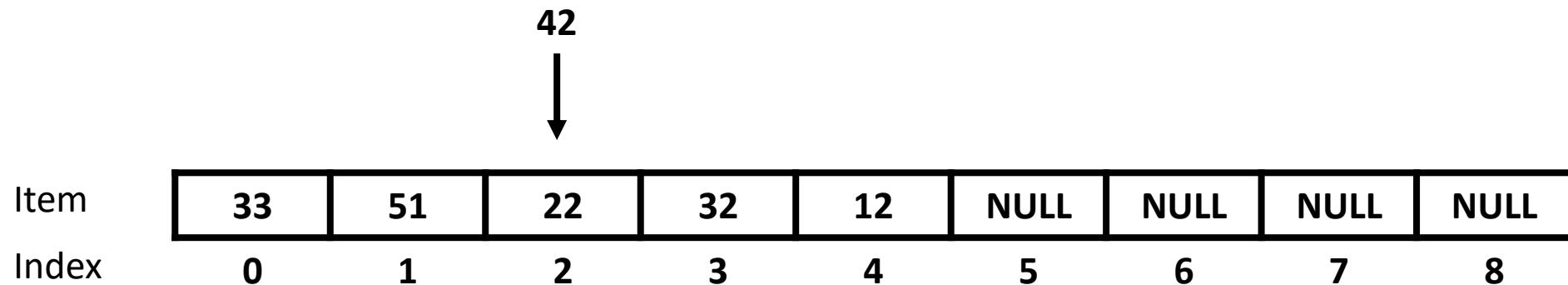


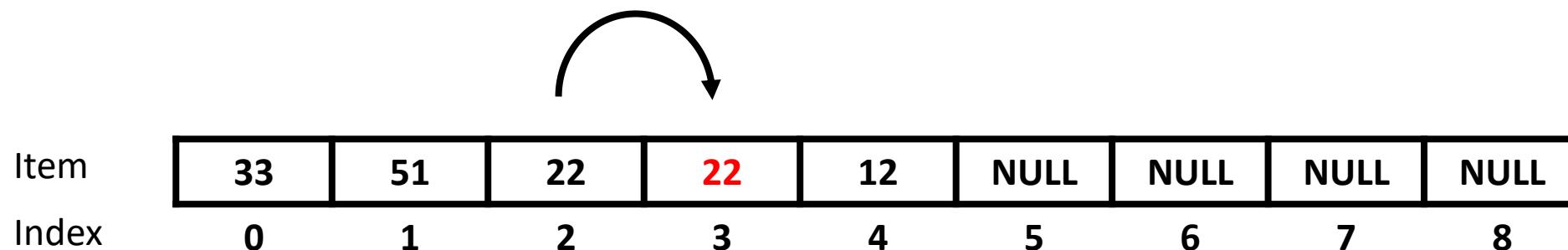
Insert when  $n + 1 \leq U$   
(space left in array)

# Wrong Way



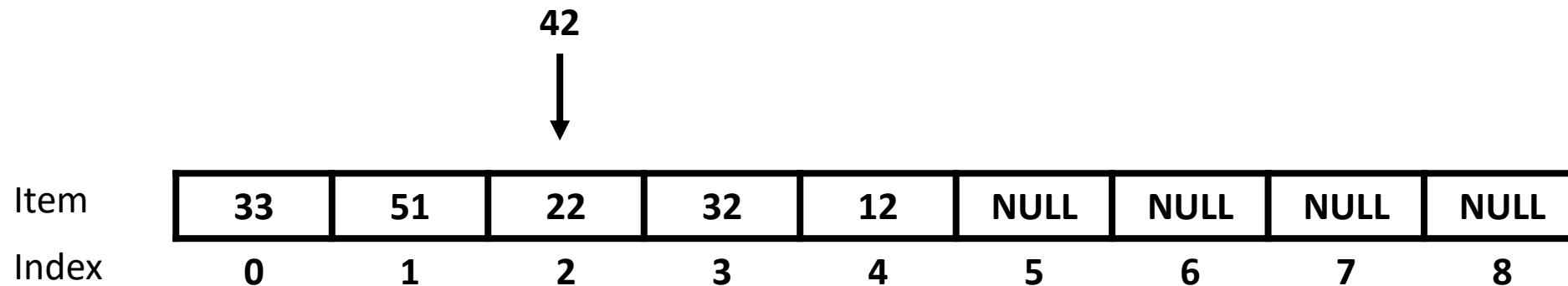
# Wrong Way

- Forward right copy – Shift items to the right starting from the front.



