# Q1

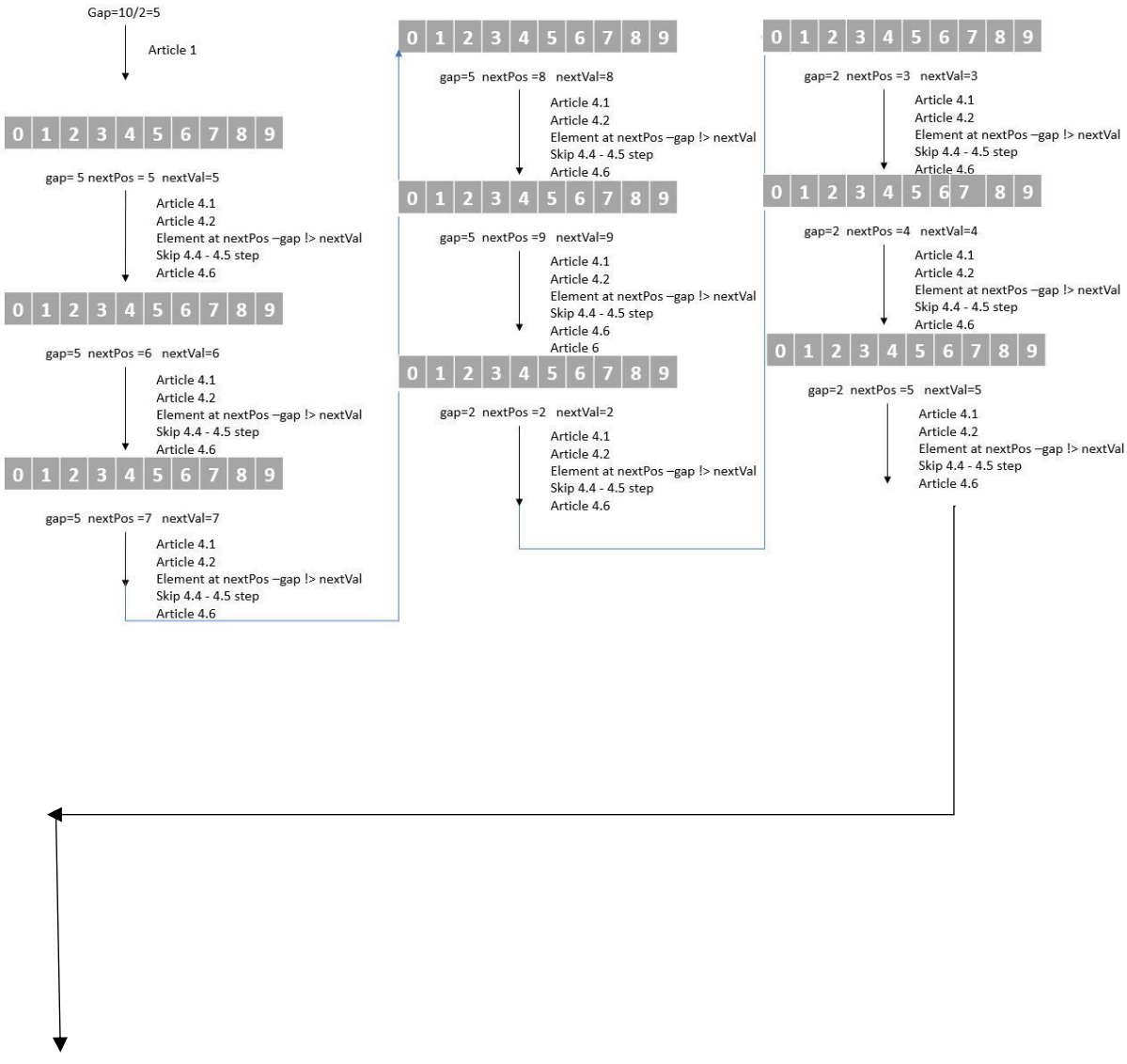
## SHELL SORT

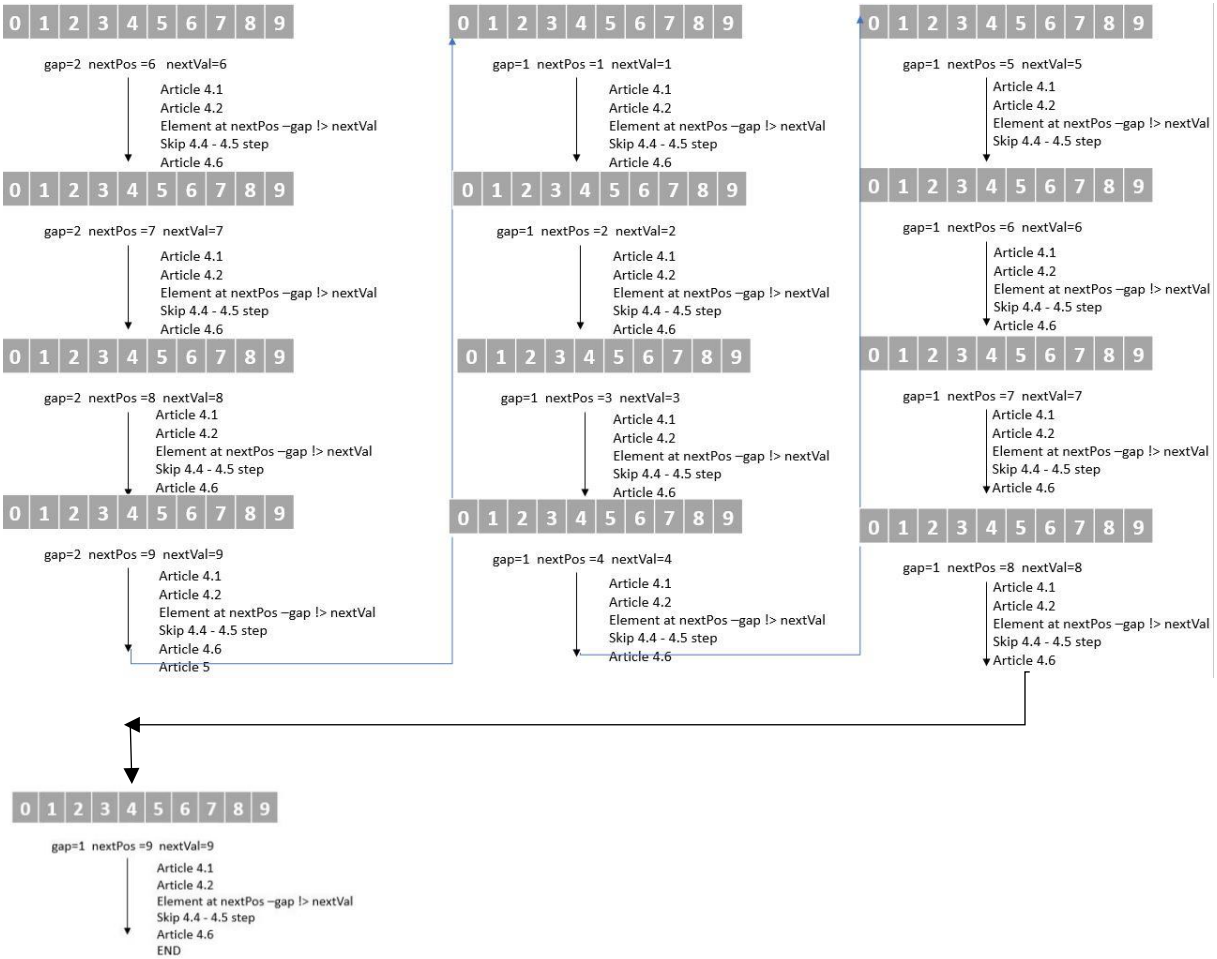
### SHELL SORT ALGORİTHM

1 Set the initial value of gap to n / 2
2. while gap > 0
3. for each array element from position gap to the last element
4.1. nextPos is the position of the element to insert
4.2 Save the value of the element to insert in nextVal
4.3 while nextPos > gap and the element at nextPos –gap > nextVal
4.4 Shift the element at nextPos –gap to position nextPos
4.5 Decrement nextPosby gap
4.6 Insert nextVal at nextPos
5. if gap is 2, set it to 1
6. else gap = gap / 2.2

### EXAMPLE 1

A=[0,1,2,3,4,5,6,7,8,9]

