Searching (part 2)

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ComS 207: Programming I (in Java)
Iowa State University, FALL 2006
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Homework #7 Hints

- **For the first 2 problems:**
  - **Instead of entering he numbers you can use the random number generator.**
- **Matrix multiplication**
- **Other Questions?**

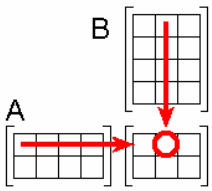
Problems with Input

```
Scanner scan = new Scanner(System.in);

String line  = scan.nextLine();
int num = Integer.parseInt(line);

String line2= scan.nextLine();
```


HW Hints: Matrix Multiplication



$$(AB)_{12} = \sum_{r=1}^{4} a_{1r} b_{r2} = a_{11}b_{12} + a_{12}b_{22} + a_{13}b_{32} + a_{14}b_{42}$$

[http://en.wikipedia.org/wiki/Matrix_multiplication]

HW Hints: Use Google

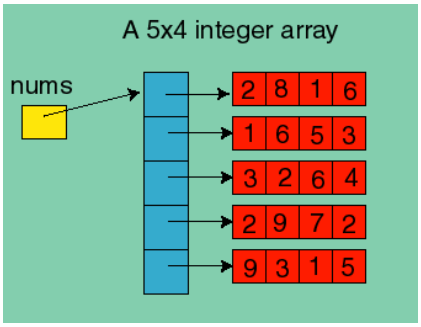
- **For example, if you don't know what standard deviation is just Google it!**

Quick review of last lecture

Arrays in Java

- Java represents 2D arrays as an array of arrays!
- In other words, a 2D integer array is really a 1D array of references to 1D integer arrays.
- The concept generalizes to N-dimensions

Anatomy of a 2D Array

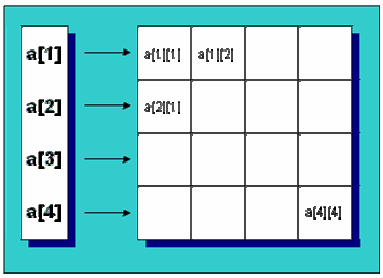


[http://www.willamette.edu/~gorr/classes/cs231/lectures/chapter9/arrays2d.htm]

Two-Dimensional Arrays

Expression	Type	Description
`table`	`int[][]`	2D array of integers, or array of integer arrays
`table[5]`	`int[]`	array of integers
`table[5][12]`	`int`	integer

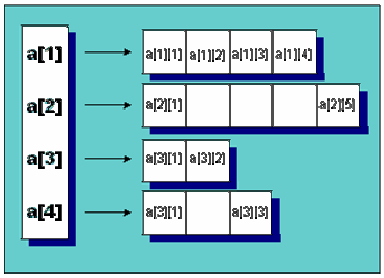
Example of a regular 2D array



Note: In Java the first index should be 0 not 1!

[http://livedocs.macromedia.com/coldfusion/5.0/Developing_ColdFusion_Applications/arrayStruct2.htm]

Example of a Ragged Array



Note: In Java the first index should be 0 not 1!

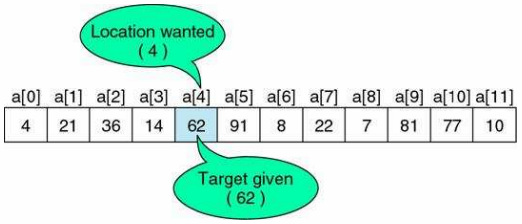
[http://livedocs.macromedia.com/coldfusion/5.0/Developing_ColdFusion_Applications/arrayStruct2.htm]

Other Stuff

- Arrays as parameters to methods

Find the minimum number in an array

Search

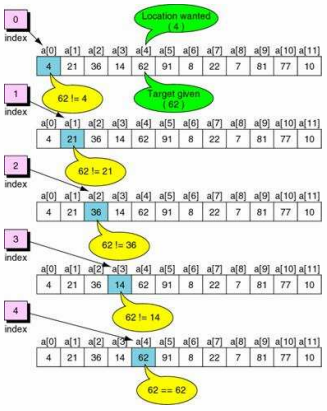


[http://web.ics.purdue.edu/~cs154/lectures/lecture011.htm]

