Data Structures

Insertion

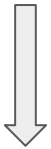
Mostafa S. Ibrahim
Teaching, Training and Coaching since more than a decade!

Artificial Intelligence & Computer Vision Researcher
PhD from Simon Fraser University - Canada
Bachelor / Msc from Cairo University - Egypt
Ex-(Software Engineer / ICPC World Finalist)

Insertion operation

- Another critical feature is insertion
- Let’s say we have the array on right
  - {10, 8, 7, 5, 3}
- Now we want to insert value 17 in index 2
  - New array: {10, 8, 17, 7, 5, 3}
- How to do it? Think for 5 minutes

Index	0	1	2	3	4
values	**10**	**8**	**7**	**5**	**3**



Index	0	1	2	3	4	5
values	**10**	**8**	**17**	**7**	**5**	**3**

Insertion operation

- {10, 8, 7, 5, 3}
- First, we need to shift all values from index 2 to the right side
- {10, 8, EMPTY, 7, 5, 3}
- Then add the value in the requested position
- {10, 8, 17, 7, 5, 3}
- Take 15 minutes and try to implement

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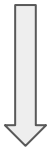

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Insertion

```
83      void insert(int idx, int value) {
84          assert(0 <= idx && idx < size);
85
86          // we can't add any more
87          if (size == capacity)
88              expand_capacity();
89
90          // Shift all the data to right first
91
92          for(int p = size-1; p >= idx; --p)
93              arr[p+1] = arr[p];
94
95          arr[idx] = value;
96          ++size;
97
98          // Common mistake to iterate from begin to end
99          // the whole array right array will be arr[idx]
100         //for (int p = idx; p < size; ++p)
101     }
```

Efficiency

- How fast is our insertion?
- If we inserted at position idx, we need first to shift the elements to the right
- Let **number of shiftings** k = size - idx ⇒ we need 3k+1 steps
- Then we need to put the element and increase the size : 2 steps
- Total **3k + 2**. Let's drop constants ⇒ K
- What is important to measure efficiency is when K is large
- This happens when idx = 0 (shift whole array) ⇒ size steps
- Overall: we need **linear number of** steps in the **worst case** (size)
- This means we need to be careful and not call this function a lot!

"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."