

15-150: Principles of Functional Programming

Quiz 3 Practice

Summer 2022

Name: _____

Andrew ID: _____

Circle the lab you are in:

A	Julia and Yosef	GHC 5207
B	Juhi, Nicole, and Susan	GHC 5208
C	Nancy and Shengchao	GHC 5210
D	Thea and Cindy	GHC 4303
E	Jacky, Jonathan, and Sonya	WEH 7500

Question	Points	Score
Practice	0	
Total:	0	

Answer the questions in the spaces provided. You will have the full 80 minutes of class time to complete this quiz. Good luck!! Y'all got this.

Question 1: Practice

Consider the following code:

```
datatype 'a tritree =
  NUB
| BRANCH of 'a * 'a tritree * 'a tritree * 'a tritree

fun mirror tri =
  (case tri of
    NUB => NUB
  | BRANCH ((x,y), t1, t2, t3) =>
    BRANCH ((y,x), mirror t3, mirror t2, mirror t1)
  )
```

- (a) (0 points) Let n be the number of nodes and d be the depth of an input tritree. Which of the following are valid **work** bounds for **mirror**? Do *not* assume that the input is balanced. Select all that apply.

- ☐ $O(\log(d))$
- ☐ $O((\log(d))^3)$
- ☐ $O(d)$
- ☐ $O(d^3)$
- ☐ $O(3^d)$
- ☐ $O(\log(n))$
- ☐ $O((\log(n))^3)$
- ☐ $O(n)$
- ☐ $O(n^3)$
- ☐ $O(3^n)$

- (b) (0 points) Let n be the number of nodes and d be the depth of an input tritree. Which of the following are valid **span** bounds for **mirror**? This time *do* assume that the input is balanced. Select all that apply.

- ☐ $O(\log(d))$
- ☐ $O((\log(d))^3)$
- ☐ $O(d)$
- ☐ $O(d^3)$
- ☐ $O(3^d)$
- ☐ $O(\log(n))$
- ☐ $O((\log(n))^3)$
- ☐ $O(n)$
- ☐ $O(n^3)$
- ☐ $O(3^n)$

- (c) (0 points) The most general type of `mirror` is _____
- (d) (0 points) Give another type that `mirror` satisfies, or state that none exists. _____
- (e) (0 points) Give a value with most general type `'a tritree`, or state that none exists. _____
- (f) (0 points) **True** or **False** : `(bool -> bool) tritree option tritree` is an instance of the type `'a tritree`
- (g) (0 points) **True** or **False** : `'b list tritree option` is an instance of the type `'a tritree`
- (h) (0 points) Suppose we are trying to prove a theorem about `mirror tri`, and want to proceed by weak structural induction over the input `tri`. Fill in the proof outline below. You do not need to prove the BC and IS, just state what the case would be. Make sure to clearly define or *quantify and type* any variables you introduce.

BC: Want to prove the theorem for `tri` = _____

(proof omitted)

IS: Want to prove the theorem for `tri` = _____

(proof omitted)

IH: We assume the theorem holds for _____