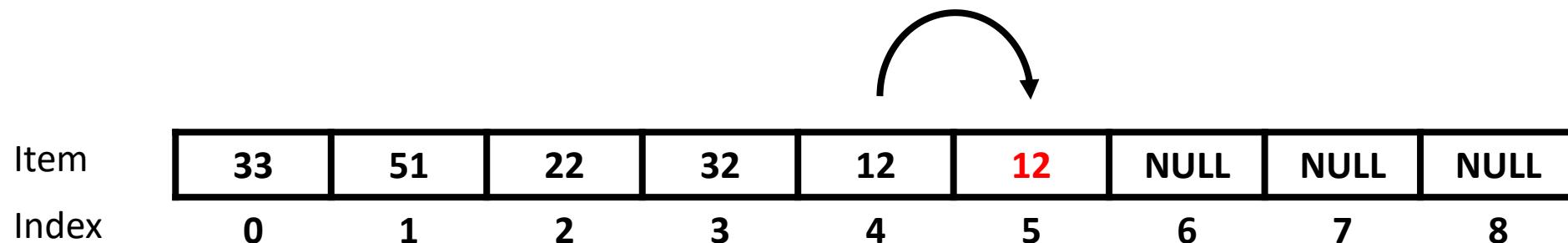
We have just written over 32. Oops!

# Right Way

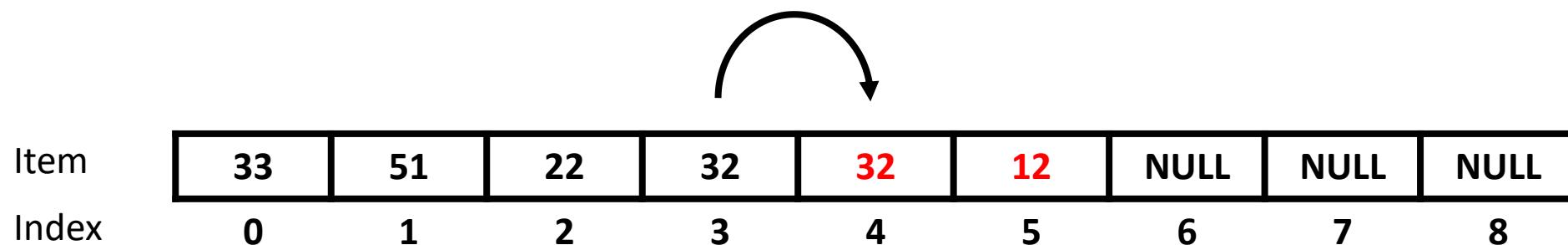


# Right Way

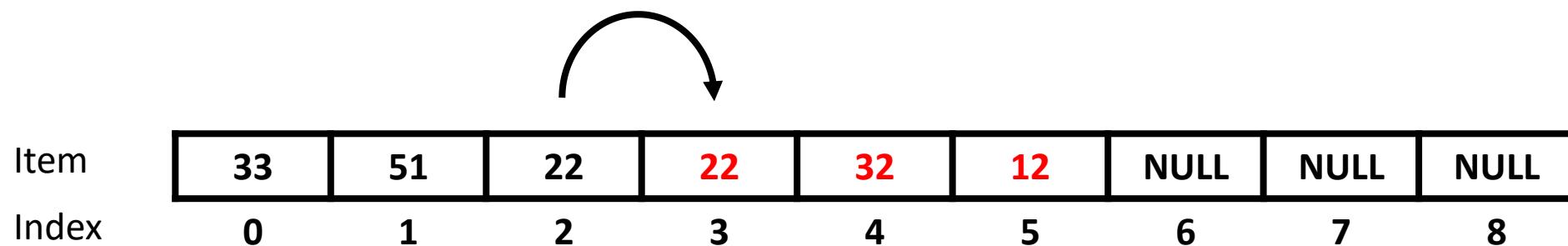
- Backward right copy – Shift items to the right starting from the back.



- Backward right copy – Shift items to the right starting from the back.



- Backward right copy – Shift items to the right starting from the back.



