COMP3121 ASSIGNMENT1 QUESTION2

2. Suppose that you bought a bag of n bolts with nuts screwed on them. Your 5 year old nephew unscrewed all the nuts from the bolts and put both the nuts and the bolts back into the bag. The bolts are all of similar quite large size but are actually of many different diameters, differing only by at most a few millimetres, so the only way to see if a nut fits a bolt is to try to screw it on and determine if the nut is too small, if it fits or if it is too large. Design an algorithm for matching each bolt with a nut of a fitting size which runs in the **expected** time $O(n \log n)$. (20 points)

Answer:

We can use double quicksort algorithm to solve this question. Chose one of the bolts to test all the nuts and split it to three part. Too small, Too large and fitting. Then use the matching nut to split all the bolts to the similar part. Chose one of big part bolts and do same thing to the big part nuts…etc. Continue until all nuts and bolts are matching. We need to apply this partitioning recursively on the large and small part of both nuts and bolts. so it will take time O($2 \cdot n \cdot log\, n$) in total, and the expected time complexity is O($n \cdot log\, n$).