . . . . .
. W . . . . . . . .
. . . . . . . . A .
. A . . . . . . . .
. . . . A . . . . .
. . . . . . A . . .
. . . . . . . . . A
. . . . . . . W . .
. . . . . A . . . .
. . . A . . . . . .
The number of Archers placed:
7
```

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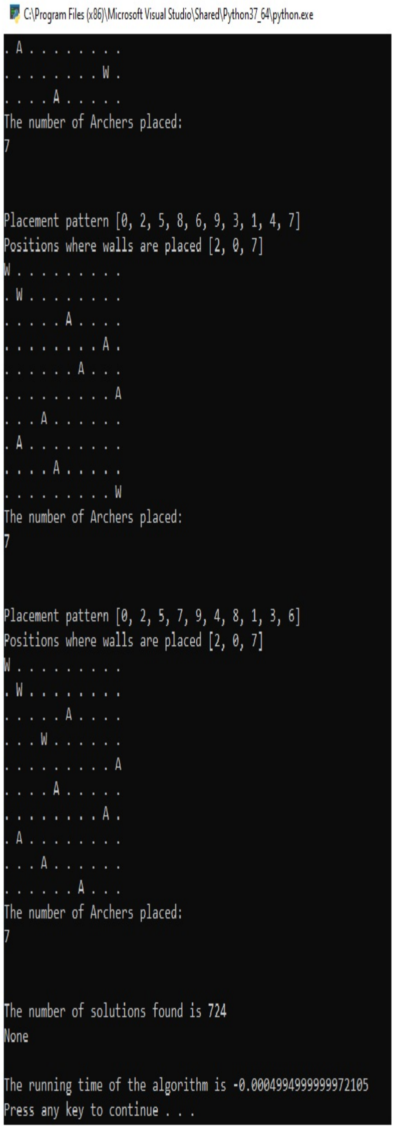
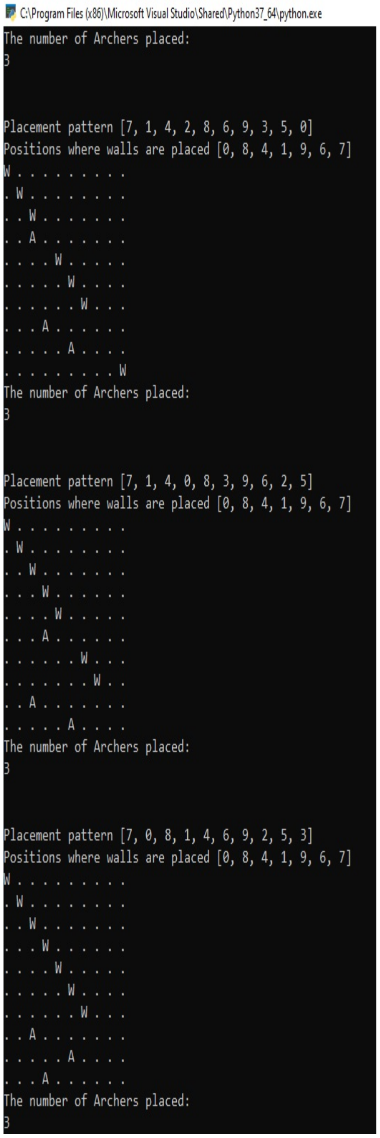

C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
. A . . . . . . . .
. . . . . . . . W .
. . . . A . . . . .
The number of Archers placed:
7


Placement pattern [0, 2, 5, 8, 6, 9, 3, 1, 4, 7]
Positions where walls are placed [2, 0, 7]
W . . . . . . . . .
. W . . . . . . . .
. . . . . A . . . .
. . . . . . . . A .
. . . . . . A . . .
. . . . . . . . . A
. . . A . . . . . .
. A . . . . . . . .
. . . . A . . . . .
. . . . . . . . . W
The number of Archers placed:
7


Placement pattern [0, 2, 5, 7, 9, 4, 8, 1, 3, 6]
Positions where walls are placed [2, 0, 7]
W . . . . . . . . .
. W . . . . . . . .
. . . . . A . . . .
. . . W . . . . . .
. . . . . . . . . A
. . . . A . . . . .
. . . . . . . . A .
. A . . . . . . . .
. . . A . . . . . .
. . . . . . A . . .
The number of Archers placed:
7


The number of solutions found is 724
None

The running time of the algorithm is -0.0004994999999972105
Press any key to continue . . .
```

