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Sorting algorithms

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Algorithm** | **Data structure** | **Time complexity** | | | **Space complexity** | **Used in Java API** | **Stable?** |
|  | | **Best** | **Average** | **Worst** | **Worst** |  |  |
| Quick sort | Array | O(*n* log(*n*)) | O(*n* log(*n*)) | O(*n*2) | O(1) | Arrays.sort() | NO |
| Merge sort | Array | O(*n* log(*n*)) | O(*n* log(*n*)) | O(*n* log(*n*)) | O(n) | Collections.sort() | YES |
| Heap sort | Array | O(*n* log(*n*)) | O(*n* log(*n*)) | O(*n* log(*n*)) | O(1) |  |  |
| Smooth sort | Array | O(*n*) | O(*n* log(*n*)) | O(*n* log(*n*)) | O(1) |  |  |
| Bubble sort | Array | O(*n*) | O(*n*2) | O(*n*2) | O(1) |  |  |
| Insertion sort | Array | O(*n*) | O(*n*2) | O(*n*2) | O(1) |  |  |
| Selection sort | Array | O(*n*2) | O(*n*2) | O(*n*2) | O(1) |  |  |

Data structures

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DSA** | **Time complexity** | | | | | | | | **Space complexity** |
|  | **Avg: Indexing** | **Avg: Search** | **Avg: Insertion** | **Avg: Deletion** | **Worst: Indexing** | **Worst: Search** | **Worst: Insertion** | **Worst: Deletion** | **Worst** |
| Basic Array | O(1) | O(*n*) | – | -– | O(1) | O(*n*) | – | – | O(*n*) |
| Dynamic array | O(1) | O(*n*) | O(*n*) | – | O(1) | O(*n*) | O(*n*) | – | O(*n*) |
| Singly linked list | O(*n*) | O(*n*) | O(1) | O(1) | O(*n*) | O(*n*) | O(1) | O(1) | O(*n*) |
| Doubly linked list | O(*n*) | O(*n*) | O(1) | O(1) | O(*n*) | O(*n*) | O(1) | O(1) | O(*n*) |
| Hash table | - | O(1) | O(1) | O(1) | – | O(*n*) | O(*n*) | O(*n*) | O(*n*) |
| Binary search tree | – | O((log *n*)) | O((log *n*)) | O((log *n*)) | – | O(*n*) | O(*n*) | O(*n*) | O(*n*) |
| B-tree | – | O((log *n*)) | O((log *n*)) | O((log *n*)) | – | O((log *n*)) | O((log *n*)) | O((log *n*)) | O(*n*) |
| Red-black tree | – | O((log *n*)) | O((log *n*)) | O((log *n*)) | – | O((log *n*)) | O((log *n*)) | O((log *n*)) | O(*n*) |
| AVL tree | – | O((log *n*)) | O((log *n*)) | O((log *n*)) | – | O((log *n*)) | O((log *n*)) | O((log *n*)) | O(*n*) |

# Why is selection sort said to be better than bubble sort though both are of order n square?

By first scanning the entire list before locating the exact pair of numbers to swap, only two writes to memory are performed by Selection Sort for each O(n) scan, whereas Bubble Sort does writes on each and every comparison. So Selection Sort does O(n) writes to memory whereas Bubble Sort does O(n^2) writes.

Need to implement below later

1. <http://www.geeksforgeeks.org/find-the-maximum-of-minimums-for-every-window-size-in-a-given-array/> (stack)

# **A Programmer’s approach of looking at Array vs. Linked List**

In general, array is considered a data structure for which size is fixed at the compile time and array memory is allocated either from Data section (e.g. global array) or Stack section (e.g. local array).   
Similarly, linked list is considered a data structure for which size is not fixed and memory is allocated from Heap section (e.g. using malloc() etc.) as and when needed. In this sense, array is taken as a static data structure (residing in Data or Stack section) while linked list is taken as a dynamic data structure (residing in Heap section).

Since elements of array are contiguous in memory, we can access any element randomly using index e.g. intArr[3] will access directly fourth element of the array. (For newbies, array indexing start from 0 and that’s why fourth element is indexed with 3). Also, due to contiguous memory for successive elements in array, no extra information is needed to be stored in individual elements i.e. no overhead of metadata in arrays. Contrary to this, linked list nodes are non-contiguous in memory. It means that we need some mechanism to traverse or access linked list nodes. To achieve this, each node stores the location of next node and this forms the basis of the link from one node to next node. Therefore, it’s called Linked list. Though storing the location of next node is overhead in linked list but it’s required.