Introduction to Programming

Week – *9*, Lecture – *1*

Structures in C – Part 2

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IIT KANPUR

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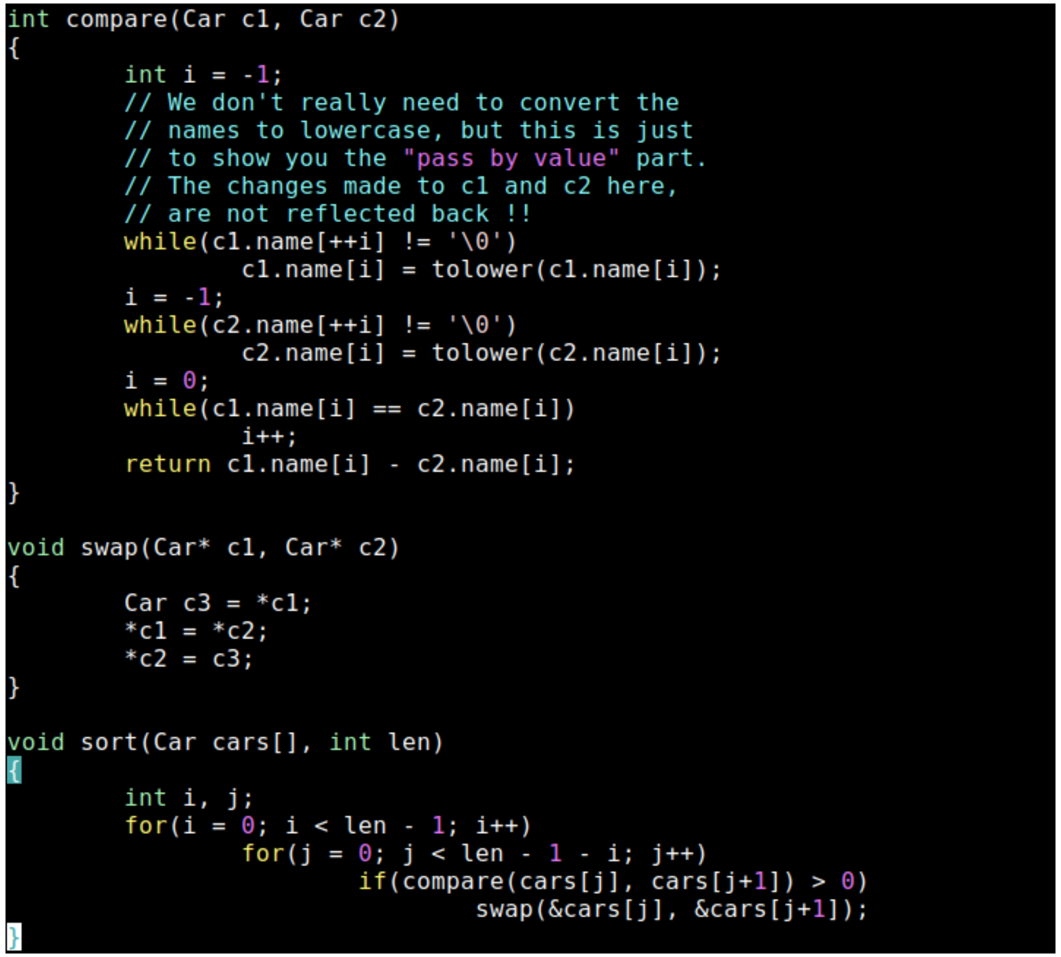
Also, you can use pointers to structures, in the same way, as you use pointers to other variables

Example – Sorting Structure Variables



```c
int compare(Car c1, Car c2)
{
        int i = -1;
        // We don't really need to convert the
        // names to lowercase, but this is just
        // to show you the "pass by value" part.
        // The changes made to c1 and c2 here,
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        while(c1.name[++i] != '\0')
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        i = -1;
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}

void swap(Car* c1, Car* c2)
{
