Insertion Sort

- Insertion sort is a very simple sorting algorithm, in which the sorted array (or list) is built one element at a time.

Insertion sort works as follows.

- The array of values to be sorted is divided into two sets. One that stores sorted values and the other contains unsorted values
- The sorting algorithm will proceed until there are elements in the unsorted set
- Suppose there are n elements in the array. Initially the element with index 0 (assuming LB, Lower Bound = 0) is in the sorted set, rest all the elements are in the unsorted set
- The first element of the unsorted partition has array index 1 (if LB = 0)
- During each iteration of the algorithm, the first element in the unsorted set is picked up and inserted into the correct position in the sorted set

Insertion Sort

Note : In Pass 1, A[0] is the only element in the sorted set.

In Pass 2, A[1] will be placed either before or after A[0], so that the array A is sorted

In Pass 3, A[2] will be placed either before A[0], in-between A[0] and A[1] or after A[1], so that the array is sorted.

In Pass 4, A[4] will be placed in its proper place so that the array A is sorted.

In Pass N, A[N-1] will be placed in its proper place so that the array A is sorted.

Insertion Sort

Example: Sort the array given below using insertion sort

39	9	81	45	90	27	72	18

PASS	ARR[0]	ARR[1]	ARR[2]	ARR[3]	ARR[4]	ARR[5]	ARR[6]	ARR[7]
1	39	9	81	45	90	27	72	18
2	9	39	81	45	90	27	72	18
3	9	39	81	45	90	27	72	18
4	9	39	45	81	90	27	72	18
5	9	39	45	81	90	27	72	18
6	9	27	39	45	81	90	72	18
7	9	27	39	45	72	81	90	18
8	9	18	27	39	45	72	81	90

Insertion Sort

```
INSERTION SORT (ARR, N)

Step 1: Repeat Steps 2 to 5 for K = 1 to N-1
Step 2:     SET TEMP = ARR[K]
Step 3:     SET J = K - 1
Step 4:     Repeat while TEMP <= ARR[J]
            SET ARR[J + 1] = ARR[J]
            SET J = J - 1
          [END OF INNER LOOP]
Step 5:     SET ARR[J + 1] = TEMP
      [END OF LOOP]
Step 6: EXIT
```

