Quicksort and Filling out our Data Structure list

4/27/26

Administrivia

- HW 4 (list methods and running times) due tomorrow night

Where we were

- Sorting: putting values in order
  - In general, use a Comparator for the order (we're just going to sort integers)
  - Assume they're in an array

- Selection, insertion, and bubble sort all $O(n^2)$
- Merge sort let us reach $O(n \log n)$

Quicksort

```
void quicksort(int[] a, int lo, int hi) {   //sort a[lo..hi]
   if(hi <= lo) return;       //base case: empty array

   //split a into values <= pivot and >= pivot
   int j = partition(a, lo, hi);     //j = index of pivot

   quicksort(a, lo, j-1);            //sort left part
   quicksort(a, j+1, hi);            //sort right part
}
```

Partition

```
int partition(int[] a, int lo, int hi) {
    int i = lo, j = hi+1;           //left and right scan indices
    int x = a[lo];                  //pivot value
    while(true) {
        while(a[++i] < x) if(i == hi) break;
        while(x < a[--j]) if(j == lo) break;
        if(i >= j) break;
        swap(a, i, j);        //swap a[i] & a[j]
    }
    swap(a, lo, j);
    return j;
}
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What is partition's running time?

A) $O(1)$
B) $O(\log n)$
C) $O(n)$
D) $O(n^2)$
E) None of the above

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Running time of Quicksort