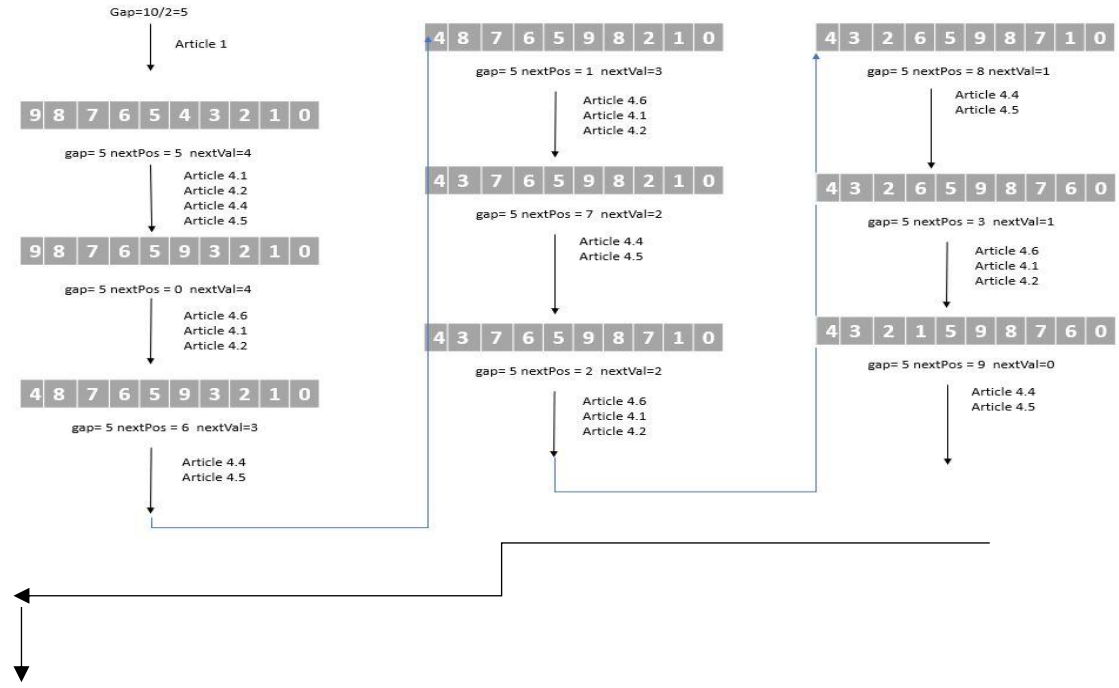


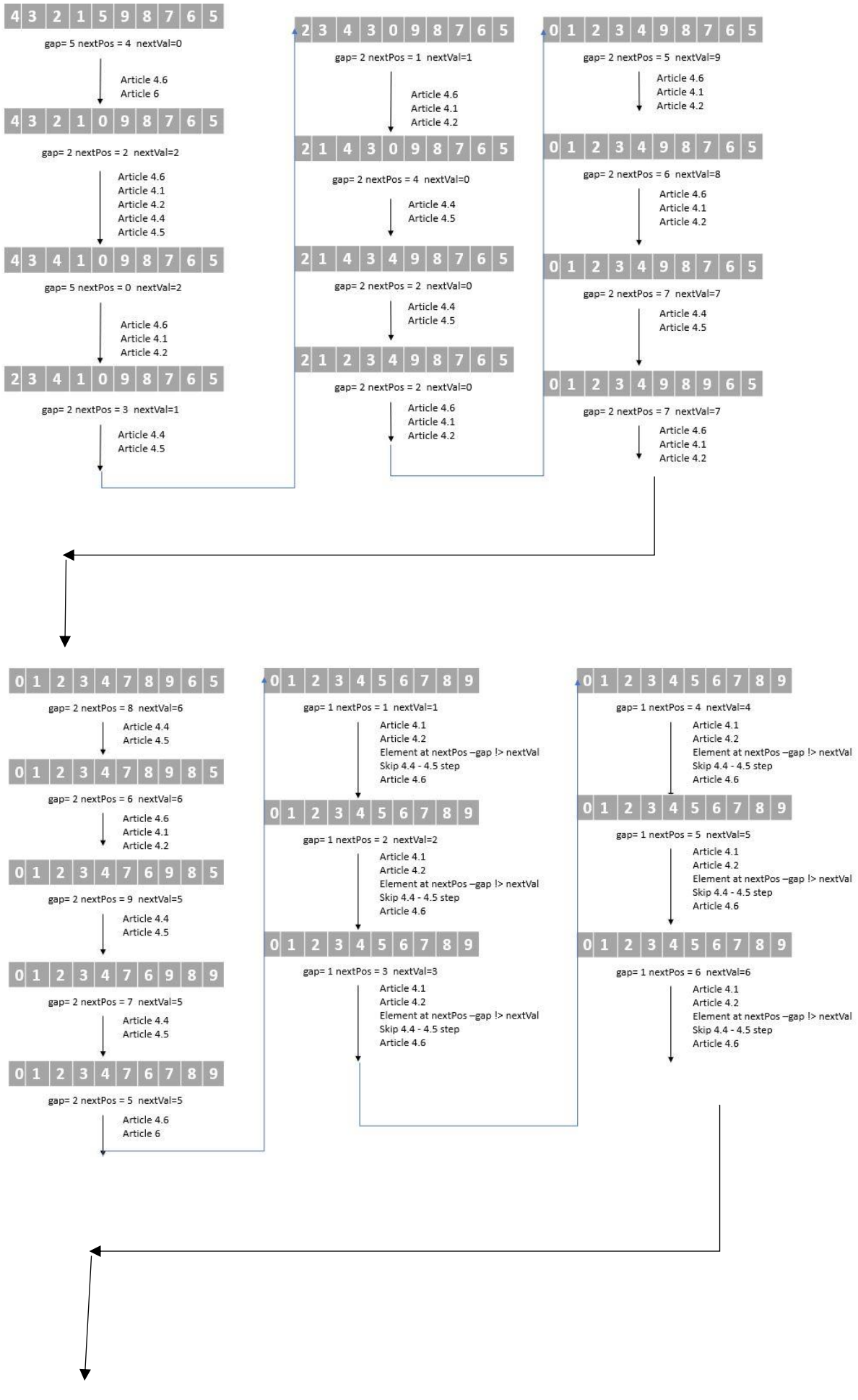


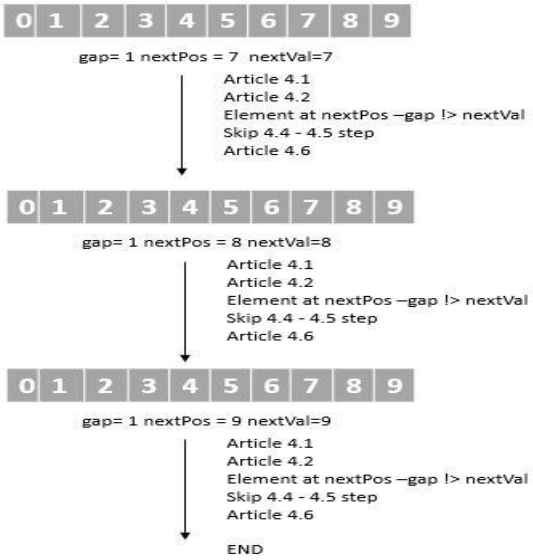

In this example there were 22 comparisons and no displacement.

## EXAMPLE 2

B=[9,8,7,6,5,4,3,2,1,0]



