

Розрахунково-графічна робота
Тема: Increase Solved, Decrease Left
Варіант: 25, 30
Виконав: Третяк Олександр Сергійович

Третяк Олександр

КС-231 |

25

30

Розрахункова частина:

Завдання 1 (2 бали) Insertion sort.

In order to perform this task, we will check each element of the array with the next one and if it is smaller than the previous changes their places.

Step-by-Step Execution of Insertion Sort:

1. Initial array:

55, 2, 66, 88, 8, 33, 0, 99, 11, 6, 22, 4, 77, 44

2. Iteration i=1:

Array is already sorted until element 55.

Now, we compare 2 with 55 and shift 55 to the right to insert 2.

Array before action:



55, 2, 66, 88, 8, 33, 0, 99, 11, 6, 22, 4, 77, 44

Array after action:

2, 55, 66, 88, 8, 33, 0, 99, 11, 6, 22, 4, 77, 44

3. Iteration i=2:

Elements 2 and 55 are sorted. Compare 66 with 55; no shift is needed.

Array before action:

2, **55, 66**, 88, 8, 33, 0, 99, 11, 6, 22, 4, 77, 44

Array after action:

2, 55, 66, 88, 8, 33, 0, 99, 11, 6, 22, 4, 77, 44

4. Iteration i=3:

Elements 2, 55, and 66 are sorted. Compare 88 with 66; no shift is needed.

Array before action:

2, 55, **66, 88**, 8, 33, 0, 99, 11, 6, 22, 4, 77, 44

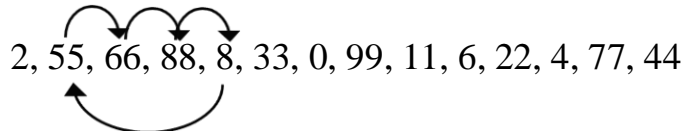
Array after action:

2, 55, 66, 88, 8, 33, 0, 99, 11, 6, 22, 4, 77, 44

5. Iteration i=4:

Elements 2, 55, 66, and 88 are sorted. Insert 8 into its position: shift 88, 66, and 55 to the right.

Array before action:



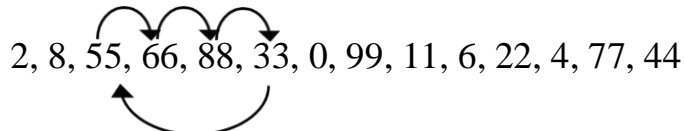
Array after action:

2, 8, 55, 66, 88, 33, 0, 99, 11, 6, 22, 4, 77, 44

6. Iteration i=5:

Insert 33 by shifting 88, 66, and 55 to the right.

Array before action:



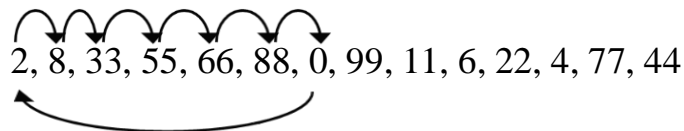
Array after action:

2, 8, 33, 55, 66, 88, 0, 99, 11, 6, 22, 4, 77, 44

7. Iteration i=6:

Insert 0 by shifting all elements to the right.

Array before action:



Array after action:

0, 2, 8, 33, 55, 66, 88, 99, 11, 6, 22, 4, 77, 44

8. Iteration i=7:

99 is already in the correct position.

Array before action:

0, 2, 8, 33, 55, 66, 88, **99**, 11, 6, 22, 4, 77, 44

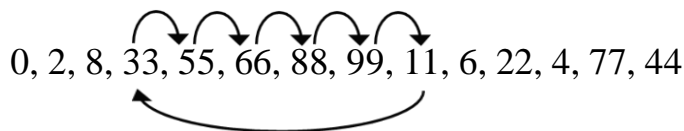
Array after action:

0, 2, 8, 33, 55, 66, 88, 99, 11, 6, 22, 4, 77, 44

9. Iteration i=8:

Insert 11 by shifting 99, 88, 66, 55, and 33 to the right.

Array before action:



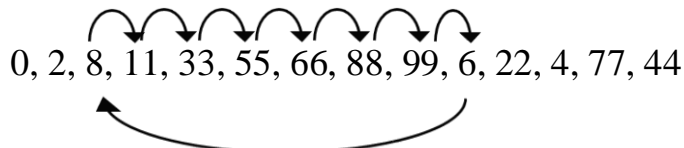
Array after action:

0, 2, 8, 11, 33, 55, 66, 88, 99, 6, 22, 4, 77, 44

10. Iteration i=9:

Insert 6 by shifting 99, 88, 66, 55, 33, 11 and 8 to the right.

Array before action:



Array after action:

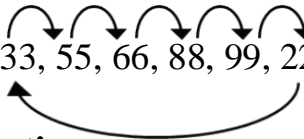
0, 2, 6, 8, 11, 33, 55, 66, 88, 99, 22, 4, 77, 44

11.Iteration i=10:

Insert 22 by shifting 99, 88, 66, 55 and 33 to the right.

