CSE 373

MAY 19TH – EVEN MORE SORTING

ASSORTED MINUTIAE

- **HW5 Due Tonight – Code + Writeup**

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- HW6 Out Monday – Covers Sorting

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- Extra assignments are out

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- **HW5 Due Tonight – Code + Writeup**
- **HW6 Out Monday – Covers Sorting**
- **Extra assignments are out**
  - Small change, instead of throwing an ObjectNotFound exception, throw a NoSuchElement exception.
    (which is in java.util)

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  - It is possible to pass command line arguments in Eclipse under run configurations
  - If you have edited your main function in FindPahts so that it **does not** use the String[] args commands, please return it to it's old state. This is part of the testing script.

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  - Collection of Comparable data

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  - Sorting v. Maintaining sortedness

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    - The most recent sort will always be the primary

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  - Comparison sort: utilizes comparisons between elements to produce the final sorted order.
    - Bogo sort is not a comparison sort
    - Comparison sorts are $\Omega(n \log n)$, they cannot do better than this

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    - In place? Can be, but can also create a separate collection (if we only want the top 5, for example)

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    - In-place? Can be easily. Since not interruptable, having a duplicate array is only necessary if you don't want the original array to be mutated

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    - N + N*log N = O(N log N)
    - Using Floyd's method does not improve the asymptotic runtime for heap sort, but it is an improvement.

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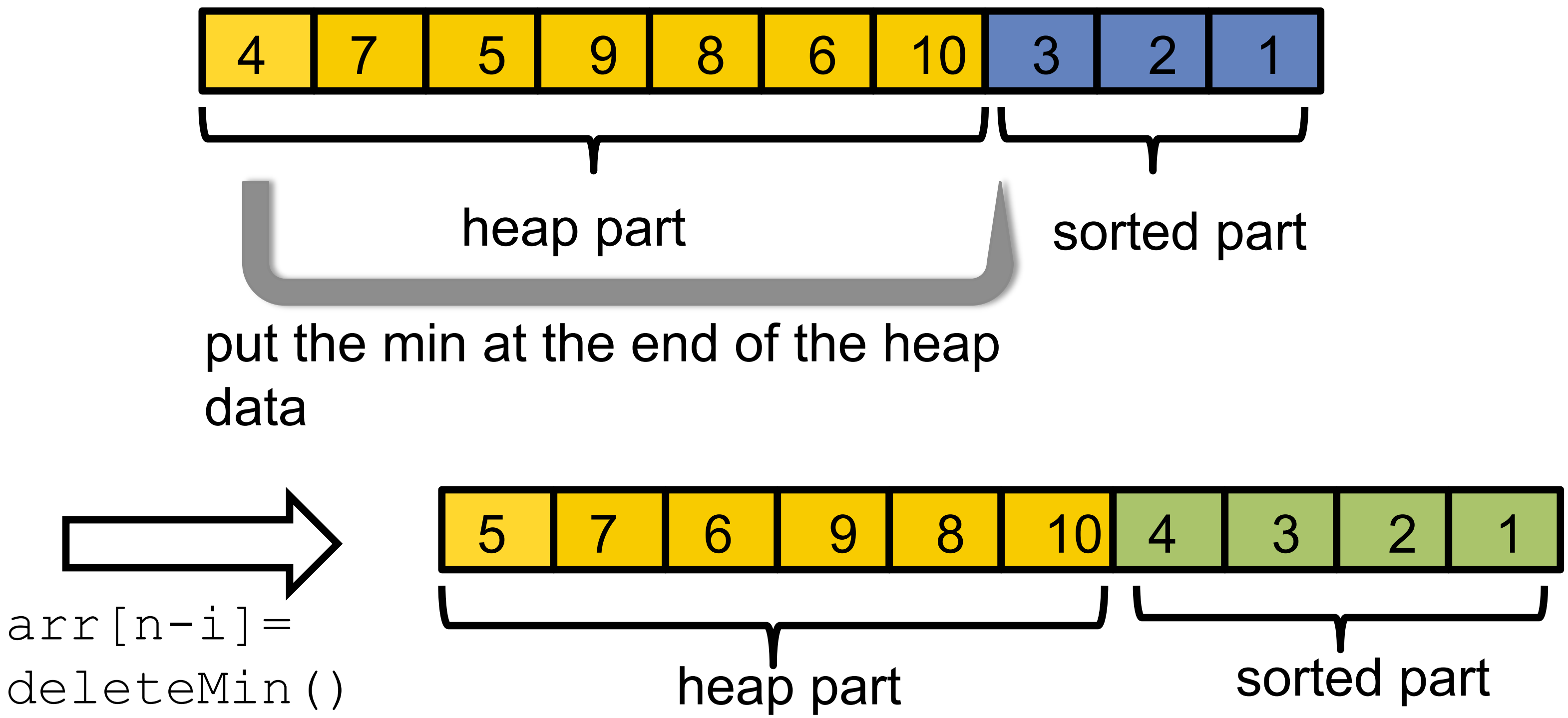
IN-PLACE HEAP SORT

