ITMO UNIVERSITY

How to Win Coding Competitions: Secrets of Champions

Week 2: Computational complexity. Linear data structures
Lecture 2: Linear data structures overview

Pavel Krotkov
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General idea

- Data structure is a way of organizing your data in memory.

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- Linear data structures are used for storing several elements of the same type.
- Elements in any linear data structure have an order, i. e. you can define first element, second element etc.
- Linear data structures differ by set of supported operations and assymptotical complexity of performing each operation.

Possible operations

Let’s define some common operations for linear data structures.

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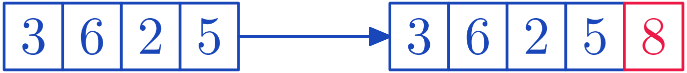
- inserting element to the end of structure ([ ]+)



3 6 2 5

3 6 2 5 8

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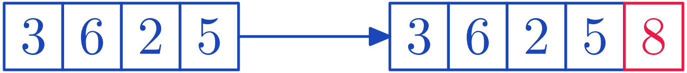
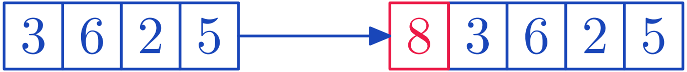


3 6 2 5 → 3 6 2 5 8

- inserting element to the beginning of structure (+[ ])



3 6 2 5 → 8 3 6 2 5

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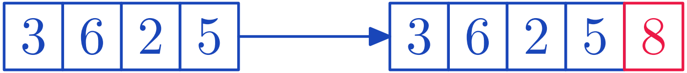
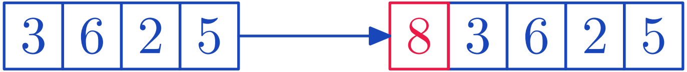
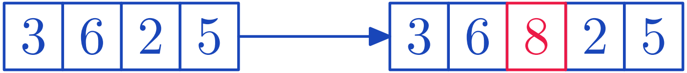


- inserting element to the beginning of structure (+[ ])



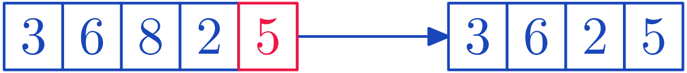
- inserting element to the middle of structure ([+])



Possible operations

Let’s define some common operations for linear data structures.

- removing element from the end of structure ([ ]-)



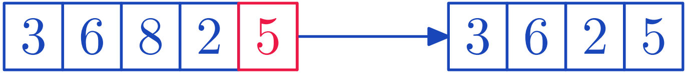
3	6	8	2	5

3	6	2	5

Possible operations

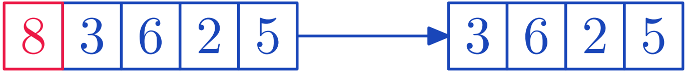
Let’s define some common operations for linear data structures.

- removing element from the end of structure ([ ]-)



3 6 8 2 5 → 3 6 2 5

- removing element from the beginning of structure (-[ ])



8 3 6 2 5 → 3 6 2 5

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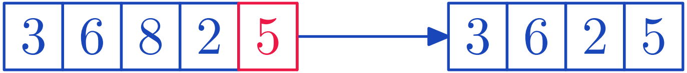
- removing element from the end of structure ([ ]-)



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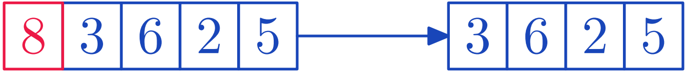
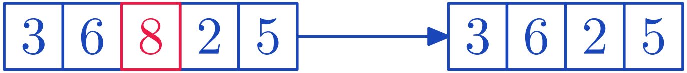


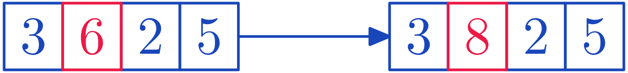
- removing element from the middle of structure ([-])



Possible operations

Let’s define some common operations for linear data structures.

- getting value of/assigning value to k-th element ([?])



$a[1] \leftarrow 8$

structure	[ ]+	+[ ]	[+]	[ ]-	-[ ]	[-]	[?]
Vector	$O(1)$	$O(n)$	$O(n)$	$O(1)$	$O(n)$	$O(n)$	$O(1)$
List	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(n)$
Queue	$O(1)$	—	—	—	$O(1)$	—	—
Stack	$O(1)$	—	—	$O(1)$	—	—	—
Deque	$O(1)$	$O(1)$	—	$O(1)$	$O(1)$	—	—

structure	[ ]+	+[ ]	[+]	[ ]-	-[ ]	[-]	[?]
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List	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(n)$
Queue	$O(1)$	—	—	—	$O(1)$	—	—
Stack	$O(1)$	—	—	$O(1)$	—	—	—
Deque	$O(1)$	$O(1)$	—	$O(1)$	$O(1)$	—	—

structure	[ ]+	+[ ]	[+]	[ ]-	-[ ]	[-]	[?]
Vector	$O(1)$	$O(n)$	$O(n)$	$O(1)$	$O(n)$	$O(n)$	$O(1)$
List	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(1)$	$O(n)$
Queue	$O(1)$	—	—	—	$O(1)$	—	—
Stack	$O(1)$	—	—	$O(1)$	—	—	—
Deque	$O(1)$	$O(1)$	—	$O(1)$	$O(1)$	—	—

Standard implementations

structure	Java	C++	Python
Vector	ArrayList	vector	list
List	LinkedList	list	deque
Queue	Queue	queue	deque
Stack	Stack	stack	list
Deque	ArrayDeque	deque	deque

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Thank you

for your attention!