Array before action:

0, 2, 6, 8, 11, 33, 55, 66, 88, 99, 22, 4, 77, 44



Array after action:

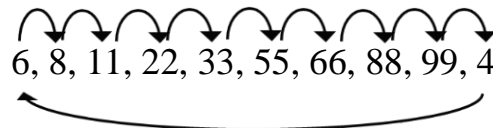
0, 2, 6, 8, 11, 22, 33, 55, 66, 88, 99, 4, 77, 44

12.Iteration i=11:

Insert 4 by shifting 99, 88, 66, 55, 33, 22, 11, 8, and 6 to the right.

Array before action:

0, 2, 6, 8, 11, 22, 33, 55, 66, 88, 99, 4, 77, 44



Array after action:

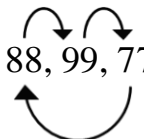
0, 2, 4, 6, 8, 11, 22, 33, 55, 66, 88, 99, 77, 44

13.Iteration i=12:

Insert 77 by shifting 99 and 88 to the right.

Array before action:

0, 2, 4, 6, 8, 11, 22, 33, 55, 66, 88, 99, 77, 44



Array after action:

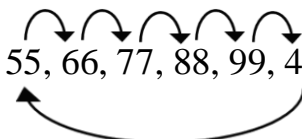
0, 2, 4, 6, 8, 11, 22, 33, 55, 66, 77, 88, 99, 44

14.Iteration i=13:

Insert 44 by shifting 99, 88, 77, 66 and 55 to the right.

Array before action:

0, 2, 4, 6, 8, 11, 22, 33, 55, 66, 77, 88, 99, 44



Final Sorted Array:

0, 2, 4, 6, 8, 11, 22, 33, 44, 55, 66, 77, 88, 99

Summary

Total moves: 46

Total insertions: 13

Task completed

Завдання 2 (3 бали) Apply manually “Exponentiation by Squaring” algorithm.

In this task, we will calculate $(5993^{6016}) \bmod 6161$ using the **Exponentiation by Squaring** algorithm. This approach allows us to compute large powers efficiently by repeatedly squaring the base and reducing the exponent. If the exponent is even, we square the base and halve the exponent; if it is odd, we multiply the result by the base, reduce the exponent by one, and continue. We repeat these steps until the exponent becomes zero, giving us the final result.

Step-by-Step Execution of Exponentiation by Squaring

1. Before loop start:

- Initial values are $a=5993$, $b=6016$, $c=6161$, $res=1$.

2. Iteration 1 (b is even):

- Since b is even, we calculate $a=(a \times a) \bmod c$.
- **Comment:** Squaring a and halving b as b is even.
- New values: $a=902$, $b=3008$, $res=1$.

3. Iteration 2 (b is even):

- Again, b is even, so we square a .
- **Comment:** Squaring a and halving b again as b remains even.
- New values: $a=4463$, $b=1504$, $res=1$.

4. Iteration 3 (b is even):

- b is still even, so we perform the same squaring operation.
- New values: $a=4322$, $b=752$, $res=1$.

5. Iteration 4 (b is even):

- Continuing with b even, we square a .
- New values: $a=1954$, $b=376$, $res=1$.

6. Iteration 5 (b is even):

- b remains even, so we square a .
- New values: $a=1558$, $b=188$, $res=1$.

7. Iteration 6 (b is even):

- Square a as b is still even.
- New values: $a=1412$, $b=94$, $res=1$.

8. Iteration 7 (b is even):

- Another even b iteration, so square a .
- New values: $a=5161$, $b=47$, $res=1$.

9. Iteration 8 (b is odd):

- Since b is now odd, we multiply res by a and perform modulo c .
- **Comment:** As b is odd, multiply res by a and apply modulo.
- New values: $res=5161$.
- Then, square a and halve b .
- New values: $a=4234$, $b=23$.

10. Iteration 9 (b is odd):

- b is odd, so multiply res by a and apply modulo.
- **Comment:** Repeating odd b steps: update res and square a .
- New values: $res=1364$.
- Square a and halve b .
- New values: $a=6015$, $b=11$.

11. Iteration 10 (b is odd):

- Multiply res by a and apply modulo as b is odd.
- New values: $res=2391$.
- Square a and halve b .
- New values: $a=3241$, $b=5$.

12. Iteration 11 (b is odd):

- Multiply res by a and apply modulo.
- New values: $res=1663$.
- Square a and halve b .
- New values: $a=2427$, $b=2$.

13. Iteration 12 (b is even):

- With b even, square a .
- New values: $a=5953$, $b=1$, $res=1663$.

14. Iteration 13 (b is odd):

- Finally, multiply res by a and apply modulo as b is odd.
- New values: $res=1631$.
- b becomes 0, ending the algorithm.

Final Result

After all iterations, the result is:

$$(5993^{6016}) \bmod 6161 = 1631$$

Task completed