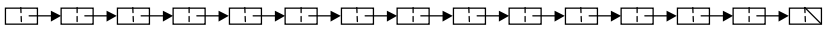
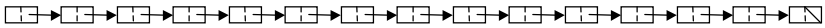
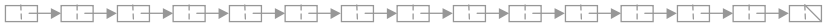


CSE 373: Selection

Miscellaneous
(bits of Chapters 1, 4, 6, 7)



The Selection Problem



Goal: Given a list of n numbers, find the k^{th} smallest

Special Cases:

$k = 1$: `FindMin()`

$k = n$: `FindMax()`

$k = n/2$: the *median* of the list

Any ideas?

Selection Brainstorming

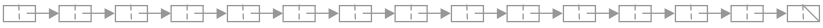
Which of the data structures that we've studied would be appropriate for selection?

- List
- Stack
- Queue
- Tree
- BST
- Hash Table
- Heap

– must be able to store data

– must maintain some sort of ordering information

List-Based Selection



Naive algorithm:

– Insert each element into a second list using `InsertSorted()`

– Return the element in the *k*th position

– Running time?

Slightly improved algorithm:

– Store only the *k* smallest elements seen so far

– Running time?

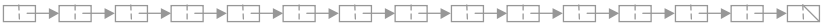
Tree-Based Selection

Naive Algorithm:

- `Insert()` all elements into a BST
- Traverse the tree using an in-order traversal
- Count off until we reach the k^{th} element
- Running time?

Improved Algorithm?

Heap-Based Selection



Naive Algorithm:

- `Insert()` all elements into a min-heap
- Perform `DeleteMin()` k -1 times
- The next `DeleteMin()` returns the target value
- Running time?

Improved Algorithm?

Relating Selection and Sorting

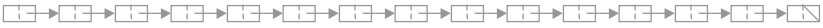
If we were to do selections for $k = 1, 2, \ldots, n$, we would end up with a sorted list

- Running time?

Alternatively, if we were to sort our input list, we could do any selection in O(1) time

- Running time?

Motivation for Sorting



- Sorted arrays allow us to do binary searches
- They also allow us to do fast selection
- The mode could be computed trivially in O(n) time if the input was sorted

(but perhaps most importantly…)

- Humans tend to like things in sorted order

How could we use our data structures to sort?

Which would be appropriate? Efficient?