University of Pittsburgh

Algorithms and Data Structures 1
CS 0445

Fall 2022

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(Slides are adapted from Dr. Ramirez's and Dr. Farnan's CS 0445 slides.)

Announcements

- Upcoming Deadlines:
  - **Assignment 2: Monday 11/7 @ 11:59 pm**
  - Lab 7: next Monday 11/7 @ 11:59 pm
  - Midterm reattempts: Thursday 11/10 @ 11:59 pm
- Live Support Session for Assignment 2
  - Video and slides available on Canvas
- QA Session on Piazza every Friday 4:30-5:30 pm

Today …

- Sorting Algorithms

Lab 7

- Please check Misc.java in the code handouts repository

Word Search Problem

- Please check WordSearch.java in the code handouts repository under the Recursion folder

Muddiest Points

- **Q: I am confused on assignment 2 runtime of push, to find the index where to push you need a loop which breaks O(1)**
- The loop is over the alphabet array. The alphabet size is assumed to be constant in this assignment

Muddiest Points

- **Q: When would you use proof by induction vs. a recursion tree to find the runtime of a recursive method?**
- You can either technique in most of the cases. I personally prefer the recursion tree approach.

Muddiest Points

- **Q: Towers of Hanoi is very confusing**
- Let's reiterate the problem

Muddiest Points

- **Since today was a muddiest point review a lot of things were clarified, but I would also like a refresher on proof by induction.**
- Please check the RecursionTimeComplexity.pdf on Canvas for more examples

Sorting

- We have seen a few container data structures
  - Bag, Stack, List
- Sorting Problem: arrange items in a List such that *entry 1* ≤ *entry 2* ≤ . . . ≤ *entry n*
- Efficiency of a sorting algorithm is significant
- Sorting an array is usually easier than sorting a chain of linked nodes

Sorting Algorithms

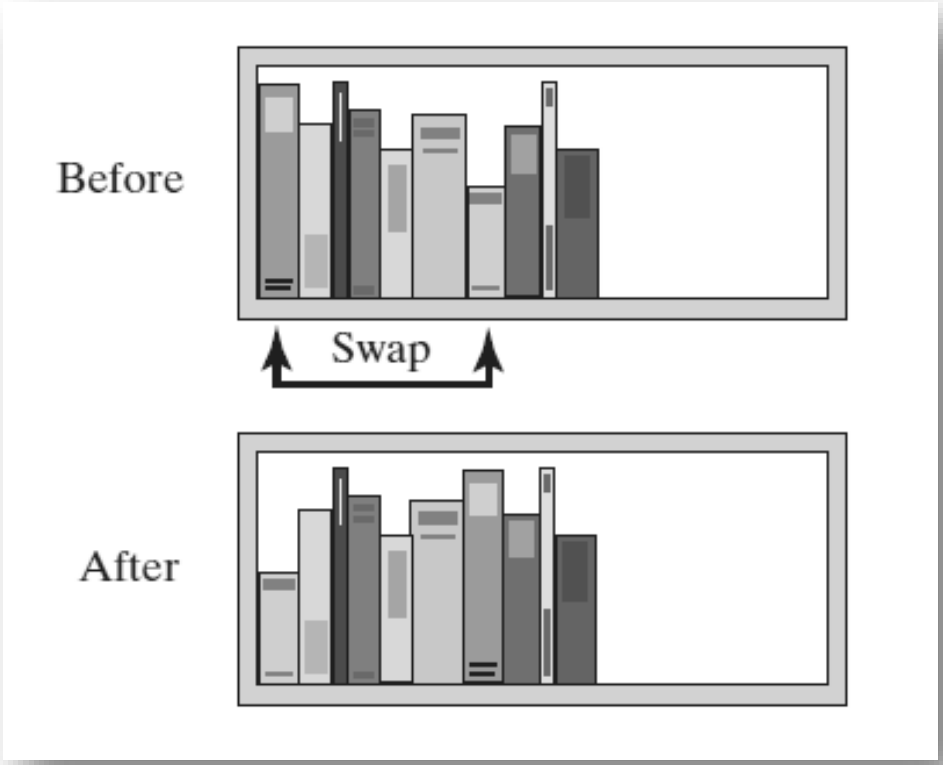
- $O(n^2)$
  - Selection Sort
  - Insertion Sort
  - Shell Sort
- O(n log n)
  - Merge Sort
  - Quick Sort
- O(1) Sorting
  - Radix Sort

Sorting Algorithms

- For each algorithm
  - understand the main concept using an example
  - implement the algorithm
    - on an Array
      - iterative
      - recursive
    - on a linked list
      - iterative
      - recursive