INSERTION SORT

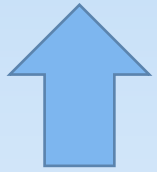
INSERTION SORT

32	89	65	98	21	16	43

INSERTION SORT

PASS - 1

32	89	65	98	21	16	43



INSERTION SORT

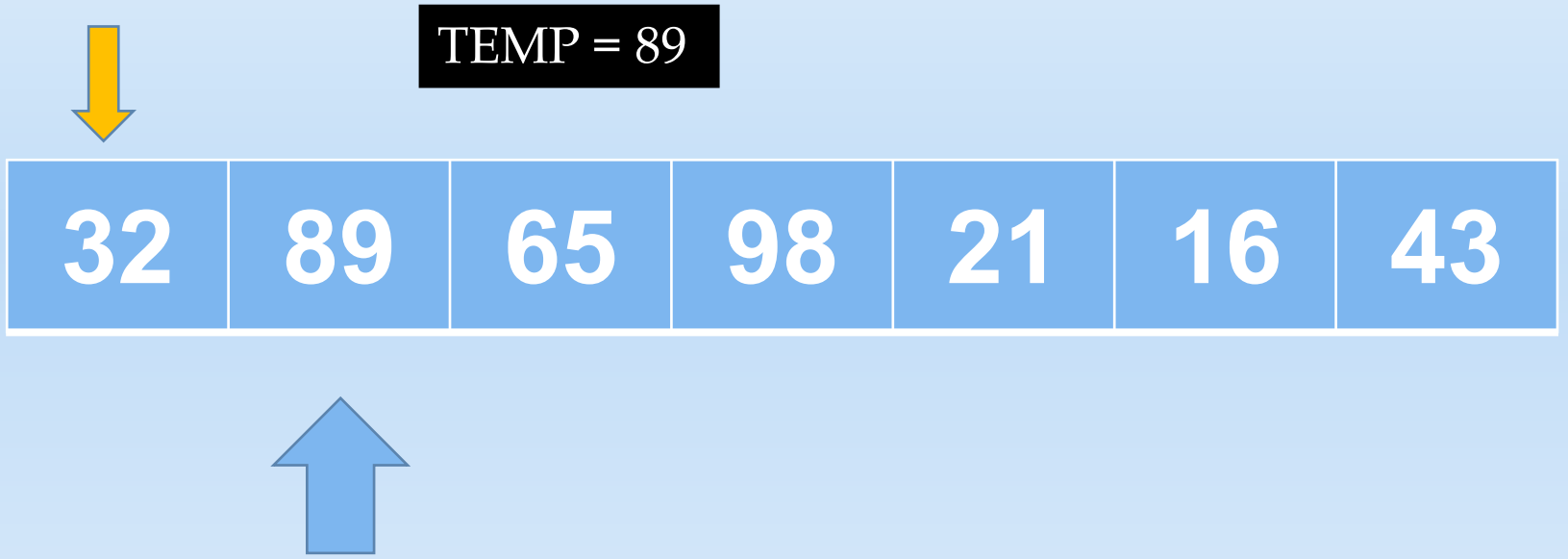
PASS - 2

TEMP = 89

32	89	65	98	21	16	43

INSERTION SORT

PASS - 2



INSERTION SORT

PASS - 2

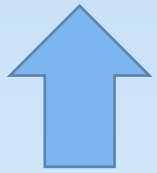
32	89	65	98	21	16	43

INSERTION SORT

PASS - 3

