Doubly-Linked Lists

Doubly-Linked Lists

- Singly-linked lists really extend our ability to collect and organize data, but they suffer from a crucial limitation.
  - We can only ever move in one direction through the list.

- Consider the implication that would have for trying to delete a node.

- A doubly-linked list, by contrast, allows us to move forward and backward through the list, all by simply adding one extra pointer to our `struct` definition.

Doubly-Linked Lists

```
typedef struct dllist
{
    VALUE val;
    struct dllist* prev;
    struct dllist* next;
}
dllnode;
```

Doubly-Linked Lists

- In order to work with linked lists effectively, there are a number of operations that we need to understand:

1. Create a linked list when it doesn’t already exist.
2. Search through a linked list to find an element.
3. Insert a new node into the linked list.
4. Delete a single element from a linked list.
5. Delete an entire linked list.

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- Steps involved:
  a. Dynamically allocate space for a new `dllnode`.
  b. Check to make sure we didn't run out of memory.
  c. Populate and insert the node at the beginning of the linked list.
  d. Fix the `prev` pointer of the old head of the linked list.
  e. Return a pointer to the new head of the linked list.

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Doubly-Linked Lists

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list = insert(list, 12);
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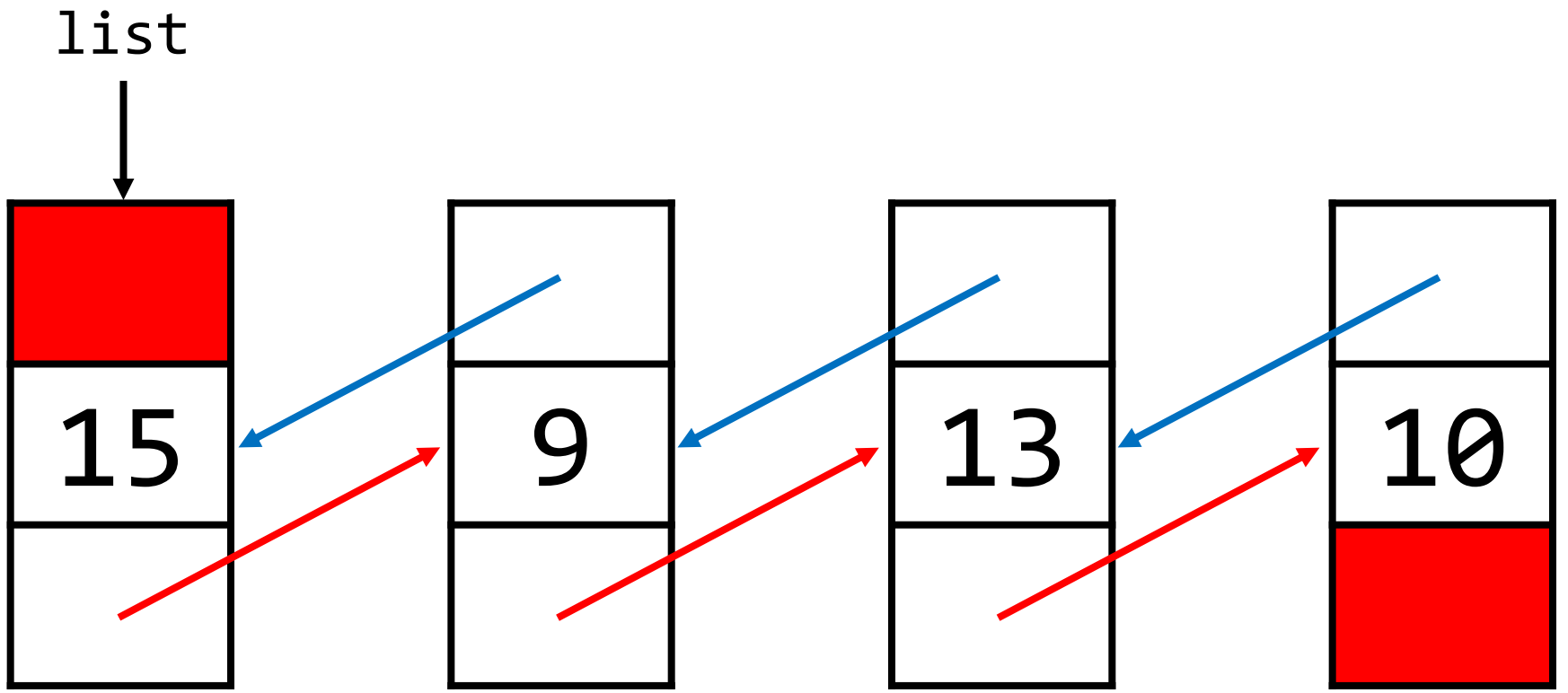

