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Assignment 5: Sorting

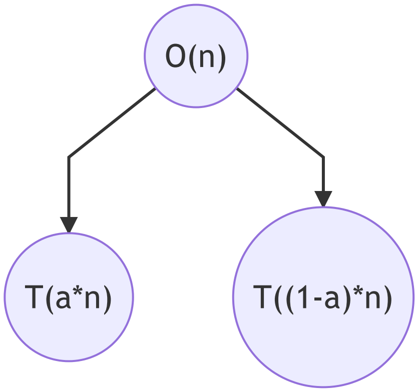
Question 1

The permutation is as follows have the odd number s sorted at the beginning and then all the even numbers to be reversely sorted after them e.g:
$[1, 3, 5, 7, ..., 8, 6, 4, 2]$ this way when we call the function the first time it will take $[1, n, 2]$ if n is odd and $[1, n-1, 2]$ if n is even of which the median is 2 then after partitioning we get $[1, 2, 3, 5, 7, ..., 8, 6, 4]$ the next call we do will take $[3, n, 4]$ and it continues with this pattern always portioning in $1 : n-2$ which leads to it being $\Omega(n^2)$

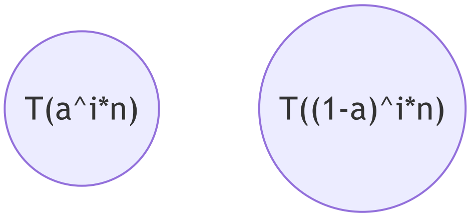
Question 2

it will be $\Theta(n^2)$ as in each comparison the pivot will be put in first or last depending on the comparison operators

Question 3



at level i



since $\alpha \leq \frac{1}{2}$
$\therefore$ the branch with $T(\alpha^i * n)$ is the minimum and the other is the maximum

- minimum
  $T(1) = T(\alpha^i * n)$
  $1 = \alpha^i * n$
  $\log n^{-1} = i * \log \alpha$
  $\therefore i = -\frac{\log n}{\log \alpha}$
- maximum
  $T(1) = T(\alpha^i * n)$
  $1 = (1 - \alpha)^i * n$
  $\log n^{-1} = i * \log{(1 - \alpha)}$
  $\therefore i = -\frac{\log n}{\log{(1-\alpha)}}$

Question 4

1. I would send the data in reverse order which would always cause the system to run in $\Theta(n^2)$
2. i would shuffle the data to get them back to their random order

Question 5

we can achieve this by pivoting around the median until we get a subset S of size d or smaller then we need to sort this subset in a way that all of it subsets to be fuzzy sorted so if the first subset is not part of the current d and it is part of the smaller S or the last subset is part of the bigger S.
this can be done by knowing the minimum and maximum of S and if an element intersects with the minimum put it at the beginning if it does with the maximum put it at the end.
this is possible because a subset of size d can only have at most 2 subsets intersecting otherwise the condition of each interval overlapping with at least b-1 others wont hold.

```
Function fuzzy(arr,d):
    if arr.len <= d:
        return Sort(arr)
    med -> Median(arr)
    left, right -> Partition(arr,med)
    left -> fuzzy(left,d)
    right -> fuzzy(right,d)
    return left + med + right

Function Sort(arr):
    mn -> min(arr)
    mx -> max(arr)
    ans -> Dequeue[arr.len]
    for int i=0; i< arr.len; i++:
        if Intersect(arr[i],mn):
            ans.addFront(arr[i])
        else:
            ans.addBac(arr[i])
    return ans
```