



Selection Sort and Insertion Sort

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CS 1324

Algorithms



- ▶ There are lots of systematic ways of solving most problems
- ▶ Figuring out which way is better, or even best is important to computer science
- ▶ Chance for non-CS majors to get a real feel for how CS people think about computing
 - ▶ Computing is not just programming!

Sorting Algorithms

- ▶ Sorted data allows the use of binary search instead of linear search
- ▶ Sorting has a cost
 - ▶ The cost depends on the details of the algorithm
- ▶ Every good software engineer knows at least ten sorting algorithms by heart
 - ▶ Most use techniques beyond the scope of this class
- ▶ The algorithms we'll examine use nested loops
- ▶ Names matter

Selection sort

- ▶ Find the smallest element and put it in the first position
- ▶ Find the second smallest element and put it in the second position
- ▶ Continue this pattern until the entire array is sorted

Example

- ▶ Trace the code by showing swaps for selection sort on this data using a table
 - ▶ `int[] data = {9, 4, 2, 7, 8, 1};`
- ▶ Array will be partitioned into sorted and unsorted areas
- ▶ One value at a time will move from unsorted to sorted

Think Pair Share

- ▶ Trace selection sort by showing swaps for this data using a table

```
int[] data = {2, 4, 9, 6, 5, 3, 1};
```

Instant Quiz Question 1

- ▶ Suppose an array initially contains:
- ▶ {2, 4, 6, 8, 5}
- ▶ True/false: The steps below represent selection sort

2	4	6	8	5
		5	6	
			6	8

Write Code

- ▶ Write the code for selection sort without using ancillary method
- ▶ Triangular or rectangular?
- ▶ What does the outer loop do?
- ▶ What does the inner loop do?
- ▶ Write selection sort for oversized array

Insertion Sort

- ▶ Array also partitioned into sorted and unsorted areas
- ▶ We take the next unsorted data value and place it into the proper position in the sorted data
- ▶ Technique is critical—**does not use swaps**
 - ▶ Next value to be sorted is placed in **auxiliary storage**
 - ▶ Larger values shifted to right until proper position found
 - ▶ Value shifted from auxiliary storage to proper position in the array
 - ▶ Why?

Example

- ▶ Trace insertion sort using a table
 - ▶ One data move at a time
 - ▶ `int[] data = {9, 4, 2, 1, 7, 8, 3, 6, 5};`

Think Pair Share

- ▶ Trace the code by showing moves for this data using a table and insertion sort
 - ▶ `int[] data = {1, 4, 7, 9, 5, 3, 2};`

Instant Quiz Question 2

- ▶ Suppose an array initially contains:
- ▶ {2, 4, 6, 8, 5}
- ▶ Which sequence of steps below represents

insertion sort

a)

2	4	6	8	5
		5		6
			6	8

c)

2	4	6	8	5
			5	8
		5	6	

2	4	6	8	5
				8
			6	
		5		

2	4	6	8	5
		5		
			6	
				8

Write Code



- ▶ Write the code for insertion sort
- ▶ Triangular or rectangular?
- ▶ What does the outer loop do?
- ▶ What does the inner loop do?
- ▶ Write insertion sort for perfect sized array

Comparison: Worst Case

- ▶ Computer scientists analyze algorithms by looking at the worst thing that can happen
- ▶ What is the worst order for insertion sort?
- ▶ What is the worst order for selection sort?
- ▶ Consider swaps versus comparisons
- ▶ Which is better if the data are partially sorted?
 - ▶ Why is this important