8. eight test(large test size,grid size:10,walls placed on positions:0,8,4,1,9,6,7)



C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
The number of Archers placed:
3


Placement pattern [7, 1, 4, 2, 8, 6, 9, 3, 5, 0]
Positions where walls are placed [0, 8, 4, 1, 9, 6, 7]
W . . . . . . . . .
. W . . . . . . . .
. . W . . . . . . .
. . A . . . . . . .
. . . . W . . . . .
. . . . . W . . . .
. . . . . . W . . .
. . . A . . . . . .
. . . . . A . . . .
. . . . . . . . . W
The number of Archers placed:
3


Placement pattern [7, 1, 4, 0, 8, 3, 9, 6, 2, 5]
Positions where walls are placed [0, 8, 4, 1, 9, 6, 7]
W . . . . . . . . .
. W . . . . . . . .
. . W . . . . . . .
. . . W . . . . . .
. . . . W . . . . .
. . . A . . . . . .
. . . . . . W . . .
. . . . . . . W . .
. . A . . . . . . .
. . . . . A . . . .
The number of Archers placed:
3


Placement pattern [7, 0, 8, 1, 4, 6, 9, 2, 5, 3]
Positions where walls are placed [0, 8, 4, 1, 9, 6, 7]
W . . . . . . . . .
. W . . . . . . . .
. . W . . . . . . .
. . . W . . . . . .
. . . . W . . . . .
. . . . . W . . . .
. . . . . . W . . .
. . A . . . . . . .
. . . . . A . . . .
. . . A . . . . . .
The number of Archers placed:
3
```

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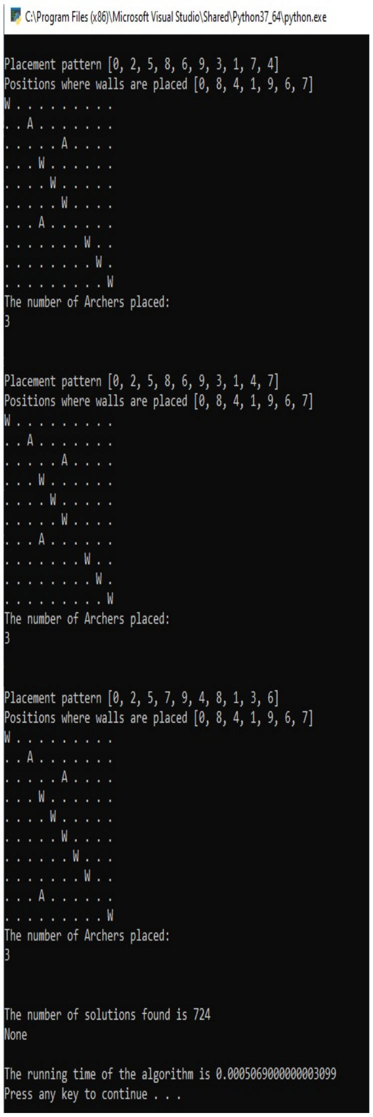
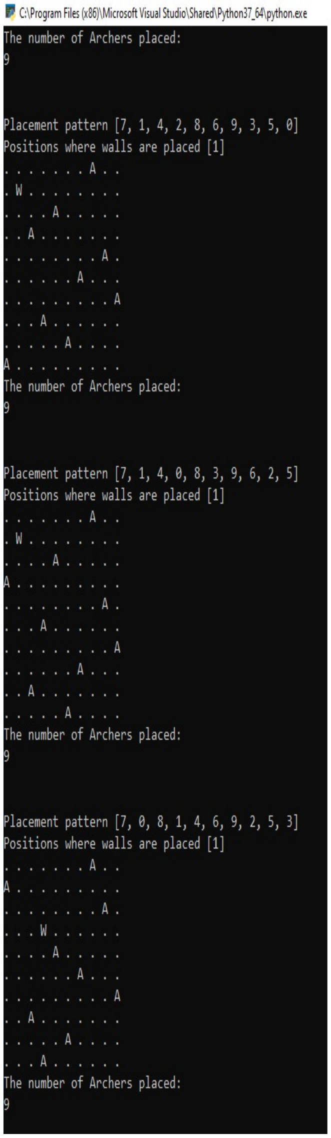


C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```

Placement pattern [0, 2, 5, 8, 6, 9, 3, 1, 7, 4]
Positions where walls are placed [0, 8, 4, 1, 9, 6, 7]
W . . . . . . . . .
. . A . . . . . . .
. . . . . A . . . .
. . . W . . . . . .
. . . . W . . . . .
. . . . . W . . . .
. . . A . . . . . .
. . . . . . . W . .
. . . . . . . . W .
. . . . . . . . . W
The number of Archers placed:
3


Placement pattern [0, 2, 5, 8, 6, 9, 3, 1, 4, 7]
Positions where walls are placed [0, 8, 4, 1, 9, 6, 7]
W . . . . . . . . .
. . A . . . . . . .
. . . . . A . . . .
. . . W . . . . . .
. . . . W . . . . .
. . . . . W . . . .
. . . A . . . . . .
. . . . . . . W . .
. . . . . . . . W .
. . . . . . . . . W
The number of Archers placed:
3


Placement pattern [0, 2, 5, 7, 9, 4, 8, 1, 3, 6]
Positions where walls are placed [0, 8, 4, 1, 9, 6, 7]
W . . . . . . . . .
. . A . . . . . . .
. . . . . A . . . .
. . . W . . . . . .
. . . . W . . . . .
. . . . . W . . . .
. . . . . . W . . .
. . . . . . . W . .
. . . A . . . . . .
. . . . . . . . . W
The number of Archers placed:
3


The number of solutions found is 724
None

The running time of the algorithm is 0.0005069000000003099
Press any key to continue . . .
```