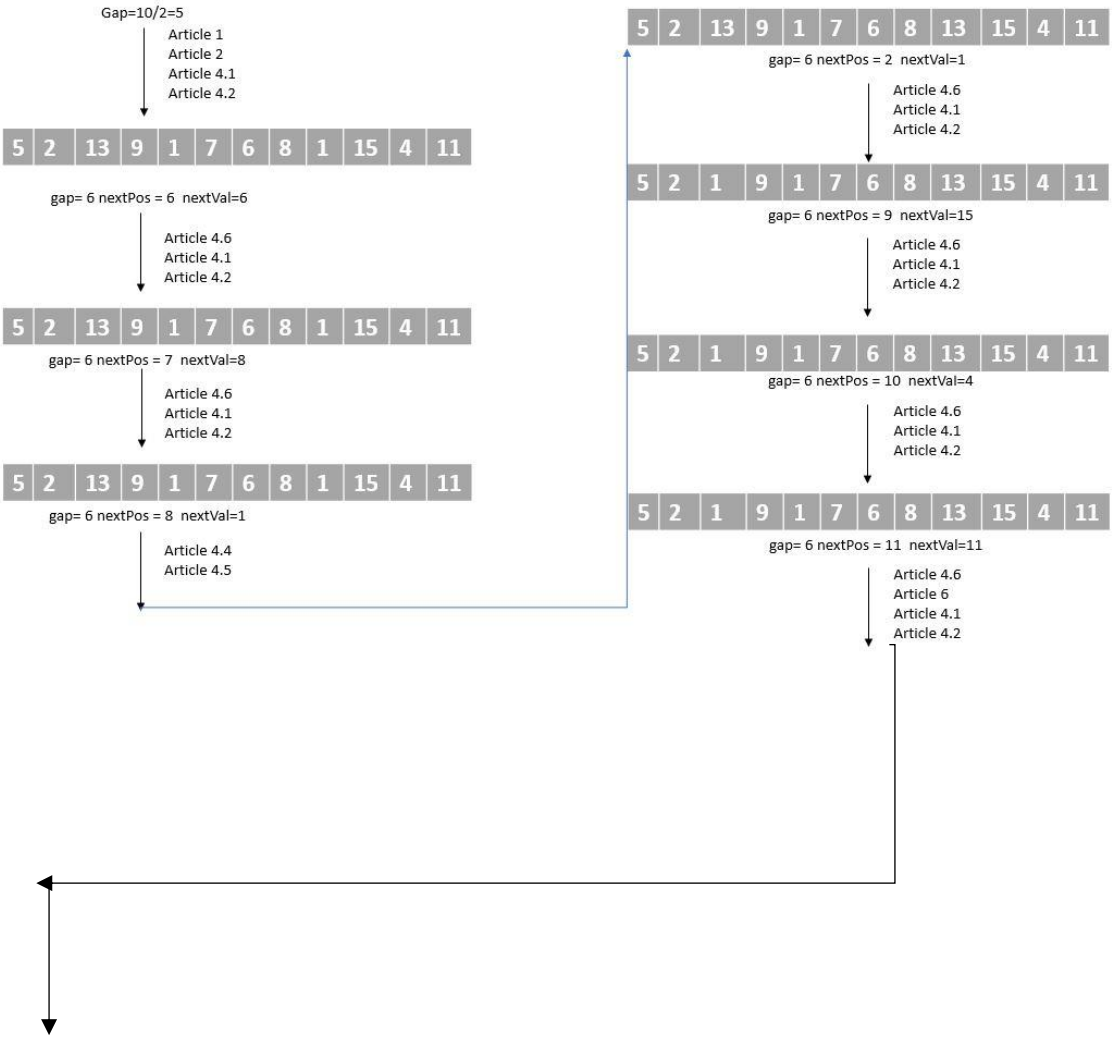

4 3 2 1 5 9 8 7 6 5
gap= 5 nextPos = 4 nextVal=0
Article 4.6
Article 6
4 3 2 1 0 9 8 7 6 5
gap= 2 nextPos = 2 nextVal=2
Article 4.6
Article 4.1
Article 4.2
Article 4.4
Article 4.5
4 3 4 1 0 9 8 7 6 5
gap= 5 nextPos = 0 nextVal=2
Article 4.6
Article 4.1
Article 4.2
2 3 4 1 0 9 8 7 6 5
gap= 2 nextPos = 3 nextVal=1
Article 4.4
Article 4.5
2 3 4 3 0 9 8 7 6 5
gap= 2 nextPos = 1 nextVal=1
Article 4.6
Article 4.1
Article 4.2
2 1 4 3 0 9 8 7 6 5
gap= 2 nextPos = 4 nextVal=0
Article 4.4
Article 4.5
2 1 4 3 4 9 8 7 6 5
gap= 2 nextPos = 2 nextVal=0
Article 4.4
Article 4.5
2 1 2 3 4 9 8 7 6 5
gap= 2 nextPos = 2 nextVal=0
Article 4.6
Article 4.1
Article 4.2
0 1 2 3 4 9 8 7 6 5
gap= 2 nextPos = 5 nextVal=9
Article 4.6
Article 4.1
Article 4.2
0 1 2 3 4 9 8 7 6 5
gap= 2 nextPos = 6 nextVal=8
Article 4.6
Article 4.1
Article 4.2
0 1 2 3 4 9 8 7 6 5
gap= 2 nextPos = 7 nextVal=7
Article 4.4
Article 4.5
0 1 2 3 4 9 8 9 6 5
gap= 2 nextPos = 7 nextVal=7
Article 4.6
Article 4.1
Article 4.2
0 1 2 3 4 7 8 9 6 5
gap= 2 nextPos = 8 nextVal=6
Article 4.4
Article 4.5
0 1 2 3 4 7 8 9 8 5
gap= 2 nextPos = 6 nextVal=6
Article 4.6
Article 4.1
Article 4.2
0 1 2 3 4 7 6 9 8 5
gap= 2 nextPos = 9 nextVal=5
Article 4.4
Article 4.5
0 1 2 3 4 7 6 9 8 9
gap= 2 nextPos = 7 nextVal=5
Article 4.4
Article 4.5
0 1 2 3 4 7 6 7 8 9
gap= 2 nextPos = 5 nextVal=5
Article 4.6
Article 6
0 1 2 3 4 5 6 7 8 9
gap= 1 nextPos = 1 nextVal=1
Article 4.1
Article 4.2
Element at nextPos –gap !> nextVal
Skip 4.4 - 4.5 step
Article 4.6
0 1 2 3 4 5 6 7 8 9
gap= 1 nextPos = 2 nextVal=2
Article 4.1
Article 4.2
Element at nextPos –gap !> nextVal
Skip 4.4 - 4.5 step
Article 4.6
0 1 2 3 4 5 6 7 8 9
gap= 1 nextPos = 3 nextVal=3
Article 4.1
Article 4.2
Element at nextPos –gap !> nextVal
Skip 4.4 - 4.5 step
Article 4.6
0 1 2 3 4 5 6 7 8 9
gap= 1 nextPos = 4 nextVal=4
Article 4.1
Article 4.2
Element at nextPos –gap !> nextVal
Skip 4.4 - 4.5 step
Article 4.6
0 1 2 3 4 5 6 7 8 9
gap= 1 nextPos = 5 nextVal=5
Article 4.1
Article 4.2
Element at nextPos –gap !> nextVal
Skip 4.4 - 4.5 step
Article 4.6
0 1 2 3 4 5 6 7 8 9
gap= 1 nextPos = 6 nextVal=6
Article 4.1
Article 4.2
Element at nextPos –gap !> nextVal
Skip 4.4 - 4.5 step
Article 4.6