        Car c3 = *c1;
        *c1 = *c2;
        *c2 = c3;
}

void sort(Car cars[], int len)
{
        int i, j;
        for(i = 0; i < len - 1; i++)
                for(j = 0; j < len - 1 - i; j++)
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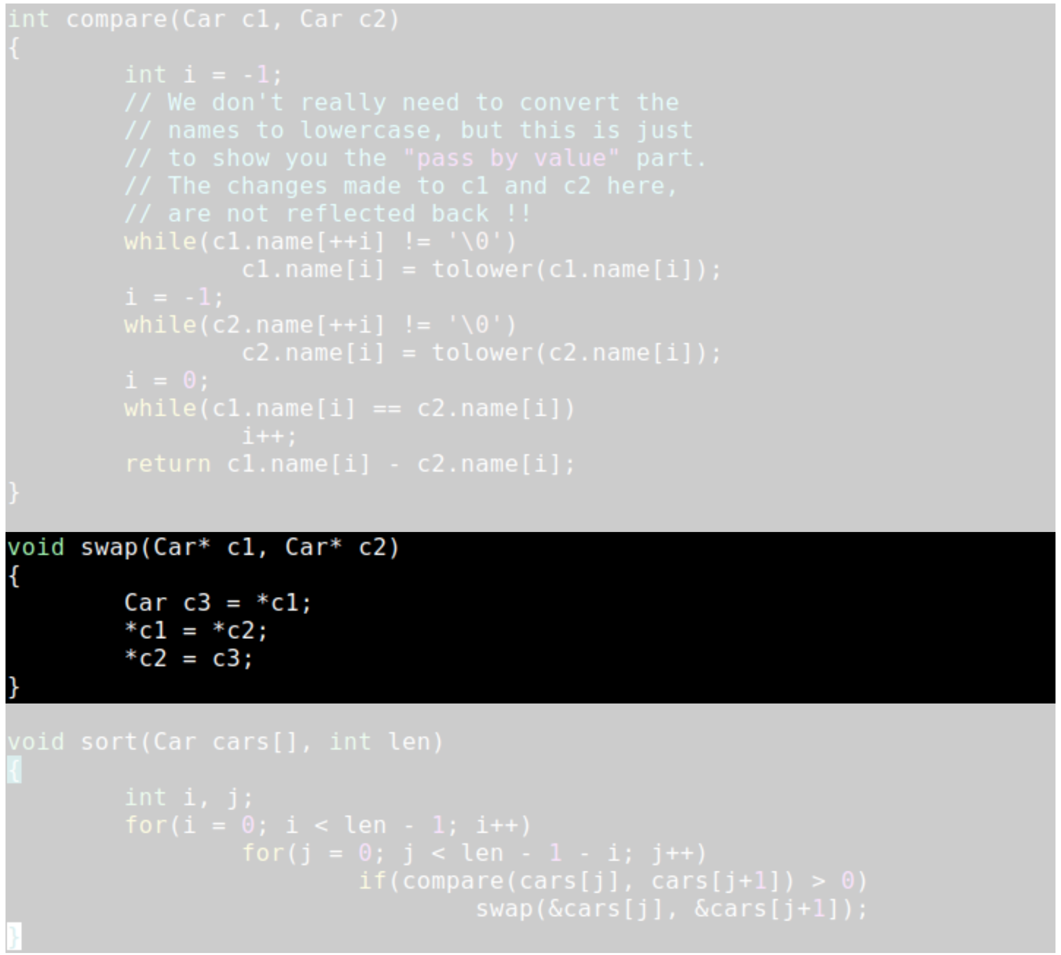

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These are some examples of passing structure variables to functions by reference

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You may read more about this operator, if you are studying (or planning to study) C++

- In C, it doesn’t serve much purpose, other than a shorthand, and a more readable code

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- Actually, you can add many such pointers as you want in the structure declaration

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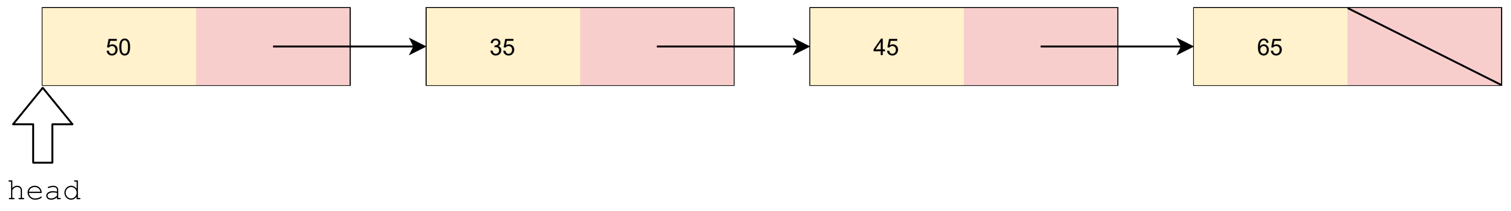

