Linked list

Linked list is a data structure implementing a list so that each element contains a reference to the preceding element and the succeeding element. Unlike with a standard list, the elements do not need to be consecutive in memory.

As an example, let us look at the list $[1, 2, 3]$ stored as a standard list and as a linked list. A standard list looks something like this:

100	101	102	103	104	105	106	107	108	109	110	111
1	2	3	0	0	0	0	0	0	0	0	0

Here the elements of the list are stored in memory starting from the location 100. The elements are in consecutive memory locations, and additions and removals are efficient only at the end of the list.

A linked list might look like this:

100	101	102	103	104	105	106	107	108	109	110	111
1	0	106	3	106	0	2	100	103	0	0	0

Here the elements are in the memory locations 100, 106 and 103. Each element consists of three components: the value of the element, a reference to the preceding element and a reference to the succeeding element. For example, the components at the location 106 are 1, 100 and 103, because the value of the element is 2, the preceding element is at the location 100 and the succeeding element is at the location 103. A reference value 0 indicates that the element has no preceding or succeeding element.

The advantage of a linked list is that elements can be added and removed easily, because they can be placed anywhere in the memory. For example, if we want to add an element to the beginning of the above list, it can be inserted in the memory location 109:

100	101	102	103	104	105	106	107	108	109	110	111
1	109	106	3	106	0	2	100	103	4	0	100

This corresponds to the list $[4, 1, 3, 2]$ with the beginning at the memory location 109.

The disadvantage of a linked list is that finding the memory location of an element can be slow. To find the location of an element, we have to follow the references starting from the beginning or the end of the list. Thus accessing an element in the middle of a list needs $O(n)$ time.

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