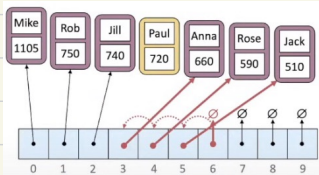
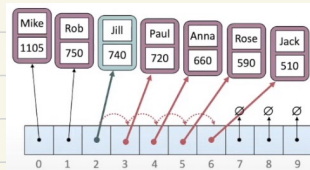
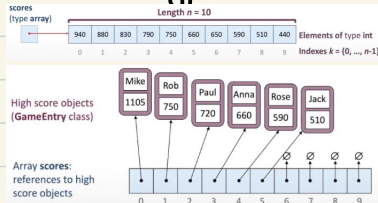


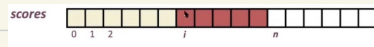
Video 1. Insertion and deletion

array - fixed-length sequence of elements of the same type
access to elements by indices $\rightarrow O(1)$ time

reference type - stores references to the values, not the actual values



insertion: add element at index i
shift forward $n-i$ elements (i to $n-1$)
set element at index i and increment n



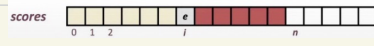
worst case:



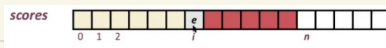
$i = 0$

time $O(n)$

space $O(1)$



deletion: remove element at index i
shift back $n-i-1$ elements ($i+1$ to $n-1$)
decrement n



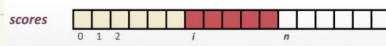
worst case:



$i = 0$

time $O(n)$

space $O(1)$



Video 2. Insertion sort

algorithm sort (a)

input: $a[n]$

output: sorted a

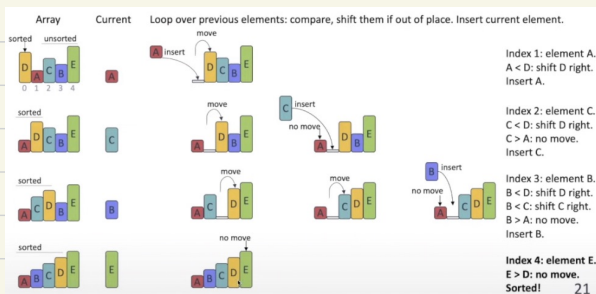


InsertionSort(a)

for k from 1 to $n-1$ do

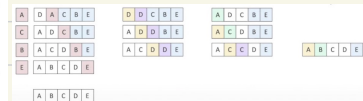
insert $a[k]$ at its proper location

in-place algorithm: modifies the array directly
implicit output no need for explicit return



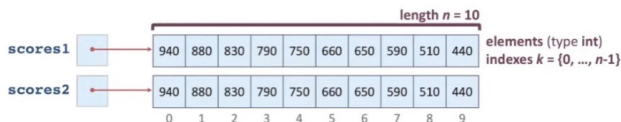
$$\text{time: } c \sum_{i=1}^{n-1} L_i = c \frac{(n-1)n}{2} = O(n^2)$$

$$\text{space: } O(1)$$



Video 3. Equality, clone, expansion

```
int[] scores1 = {940, 880, 830, 790, 750, 660, 650, 590, 510, 440};
int[] scores2 = {940, 880, 830, 790, 750, 660, 650, 590, 510, 440};
```



Tests for equality

```
scores1 == scores2
```

What is compared? array variable (reference) Result? false Time? O(1)

```
scores1.equals(scores2)
```

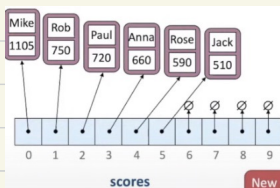
(defined for Object, compares with == by default; should be overridden)

array variable (reference) false O(1)

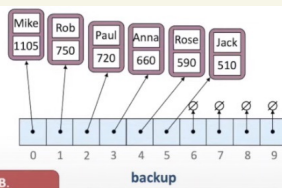
```
java.util.Arrays.equals(scores1, scores2)
```

(loops over k to compare a[k] against b[k]; uses a[k] == b[k] for primitives, calls a[k].equals(b[k]) for objects)

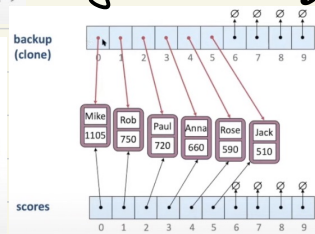
array's elements true O(n)



New array scoresB.
Elements copied by value.



backup
(deep copy of scores) 28



scores

expansion with at most n additional positions:

$O(n)$ time

$O(n)$ space

array.clone()
↳ adopts size
and points to the
same references
↳ shallow copy
(elements copied
by reference) ↳