- Treat the initial array as a heap (via **`buildHeap`**)
- When you delete the **`i`**th element, put it at **`arr[n-i]`**
  - That array location isn't needed for the heap anymore!



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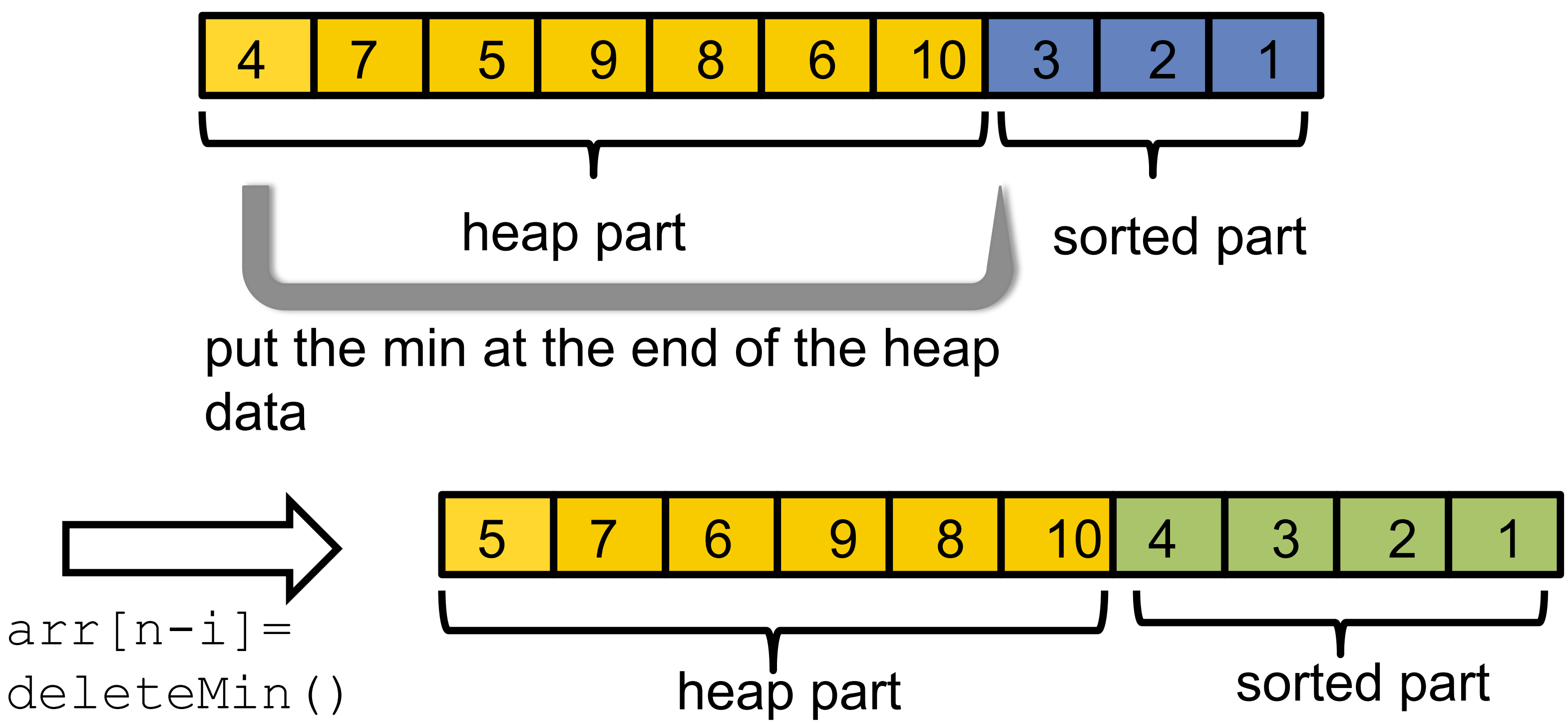
  - No. Recall that heaps do not preserve FIFO property
  - If it needed to be stable, we would have to modify the priority to indicate its place in the array, so that each element has a unique priority.