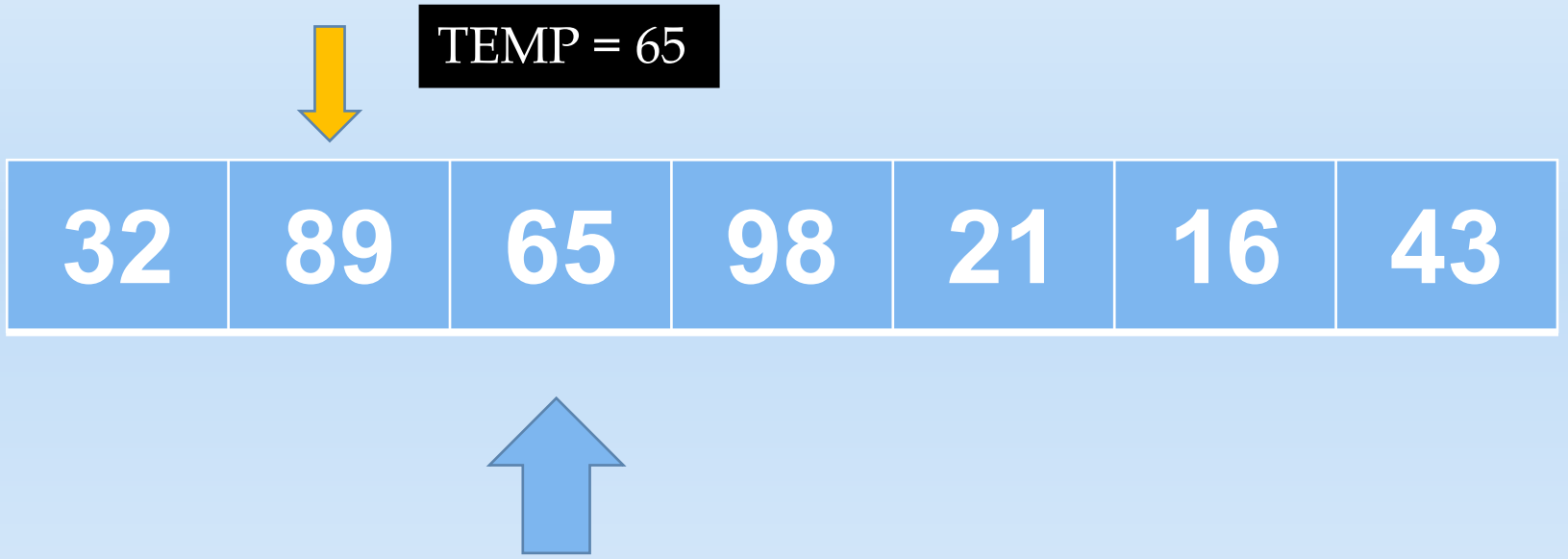
TEMP = 65

32	89	65	98	21	16	43



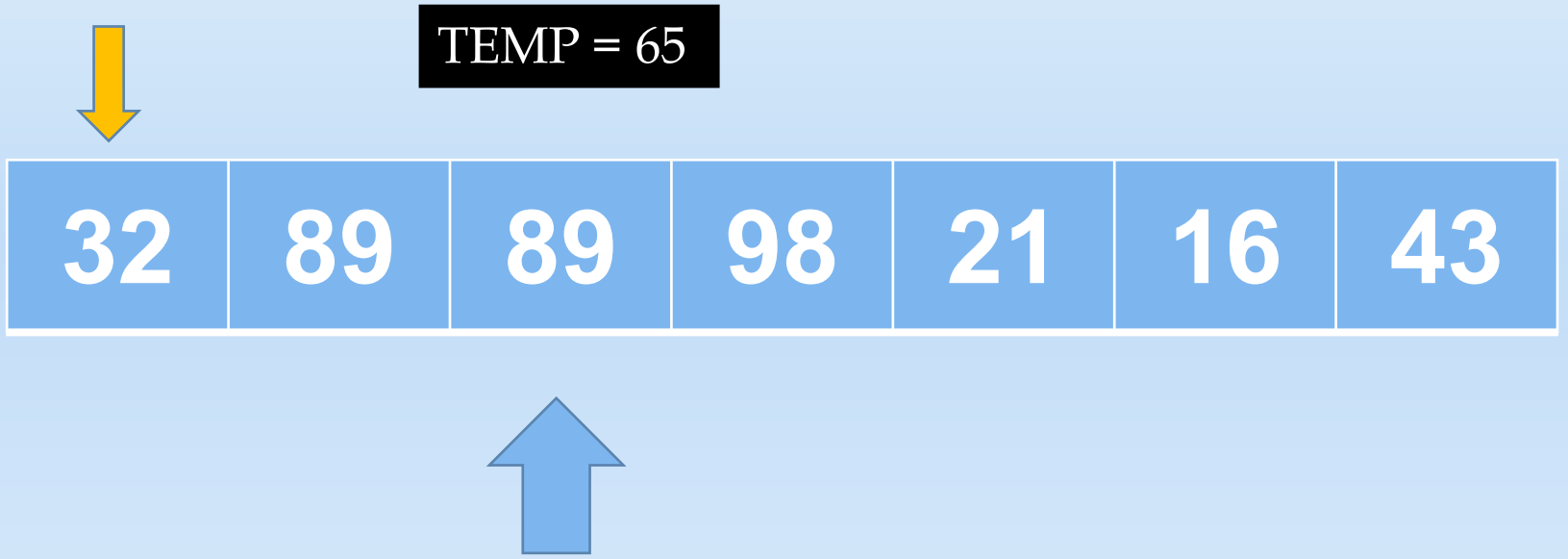
INSERTION SORT

PASS - 3



INSERTION SORT

PASS - 3

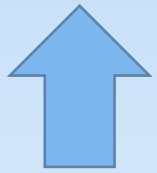


INSERTION SORT

PASS - 3

TEMP = 65

32	65	89	98	21	16	43



INSERTION SORT

PASS - 3

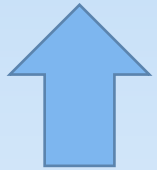
32	65	89	98	21	16	43

INSERTION SORT

PASS - 4