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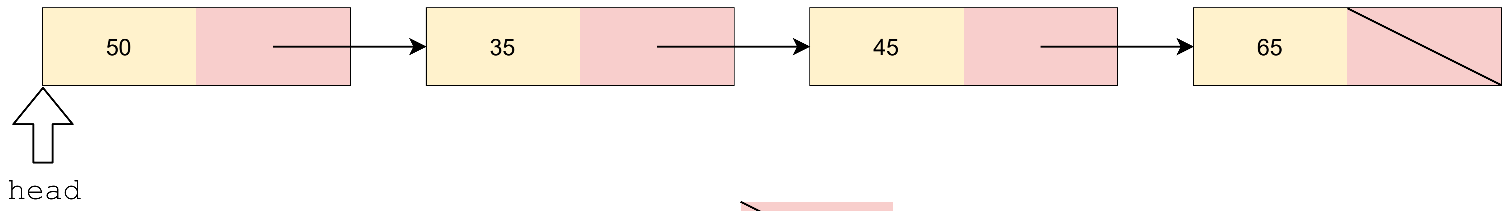
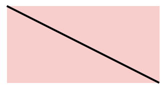


The  signifies `NULL`

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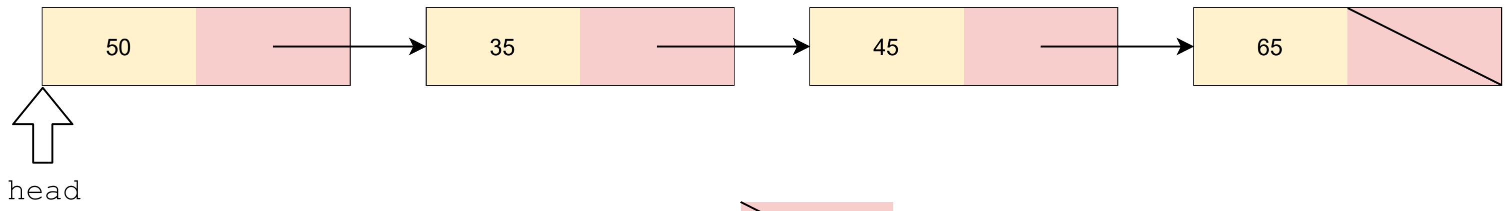
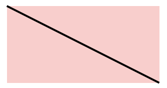
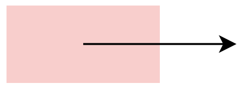


The  signifies `NULL`

The  signifies a pointer to the next structure node

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insert_at_head(50)
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The first insertion, needs to be done at the `head` of the list

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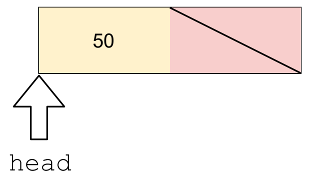

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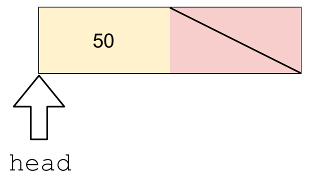

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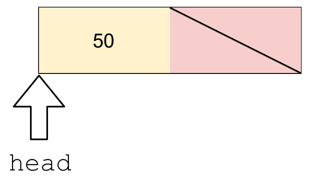

