

Subject:

Final Exam

Year:

Month:

Date:

Problem 2 Benjamin Tazayeri

Problem 1

- |                      |                        |
|----------------------|------------------------|
| (a) T ✓              | (P) F ✓                |
| (b) F ✓              | (g) F ✗ -2             |
| (c) F ✓              | (r) T ✓                |
| (d) <del>F</del> T ✓ |                        |
| (e) F ✓              | 160 / <del>188</del> / |
| (f) T ✓              | 180                    |
| (g) T ✓              |                        |
| (h) F ✓              |                        |
| (i) T ✓              |                        |
| (j) F ✓              |                        |
| (k) F ✓              |                        |
| (l) F ✓              |                        |
| (m) T ✓              |                        |
| (n) F ✓              |                        |
| (o) T ✓              |                        |

## Problem 2

(a) 1 ✓

(b) ~~13~~ -3

(c) 3 ✓

## Problem 3

(a) we will use an AVL Tree  
and augment it with satellite  
data of the size of the  
subtree rooted at a node ✓  
this is our <sup>extra</sup> invariant.

(b) We need not do anything. ✓

when  $\text{root}_i$  gets occupied.we insert  $i$ . when out, we delete it.

(c) we find  $\text{LstSucc}(L)$  and  $h$  or  $\text{Pred}(h)$   
we find their LCA  
then  $\text{LCA} - L.\text{size} - h.\text{size} + 2$

(conditional)

(d) if  $\text{Suc}(l)$  or  $\text{Pred}(h)$  in  $(l, h)$  is True

else: nil (e)  $\text{Del}(i) \checkmark + \cancel{i-1}$

Problem 4

$$(a) \frac{m-k}{m} \checkmark$$

$$(b) \sum_{K=c}^{w_2} \frac{m-k}{m} \cdot P(k) \checkmark -2$$

$$(c) \frac{\binom{m}{n}}{m^n} \checkmark$$

Problem 5

$$\pi^2 + 4\pi + 1 = (n+2)^2 - 3 = 0 \checkmark$$

$$\text{So } n+2 = \sqrt{3} \text{ So } n = \sqrt{3} - 2$$

We use newton to find  $\sqrt{3}$  then

## Problem 6

(a) We sort  $V$  by degree - deleting  
the node with the biggest degree  
and its neighbors. Return the #  
of deletions.  $O(V)$

(b) we need to check if bipartite. ✓  
Run dfs  $O(V+E)$ . Check cycle length.  
if odd False else True.

:

## Problem 7

(a) 3 ✓

(b) 4 ✓

(c) 4 X - 3

(d) 3 X - 2 ✓

(e) 1 ✓

## Problem 8

(a) ✓  $i=1 \quad i=2 \quad i=3 \quad i=4 \quad i=5 \quad i=6$  $b = \text{True}$       1      2      3      4      5 $b = \text{False}$       1      2      3      4      5

$$(b) DP(i, b) = DP(i-1, \neg b) + \begin{cases} 1 & \text{if } i \geq i- \\ & == b \\ 0 & \text{else} \end{cases}$$

$$(c) DP(0, b) = 1 \cdot \neg b - 2$$

(d) for  $i \in [0..h]$ for  $j \in [b, \neg b]$  ✓

(e)  $\max \{DP[i, T], DP[i, F]\}$  ✓

(f)  $O(n^2)$

Problem 9

DP of All SubStrings.

Recurrence  $\max(DP[i][k] + DP[k+1, j])$   
 for  $k = i \dots j$   
 + outer ✓

Problem 10

(a) if we have 3 balls. Excluding the median after that there is nothing t.d.. ✓

(b) Median(L, a, b) ✓

(c) from give some ordering,

call median(i, it1, it2)  
 for  $i = 1 \dots h-2$  ✓

call med each time,

Subject:

Year:

Month:

Date:

(d)  $O(h)$  to find  $l$  and  $h$

make < function

$O(h \lg h)$  merge sort. ✓

(e) comparison bin tree  $N!$  leaves. ✓