Unordered and Ordered Arrays

University of Massachusetts Amherst
ECE 242 – Data Structures and Algorithms
Lecture 3

Array

• What is an array?
  – What are principle Java functions that can be done on array?
Arrays in Java

• Arrays have fixed size
  – Valid index 0...length-1
  – Accesses to indices outside valid range cause problems
• Elements stay in place where they were put
• Insertion operation needs to check for size
  – If not enough space, then need to increase size

Example code

• ArraySearchLinear.java
  – Insertion of elements
  – Search for elements
  – Main function fills with random numbers and does random searches
An analogy

• “Price is Right” game show game
  – Find unknown price by guessing
  – Feedback: “higher” or “lower”
• Analogy to search
  – Guessed price is index in array (not value!)
• Examples
  – Not so good:
    http://www.youtube.com/watch?v=oc9H8bo8yg0
  – Much better (2 min into movie):
    http://www.youtube.com/watch?v=REhqoLIRJwY

Improved search

• How can we improve search in array?
Binary search

• Reduce size of search space by half
  – Check middle of array
  – Decide to search in lower or upper half
• Requires sorted array!
  – Assume elements have been inserted in order

Binary search draft

• Write pseudo code for binary search on paper
  – After you complete your draft, discuss with one of your neighbors
Binary search pseudo code

```java
private int binarySearch(int item) {
    int lo = 0; int hi = fillLevel-1;
    while (lo<=hi) {
        int mid = (lo+hi)/2;
        if (item < content[mid]) {
            hi = mid-1;
        } else if (item > content[mid]) {
            lo = mid+1;
        } else {
            return mid;
        }
    }
    return -1;
}
```

Example code

- **ArraySearchBinary.java**
  - Insertion operation changed to maintain order
  - Search operation based on binary search
Running time performance

• What are the differences in running time?

Next Steps

• Homework 1 can be submitted on Moodle
• TA office hours posted on web
• Lecture on Wednesday