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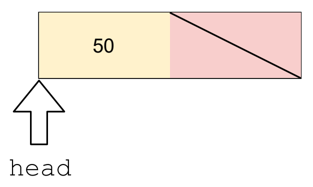

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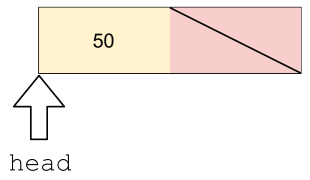

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This saves us the hassle of managing scopes `head = NULL`

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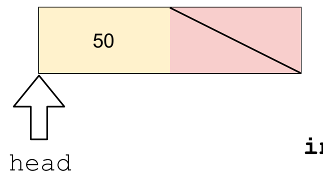
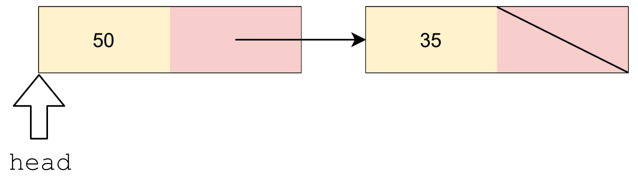
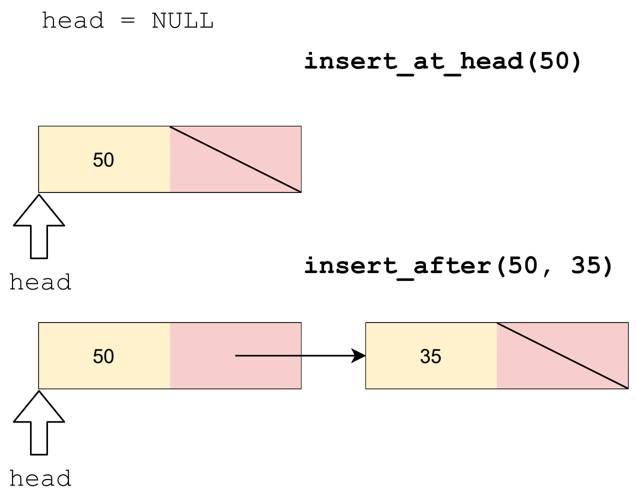


`insert_after(50, 35)`



The subsequent insertions expect that the user provides us with the value of the ”previous” node



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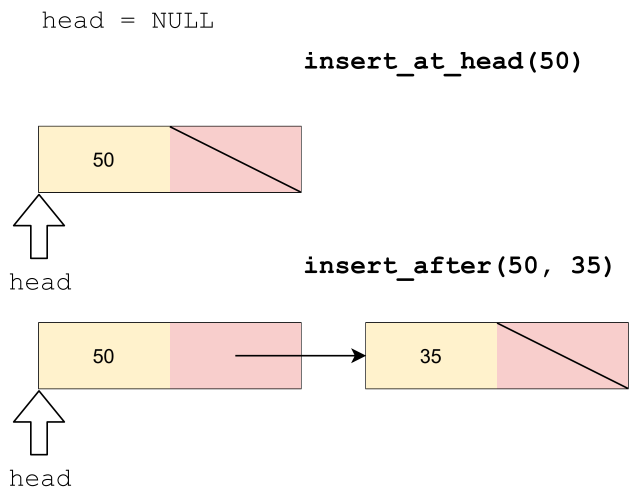
For example, here, the value `35`, is supposed to be inserted next to the value `50`



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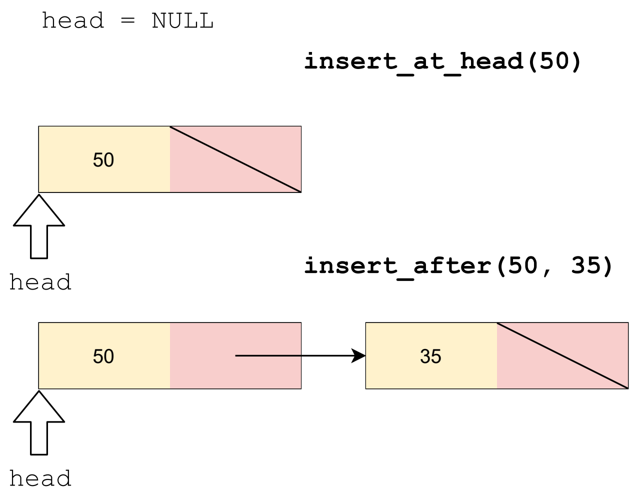

