Question: Prove that you cannot do less than in floor (1.5n) – 2 comparisons for finding the min-max elements in each set

Solution:

The task here is to prove that 1.5n-2 comparisons are the best number of similarities to get a min and max elements simultaneously in a set.

1. Whenever we consider an array of elements in which we must find the min-max elements, we start with creating a min and max set, which is the same number of elements of the given array.
2. We then follow the process of elimination to eliminate the elements that are not belonging to the set.
   a. For example, our given array be [2, 1, 4, 6, 3, 5]
   b. First step is to create two arrays, min and max. which are exactly same as our given array
      a. Min = [2, 1, 4, 6, 3, 5]
      b. Max = [2, 1, 4, 6, 3, 5]
3. Now we compare the elements pairwise and divide the list into two (compare 2 with 1. Since 2 is greater than 1, it belongs to the max list, and 1 belongs to the min list). Hence, we make n/2 comparisons where n is the size of the array. After this set, two disjoint sets min (which has all the potential min elements) and max (which has potential max elements) are created.
   a. Min = [1, 4, 3]
   b. Max = [2, 6, 5]
   c. Here, n/2 comparisons are required
4. Now within each set, we compare the pairs within each. Every comparison result in the elimination of one element from the set.
   a. Thus, Min = [1, 4, 3] -> [1, 3] -> [1]
   b. Max = [2, 6, 5] -> [6, 5] -> [6]
   c. Since here also we make n/2 comparisons for each set and eliminate 1 element after each comparison, total comparisons are (n/2 - 1) + (n/2 - 1)
5. Adding all the comparisons we get n/2 + n – 2 = 3n/2 – 2.

   This is inevitably the least number of comparisons to get a min and max set because we take elements pairwise and eliminate the outliers of the particular set to reduce redundant comparisons