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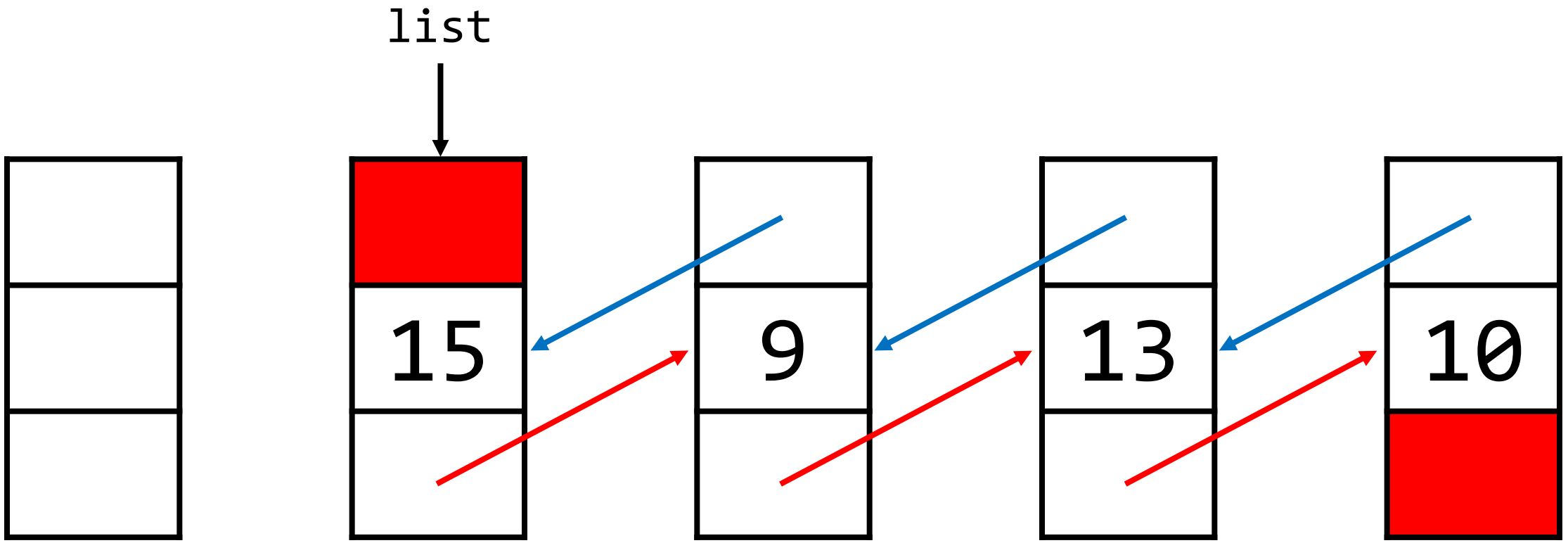

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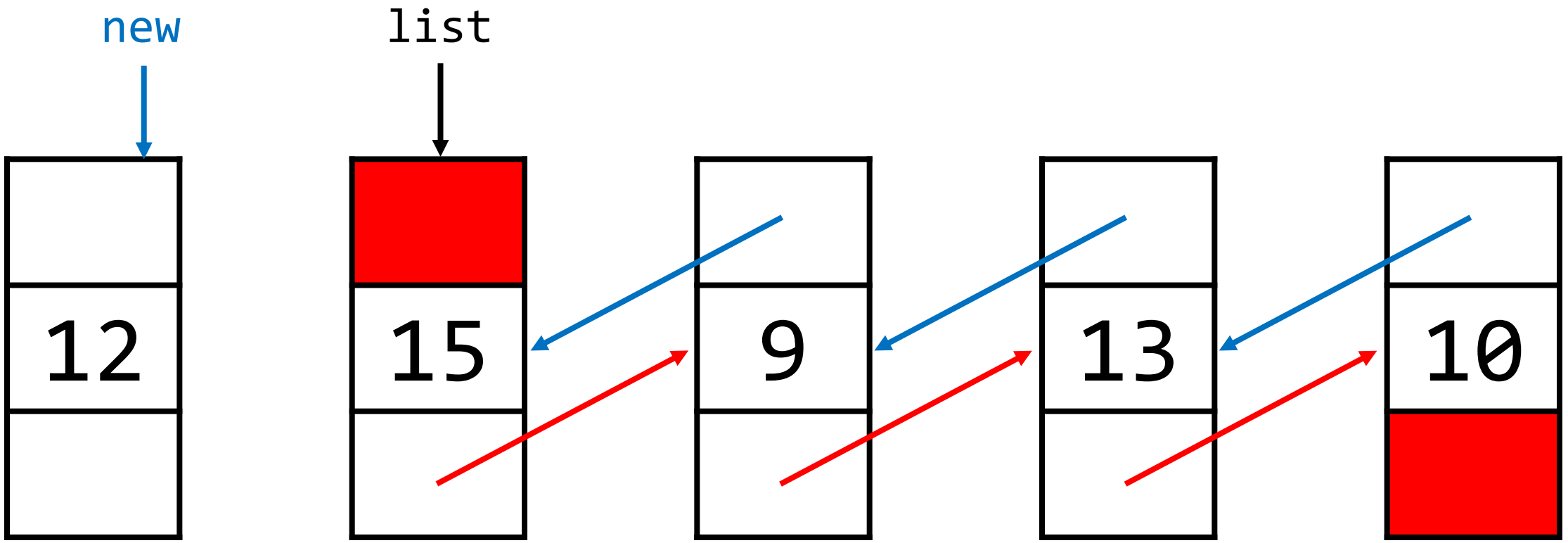

Doubly-Linked Lists

- Remember, we can never break the chain when rearranging the pointers.