- Perform Insert

Item	33	51	42	22	32	12	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8

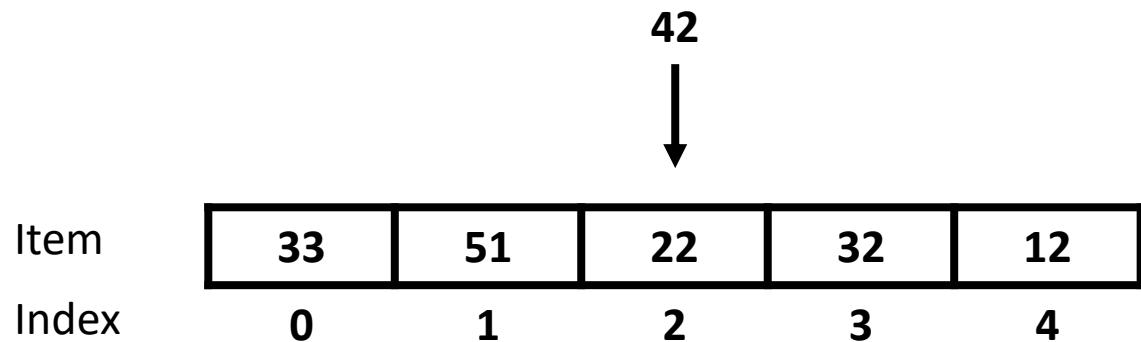
Item

33	51	42	22	32	12	NULL	NULL	NULL
0	1	2	3	4	5	6	7	8

Index

Insert when  $n + 1 > U$   
(array full)

- Resize and Forward right copy. We could use a backward right copy as well.



We assume this is constant time as we are just asking for a chunk of memory.

At a low level this will be dependent on the OS and programming language.

Our assumption is we ignore it which is fine for our analysis.