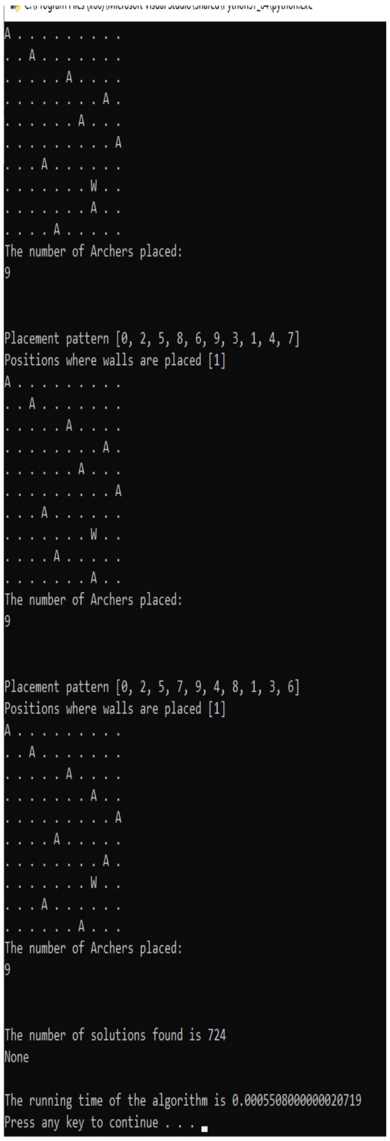
9. ninth test(large test size,grid size:10,walls placed on positions:1)