- Even if we need to have redundant pointers temporarily, that’s okay.

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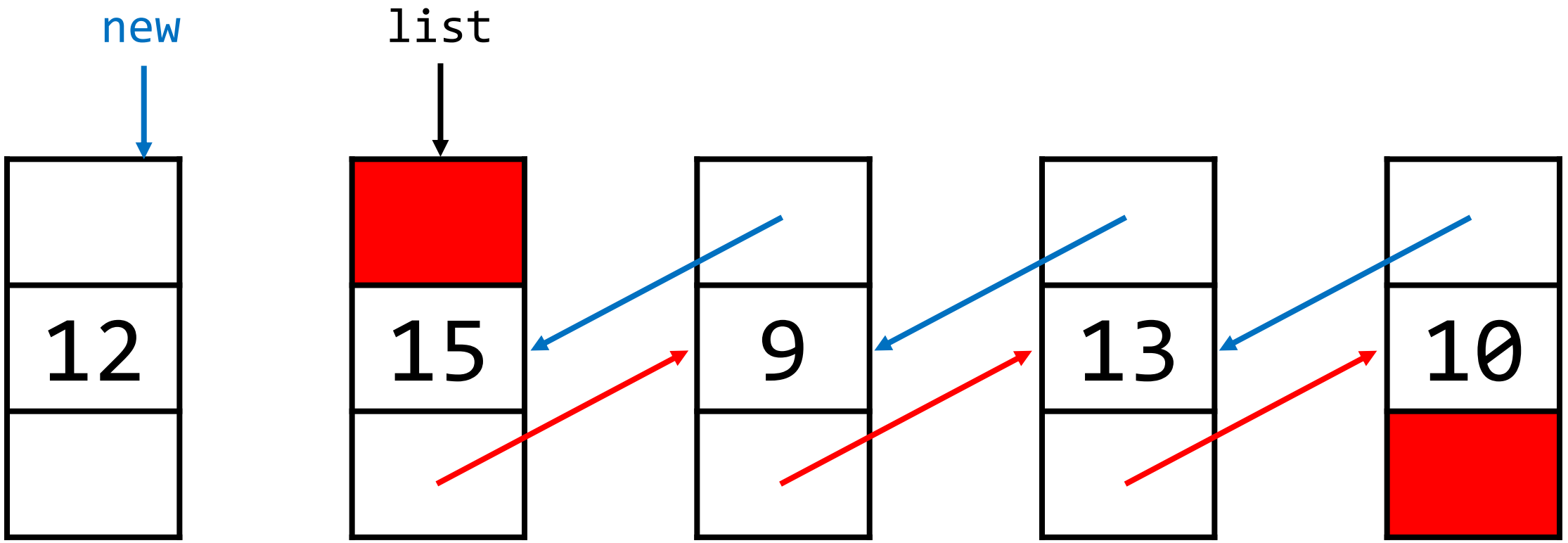

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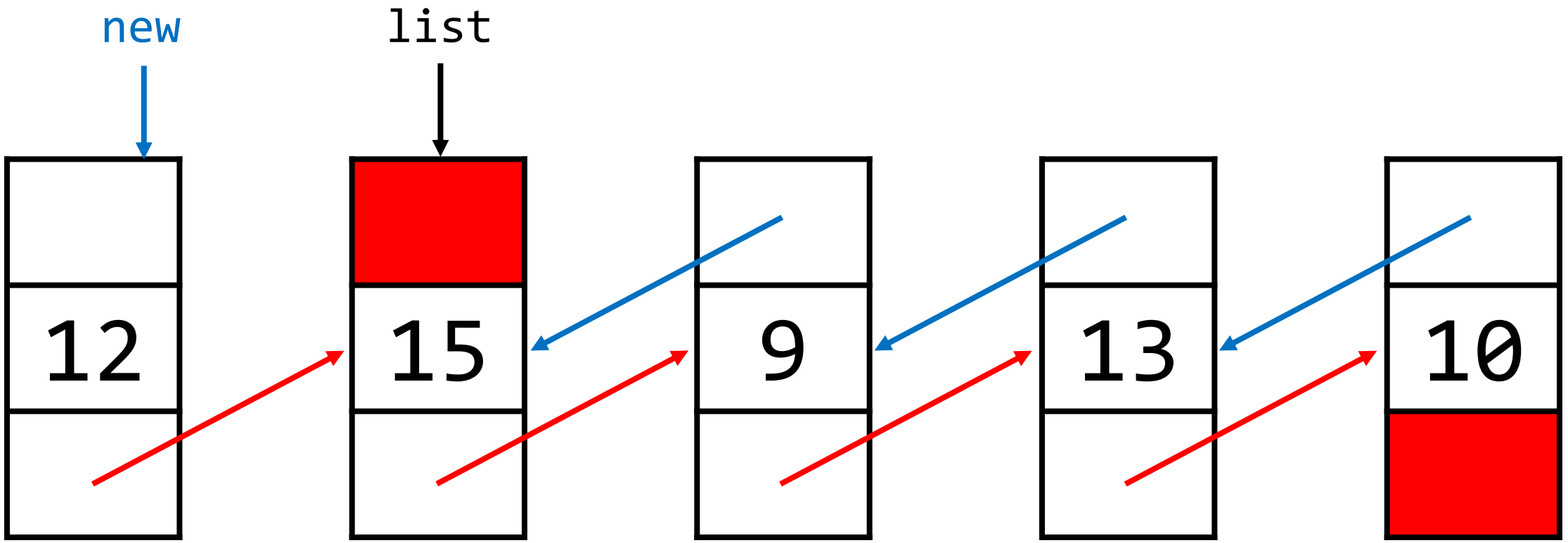