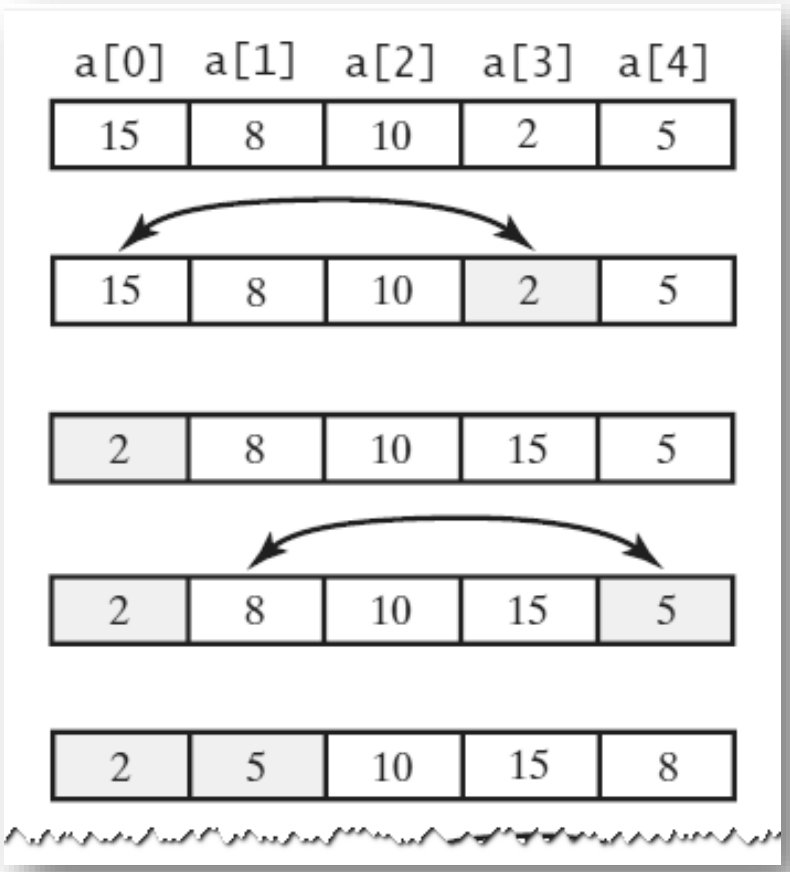
Selection Sort

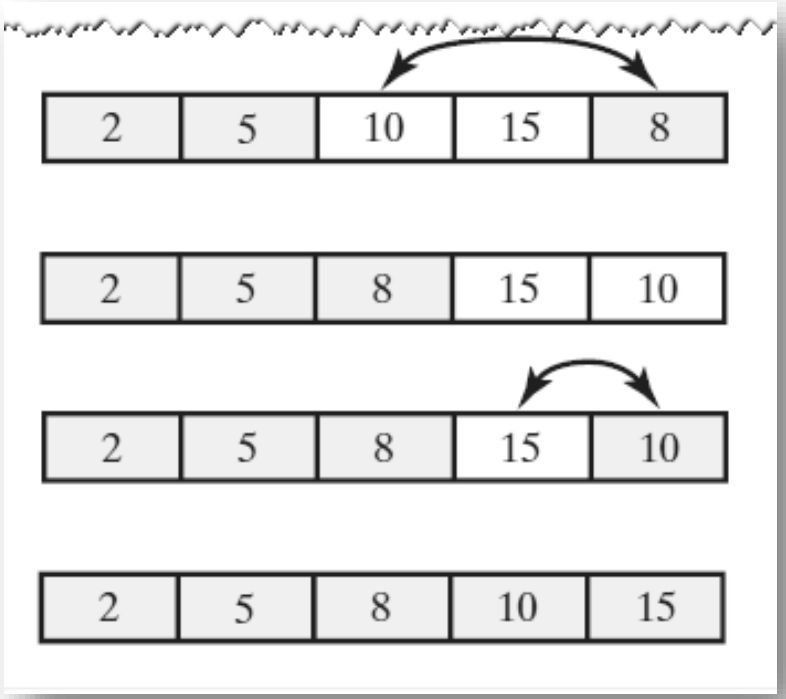
- Before and after exchanging the shortest book and the first book



Selection Sort

- A selection sort of an array of integers into ascending order





Iterative Selection Sort

- This pseudocode describes an iterative algorithm for the selection sort

```
Algorithm selectionSort(a, n)
// Sorts the first n entries of an array a.

for (index = 0; index < n - 1; index++)
{
   indexOfNextSmallest = the index of the smallest value among
                         a[index], a[index + 1], . . . , a[n - 1]
   Interchange the values of a[index] and a[indexOfNextSmallest]
   // Assertion: a[0] ≤ a[1] ≤ . . . ≤ a[index], and these are the smallest
   // of the original array entries. The remaining array entries begin at a[index + 1].
}
```