CSE12 - Lecture 13 - A00

Monday, October 24, 2022 8:00 AM

PA4 due tomorrow
PA5 Late/Resubmit → tomorrow

Quick Sort → in-place

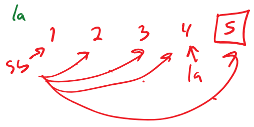
Sorting Quickly

```
public class SortQuickly {

  public static void swap(String[] array, int i1, int i2) {
    String temp = array[i1];
    array[i1] = array[i2];
    array[i2] = temp;
  }

  public static int partition(String[] array, int low, int high) {
    int pivotStartIndex = high - 1;
    String pivot = array[pivotStartIndex];
    int smallerBefore = low, largerAfter = high - 2;

    while (smallerBefore <= largerAfter) {
      if (array[smallerBefore].compareTo(pivot) < 0) {
        smallerBefore += 1;
      }
      else {
        swap(array, smallerBefore, largerAfter);
        largerAfter -= 1;
      }
    }

    swap(array, smallerBefore, pivotStartIndex);
    return smallerBefore;
  }

  public static void qsort(String[] array, int low, int high) {
    if (high - low <= 1) { return; }
    int splitAt = partition(array, low, high);
    qsort(array, low, splitAt);
    qsort(array, splitAt + 1, high);
  }

  public static void sortD(String[] array) {
    qsort(array, 0, array.length);
  }

  public static void main(String[] args) {
    String[] str = {"f", "b", "a", "e", "d", "c" };
    int[] result = SortQuickly.sortD(str);
    System.out.println(Arrays.deepToString(result));
  }
}
```

$\Theta(1)$ 3 (swap body)

partition: array N, low 0, high N; 1, 1, 2 (first three lines); while loop: N^2, $N-2$, $\Theta(1)$ swap; $\Theta(N)$; $\Theta(1)$ final swap, 1 return

→ don't stop until sb is larger than la



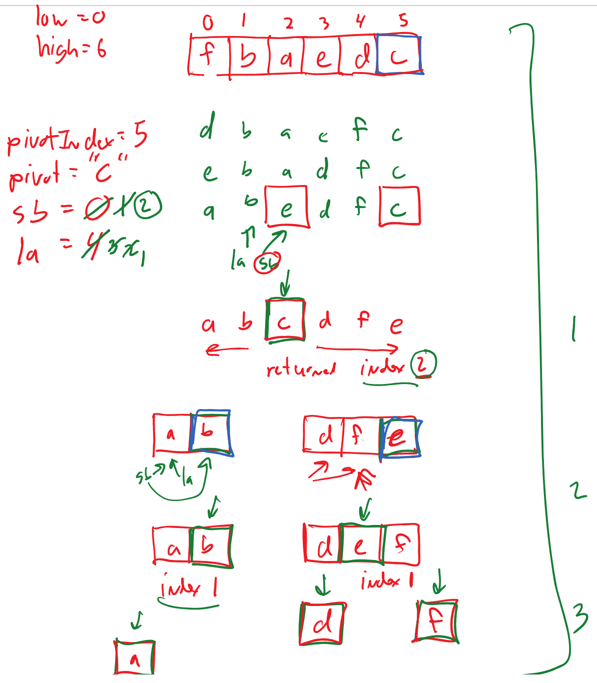
qsort: low 0, high 6; splitAt 2; qsort(array, 0, 2); qsort(array, 2, 6)

Draw the picture of sortD()

What is the tight bound of sortD:

Best case: $\Theta(N * \log_2(N))$ → median value at every level

Worst case: $\Theta(N^2)$ → sorted array



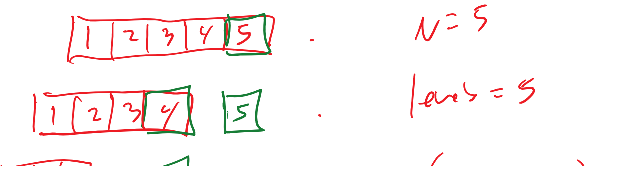
$N = 6$

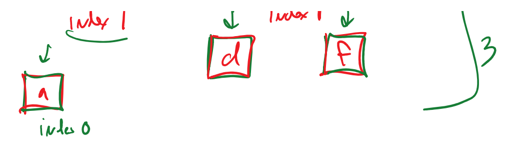
height $= 3$

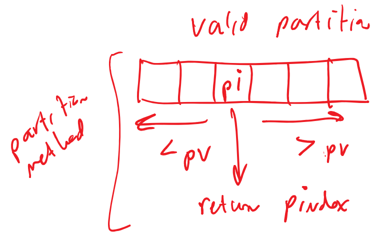
↳ $\log_2(N)$

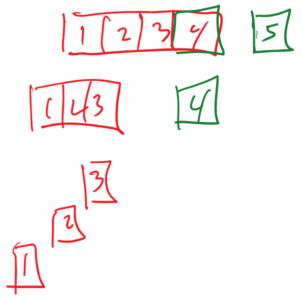
$\Theta(N * \log_2(N))$

worst case → sorted array









levels = 5

$\Theta(N * N)$

$\Theta(N^2)$

best case

median value

$\Theta(N + \log_2(n))$

$1\ 2\ 4\ 5\ \boxed{3}$

$1\ 2\ \boxed{3}\ 4\ 5$