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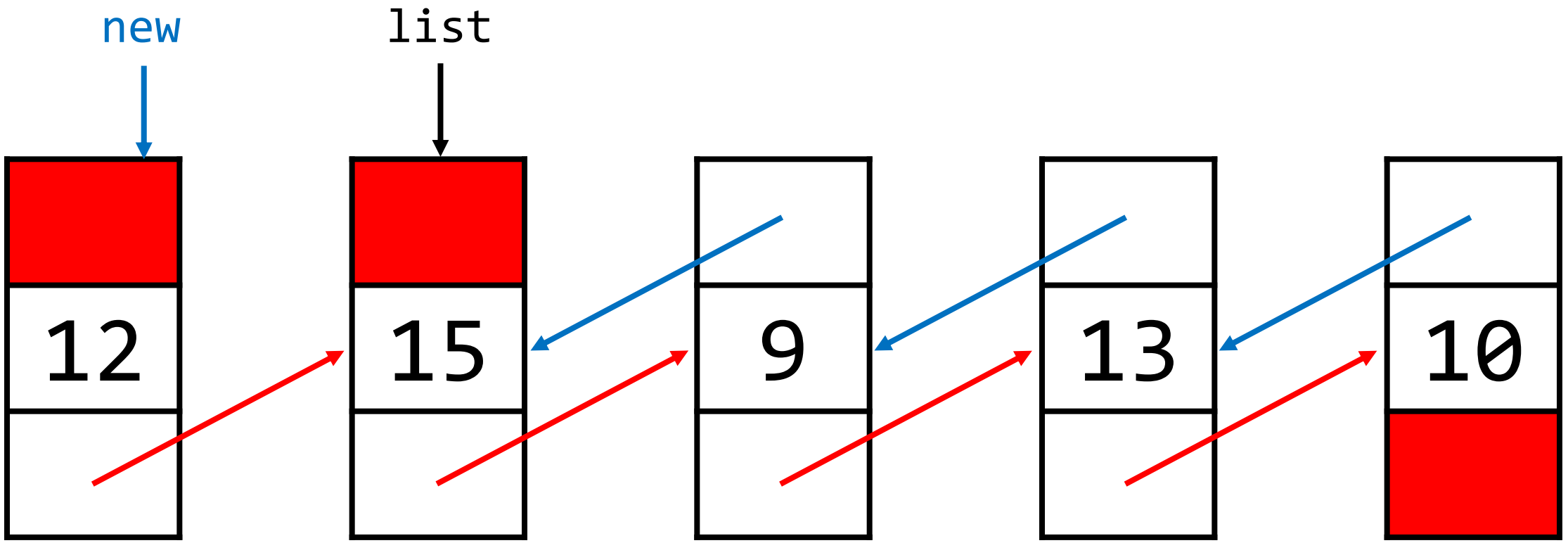

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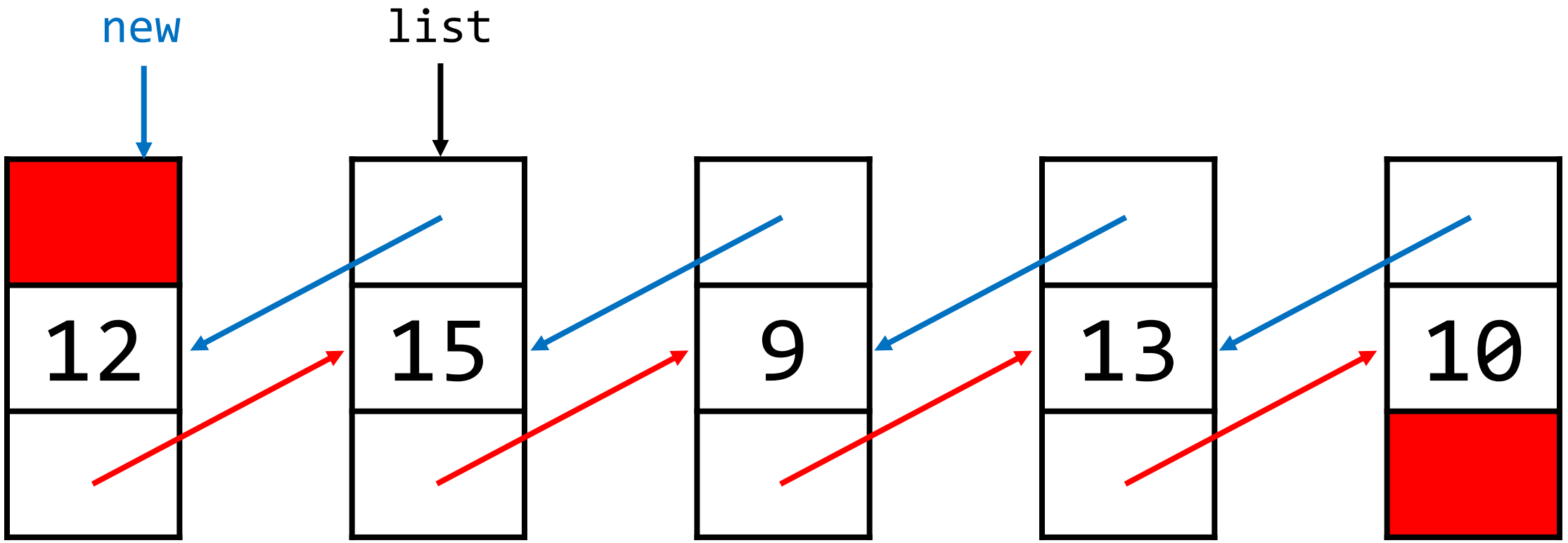

