

# CMSC330 Spring 2024 Quiz 4



Proctoring TA: \_\_\_\_\_ Name: \_\_\_\_\_

Section Number: \_\_\_\_\_ UID: \_\_\_\_\_

## Problem 1: Basics

[Total 4 pts]

	True	False
There are some data structures in Rust which will not deallocate using the Reference Counting Garbage Collection Strategy	<input type="radio"/>	<input type="radio"/>
Rust's Type System prevents Double Frees unless the <code>unsafe</code> keyword is used	<input type="radio"/>	<input type="radio"/>
It is theoretically possible to implement project 3 (NFA to DFA) in Lambda Calculus	<input type="radio"/>	<input type="radio"/>
$(\lambda x. y)((\lambda x. x x)(\lambda z. z z))$ has a beta normal form under eager evaluation	<input type="radio"/>	<input type="radio"/>

## Problem 2: Lambda Calculus - Variables

[Total 2 pts]

Underline the free variables and circle the bound variables in the expression below.

**Note:** Do not mark any of the lambda parameter variables.

$a (\lambda a. \lambda b. b \lambda a. a)(\lambda c. d) c$

## Problem 3: Lambda Calculus - Alpha Equivalence

[Total 2 pts]

Which lambda calculus expressions are alpha equivalent to  $(\lambda a. a)((\lambda b. c \lambda x. x) a b c)$ ? Circle all that apply.

- (A)  $(\lambda a. a)((\lambda a. c \lambda a. a) a b c)$      (B)  $(c \lambda a. a) c$   
 (C)  $(\lambda c. a)((\lambda b. c \lambda c. c) a b c)$      (D)  $(\lambda f. f)((\lambda c. c \lambda g. g) a b c)$

## Problem 4: Lambda Calculus - Reduction

[Total 4 pts]

Reduce  $(\lambda a.(\lambda b.(\lambda c.c\ c)b)a)d$  to beta normal form and show each step.

## Problem 5: Rust Ownership

[Total 8 pts]

```
fn main(){
  {
    let a = String::from("hello");
    let b = f1(a);
    // Mark 1
    let c = f2(&b);
    // Mark 2
  }
  // Mark 3
}

fn f1(s: String) -> String{
  println!("{}",s.len());
  // Mark 4
  s
}

fn f2(s: &str)-> i32{
  s.len() as i32
}
```

If there is no owner (because the value has been dropped) put "None". Assume that we are asking about ownership **during** execution.

Who is the owner of the value "hello" at Mark 1?

Who is the owner of the value "hello" at Mark 2?

Who is the owner of the value "hello" at Mark 3?

Who is the owner of the value "hello" at Mark 4?