C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

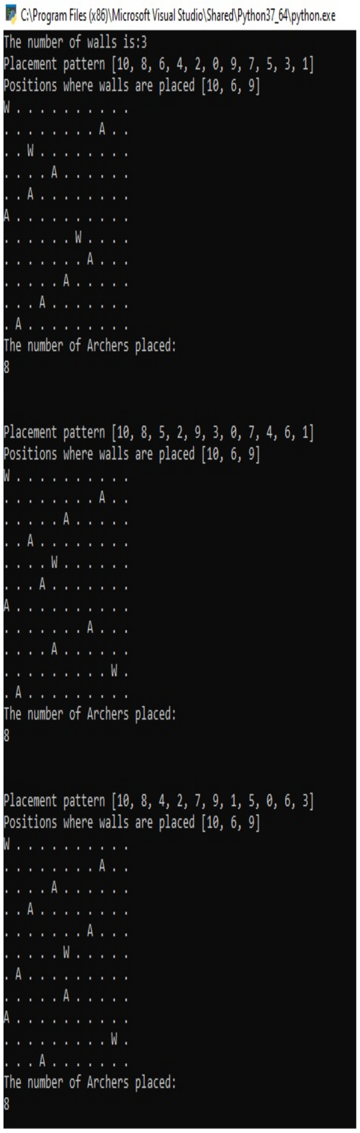
```
The number of Archers placed:
9


Placement pattern [7, 1, 4, 2, 8, 6, 9, 3, 5, 0]
Positions where walls are placed [1]
. . . . . . . A . .
. W . . . . . . . .
. . . . A . . . . .
. . A . . . . . . .
. . . . . . . . A .
. . . . . . A . . .
. . . . . . . . . A
. . . A . . . . . .
. . . . . A . . . .
A . . . . . . . . .
The number of Archers placed:
9


Placement pattern [7, 1, 4, 0, 8, 3, 9, 6, 2, 5]
Positions where walls are placed [1]
. . . . . . . A . .
. W . . . . . . . .
. . . . A . . . . .
A . . . . . . . . .
. . . . . . . . A .
. . . A . . . . . .
. . . . . . . . . A
. . . . . . A . . .
. . A . . . . . . .
. . . . . A . . . .
The number of Archers placed:
9


Placement pattern [7, 0, 8, 1, 4, 6, 9, 2, 5, 3]
Positions where walls are placed [1]
. . . . . . . A . .
A . . . . . . . . .
. . . . . . . . A .
. . . W . . . . . .
. . . . A . . . . .
. . . . . . A . . .
. . . . . . . . . A
. . A . . . . . . .
. . . . . A . . . .
. . . A . . . . . .
The number of Archers placed:
9
```

• • •



```
A . . . . . . . . .
. . A . . . . . . .
. . . . . A . . . .
. . . . . . . . A .
. . . . . . A . . .
. . . . . . . . . A
. . . A . . . . . .
. . . . . . . W . .
. . . . . . . A . .
. . . . A . . . . .
The number of Archers placed:
9


Placement pattern [0, 2, 5, 8, 6, 9, 3, 1, 4, 7]
Positions where walls are placed [1]
A . . . . . . . . .
. . A . . . . . . .
. . . . . A . . . .
. . . . . . . . A .
. . . . . . A . . .
. . . . . . . . . A
. . . A . . . . . .
. . . . . . . W . .
. . . . A . . . . .
. . . . . . . A . .
The number of Archers placed:
9


Placement pattern [0, 2, 5, 7, 9, 4, 8, 1, 3, 6]
Positions where walls are placed [1]
A . . . . . . . . .
. . A . . . . . . .
. . . . . A . . . .
. . . . . . . A . .
. . . . . . . . . A
. . . . A . . . . .
. . . . . . . . A .
. . . . . . . W . .
. . . A . . . . . .
. . . . . . A . . .
The number of Archers placed:
9


The number of solutions found is 724
None

The running time of the algorithm is 0.0005508000000020719
Press any key to continue . . .
```

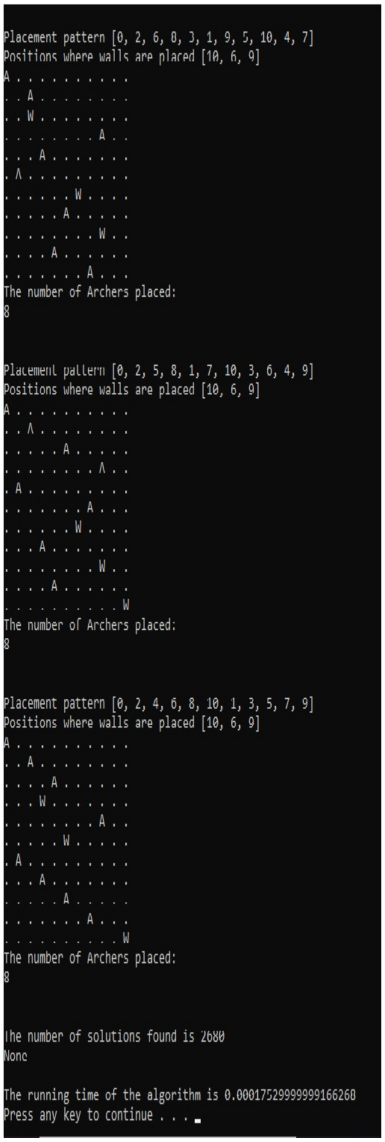
10. tenth test(large test size,grid size:10,walls placed on positions:10,6,9)