IN-PLACE HEAP SORT

What is undesirable about this method?



IN-PLACE HEAP SORT

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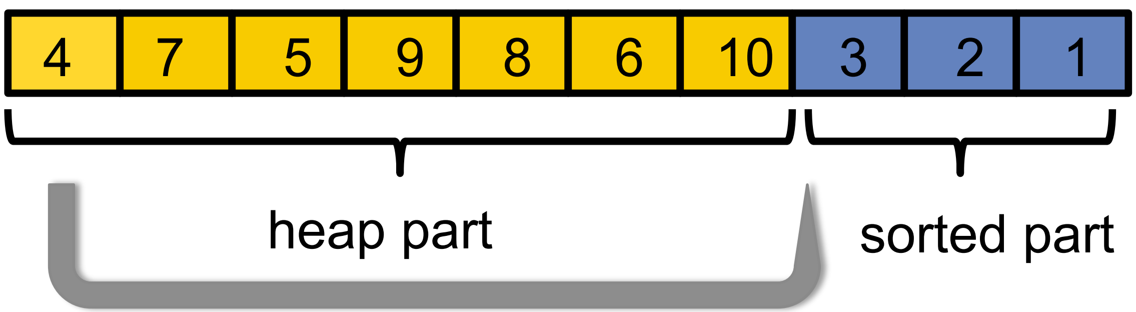
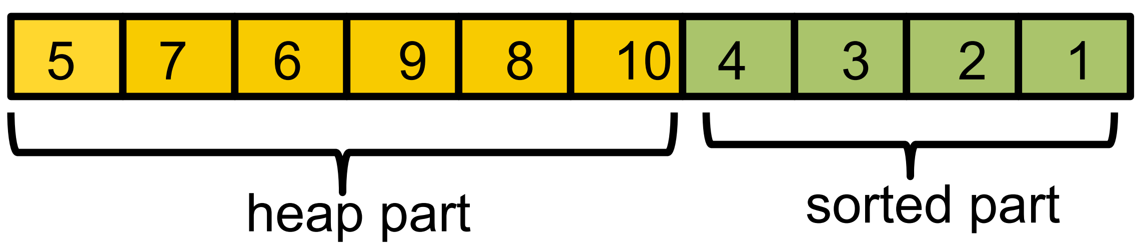
You must reverse the array at the end.



put the min at the end of the heap data

`arr[n-i]= deleteMin()`



HEAP SORT

- Can implement with a max-heap, then the sorted portion of the array fills in from the back and doesn't need to be reversed at the end.

