

Midterm

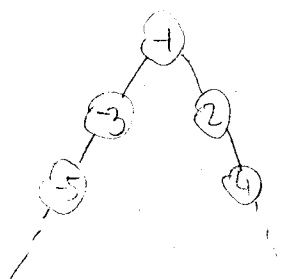
I have not consulted any resources including but not limited to classmates, tutors, text books, webpages, cheat sheets.

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2. a) $2^{n+1} = 2(2^n) \in O(2^n)$ True

b) $\lim_{n \rightarrow \infty} \frac{2^{2n}}{2^n} = \lim_{n \rightarrow \infty} 2^n = \infty \notin O(2^n)$ False

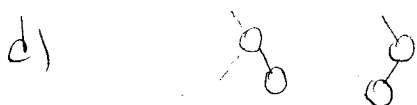
3.



About $\frac{1}{2}n \in \Theta(n)$

a)

4.



5. $g(n) = \frac{1}{13}n - 2 \log n + 10\pi$

d) $O(n \log n)$ g) $\Omega(\sqrt{n})$

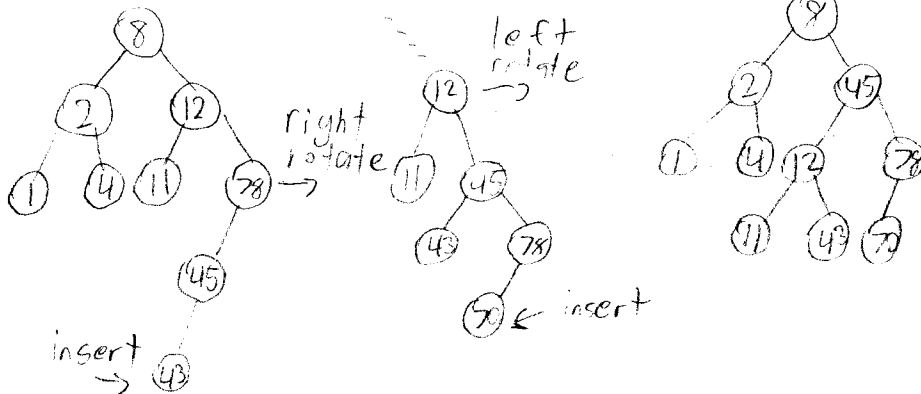
6. $\lim_{n \rightarrow \infty} \frac{2^{\sqrt{\log_2 n}}}{n^{1/3}} = \frac{(2^{\log_2 n})^{1/2}}{n^{1/3}} = \frac{n^{1/2}}{n^{1/3}} = n^{1/6} = \infty$

$\therefore 2^{\sqrt{\log_2 n}} \notin O(n^{1/3})$

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7.



8. Augment an AVL tree with the key being the grade and additionally store the max occurrences in the subtree

Insert and delete shall be similar to a normal AVL tree, with an extra step of updating the max occurrences of the parent nodes.

For max grade implement it recursively from the root so that it always tries to traverse to the right side tree if the max occurrences in that tree are greater than or equal to parameter k .