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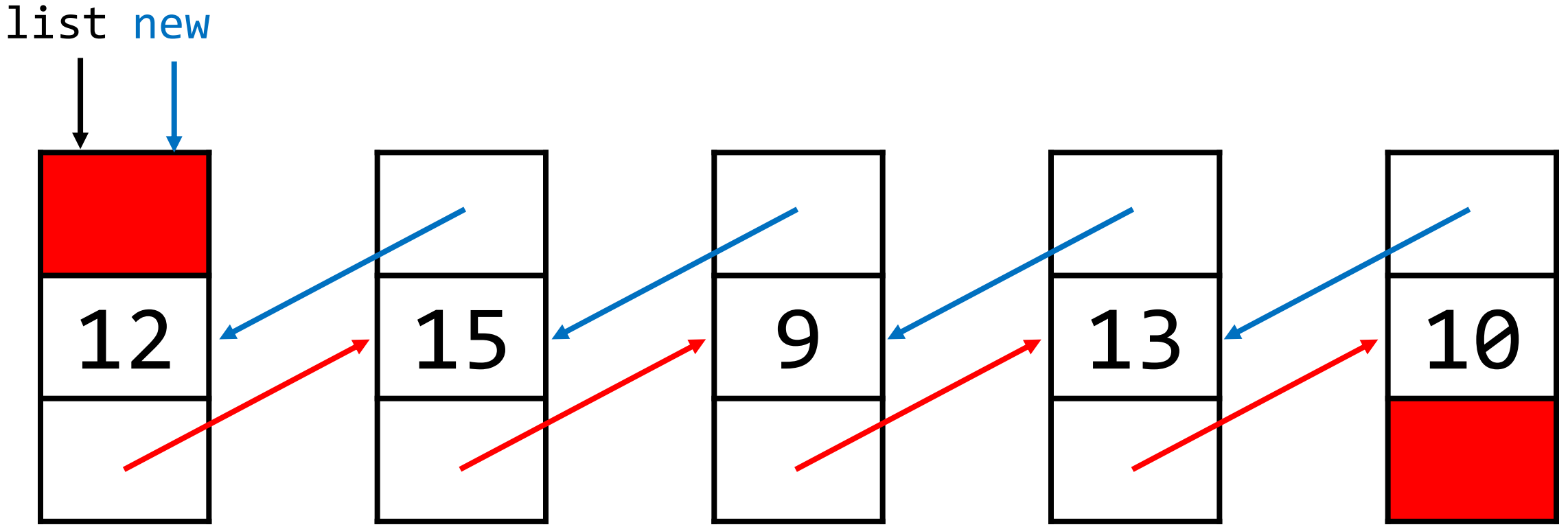

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- Delete a node from a linked list.

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void delete(dllnode* target);
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- Steps involved:
  a. Fix the pointers of the surrounding nodes to “skip over” `target`.
  b. Free `target`.