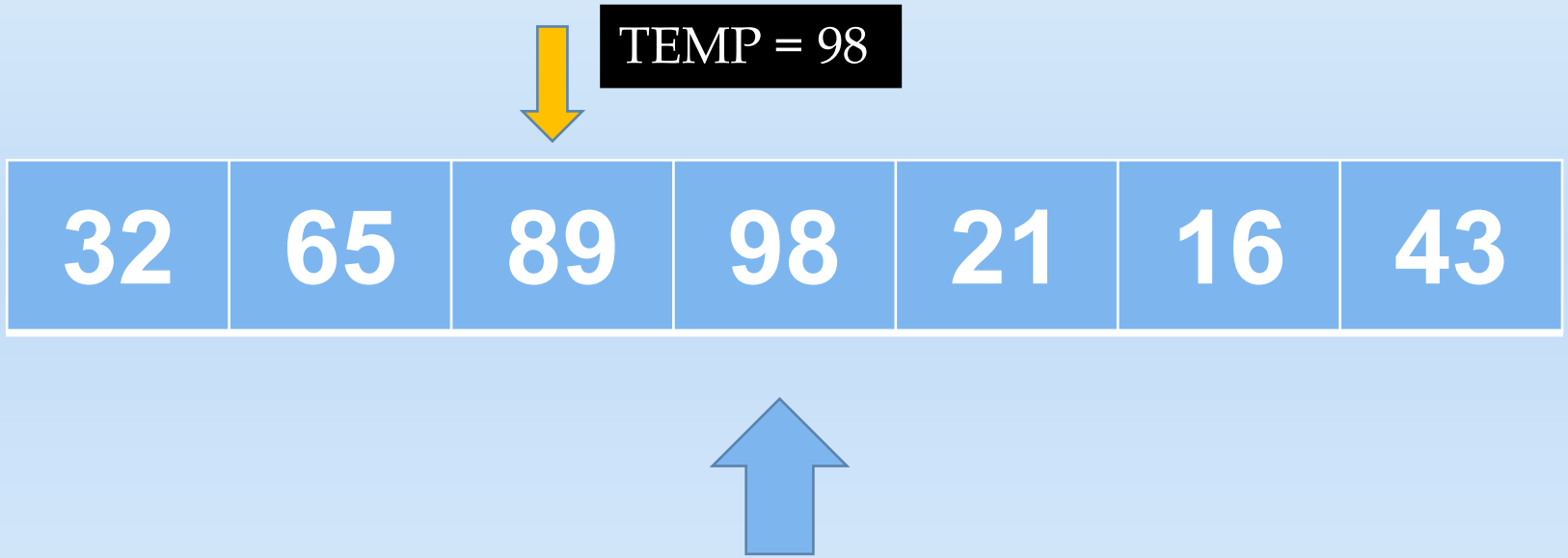
TEMP = 98

32	65	89	98	21	16	43



INSERTION SORT

PASS - 4



INSERTION SORT

PASS - 4

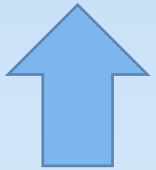
32	65	89	98	21	16	43

INSERTION SORT

PASS - 5

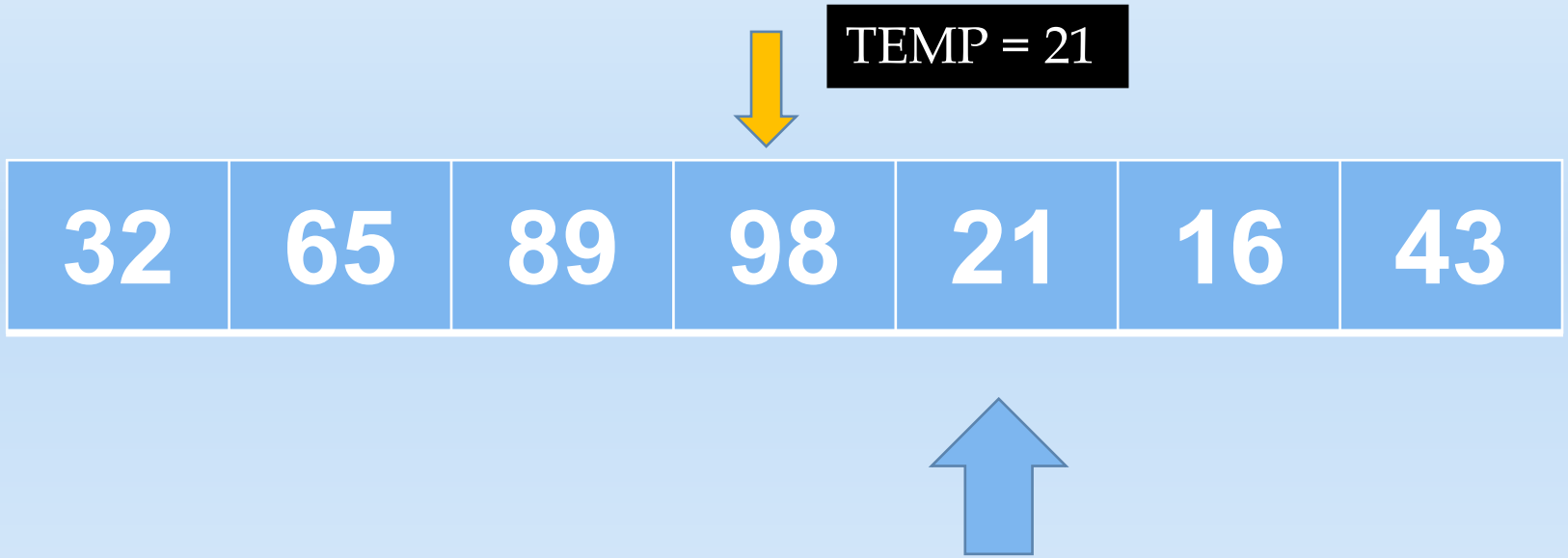
TEMP = 21

32	65	89	98	21	16	43



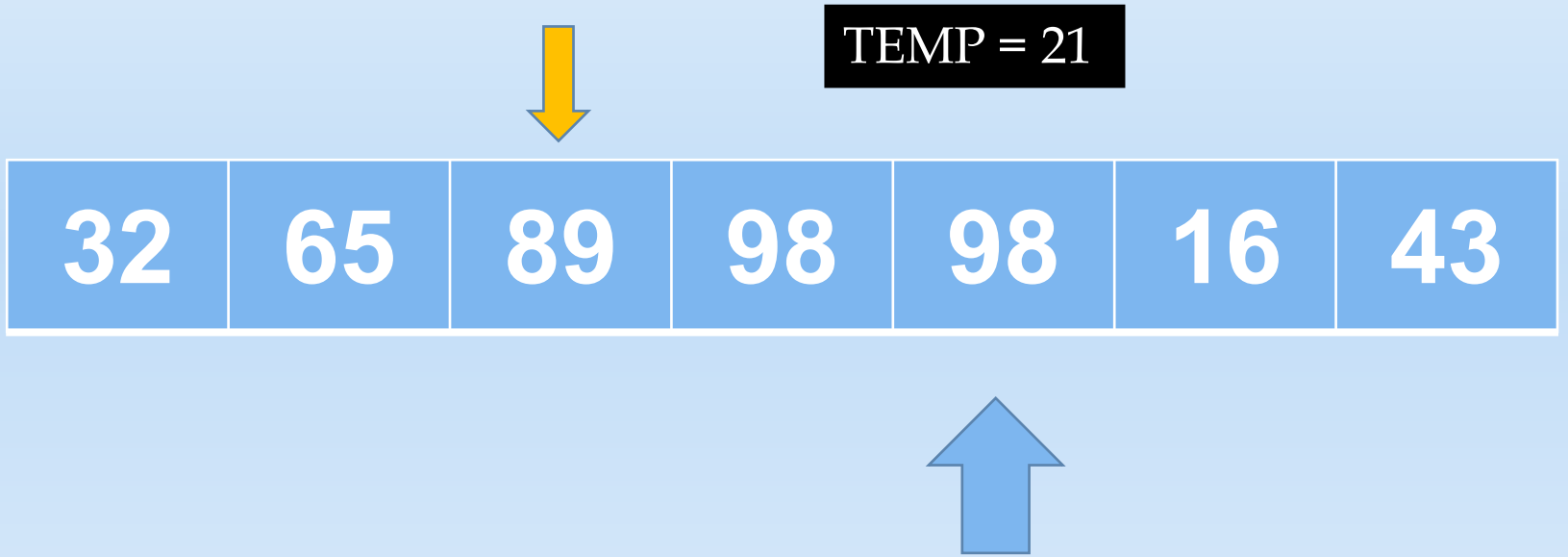
INSERTION SORT

PASS - 5



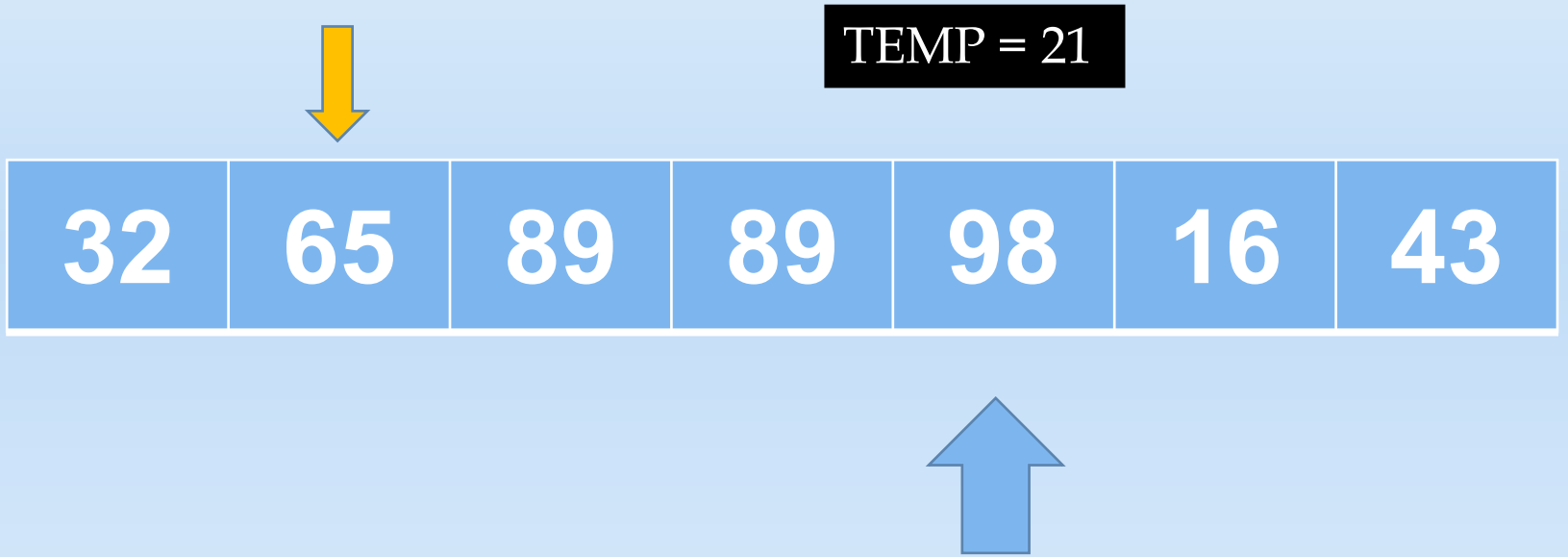