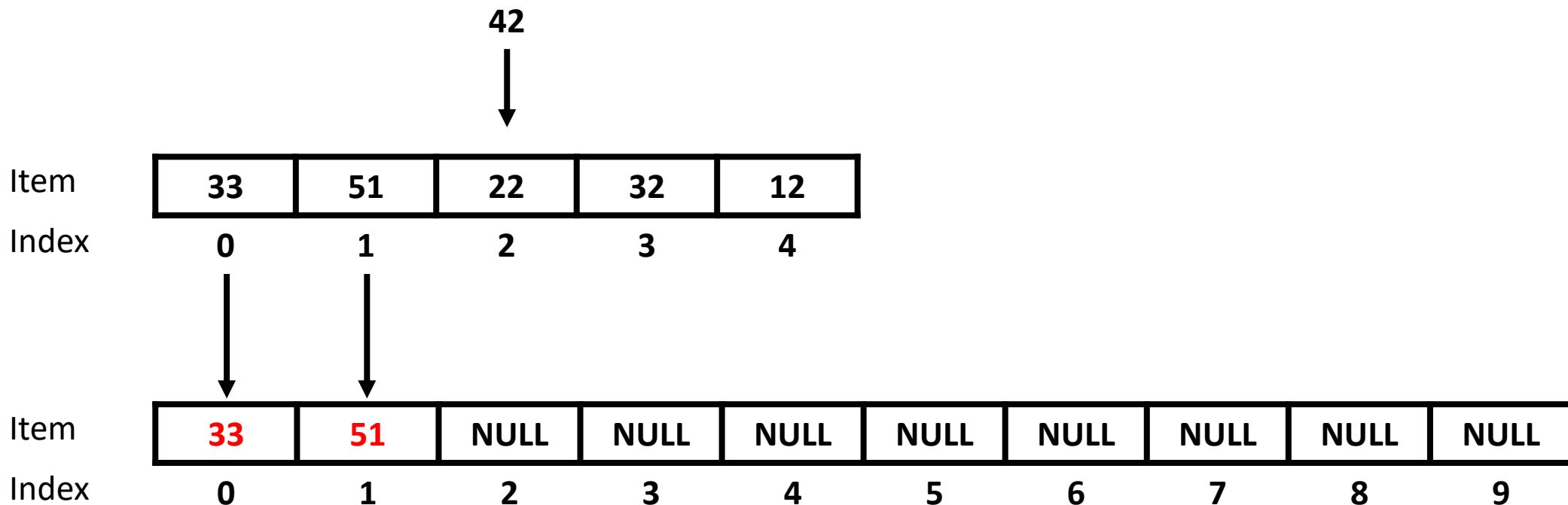
Item	33	51	22	32	12
Index	0	1	2	3	4

42  
↓

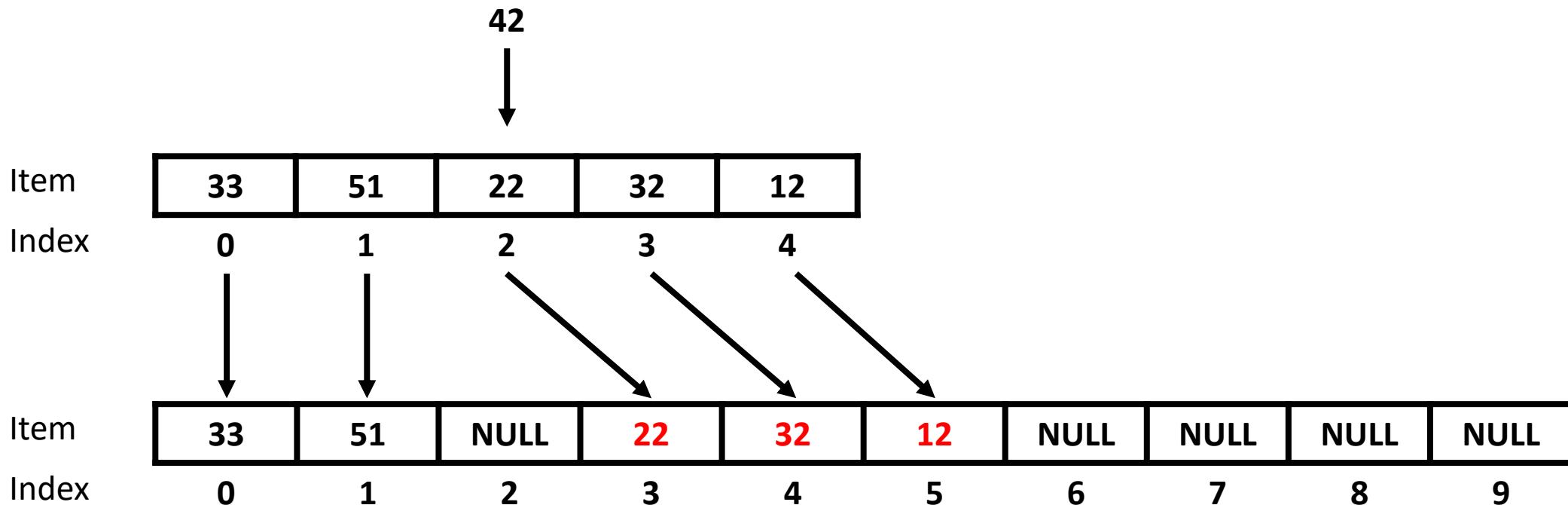
Item	NULL								
Index	0	1	2	3	4	5	6	7	8



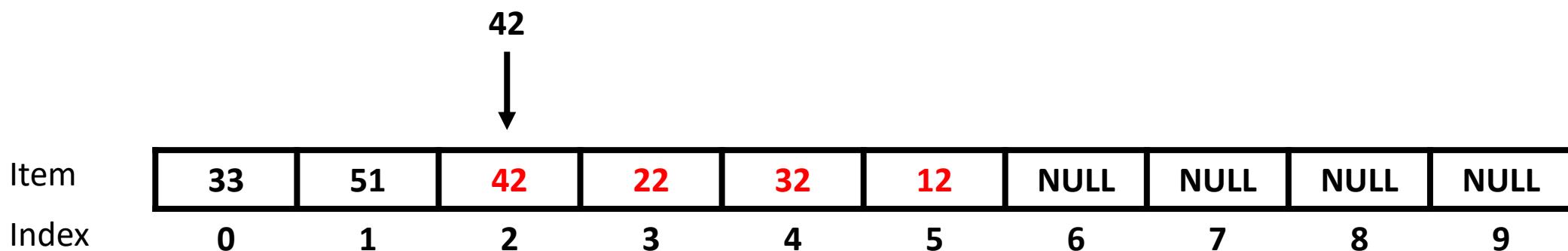
- Copy across before insert



- Copy across after insert



- Perform Insert



Item	33	51	42	22	32	12	NULL	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8	9

Delete when  $n - 1 > L$   
(above threshold)

# Wrong Way

- Delete, backward left copy. Threshold might be 4 items.  $6-1 = 5 > 4$

Delete

The diagram illustrates a linked list structure with 10 slots. The 'Item' row shows the data values, and the 'Index' row shows the slot indices from 0 to 9. A vertical arrow labeled 'Delete' points to the slot at index 2, which contains the value 42. This indicates that the node at index 2 is being removed. The slot at index 2 is empty after the delete operation.