Linear Search

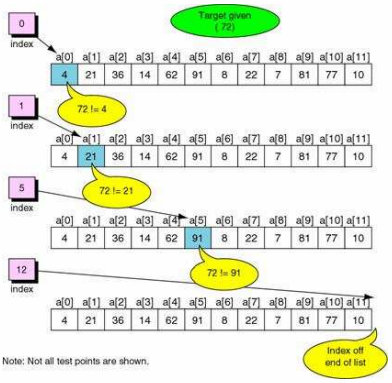
- The most basic
- Very easy to implement
- The array DOESN'T have to be sorted
- All array elements must be visited if the search fails
- Could be very slow

Example: Successful Linear Search



[http://web.ics.purdue.edu/~cs154/lectures/lecture011.htm]

Example: Failed Linear Search

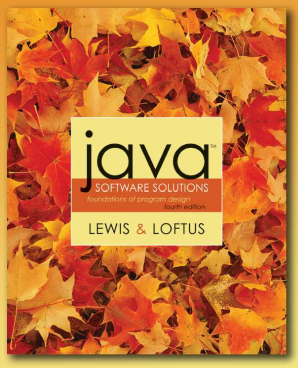


Note: Not all test points are shown.

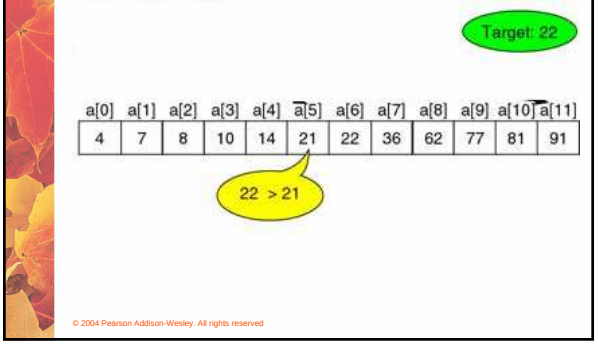
[http://web.ics.purdue.edu/~cs154/lectures/lecture011.htm]

Searching

Not in the Textbook



Java Example:
Finding the index of a number in a sorted array of integers using linear search



Example:
LinearSearch_InSortedArray.java

Analysis

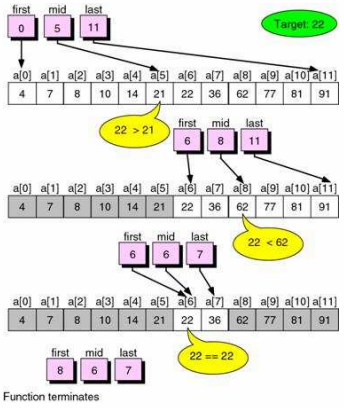
- If the list is unsorted we have to search all numbers before we declare that the target is not present in the array.
- Because the list is sorted we can stop as soon as we reach a number that is greater than our target
- Can we do even better?

Binary Search

- At each step it splits the remaining array elements into two groups
- Therefore, it is faster than the linear search
- Works only on an already SORTED array
- Thus, there is a performance penalty for sorting the array

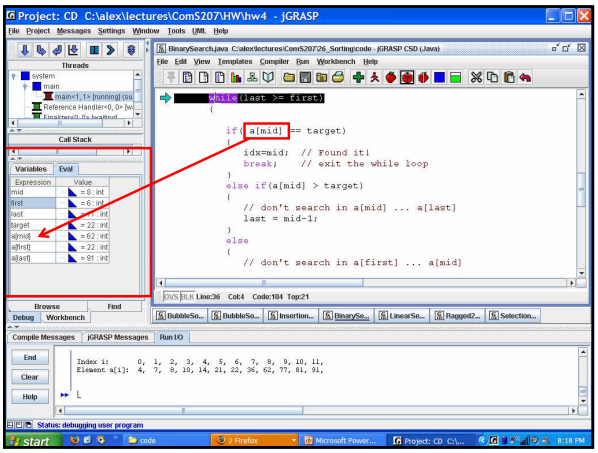
[http://web.ics.purdue.edu/~cs154/lectures/lecture011.htm]

Example: Successful Binary Search



[http://web.ics.purdue.edu/~cs154/lectures/lecture011.htm]

Example: BinarySearch.java



Analysis of Searching Methods

- For an array of size n
- Sequential Search (Average-Case) n/2
- Sequential Search (Worst-Case) n
- Binary Search (Average-Case) log(n)/2
- Binary Search (Worst-Case) log(n)

THE END