INSERTION SORT

PASS - 5



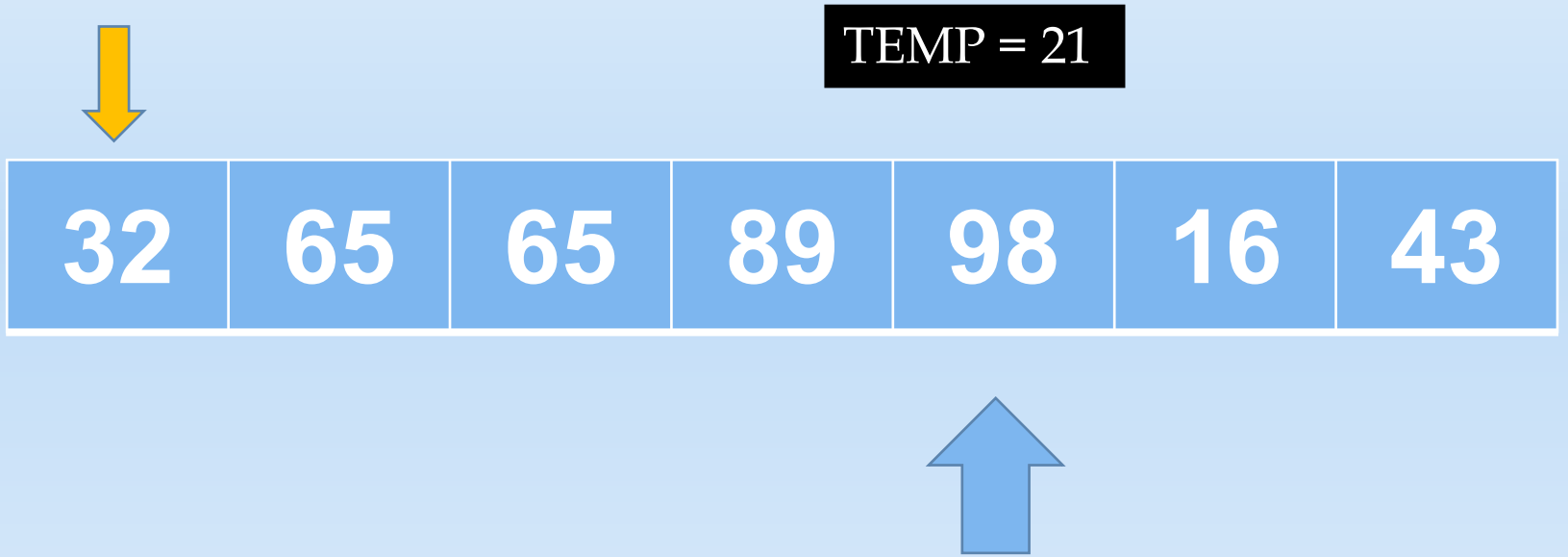
INSERTION SORT

PASS - 5



INSERTION SORT

PASS - 5

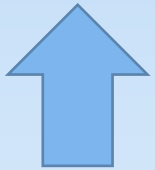


INSERTION SORT

PASS - 5

TEMP = 21

32	32	65	89	98	16	43

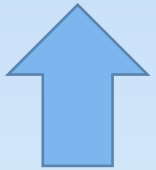


INSERTION SORT

PASS - 5

TEMP = 21

21	32	65	89	98	16	43



INSERTION SORT

PASS - 5

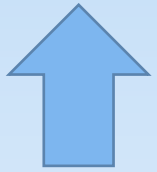