C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe

```
The number of walls is:3
Placement pattern [10, 8, 6, 4, 2, 0, 9, 7, 5, 3, 1]
Positions where walls are placed [10, 6, 9]
W . . . . . . . . . .
. . . . . . . . A . .
. . W . . . . . . . .
. . . . A . . . . . .
. . A . . . . . . . .
A . . . . . . . . . .
. . . . . . W . . . .
. . . . . . . A . . .
. . . . . A . . . . .
. . . A . . . . . . .
. A . . . . . . . . .
The number of Archers placed:
8


Placement pattern [10, 8, 5, 2, 9, 3, 0, 7, 4, 6, 1]
Positions where walls are placed [10, 6, 9]
W . . . . . . . . . .
. . . . . . . . A . .
. . . . . A . . . . .
. . A . . . . . . . .
. . . . W . . . . . .
. . . A . . . . . . .
A . . . . . . . . . .
. . . . . . . A . . .
. . . . A . . . . . .
. . . . . . . . . W .
. A . . . . . . . . .
The number of Archers placed:
8


Placement pattern [10, 8, 4, 2, 7, 9, 1, 5, 0, 6, 3]
Positions where walls are placed [10, 6, 9]
W . . . . . . . . . .
. . . . . . . . A . .
. . . . A . . . . . .
. . A . . . . . . . .
. . . . . . . A . . .
. . . . . W . . . . .
. A . . . . . . . . .
. . . . . A . . . . .
A . . . . . . . . . .
. . . . . . . . . W .
. . . A . . . . . . .
The number of Archers placed:
8
```

• • •



```
Placement pattern [0, 2, 6, 8, 3, 1, 9, 5, 10, 4, 7]
Positions where walls are placed [10, 6, 9]
A . . . . . . . . . .
. . A . . . . . . . .
. . W . . . . . . . .
. . . . . . . . A . .
. . . A . . . . . . .
. A . . . . . . . . .
. . . . . . W . . . .
. . . . . A . . . . .
. . . . . . . . W . .
. . . . A . . . . . .
. . . . . . . A . . .
The number of Archers placed:
8


Placement pattern [0, 2, 5, 8, 1, 7, 10, 3, 6, 4, 9]
Positions where walls are placed [10, 6, 9]
A . . . . . . . . . .
. . A . . . . . . . .
. . . . . A . . . . .
. . . . . . . . A . .
. A . . . . . . . . .
. . . . . . . A . . .
. . . . . . W . . . .
. . . A . . . . . . .
. . . . . . . . W . .
. . . . A . . . . . .
. . . . . . . . . . W
The number of Archers placed:
8


Placement pattern [0, 2, 4, 6, 8, 10, 1, 3, 5, 7, 9]
Positions where walls are placed [10, 6, 9]
A . . . . . . . . . .
. . A . . . . . . . .
. . . . A . . . . . .
. . . W . . . . . . .
. . . . . . . . A . .
. . . . . W . . . . .
. A . . . . . . . . .
. . . A . . . . . . .
. . . . . A . . . . .
. . . . . . . A . . .
. . . . . . . . . . W
The number of Archers placed:
8


The number of solutions found is 2680
None

The running time of the algorithm is 0.00017529999999166268
Press any key to continue . . .
```

2 Conclusions

As we can see from the 10 tests that we made,the algorithm's data output is corresponding to how I implemented the problem.

We can observe that the solutions found and the running time of the algorithm(which you can see in each picture at the bottom) get bigger the more we have a larger grid.

The output data sets design help us to both visualise the solution(by printing each grid with the Archers and Walls placed),but to also see the logic behind it,having displayed both the list which contains the positions of the archers as well as the position of the walls.