CSI 503 – Data Structures and Algorithms
Pseudocode for Selection Algorithms

Handout 10.1

(a) Pseudocode for Randomized Select:

Randomized-Select (A, p, r, i)
// Finds the ith smallest value in A[p .. r].
1. if (p = r)
   return A[p].
2. q = Randomized-Partition(A, p, r).
3. k = q - p + 1 // k = size of low side + 1 (pivot)
4. if (i = k)
   return A[q]
   else if (i < k)
   return Randomized-Select(A, p, q-1, i)
   else
   return Randomized-Select(A, q+1, r, i-k)

(b) Outline of Algorithm Select:

Select (A, i) (Returns the i\textsuperscript{th} smallest value in A)

1. Divide the n elements of A into \lceil n/5 \rceil groups of 5 elements at most one group consisting of
   n mod 5 elements. (Thus, the total number of groups = \lceil n/5 \rceil.)

2. Sort each group using INSERTION-SORT and find the median (the middle element) of each group.
   For the last group which may have an even number of elements, take the lower median.

3. Use Select recursively to find the median of the \lceil n/5 \rceil medians found in Step 2. Let x denote
   the median of medians. (If \lceil n/5 \rceil is even, then by our convention, x is the lower median.)

4. Use Partition on A using x as the pivot. Let k denote the number of elements in the low side
   plus the pivot after this partitioning step.

5. If i = k, then return x. If i < k, use Select recursively to find the i\textsuperscript{th} smallest on the low side;
   otherwise, use Select recursively to find the (i - k)\textsuperscript{th} smallest on the high side.