Doubly-Linked Lists

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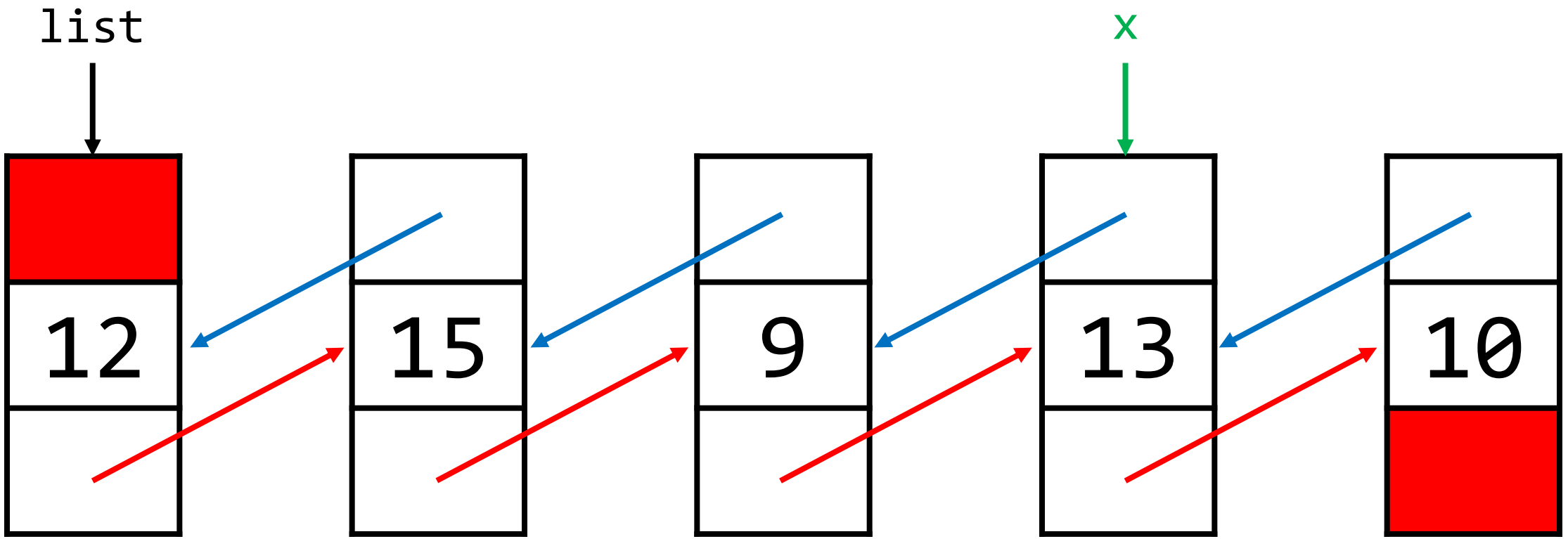
delete(x);
```



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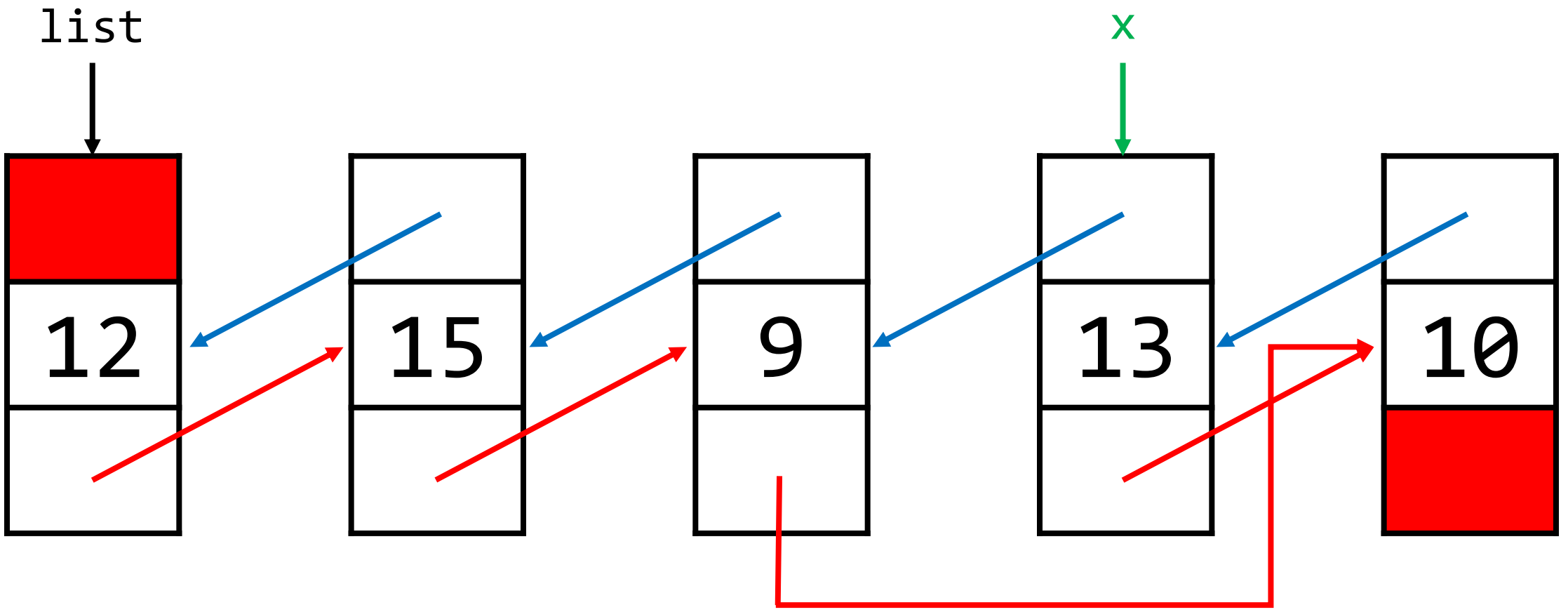

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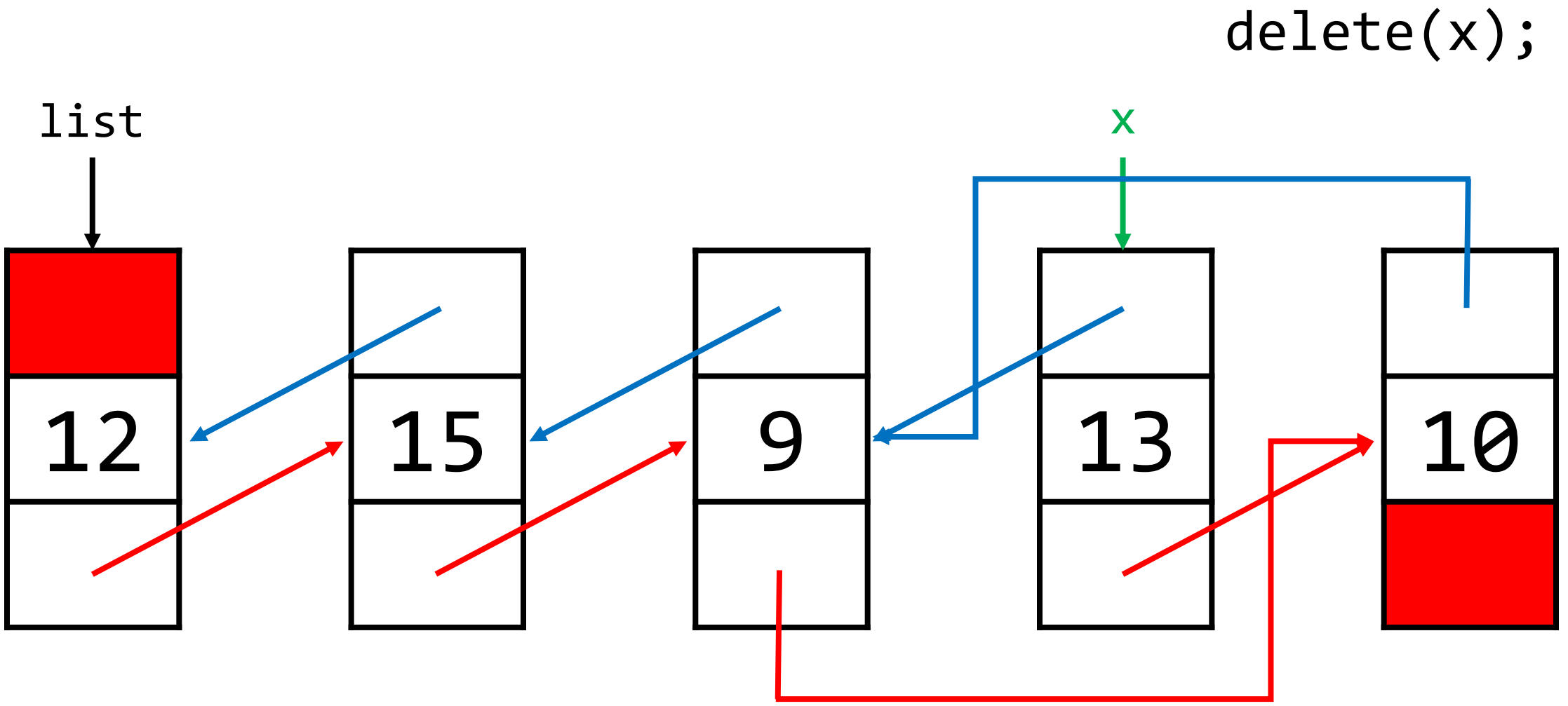

