

# CS 101 Computer Programming and Utilization

## Lecture 19

# Sorting and Searching

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# Revision (last lecture was a Q/A session)

- Pointer Arithmetic
  - computing locations in 1d arrays
  - computing locations in 2d arrays
- 4 ways to handle 2d arrays
  - as a continuous 1d array
    - `int *A;`
  - as a 2d array with both dimensions declared
    - `int A[M][N]`
  - as 2d array with 2<sup>nd</sup> dimension declared
    - `int A[ ][N]`
  - as a pointer to pointer
    - `int **A;`
- when do you use pointers?
  - dynamic allocation and declaration to not happen at the same place
  - returning dynamically created objects/values/arrays
  - use a variable to point to various objects
- why the following code counts 1 string extra?

```
count=0;

while (!f.eof()) {

    f >> str;

    count ++;

}
```

# Sorting

- $A = \{ 3, 1, 10, 22, 4, 2, 178, 11, 29 \}$
- How to sort the array?

# Sorting

4	3	1	8	2
---	---	---	---	---

keep comparing  $A[i]$  and  $A[i+1]$  and keep swapping if needed  
In each iteration, one element will be at its position  
→ Bubble sort

# Sorting

4	3	1	8	2
3	4	1	8	2

# Sorting

4	3	1	8	2
3	4	1	8	2
3	1	4	8	2

# Sorting

4	3	1	8	2
3	4	1	8	2
3	1	4	8	2
3	1	4	2	8

# Sorting

4	3	1	8	2
3	4	1	8	2
3	1	4	8	2
3	1	4	2	8
1	3	4	2	8



# Sorting

4	3	1	8	2
3	4	1	8	2
3	1	4	8	2
3	1	4	2	8
1	3	4	2	8
1	3	2	4	8

# Sorting

4	3	1	8	2
3	4	1	8	2
3	1	4	8	2
3	1	4	2	8
1	3	4	2	8
1	3	2	4	8
1	2	3	4	8

# Searching through a sorted array

## Binary Search

- $A = \{ 3, 5, 6, 66, 88, 199, 200, 291, 300 \}$
- does A have element 291?
- where to start searching?
- we know that the array is sorted
- how to you search a word through a dictionary?
  - do you start from first page always?

# Binary Search

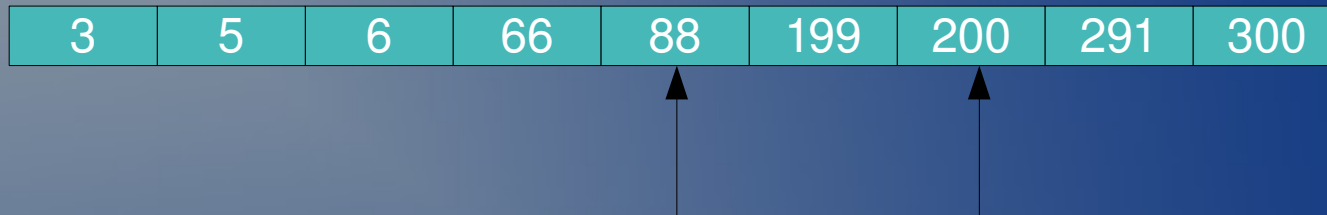
3	5	6	66	88	199	200	291	300
---	---	---	----	----	-----	-----	-----	-----



Is it the element that we want?  
is it smaller than this one?  
is it larger than this one?

# Binary Search

3	5	6	66	88	199	200	291	300
---	---	---	----	----	-----	-----	-----	-----

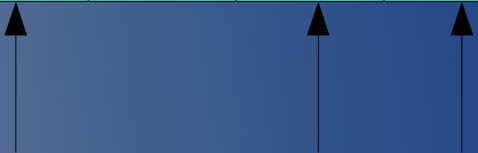


The diagram shows a horizontal array of nine teal-colored boxes, each containing a white number. The numbers are 3, 5, 6, 66, 88, 199, 200, 291, and 300. Below the array, two black arrows point upwards. The first arrow points to the box containing the number 88. The second arrow points to the box containing the number 200.

Is it the element that we want?  
is it smaller than this one?  
is it larger than this one?

# Binary Search

3	5	6	66	88	199	200	291	300
---	---	---	----	----	-----	-----	-----	-----



The diagram shows a horizontal array of nine teal-colored boxes, each containing a white number. Below the array, three black arrows point upwards to specific elements: the first arrow points to the box containing '88', the second arrow points to the box containing '200', and the third arrow points to the box containing '291'.

Is it the element?