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Problem 0

Points:

Acknowledgements

(a) I did not work in a group.

(b) I did not consult without anyone my group members.

(c) I did not consult any non-class materials.

Problem 1 **Points:**

Solving recurrences

$$T(n) = aT(n/b) + \theta(n^d)$$

(a) Here, $d = 1.3$ and $\log_b a = \log_5 11 = 1.48$

So, $\log_b a > d$, we will use case-3 of Master's Theorem:

$T(n) = \underline{\theta(n^{\log_5 11}) = \theta(n^{1.48})}$

(b) Here, $d = 2.8$ and $\log_b a = \log_2 6 = 2.58$

So, $d > \log_b a$, we will use case-1 of Master's Theorem:

$T(n) = \underline{\theta(n^{2.8})}$

(c) Here, $d = 0$ and $\log_b a = \log_3 5 = 1.46$

So, $\log_b a > d$, we will use case-3 of Master's Theorem:

$T(n) = \underline{\theta(n^{\log_3 5}) = \theta(n^{1.46})}$

(d) $T(n) = T(n-2) + \log(n)$

$= [T(n-4) + \log(n-2)] + \log(n)$

$= [T(n-6) + \log(n-4)] + \log(n-2) + \log(n)$

$\vdots$

$= [T(n-k) + \log(n-(k-2))] + \cdots + \log(n-2) + \log(n)$

let $k = n$,

$= T(0) + \log(2) + \cdots + \log(n)$

$= 1 + \log(n!)$

$\log(1) + \cdots + \log(1) < \log(1) + \log(2) + \cdots + \log(n) < \log(n) + \cdots + \log(n) \rightarrow 0 < \log(n!) < \log(n^n)$

$= \underline{O(n\log(n))}$

Problem 2

Points:

Sorted Array

```
def Search(low, high, A):
    if (low == high):
        if (A[low] == low):
            return low
        else:
            return False
    else:
        mid = (low + high)//2
        if (A[mid] == mid):
            return mid
        elif (A[mid] > mid) :
            return Search(low, mid - 1, A)
        else:
            return Search(mid + 1, high, A)
```

Run-time Analysis : $O(\log(n))$

Problem 3

Points:

Linear Time Sorting