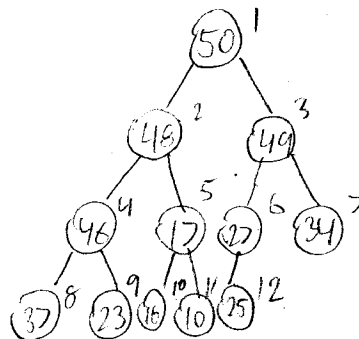
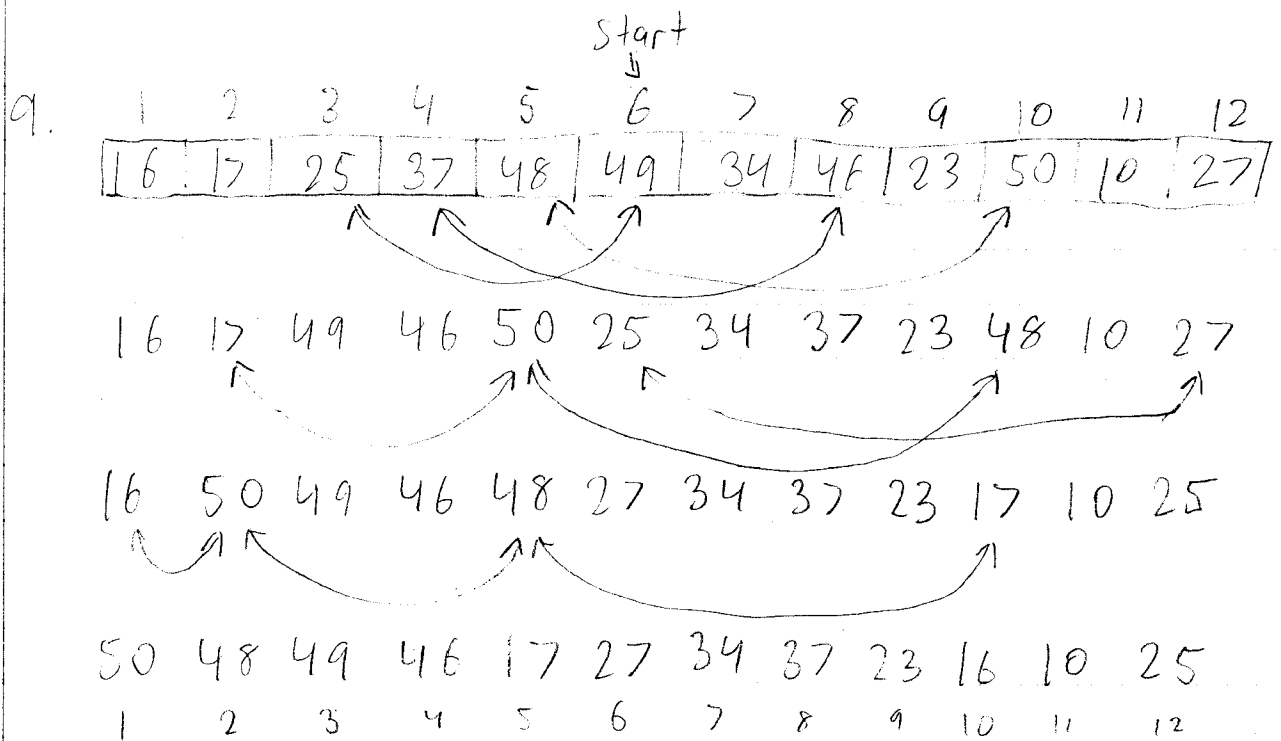
Do this until you cannot traverse right anymore due to being a leaf node or max occurrences not being enough.

Only traverse left if the current node occurrences are less than k and only the left tree occurrences are $\geq k$.

If root node max occurrences $< k$ return null
Since you traverse one path complexity should be $O(\log n)$ by AVL tree design

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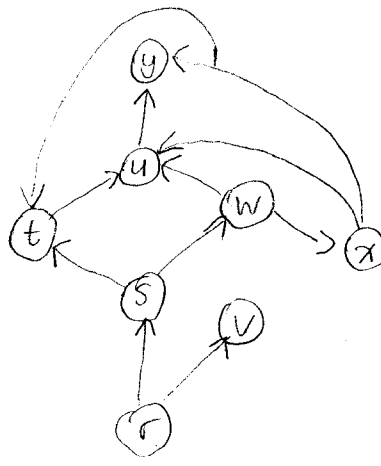
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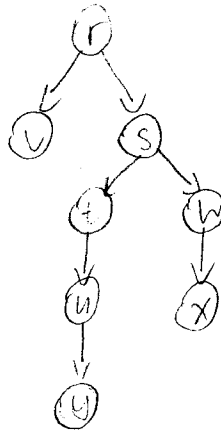
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10.

a)



b)



c)

r
s
t
u
v
w
x
y

s, v
w, t
u
y
/
x, u
t, u, y
/



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