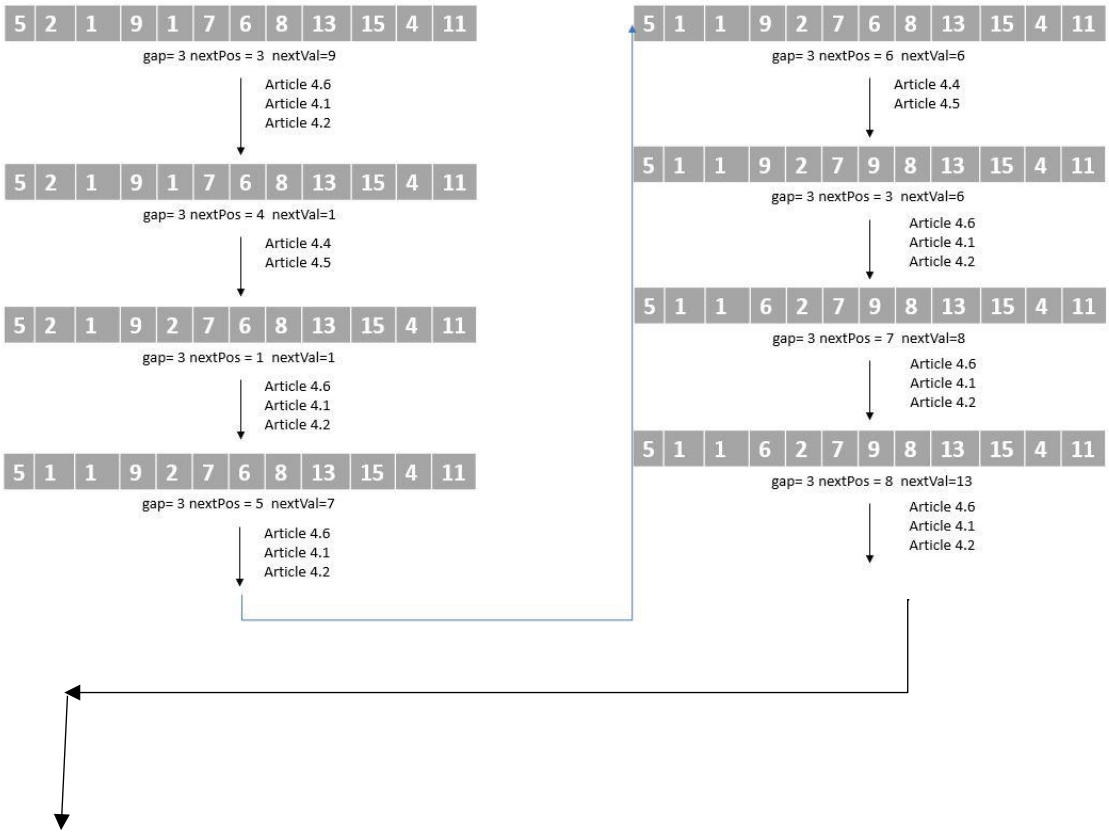


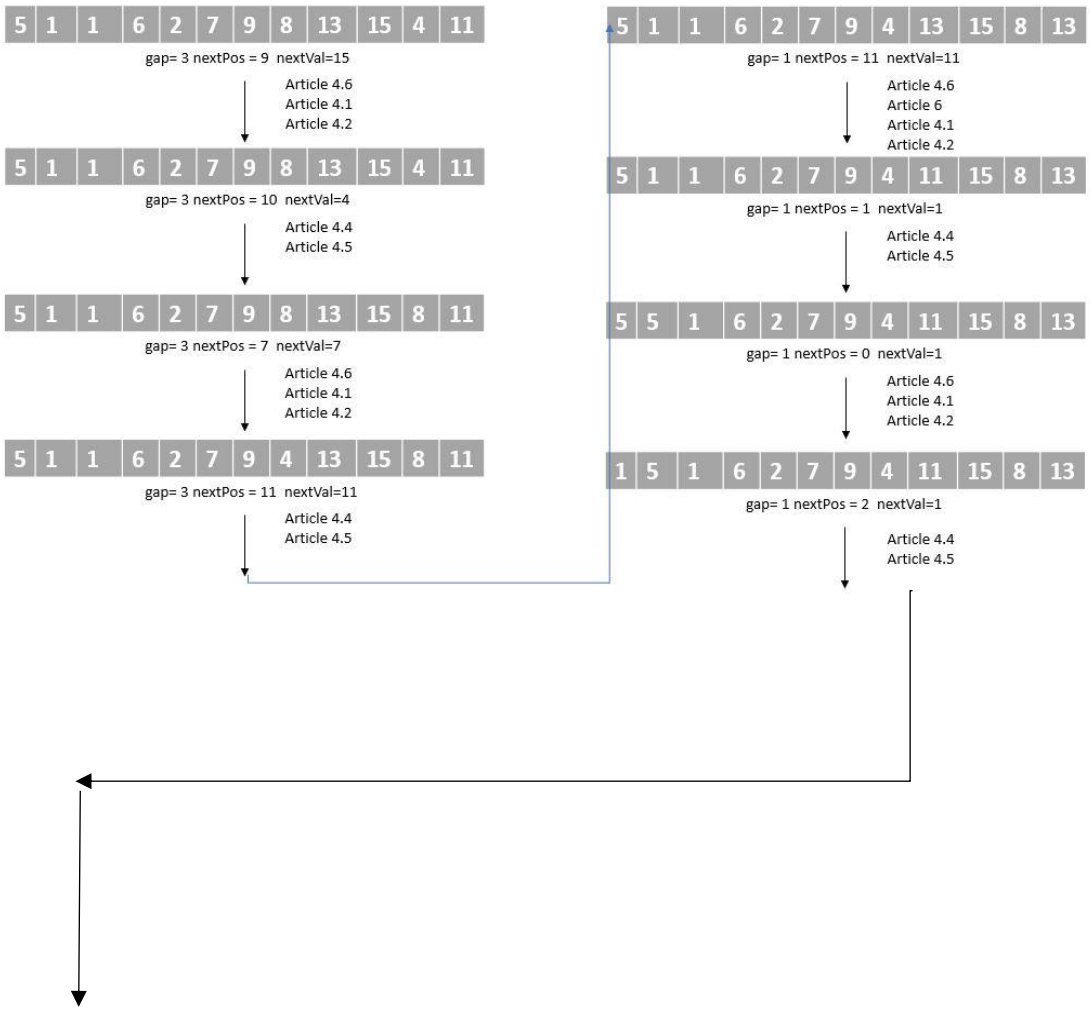

In this example there were 35 comparisons and 24 displacement.

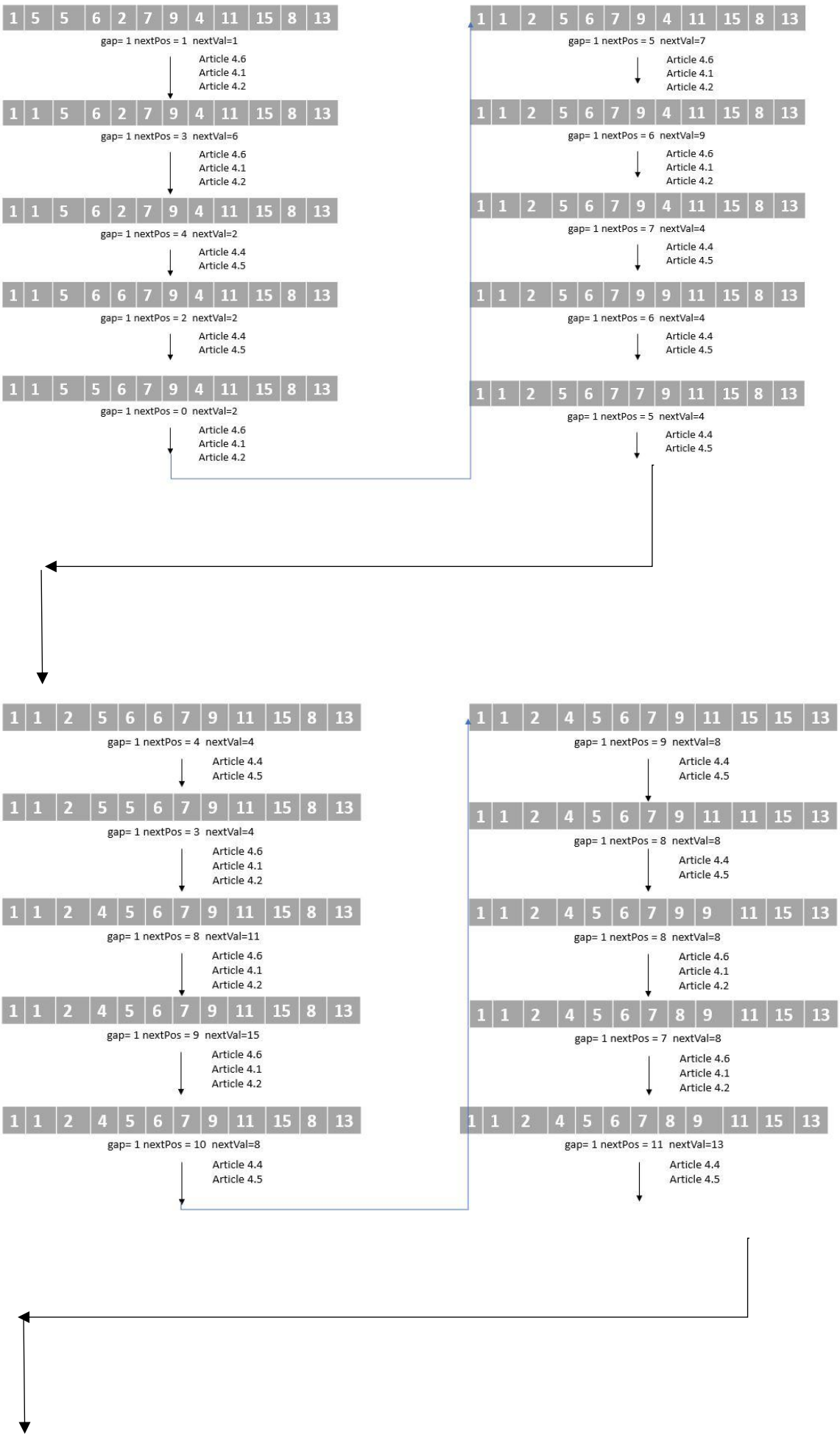
## EXAMPLE 3

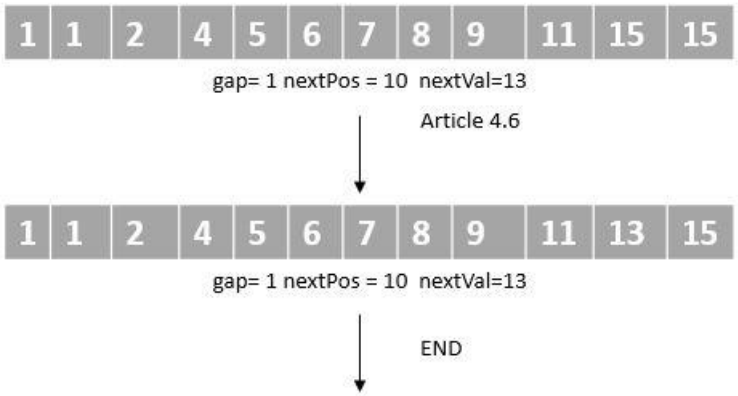
C=[ 5, 2, 13, 9, 1, 7, 6, 8, 1, 15, 4, 11]




5 2 1 9 1 7 6 8 13 15 4 11
gap= 3 nextPos = 3 nextVal=9
Article 4.6
Article 4.1
Article 4.2
5 2 1 9 1 7 6 8 13 15 4 11
gap= 3 nextPos = 4 nextVal=1
Article 4.4
Article 4.5
5 2 1 9 2 7 6 8 13 15 4 11
gap= 3 nextPos = 1 nextVal=1
Article 4.6
Article 4.1
Article 4.2
5 1 1 9 2 7 6 8 13 15 4 11
gap= 3 nextPos = 5 nextVal=7
Article 4.6
Article 4.1
Article 4.2
5 1 1 9 2 7 6 8 13 15 4 11
gap= 3 nextPos = 6 nextVal=6
Article 4.4
Article 4.5
5 1 1 9 2 7 9 8 13 15 4 11
gap= 3 nextPos = 3 nextVal=6
Article 4.6
Article 4.1
Article 4.2
5 1 1 6 2 7 9 8 13 15 4 11
gap= 3 nextPos = 7 nextVal=8
Article 4.6
Article 4.1
Article 4.2
5 1 1 6 2 7 9 8 13 15 4 11
gap= 3 nextPos = 8 nextVal=13
Article 4.6
Article 4.1
Article 4.2