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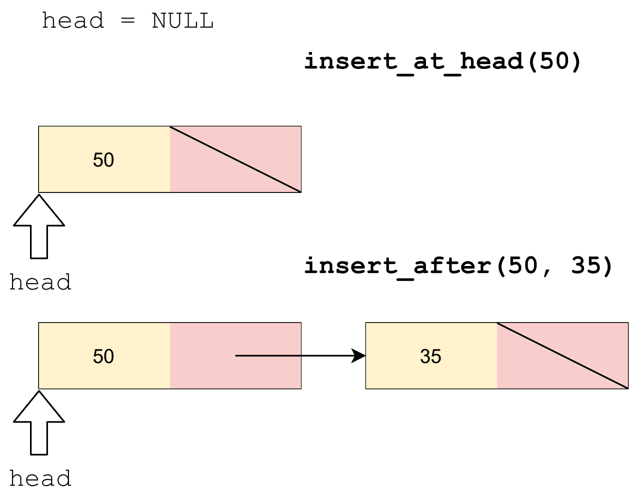

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If we cannot find a suitable previous node, we may signal that the insertion has failed

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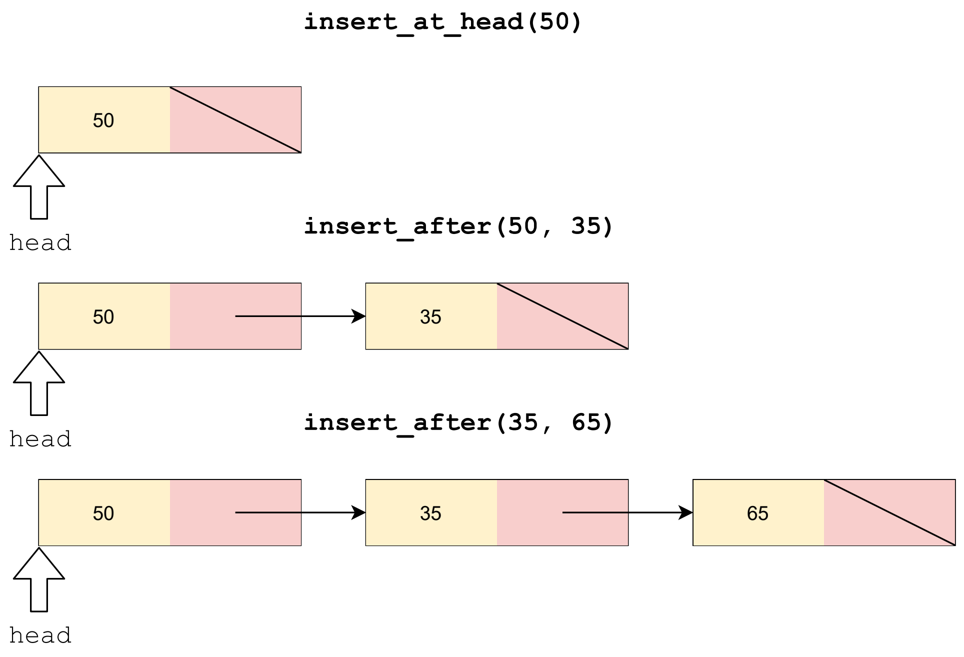

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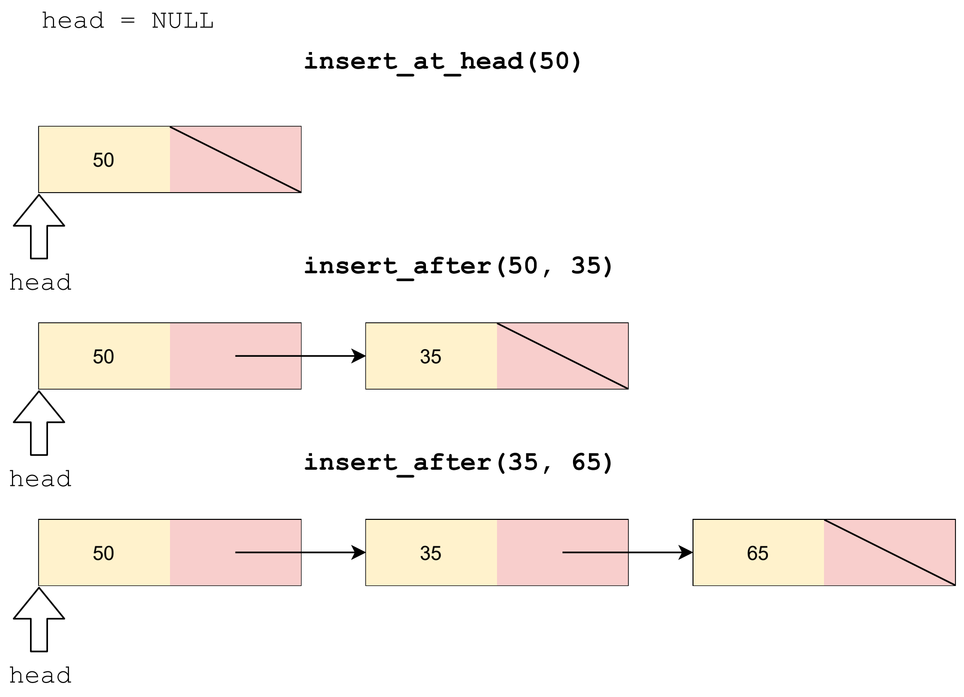

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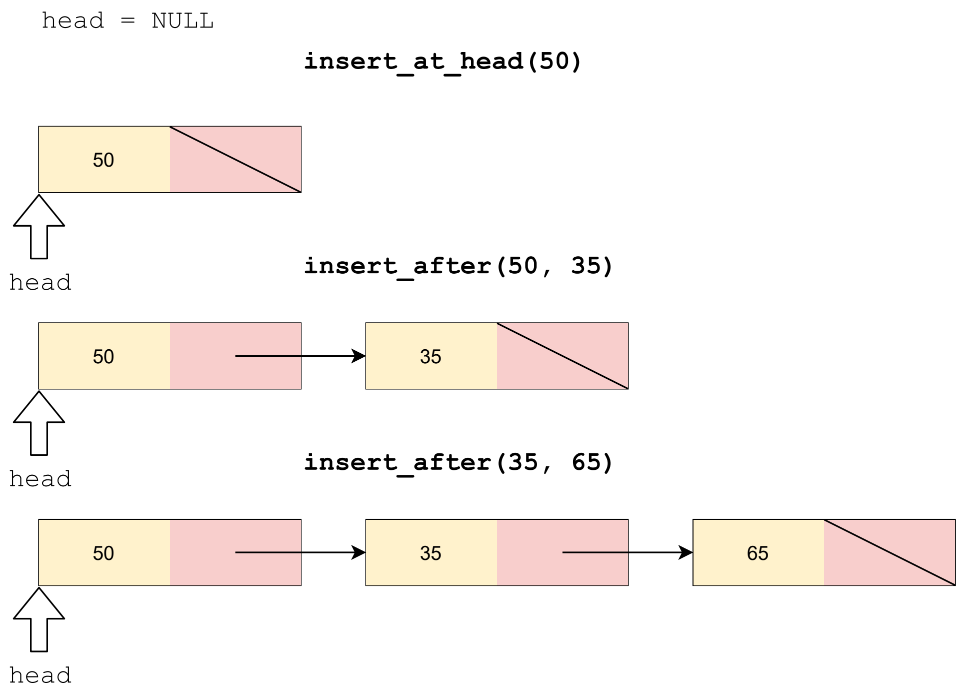

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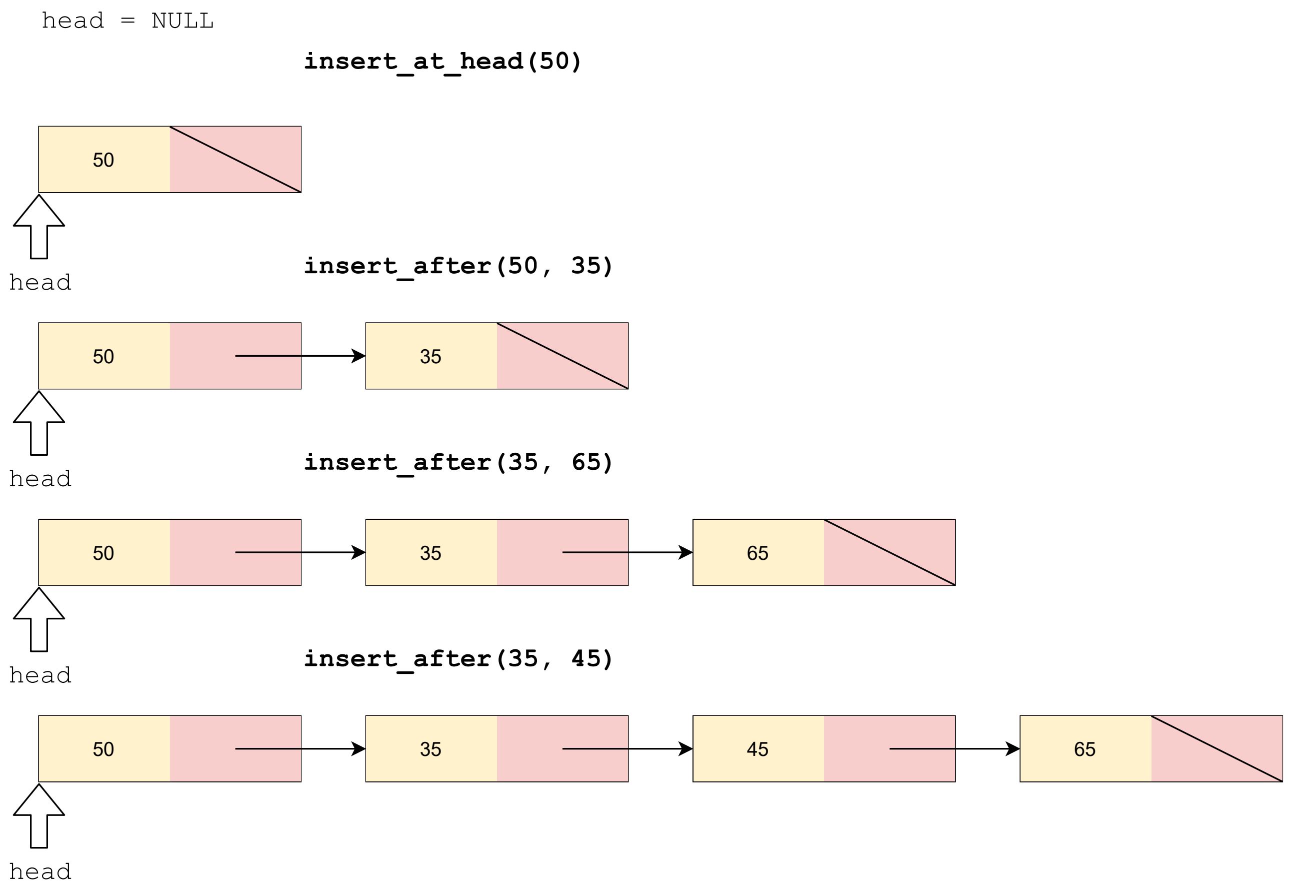
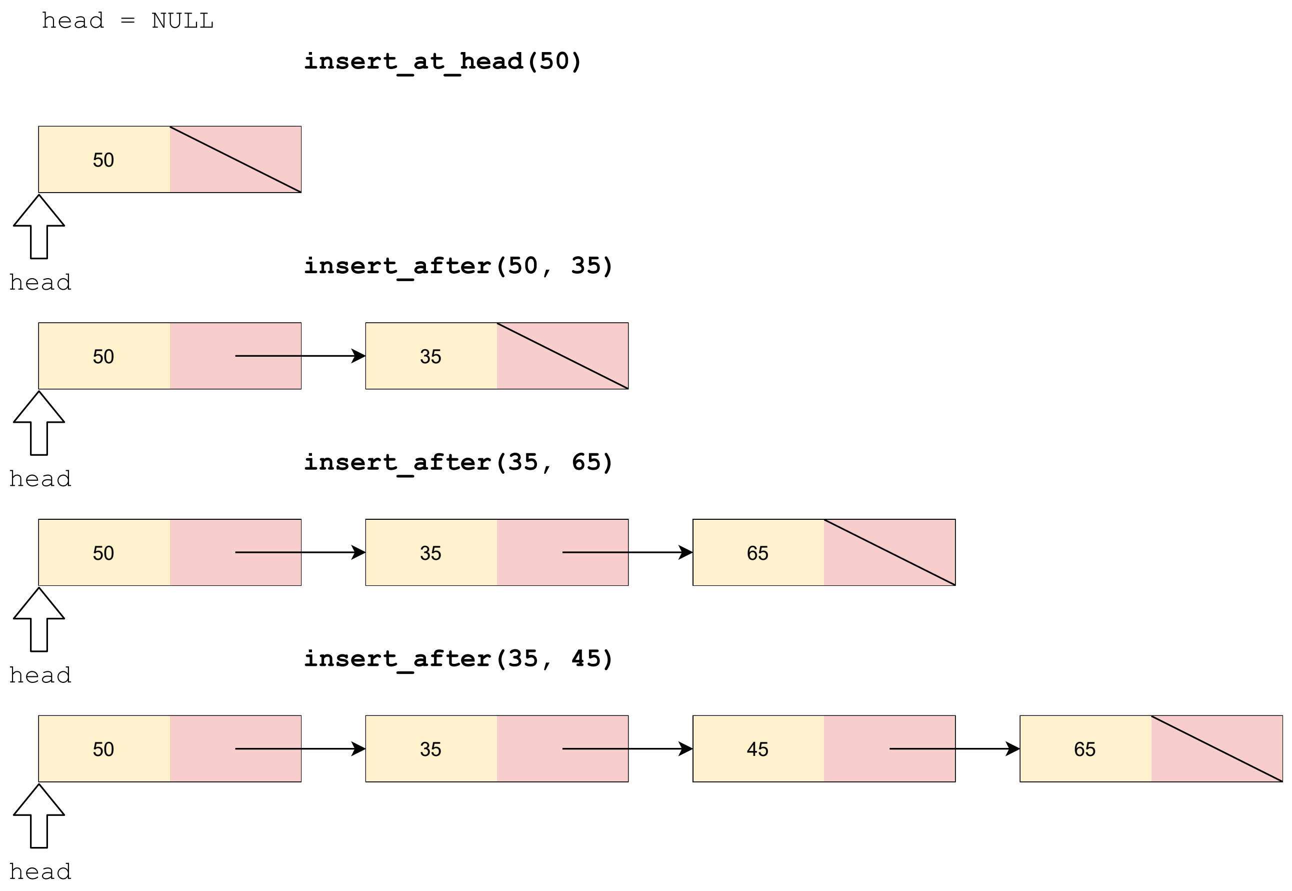
For example, the simplest policy is to insert it after the first encountered instance (starting from head)

... and one more example of insertion