21	32	65	89	98	16	43

INSERTION SORT

PASS - 6

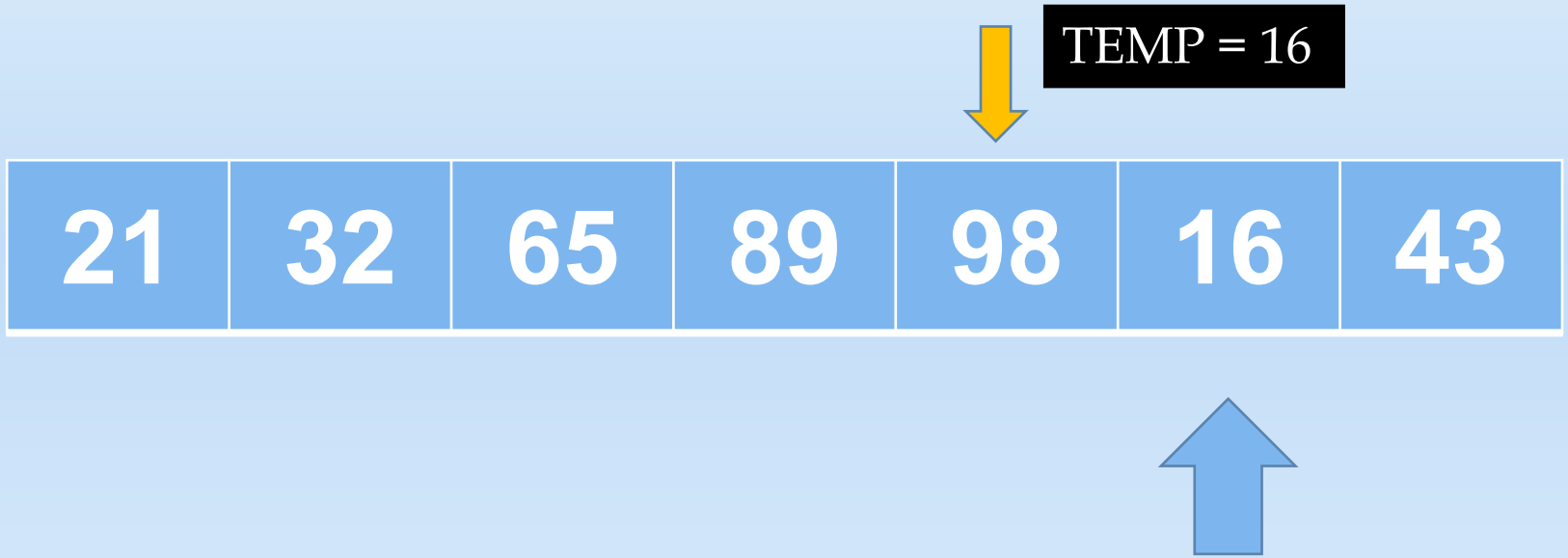
TEMP = 16

21	32	65	89	98	16	43



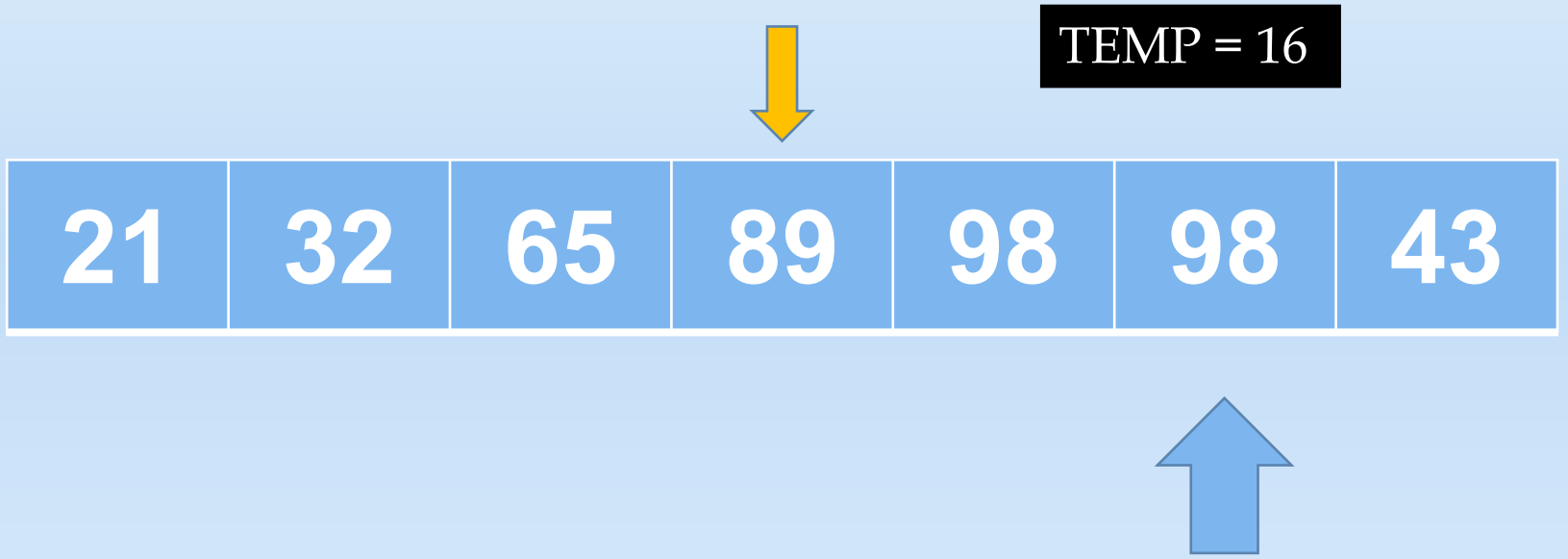
INSERTION SORT

PASS - 6



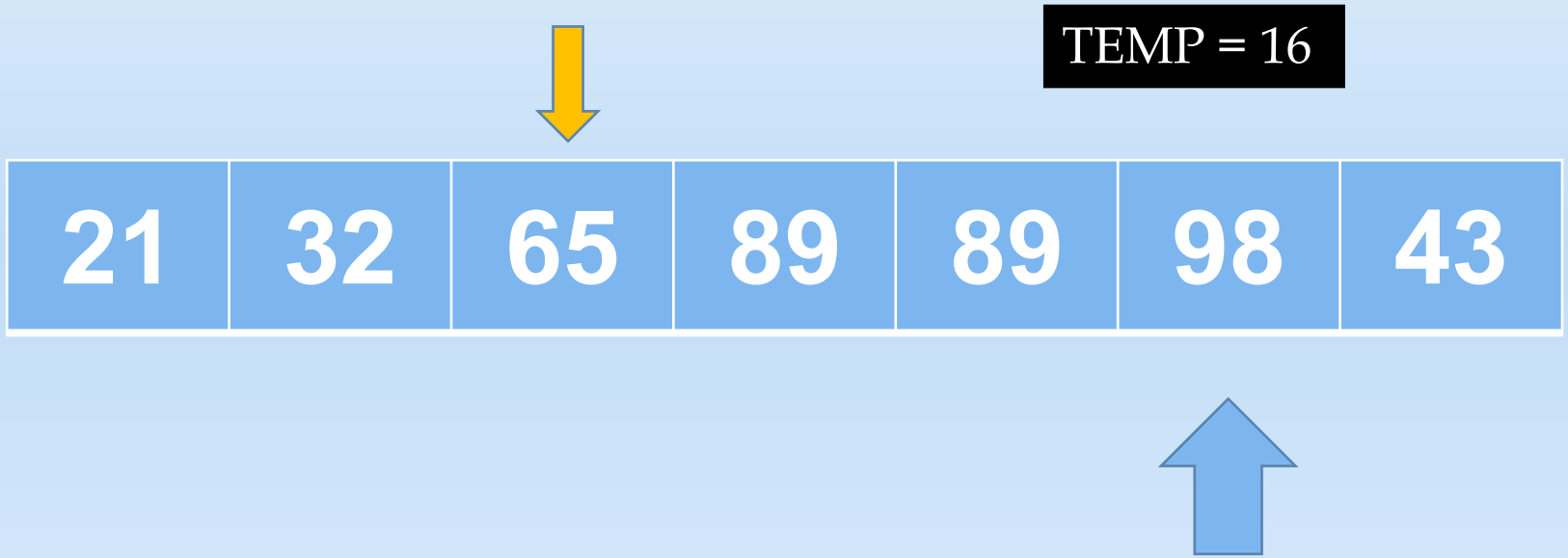
INSERTION SORT

PASS - 6



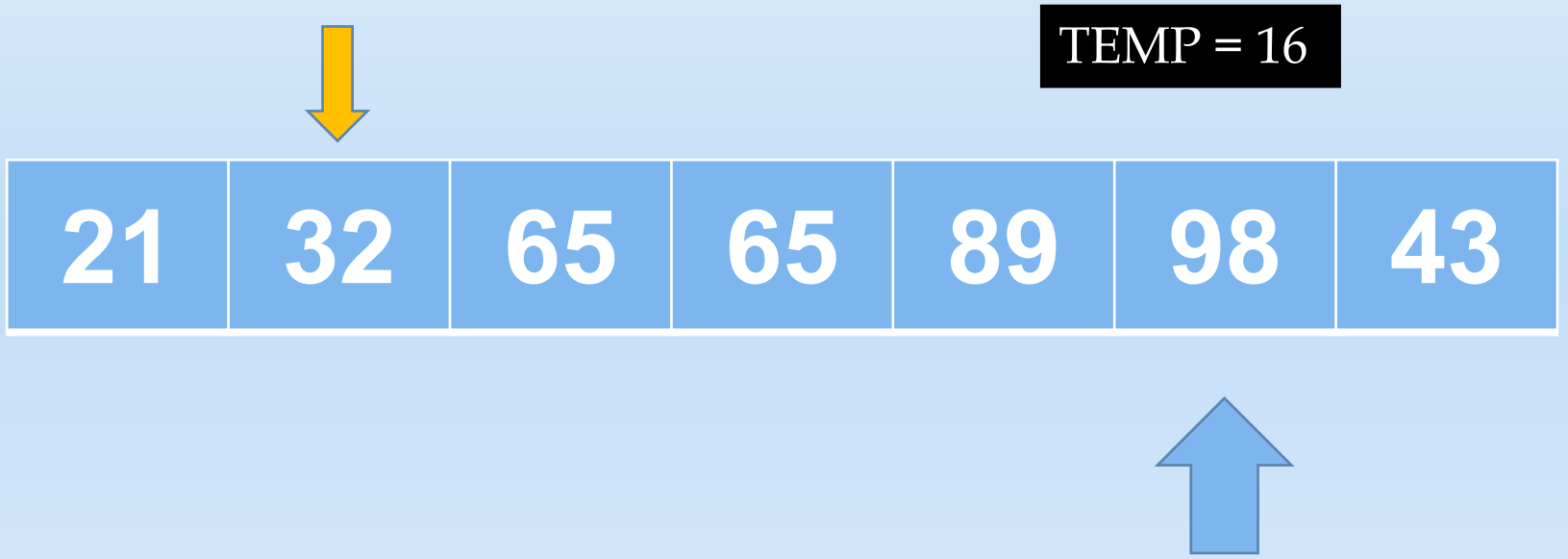
INSERTION SORT

PASS - 6



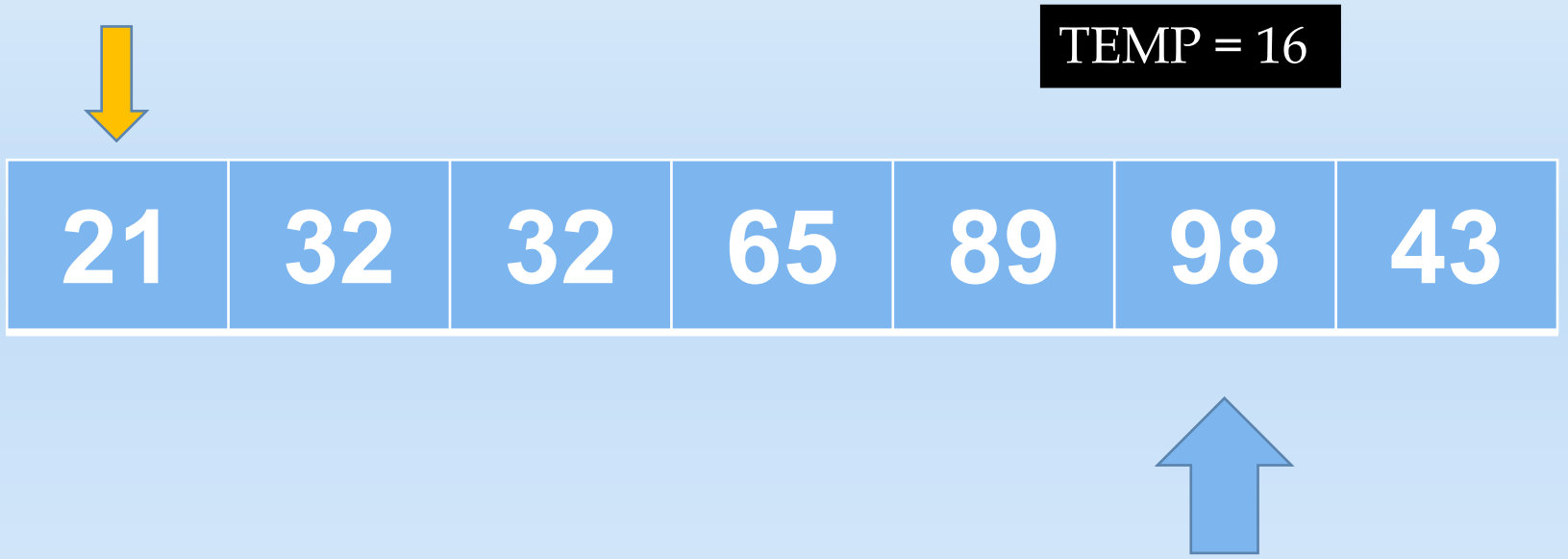
INSERTION SORT