5 1 1 6 2 7 9 8 13 15 4 11
gap= 3 nextPos = 9 nextVal=15
Article 4.6
Article 4.1
Article 4.2
5 1 1 6 2 7 9 8 13 15 4 11
gap= 3 nextPos = 10 nextVal=4
Article 4.4
Article 4.5
5 1 1 6 2 7 9 8 13 15 8 11
gap= 3 nextPos = 7 nextVal=7
Article 4.6
Article 4.1
Article 4.2
5 1 1 6 2 7 9 4 13 15 8 11
gap= 3 nextPos = 11 nextVal=11
Article 4.4
Article 4.5
5 1 1 6 2 7 9 4 13 15 8 13
gap= 1 nextPos = 11 nextVal=11
Article 4.6
Article 6
Article 4.1
Article 4.2
5 1 1 6 2 7 9 4 11 15 8 13
gap= 1 nextPos = 1 nextVal=1
Article 4.4
Article 4.5
5 5 1 6 2 7 9 4 11 15 8 13
gap= 1 nextPos = 0 nextVal=1
Article 4.6
Article 4.1
Article 4.2
1 5 1 6 2 7 9 4 11 15 8 13
gap= 1 nextPos = 2 nextVal=1
Article 4.4
Article 4.5

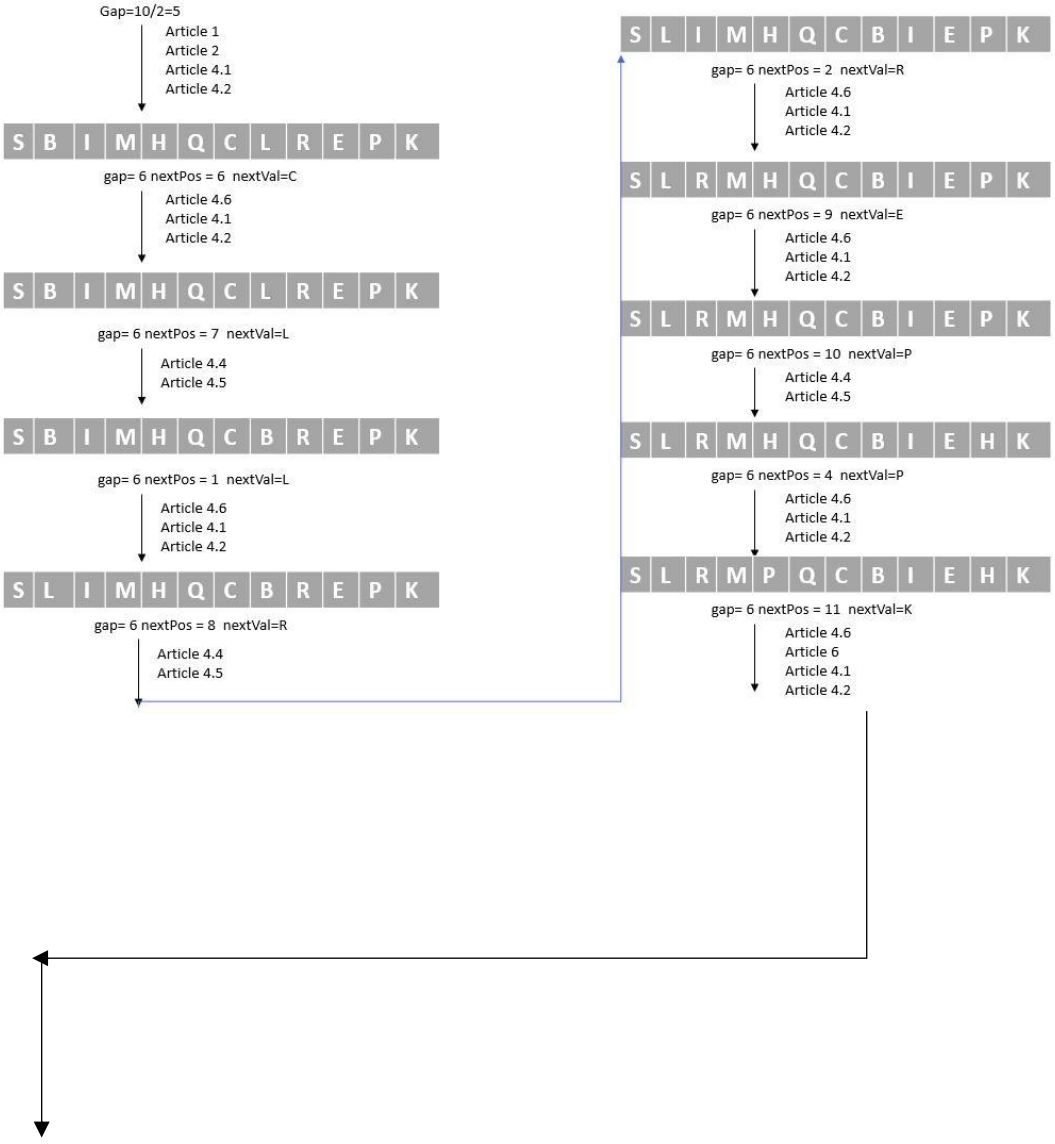

1 5 5 6 2 7 9 4 11 15 8 13
gap= 1 nextPos = 1 nextVal=1
Article 4.6
Article 4.1
Article 4.2
1 1 5 6 2 7 9 4 11 15 8 13
gap= 1 nextPos = 3 nextVal=6
Article 4.6
Article 4.1
Article 4.2
1 1 5 6 2 7 9 4 11 15 8 13
gap= 1 nextPos = 4 nextVal=2
Article 4.4
Article 4.5
1 1 5 6 6 7 9 4 11 15 8 13
gap= 1 nextPos = 2 nextVal=2
Article 4.4
Article 4.5
1 1 5 5 6 7 9 4 11 15 8 13
gap= 1 nextPos = 0 nextVal=2
Article 4.6
Article 4.1
Article 4.2
1 1 2 5 6 7 9 4 11 15 8 13
gap= 1 nextPos = 5 nextVal=7
Article 4.6
Article 4.1
Article 4.2
1 1 2 5 6 7 9 4 11 15 8 13
gap= 1 nextPos = 6 nextVal=9
Article 4.6
Article 4.1
Article 4.2
1 1 2 5 6 7 9 4 11 15 8 13
gap= 1 nextPos = 7 nextVal=4
Article 4.4
Article 4.5
1 1 2 5 6 7 9 9 11 15 8 13
gap= 1 nextPos = 6 nextVal=4
Article 4.4
Article 4.5
1 1 2 5 6 7 7 9 11 15 8 13
gap= 1 nextPos = 5 nextVal=4
Article 4.4
Article 4.5
1 1 2 5 6 6 7 9 11 15 8 13
gap= 1 nextPos = 4 nextVal=4
Article 4.4
Article 4.5
1 1 2 5 5 6 7 9 11 15 8 13
gap= 1 nextPos = 3 nextVal=4
Article 4.6
Article 4.1
Article 4.2
1 1 2 4 5 6 7 9 11 15 8 13
gap= 1 nextPos = 8 nextVal=11
Article 4.6
Article 4.1
Article 4.2
1 1 2 4 5 6 7 9 11 15 8 13
gap= 1 nextPos = 9 nextVal=15
Article 4.6
Article 4.1
Article 4.2
1 1 2 4 5 6 7 9 11 15 8 13
gap= 1 nextPos = 10 nextVal=8
Article 4.4
Article 4.5
1 1 2 4 5 6 7 9 11 15 15 13
gap= 1 nextPos = 9 nextVal=8
Article 4.4
Article 4.5
1 1 2 4 5 6 7 9 11 11 15 13
gap= 1 nextPos = 8 nextVal=8
Article 4.4
Article 4.5
1 1 2 4 5 6 7 9 9 11 15 13
gap= 1 nextPos = 8 nextVal=8
Article 4.6
Article 4.1
Article 4.2
1 1 2 4 5 6 7 8 9 11 15 13
gap= 1 nextPos = 7 nextVal=8
Article 4.6
Article 4.1
Article 4.2
1 1 2 4 5 6 7 8 9 11 15 13
gap= 1 nextPos = 11 nextVal=13
Article 4.4
Article 4.5

