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COMP9101 (T2-2020)
Homework 1 – Q2

Pick a nut as a pivot, try to screw it on all n bolts to split them into three groups: those for which the nut is too large, those which fit and those for which the nut is too small. This takes n time.

Then select a bolt from which the nut is fit and let the bolt try to screw all n nuts, split them into three groups as well: nuts are too large, nuts which fit it and nuts are too small. This also takes n time.

At present, the second group of bolts match with the second group of nuts. Continue these same operations with the first group of bolts and the first group of nuts, and then also the third group of bolts and the third group of nuts. This takes expected $2T\left(\frac{n}{2}\right)$ time.

Thus, $T(n) = n + n + 2T\left(\frac{n}{2}\right) = 2T\left(\frac{n}{2}\right) + 2n$. After applying master theorem, $T(n) = \Theta(n \log n)$. It means this algorithm runs in the expected time $O(n \log n)$.