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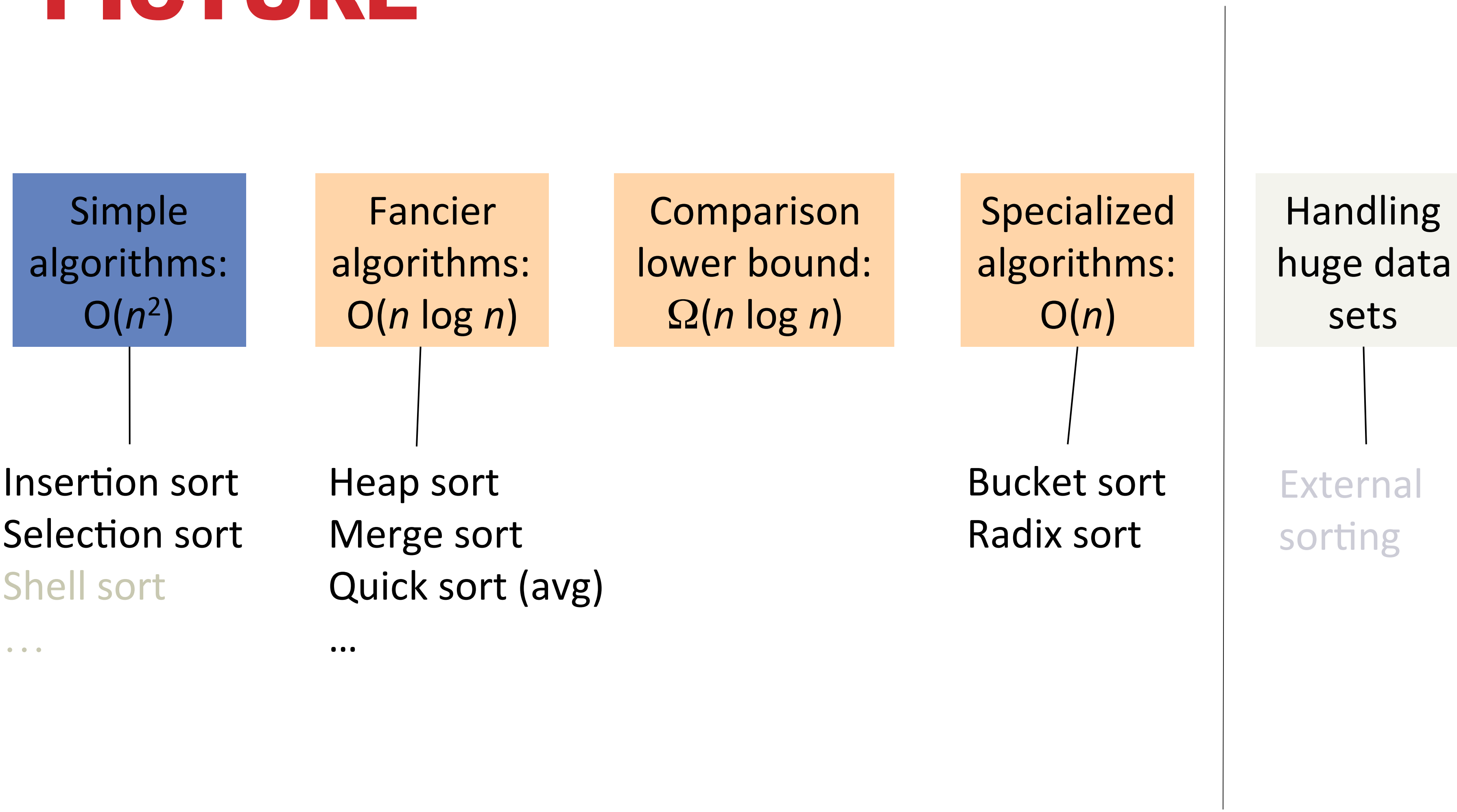
- Finding min item in a hashtable is $O(\text{n})$, so this would be a slower, more complicated selection sort

SORTING: THE BIG PICTURE



DIVIDE AND CONQUER

Divide-and-conquer is a useful technique for solving many kinds of problems (not just sorting). It consists of the following steps:

1. Divide your work up into smaller pieces (recursively)
2. Conquer the individual pieces (as base cases)
3. Combine the results together (recursively)

```
algorithm(input) {
    if (small enough) {
        CONQUER, solve, and return input
    } else {
        DIVIDE input into multiple pieces
        RECURSE on each piece
        COMBINE and return results
    }
}
```

DIVIDE-AND-CONQUER SORTING

Two great sorting methods are fundamentally divide-and-conquer

Mergesort:

Sort the left half of the elements (recursively)
Sort the right half of the elements (recursively)
Merge the two sorted halves into a sorted whole

Quicksort:

Pick a "pivot" element
Divide elements into less-than pivot and greater-than pivot
Sort the two divisions (recursively on each)
Answer is: sorted-less-than....pivot....sorted-greater-than