PASS - 6



INSERTION SORT

PASS - 6

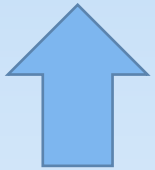


INSERTION SORT

PASS - 6

TEMP = 16

21	21	32	65	89	98	43

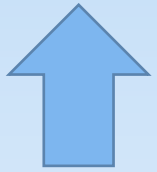


INSERTION SORT

PASS - 6

TEMP = 16

16	21	32	65	89	98	43



INSERTION SORT

PASS - 6

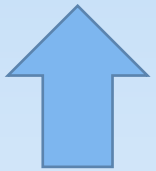
16	21	32	65	89	98	43

INSERTION SORT

PASS - 7

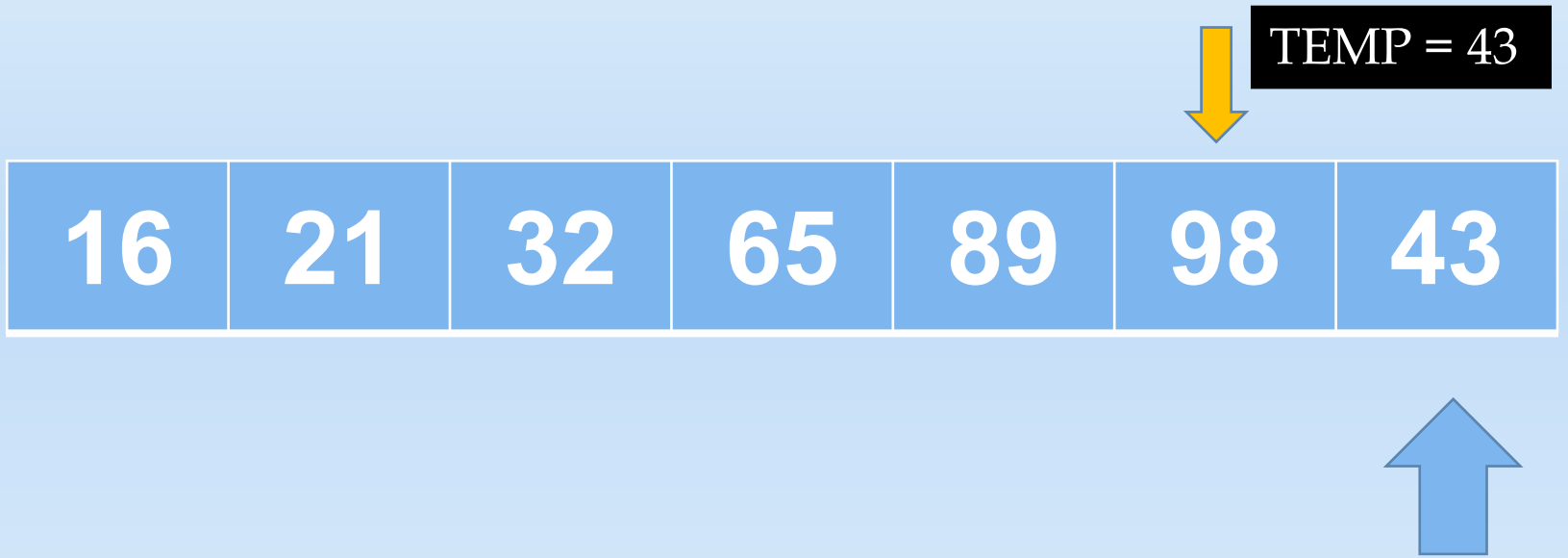
