

Module 6 Problems

1. [15 pts] Run quickselect on the sequence below to find the 7th smallest element.

Assume the pivot for any subsequence is always the 1st element in the sequence.

Please show intermediate steps of the algorithm.

3, 17, -5, 4, 13, 8, 7, 6, 9 find 7th smallest element

2. [15 pts] Run quickselect on the sequence below to find the median of the sequence.

Assume the pivot for any subsequence is always the 1st element in the subsequence.

Please show all intermediate steps of the algorithm.

9, 8, 6, 4, -100 find the median

3. [20 pts] You have just run quickselect on integers from 1 - 9. The array below shows the output of the partition

3 1 2 4 5 8 7 6 9

What are the possible pivot elements ?

4. [20 pts] Given a set of 5 numbers:

1, 2, 3, 4, 5

The output of the KFY shuffle is:

1, 4, 2, 5, 3

Give a sequence from the random number generator that produced this output.

5. [30 pts] Suppose you change the shuffling algorithm to select a random number between 0 and $N-1$ at each stage. For this problem, let $N = 3$. (Sorting 3 items).

5.1 [10 pts] What is the total number of exchange sequences generated by "always between 0 and $N-1$ " (`bshuffle`)?

5.2 [10 pts] What is the total number of exchange sequences generated by KFY shuffling algorithm?

5.3 [10 pts] How does this show a bias for the faulty algorithm?