

# COL202 Quiz 1

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TOTAL POINTS

**0 / 5**

QUESTION 1

## 1 Loop invariant 0 / 5

✓ + **0 pts** Incorrect/Not attempted

+ **0.5 pts** The algorithm returns a linked list of length  $2^{\text{length}(l)}$ .

+ **1 pts** Invariant- for all  $0 \leq i \leq \text{len}(l)$ :

$\text{len}(l') = 2^i$  at the end of  $i^{\text{th}}$  iteration.

+ **0.5 pts** Proof by induction on the outer loop.

+ **1 pts** Base Case

+ **0.5 pts** Induction Hypothesis

+ **1 pts** Induction Step

+ **0.5 pts** Conclusion- At the end of the algorithm the value of  $i = \text{length}(l)$  and hence the length of  $l'$  is  $2^{\text{length}(l)}$ .

Name Aryan SharmaEnt. No. 2021CS10553**Important:** Answer within the box. Anything written outside the box will be treated as rough work.**Problem 1 (5 marks)**

What does the algorithm on the right return?  
 Prove that your answer is correct by defining an appropriate loop invariant and proving its correctness by induction. Assume that the last node of a linked list points to NULL.

**Require:** : Given a linked list  $\ell$ .  
 1: initialise a list  $\ell'$  containing 1 node  
 2: **while**  $\ell$  is not NULL **do**  
 3:    $\ell'' \leftarrow \ell'$   
 4:   **while**  $\ell''$  is not NULL **do**  
 5:      $t \leftarrow \ell''.next$   
 6:     Insert a new node after  $\ell''$   
 7:      $\ell'' \leftarrow t$   
 8:   **end while**  
 9:    $\ell \leftarrow \ell.next$   
 10: **end while**  
 11: Return  $\ell'$

A list with length = length of list  $\ell + 1$ .

loop invariant for inner loop:  $\ell''$  is NULL at the end of the loop.

loop invariant for outer loop:

Let  $i$  be the  $i^{th}$  iteration of outer loop and for every  $i$ , let  $j$  be initialised to  $i$ .  $j$

In the inner loop  $\ell''$  is the last element of list  $\ell'$   
 Thus  $t \leftarrow \ell''.next$  gives  $t \leftarrow \text{NULL}$ , on inserting a new node after  $\ell''$   $t \leftarrow \text{new node } \ell''$