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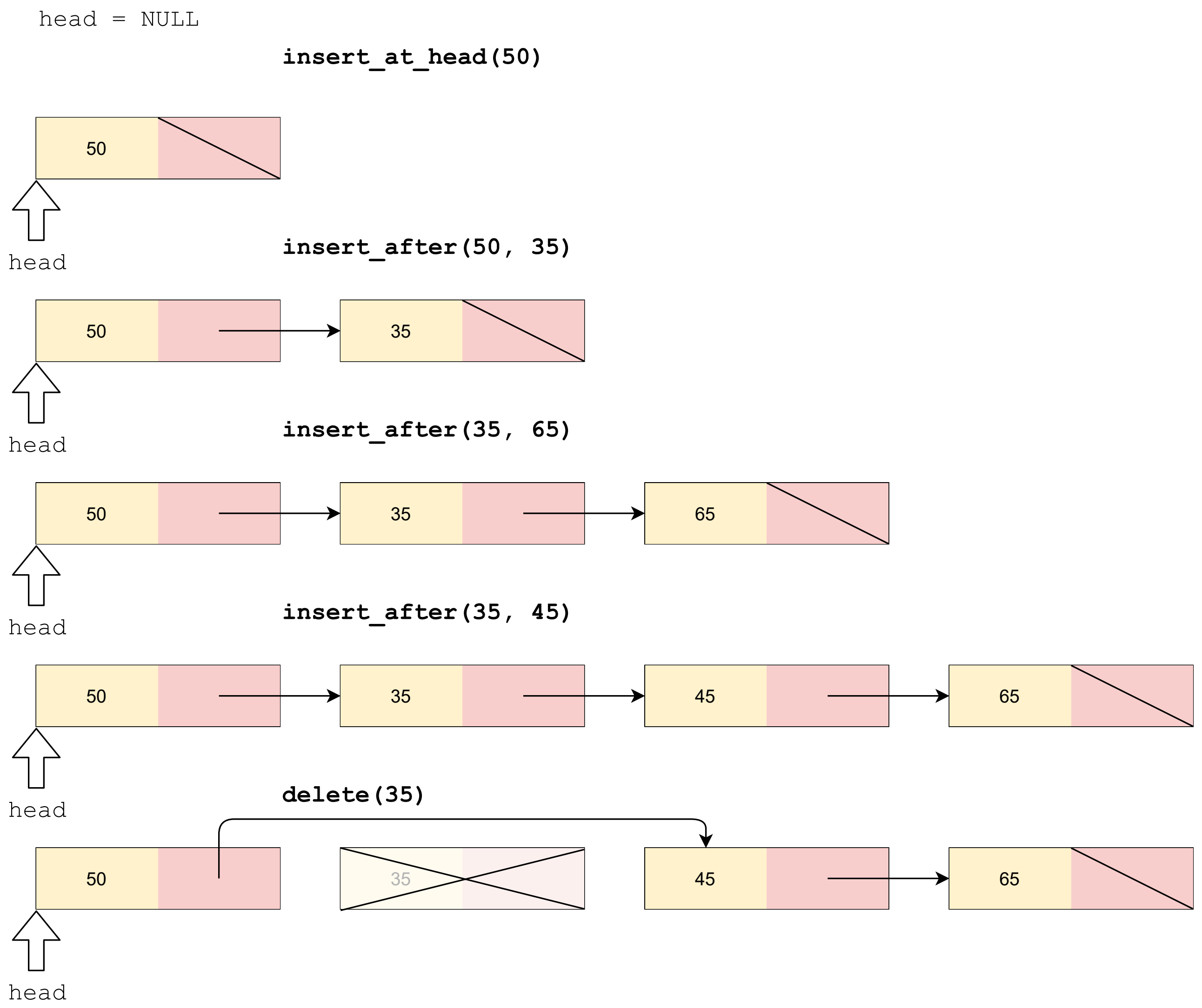
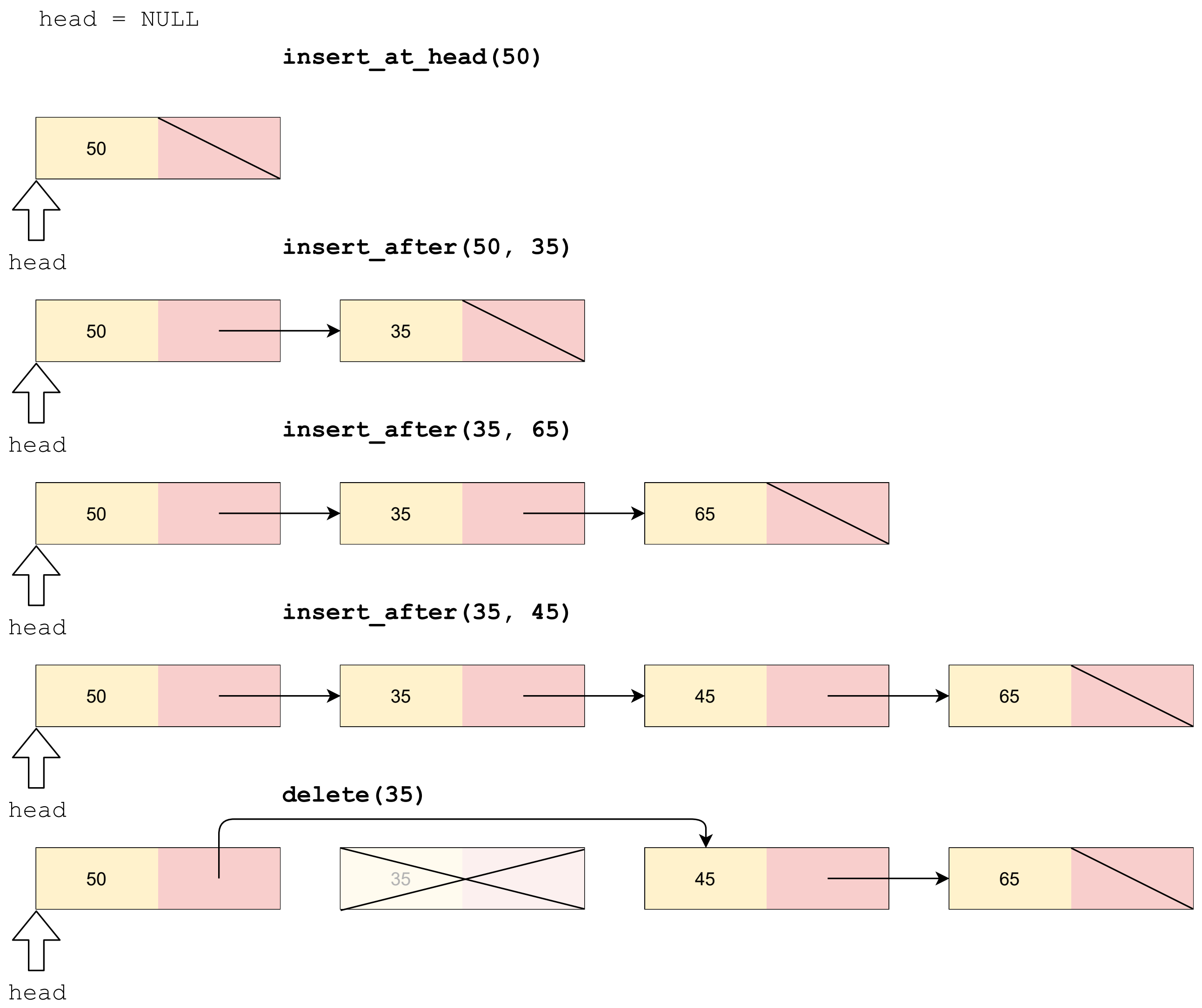
Convince yourself that you understand how the insertion operation works in a linked list



During the deletion, the user provides the value which should be deleted



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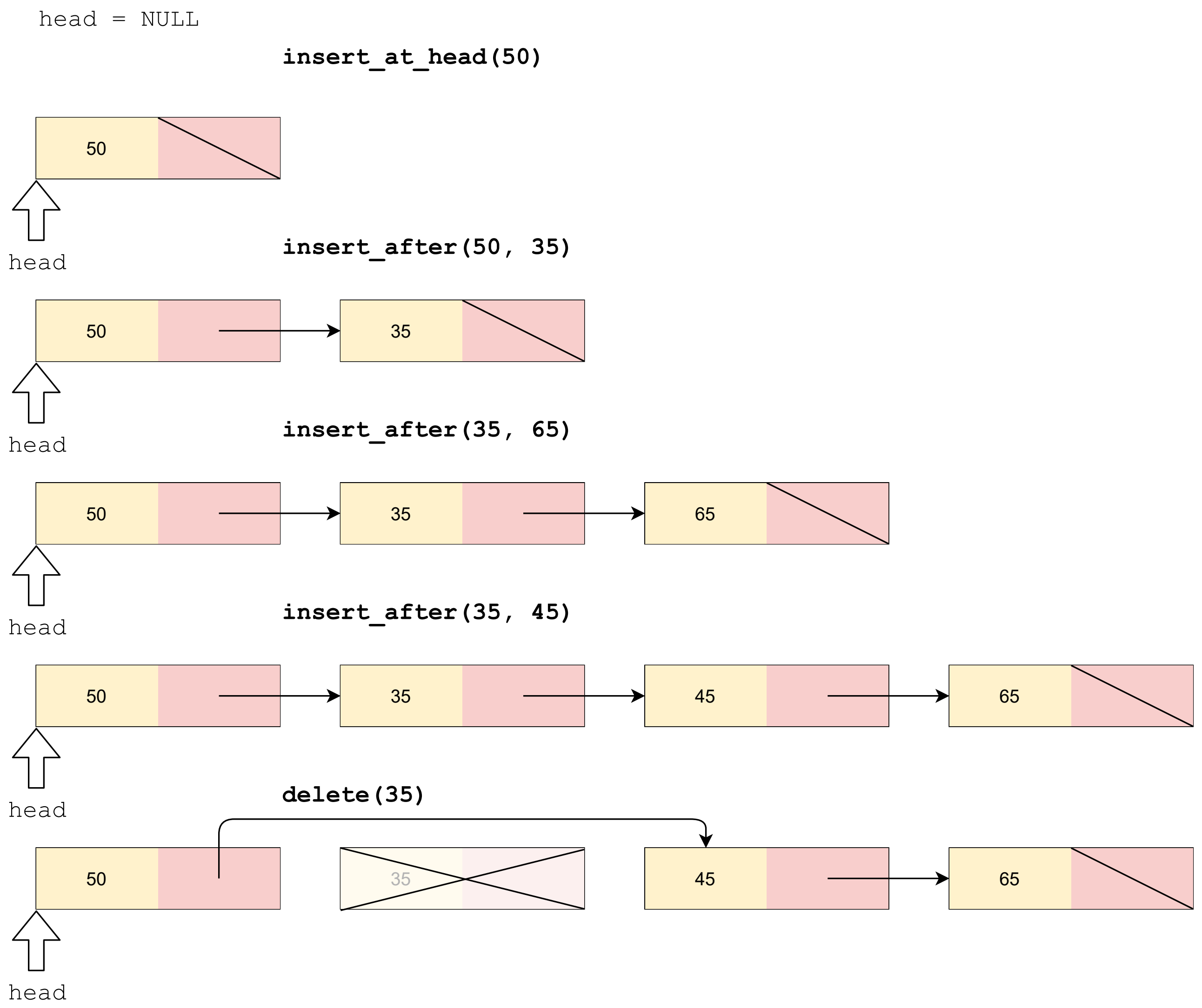

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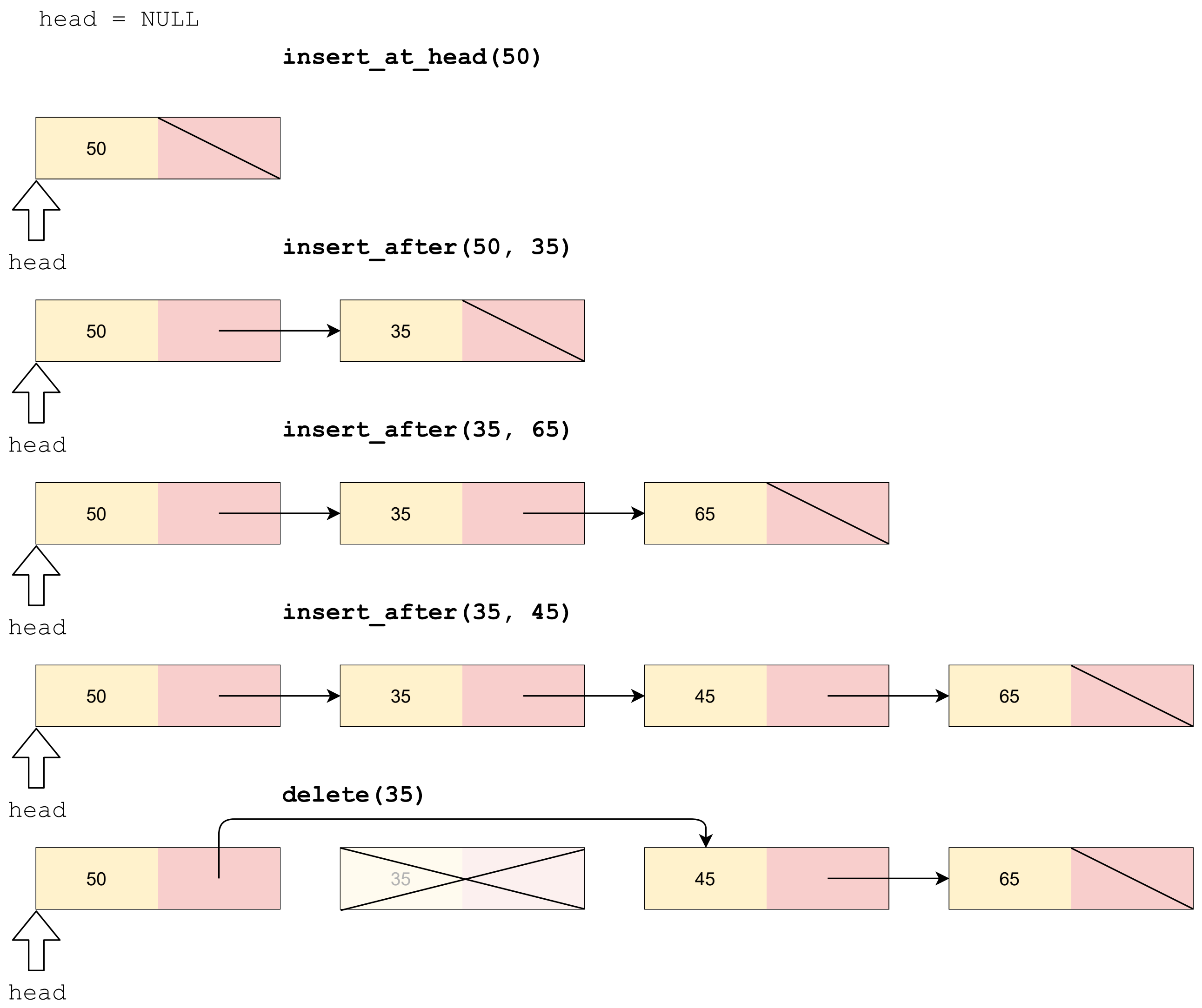

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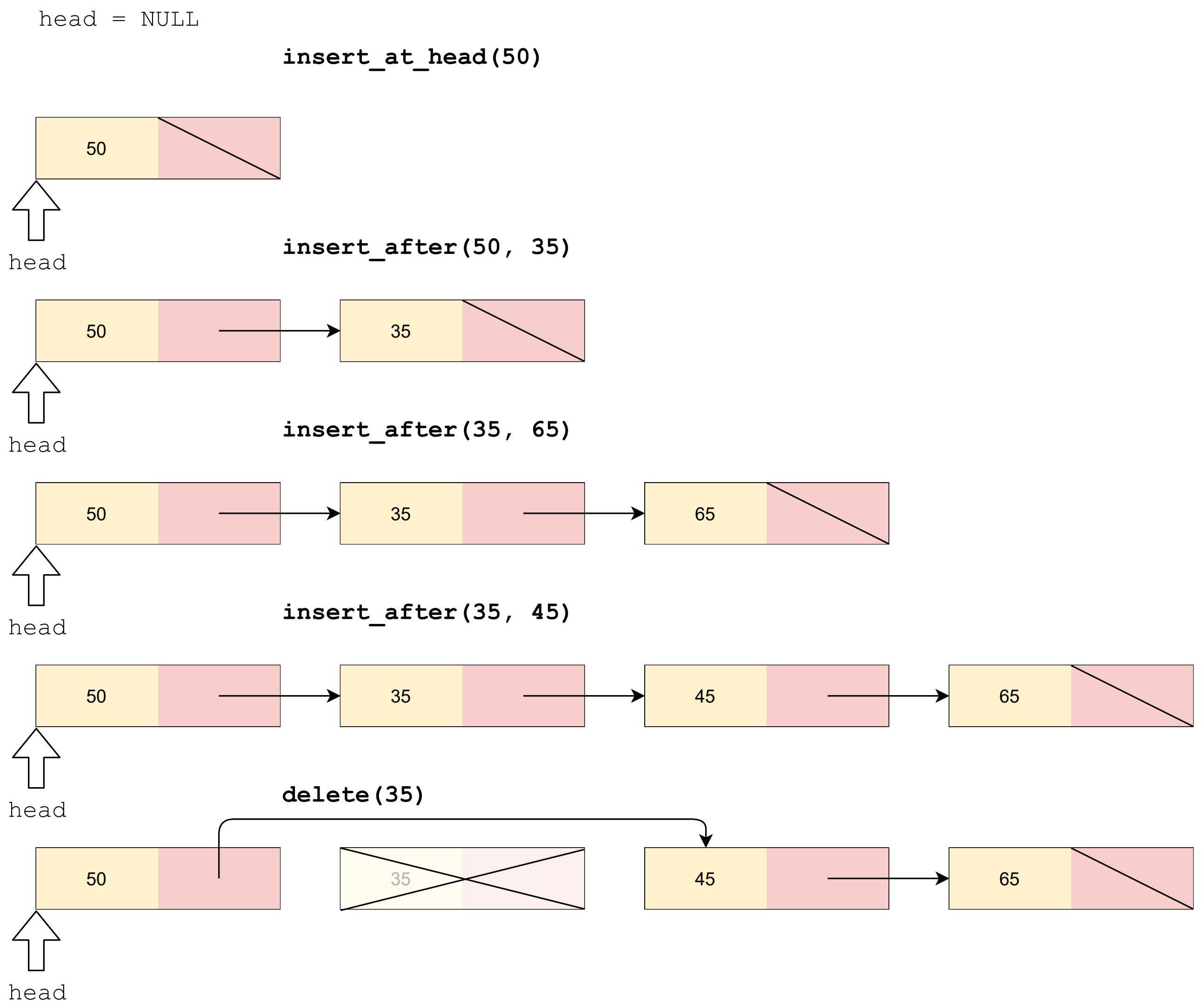

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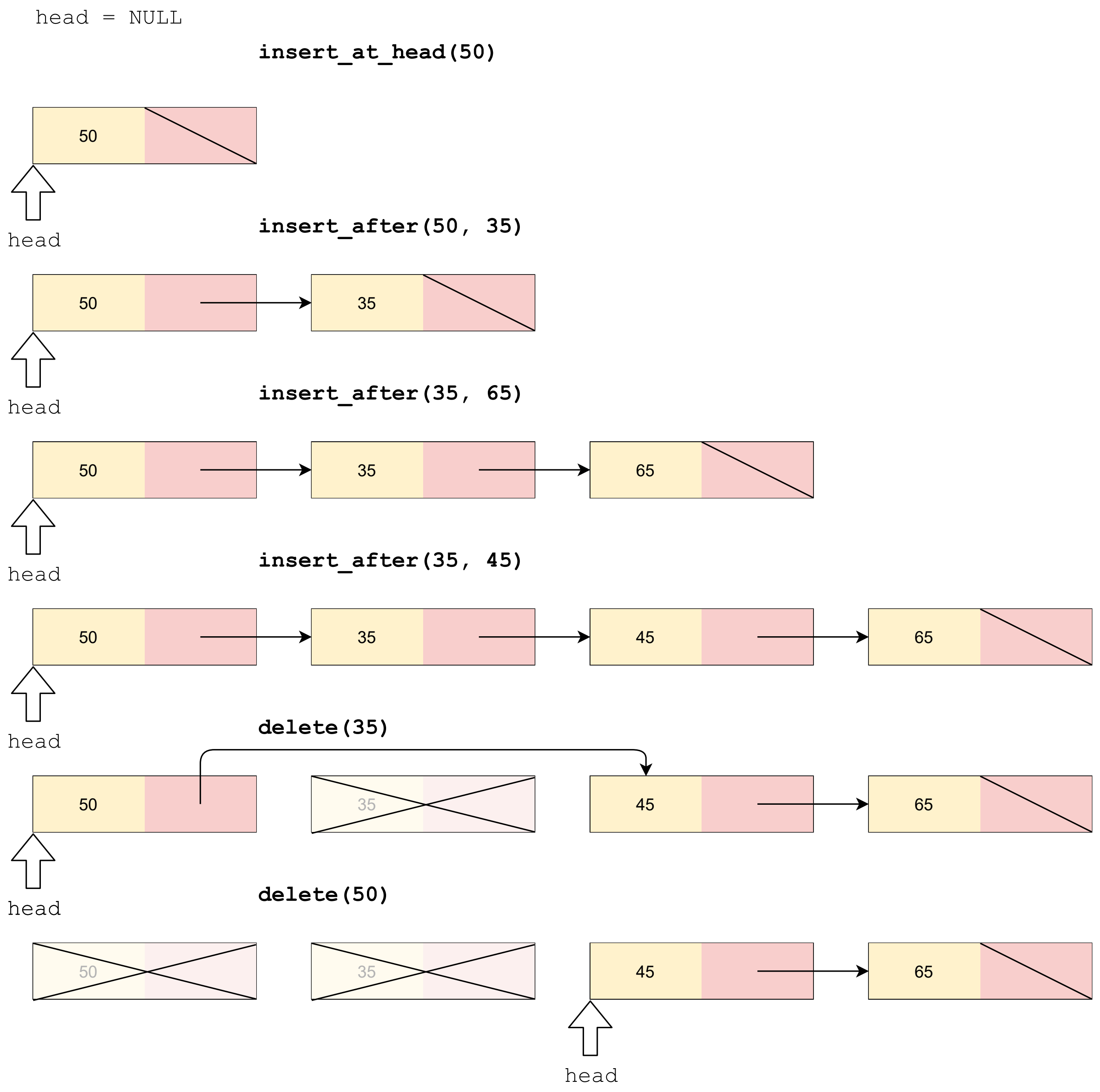
Finally, the node with value 35 is deallocated, say by calling `free()` (if it was allocated dynamically)



```
head = NULL
insert_at_head(50)
insert_after(50, 35)
insert_after(35, 65)
insert_after(35, 45)
delete(35)