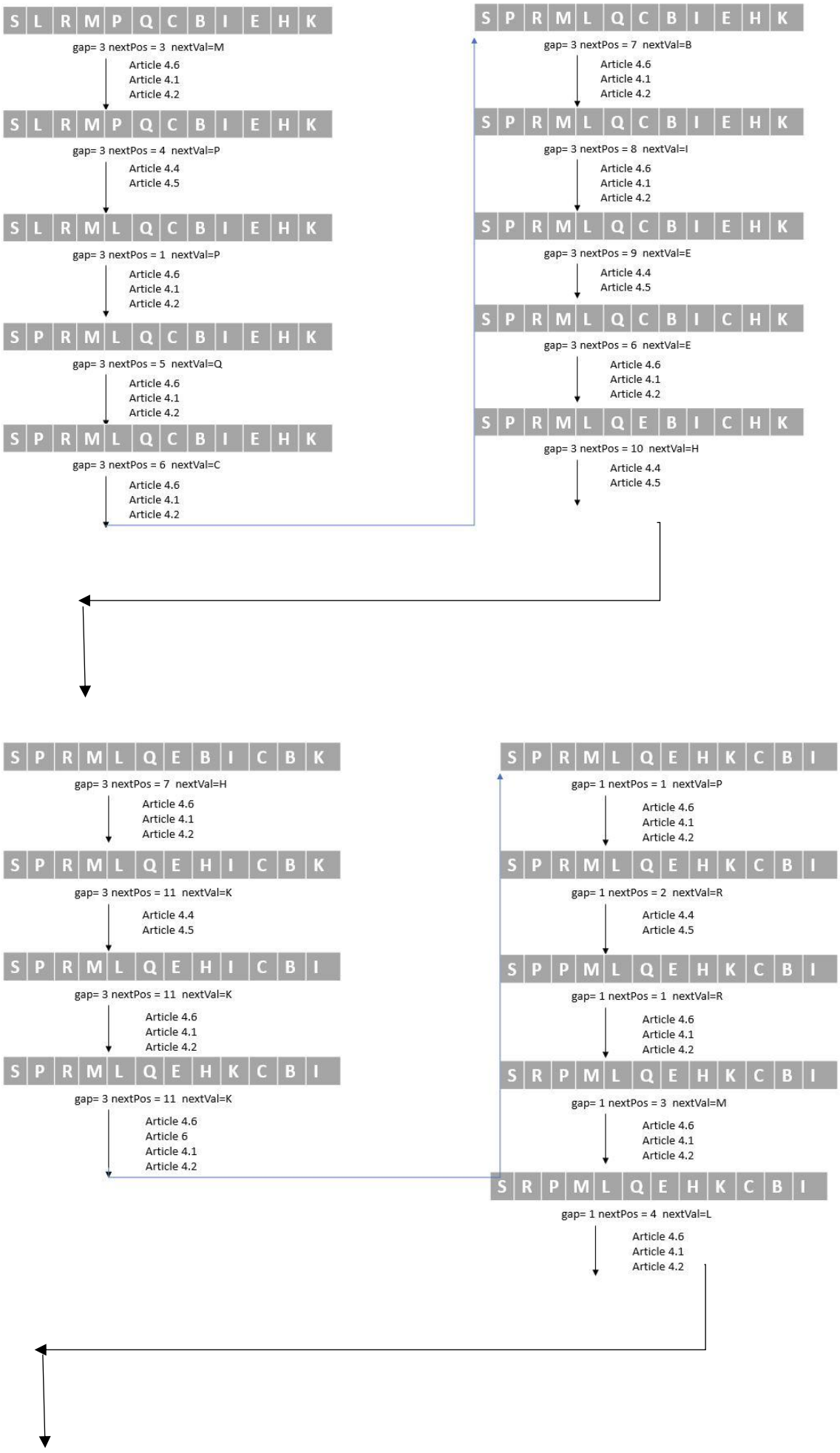


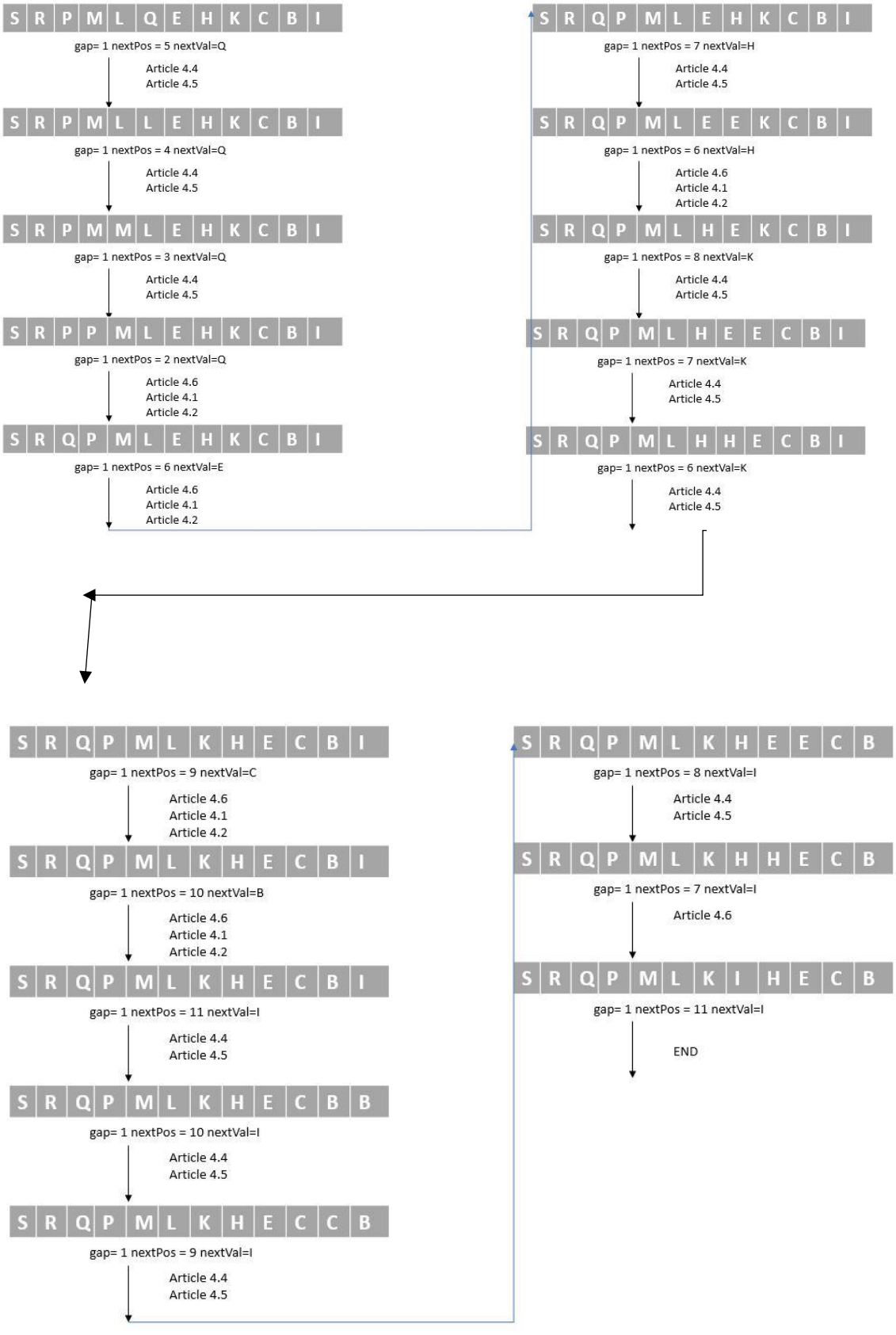

In this example there were 43 comparisons and 27 displacement.

EXAMPLE 4

D=[‘S’,‘B’ ‘I’,‘M’,‘H’,‘Q’,‘C’,‘L’,‘R’,‘E’,‘P’,‘K’]




S L R M P Q C B I E H K
gap= 3 nextPos = 3 nextVal=M
Article 4.6
Article 4.1
Article 4.2
S L R M P Q C B I E H K
gap= 3 nextPos = 4 nextVal=P
Article 4.4
Article 4.5
S L R M L Q C B I E H K
gap= 3 nextPos = 1 nextVal=P
Article 4.6
Article 4.1
Article 4.2
S P R M L Q C B I E H K
gap= 3 nextPos = 5 nextVal=Q
Article 4.6
Article 4.1
Article 4.2
S P R M L Q C B I E H K
gap= 3 nextPos = 6 nextVal=C
Article 4.6
Article 4.1
Article 4.2
S P R M L Q C B I E H K
gap= 3 nextPos = 7 nextVal=B
Article 4.6
Article 4.1
Article 4.2
S P R M L Q C B I E H K
gap= 3 nextPos = 8 nextVal=I
Article 4.6
Article 4.1
Article 4.2
S P R M L Q C B I E H K
gap= 3 nextPos = 9 nextVal=E
Article 4.4
Article 4.5
S P R M L Q C B I C H K
gap= 3 nextPos = 6 nextVal=E
Article 4.6
Article 4.1
Article 4.2
S P R M L Q E B I C H K
gap= 3 nextPos = 10 nextVal=H
Article 4.4
Article 4.5
S P R M L Q E B I C B K
gap= 3 nextPos = 7 nextVal=H
Article 4.6
Article 4.1
Article 4.2
S P R M L Q E H I C B K
gap= 3 nextPos = 11 nextVal=K
Article 4.4
Article 4.5
S P R M L Q E H I C B I
gap= 3 nextPos = 11 nextVal=K
Article 4.6
Article 4.1
Article 4.2
S P R M L Q E H K C B I
gap= 3 nextPos = 11 nextVal=K
Article 4.6
Article 6
Article 4.1
Article 4.2
S P R M L Q E H K C B I
gap= 1 nextPos = 1 nextVal=P
Article 4.6
Article 4.1
Article 4.2
S P R M L Q E H K C B I
gap= 1 nextPos = 2 nextVal=R
Article 4.4
Article 4.5
S P P M L Q E H K C B I
gap= 1 nextPos = 1 nextVal=R