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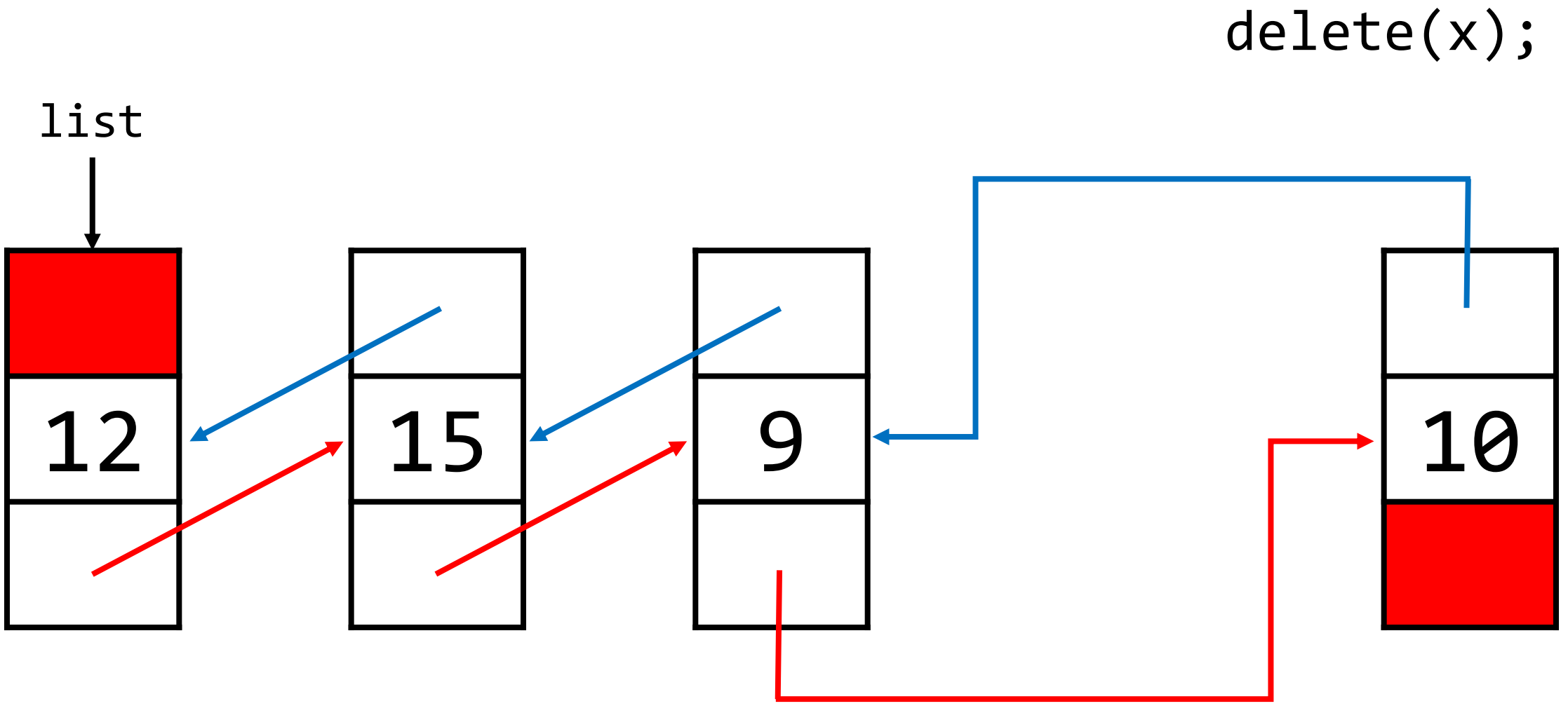

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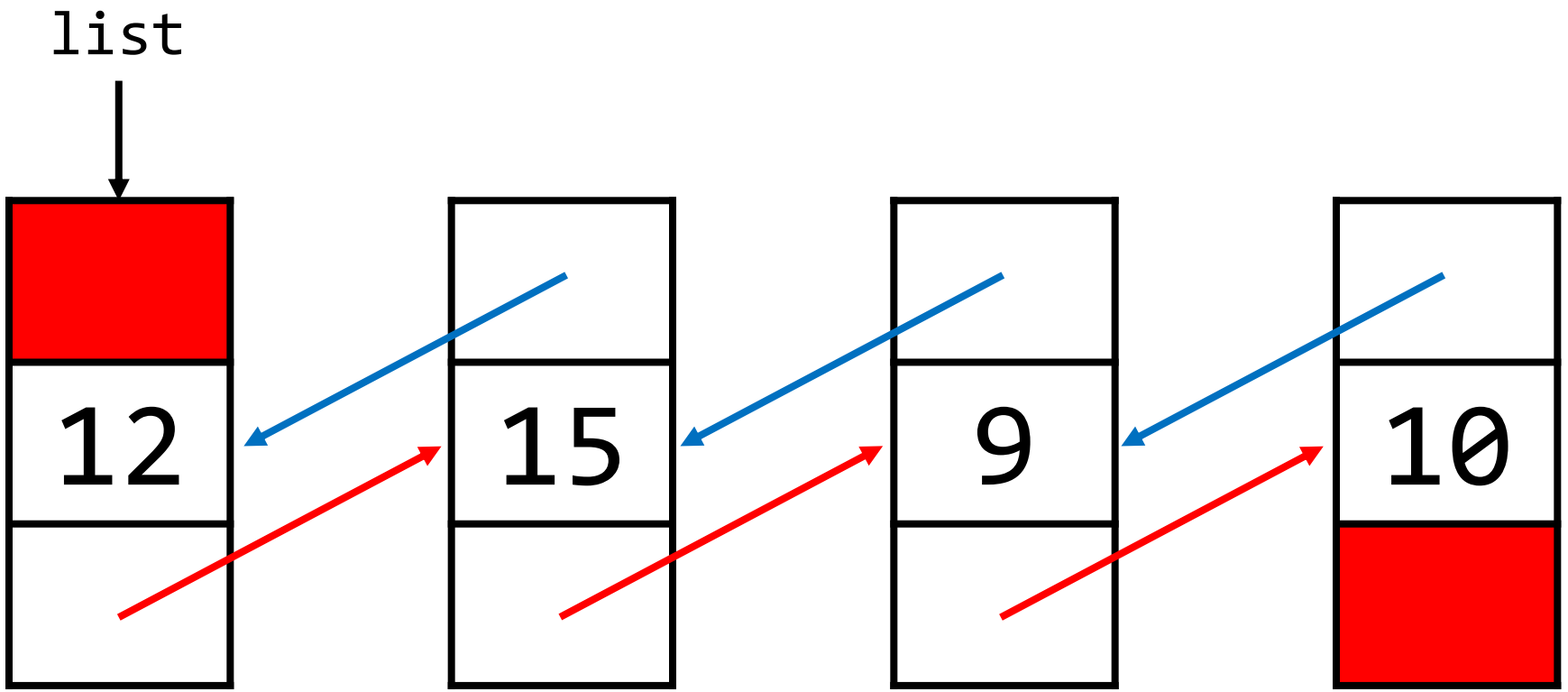

Doubly-Linked Lists

- Linked lists, of both the singly- and doubly-linked varieties, support extremely efficient *insertion* and *deletion* of elements.
  - In fact, these operations can be done in **constant time**.

- What's the downside? Remember how we had to find an element? We've lost the ability to randomly-access list elements.
  - Accessing a desired element may now take **linear time**.