delete(50)
```

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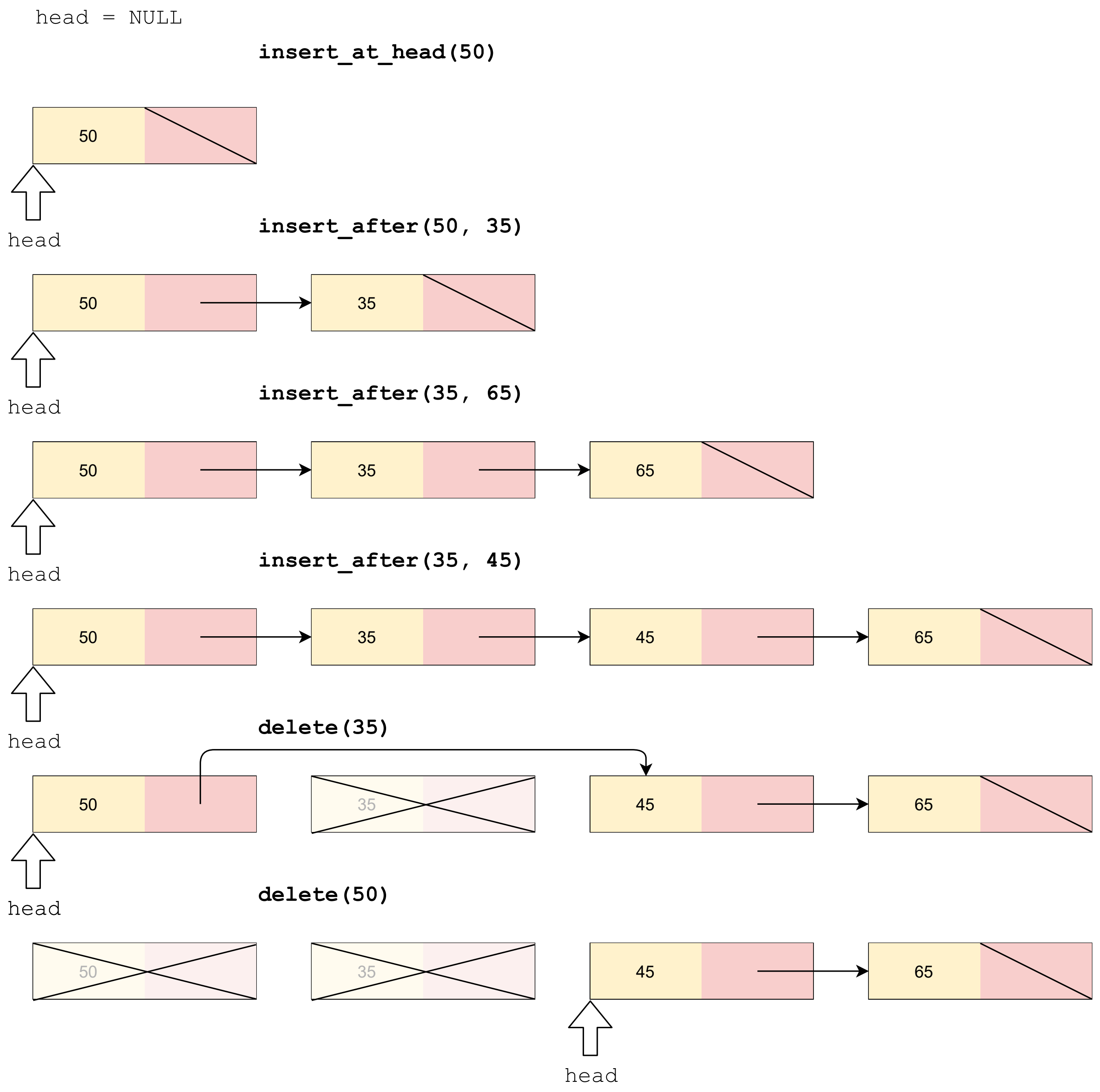

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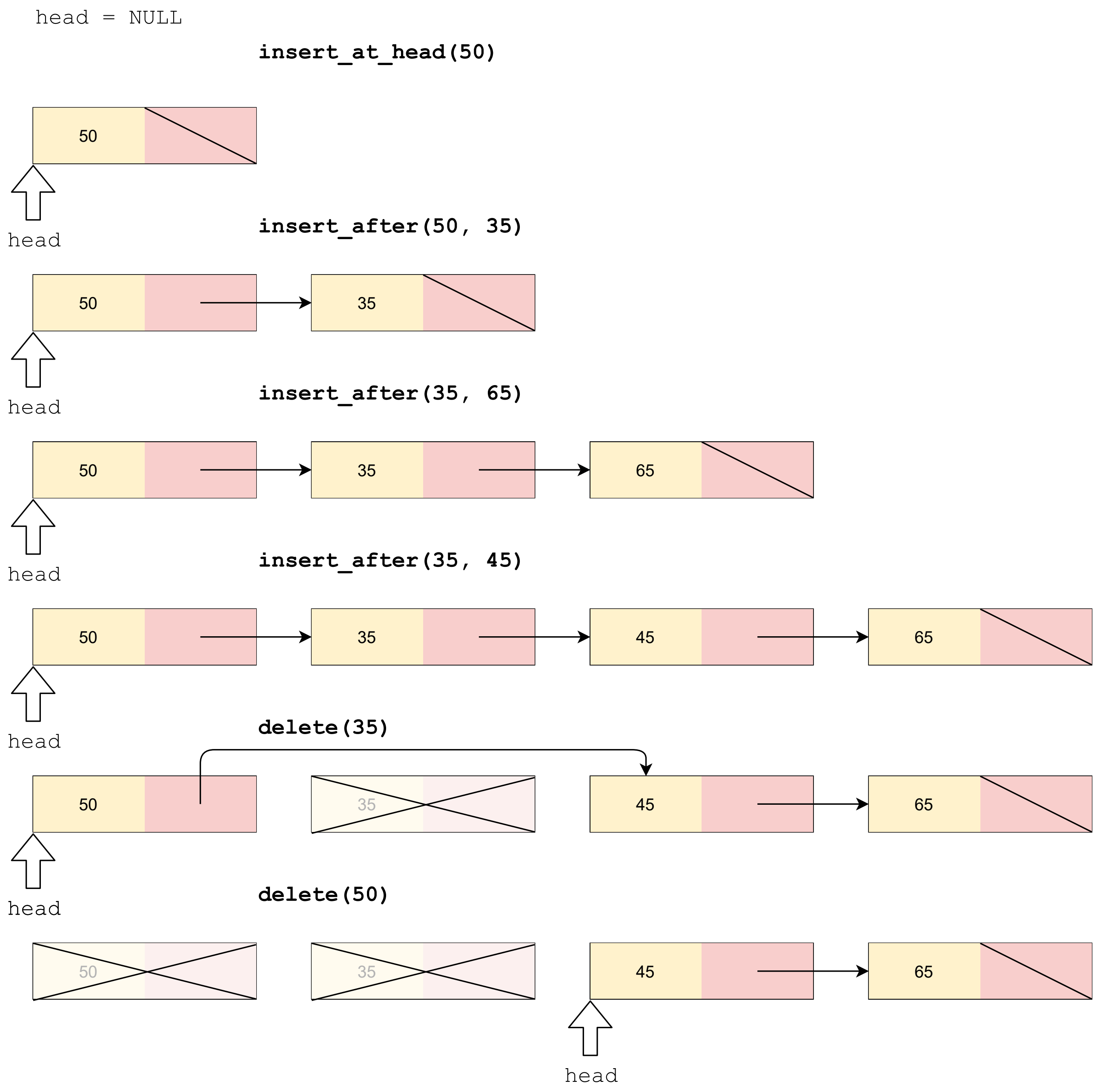

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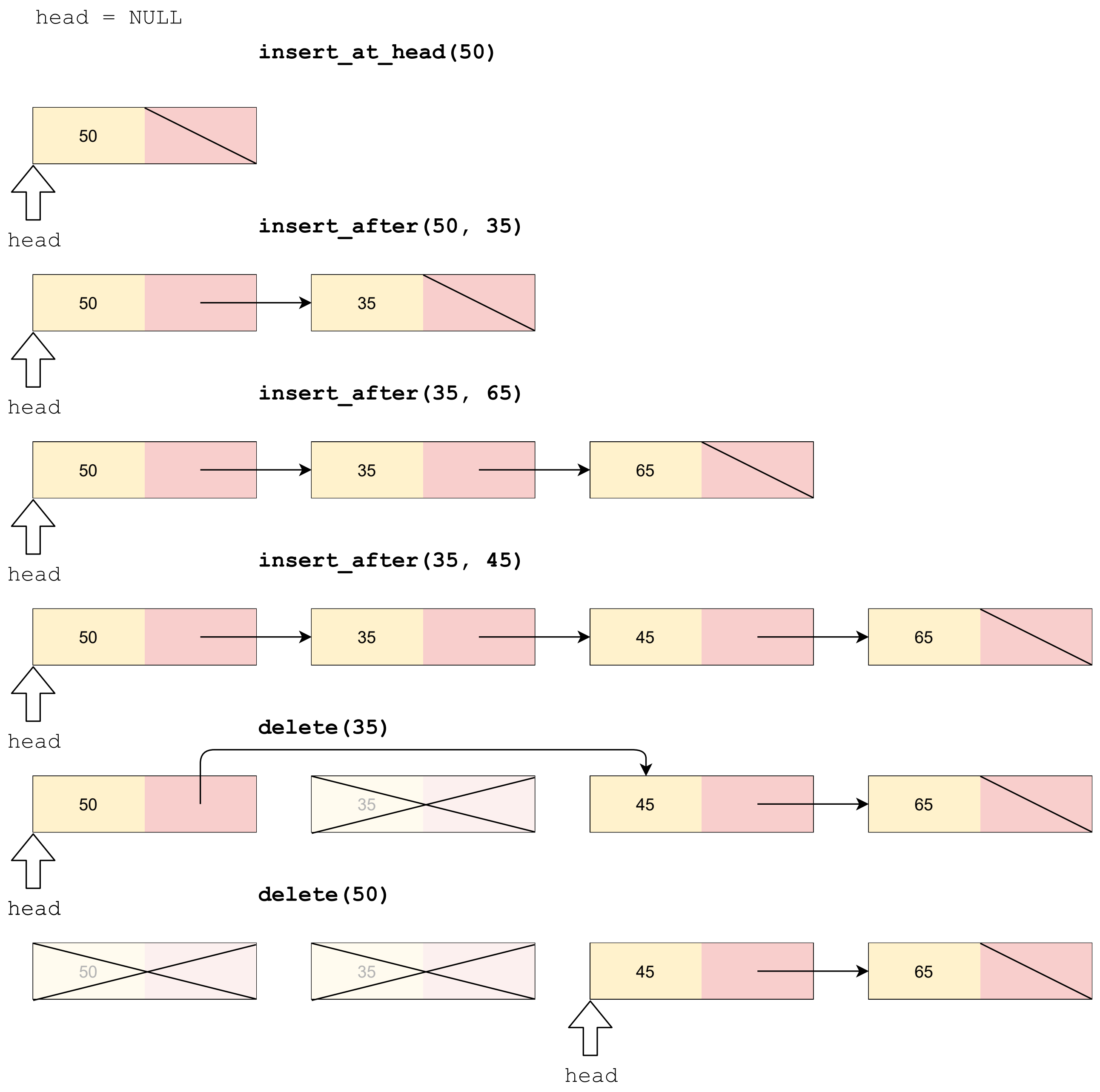
Here, we simply point the `head` to the next node in the list, and free the current `head` node

Similar to insertion, we need to set a policy for handling multiple instances of the same value



… another deletion example, this time there is no "previous" node though, since it is the first node

Here, we simply point the `head` to the next node in the list, and free the current `head` node

Similar to insertion, we need to set a policy for handling multiple instances of the same value

Again, the simplest policy is to delete the first instance encountered while browsing from `head`

Homework !!

I have shared a simple implementation for a linked list in the Google Drive folder

- It is called `SimpleLinkedList.c`
- Read the code and run the program to understand its working
- (if you find a bug, send me an email, I'll fix it; I wrote the code in a hurry, so couldn't test it satisfactorily)

Additional Reading

There is an annoying problem with the linked list that we discussed, also called *singly linked list*

- We can only move in one direction, i.e. starting from the head, and moving forward

There is another version of linked lists, called the *doubly linked list*

- Doubly linked lists have two pointers in each node, one for the next, and one for the previous node

Read more about doubly linked lists

- You may start here: https://www.geeksforgeeks.org/difference-between-singly-linked-list-and-doubly-linked-list/