TEMP = 43

16	21	32	65	89	98	43



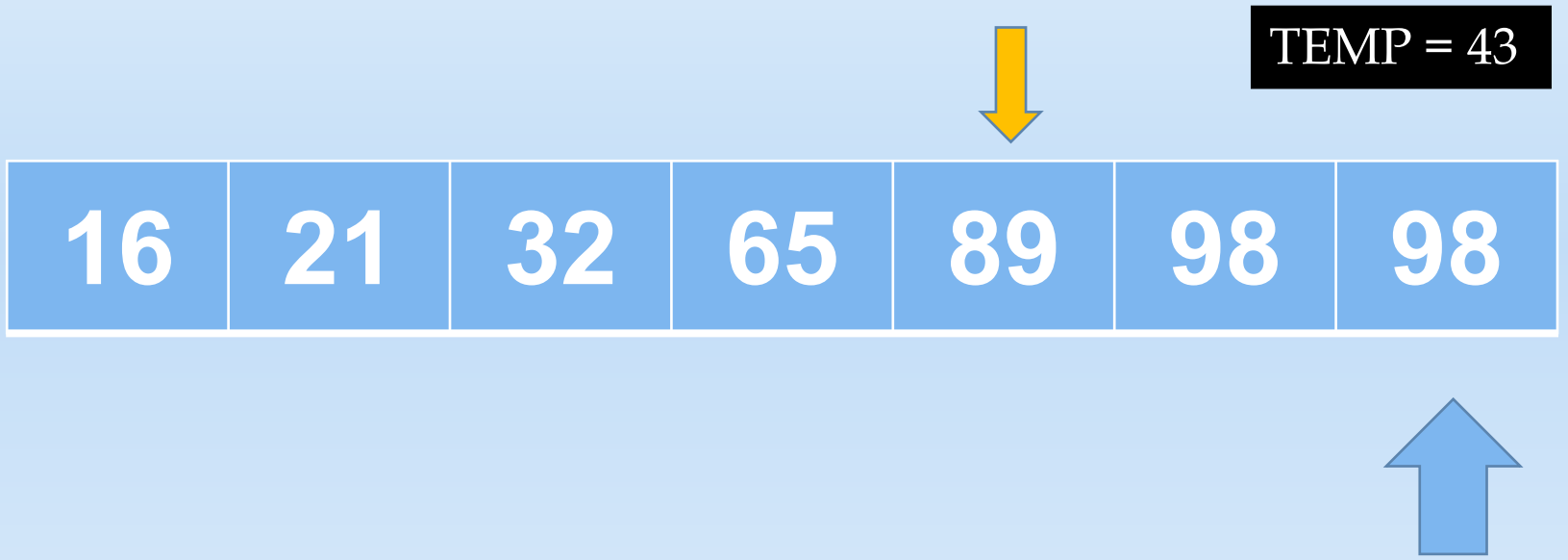
INSERTION SORT

PASS - 7



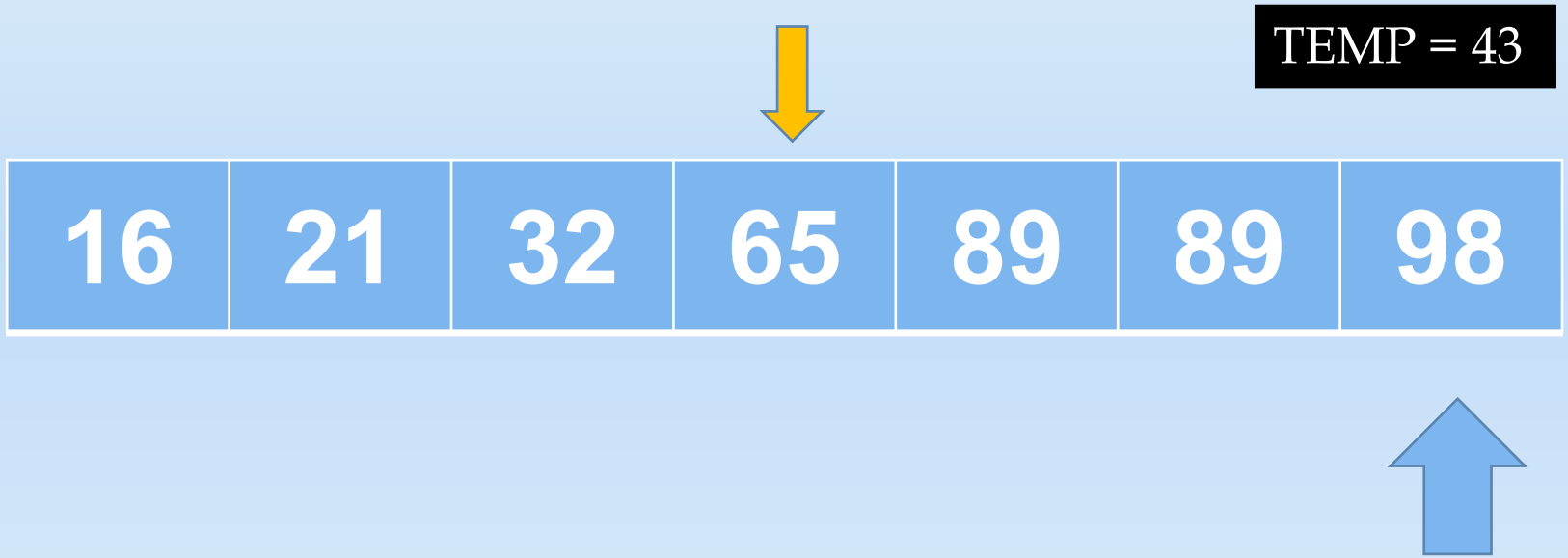
INSERTION SORT

PASS - 7



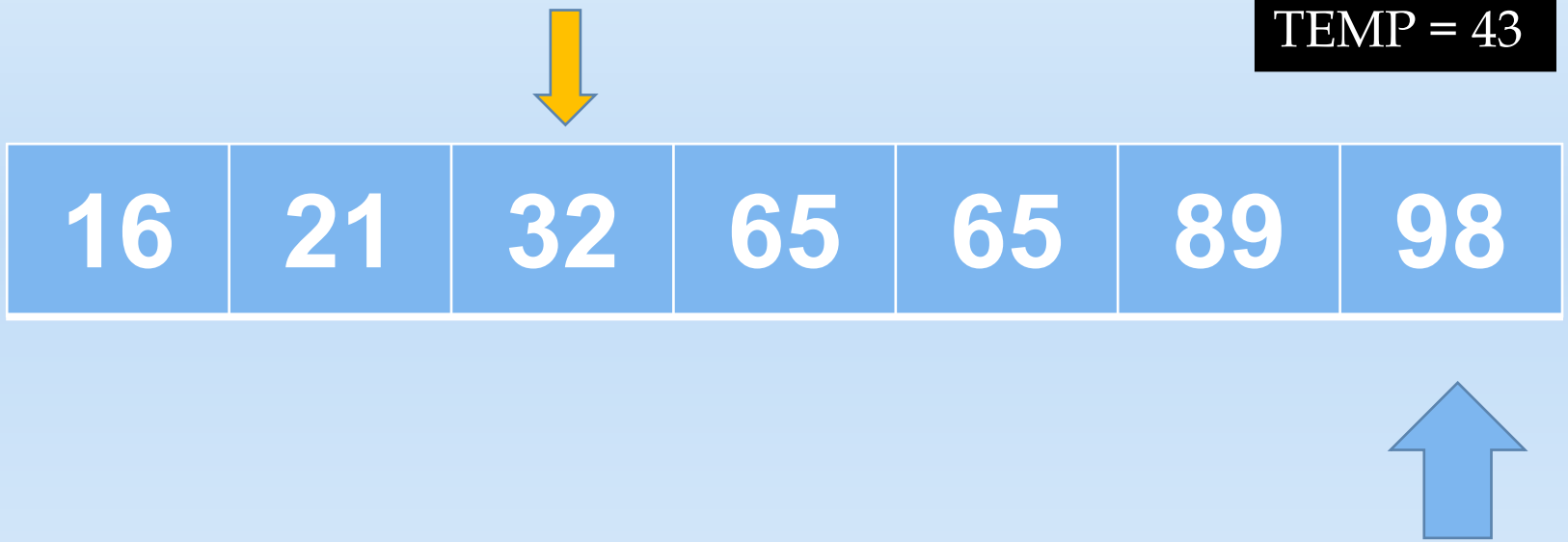
INSERTION SORT

PASS - 7



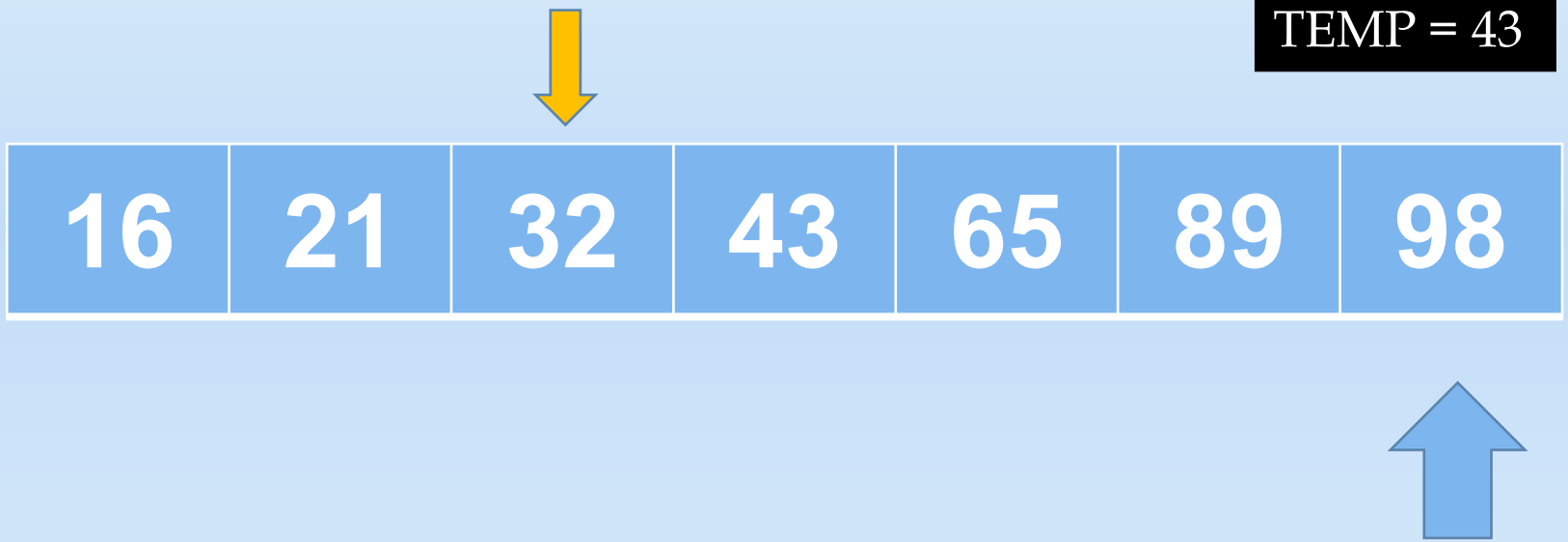
INSERTION SORT

PASS - 7



INSERTION SORT

PASS - 7



INSERTION SORT

PASS - 7

16	21	32	43	65	89	98