

CS300 Final Problem #5 Solution

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(a)

$$A(u) = \max\{w(u) + B(\text{left}(u)) + B(\text{right}(u)), A(\text{left}(u)) + A(\text{right}(u))\}$$

$$B(u) = A(\text{left}(u)) + A(\text{right}(u))$$

Grading Criteria See the table below.

$A(u) \backslash B(u)$	Correct	Partially correct	Incorrect
Correct	10 points	7 points	5 points
Partially correct	7 points	4 points	2 points
Incorrect	5 points	2 points	0 points

(b)

- $\text{left}(u)$ is NIL if u has no left child.
- $\text{right}(u)$ is NIL if u has no right child.

```
1: function LARGESTWEIGHTEDINDEPENDENTSET( $u$ )
2:   if  $u$  is NIL then
3:     return (0, 0)
4:   ( $a_l, b_l$ )  $\leftarrow$  LARGESTWEIGHTEDINDEPENDENTSET( $\text{left}(u)$ )
5:   ( $a_r, b_r$ )  $\leftarrow$  LARGESTWEIGHTEDINDEPENDENTSET( $\text{right}(u)$ )
6:    $b \leftarrow a_l + b_r$ 
7:    $a \leftarrow \max\{w(u) + b_l + b_r, b\}$ 
8:   return ( $a, b$ )
9:
10: function ENTRYPOINT( $T$ )
11:   ( $a, \_$ )  $\leftarrow$  LARGESTWEIGHTEDINDEPENDENTSET( $\text{root}(T)$ )
12:   return  $a$ 
```

$O(|V|)$ or $O(n)$ where $|V|$ and n are the number of nodes in tree T .

Grading Criteria

- 0 points: Mostly incorrect.
- 1 point: Only basic ideas are presented.
- 3 points: Some critical errors.
- In other cases, see the table below.

Analysis \ Correctness	Correct	Partially correct
	Correct	Partially correct
Correct	10 points	7 points
Incorrect	8 points	5 points

Checklist

- Recurrence relations
- Order of computation
- Base condition
- Input and output
- Time complexity of $O(n)$

Minor errors are ignored. Also, 10 points will be given even if the base condition covers only full binary trees. The algorithm should be detailed enough to be implemented directly.

Appendix

Sample Test Cases Test your recurrence relations and algorithm with the test cases below.