Item	33	51	42	22	32	12	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8

- Delete, Backward left copy. Threshold might be 4 items.  $6-1 = 5 > 4$

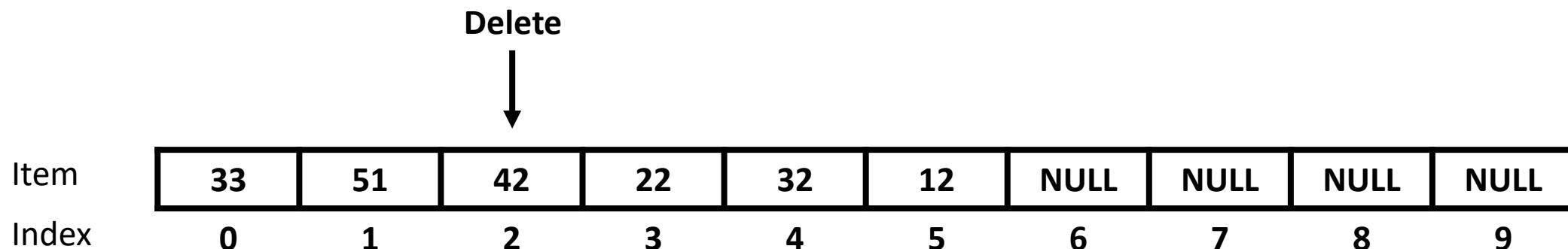


Item	33	51	42	22	12	12	NULL	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8	9

We have just written over 32. Oops!

# Right Way

- Delete, Forward left copy. Threshold might be 4 items.  $6-1 = 5 > 4$



- Delete, Forward left copy. Threshold might be 4 items.  $6-1 = 5 > 4$



Item	33	51	22	22	32	12	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8

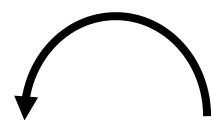
- Delete, Forward left copy. Threshold might be 4 items.  $6-1 = 5 > 4$



Item	33	51	22	32	32	12	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8

- Delete, Forward left copy. Threshold might be 4 items.  $6-1 = 5 > 4$

Item	33	51	22	32	12	12	NULL	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8	9



- Delete, Forward left copy. Threshold might be 4 items.  $6-1 = 5 > 4$



Item	33	51	22	32	12	NULL	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8

Item	33	51	22	32	12	NULL	NULL	NULL	NULL	
Index	0	1	2	3	4	5	6	7	8	9

Delete when  $n - 1 \leq L$   
(at threshold)

- Resize, Forward left copy,  $n - 1 = 4 - 1 = 3 \leq 3$ . Here our threshold is  $L = 3$

**Delete**

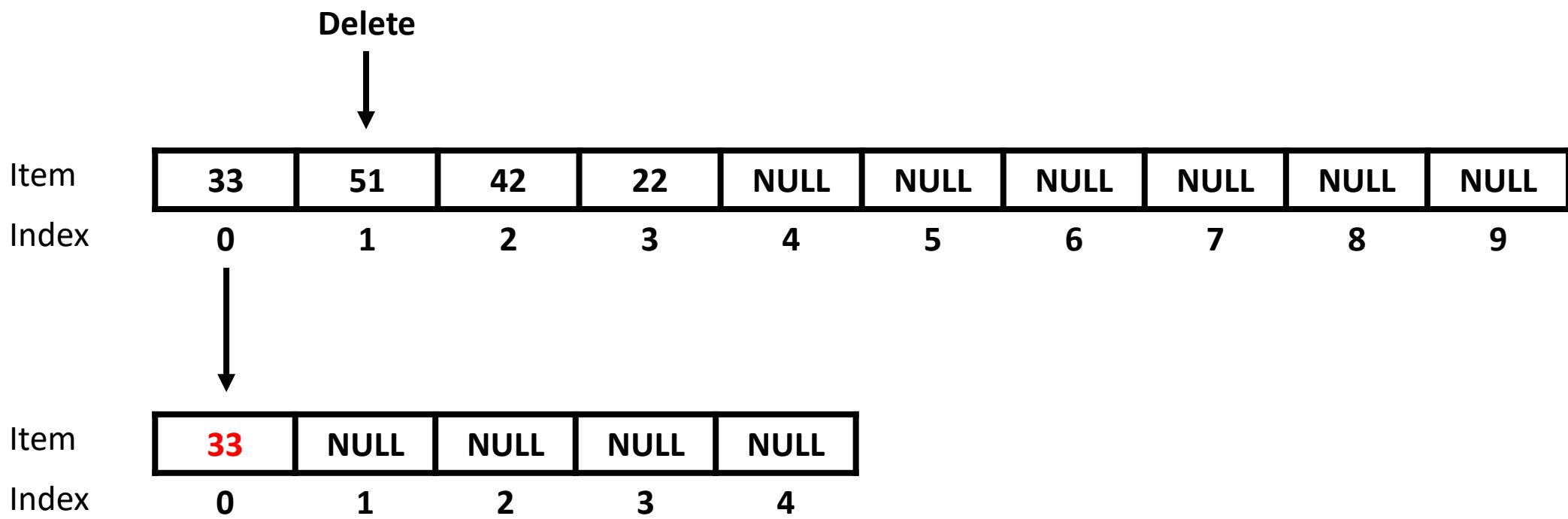
Item	33	51	42	22	NULL	NULL	NULL	NULL	NULL	
Index	0	1	2	3	4	5	6	7	8	9