Article 4.6
Article 4.1
Article 4.2
S R P M L Q E H K C B I
gap= 1 nextPos = 3 nextVal=M
Article 4.6
Article 4.1
Article 4.2
S R P M L Q E H K C B I
gap= 1 nextPos = 4 nextVal=L
Article 4.6
Article 4.1
Article 4.2


S R P M L Q E H K C B I
gap= 1 nextPos = 5 nextVal=Q
Article 4.4
Article 4.5
S R P M L L E H K C B I
gap= 1 nextPos = 4 nextVal=Q
Article 4.4
Article 4.5
S R P M M L E H K C B I
gap= 1 nextPos = 3 nextVal=Q
Article 4.4
Article 4.5
S R P P M L E H K C B I
gap= 1 nextPos = 2 nextVal=Q
Article 4.6
Article 4.1
Article 4.2
S R Q P M L E H K C B I
gap= 1 nextPos = 6 nextVal=E
Article 4.6
Article 4.1
Article 4.2
S R Q P M L E H K C B I
gap= 1 nextPos = 7 nextVal=H
Article 4.4
Article 4.5
S R Q P M L E E K C B I
gap= 1 nextPos = 6 nextVal=H
Article 4.6
Article 4.1
Article 4.2
S R Q P M L H E K C B I
gap= 1 nextPos = 8 nextVal=K
Article 4.4
Article 4.5
S R Q P M L H E E C B I
gap= 1 nextPos = 7 nextVal=K
Article 4.4
Article 4.5
S R Q P M L H H E C B I
gap= 1 nextPos = 6 nextVal=K
Article 4.4
Article 4.5
S R Q P M L K H E C B I
gap= 1 nextPos = 9 nextVal=C
Article 4.6
Article 4.1
Article 4.2
S R Q P M L K H E C B I
gap= 1 nextPos = 10 nextVal=B
Article 4.6
Article 4.1
Article 4.2
S R Q P M L K H E C B I
gap= 1 nextPos = 11 nextVal=I
Article 4.4
Article 4.5
S R Q P M L K H E C B B
gap= 1 nextPos = 10 nextVal=I
Article 4.4
Article 4.5
S R Q P M L K H E C C B
gap= 1 nextPos = 9 nextVal=I
Article 4.4
Article 4.5
S R Q P M L K H E E C B
gap= 1 nextPos = 8 nextVal=I
Article 4.4
Article 4.5
S R Q P M L K H H E C B
gap= 1 nextPos = 7 nextVal=I
Article 4.6
S R Q P M L K I H E C B
gap= 1 nextPos = 11 nextVal=I
END