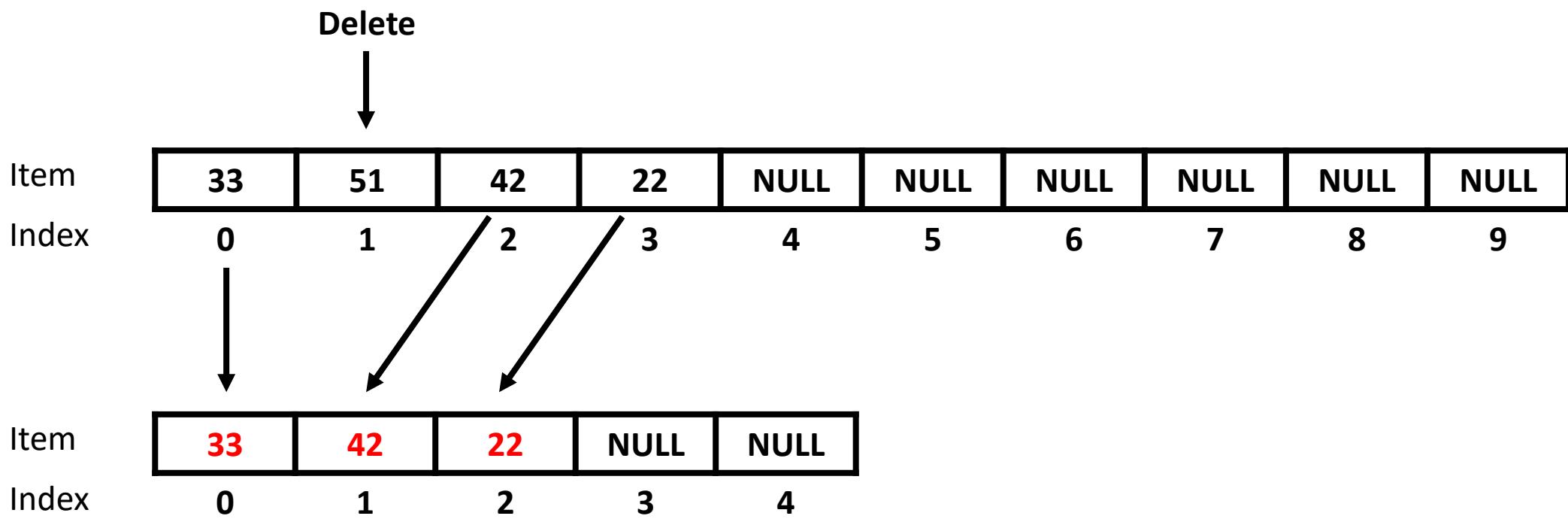
**Delete**



Item	33	51	42	22	NULL	NULL	NULL	NULL	NULL
Index	0	1	2	3	4	5	6	7	8

Item	NULL	NULL	NULL	NULL	NULL
Index	0	1	2	3	4





**Delete**



Item	33	51	42	22	NULL	NULL	NULL	NULL	NULL	
Index	0	1	2	3	4	5	6	7	8	9

Item	33	42	22	NULL	NULL
Index	0	1	2	3	4