

CMSC330 Fall 2015 Quiz #4 Solution

Name _____

Discussion Time (circle one): 10am 11am 12pm 1pm 2pm 3pm

Discussion TA (circle one): Adam Amelia Maria Chris Samuel Josh Michael Max Candice

Instructions

- Do not start this test until you are told to do so!
 - You have 15 minutes for this quiz.
 - This is a closed book exam. No notes or other aids are allowed.
 - For partial credit, show all of your work and clearly indicate your answers.
1. (5 pts) Use the operational semantics rules given in class, included here for your reference. Show the derivation for

if 0 = 1 then 2 + 3 else 2 - 3

AST

$a ::= n \mid a + a \mid a - a$
 $b ::= a = a \mid \text{if } b \text{ then } a \text{ else } a$

Rules:

-
$n \Rightarrow n$

$E_1 \Rightarrow tt \quad E_2 \Rightarrow v_2$
$\text{if } E_1 \text{ then } E_2 \text{ else } E_3 \Rightarrow v_2$

$E_1 \Rightarrow v_1 \quad E_2 \Rightarrow v_2$
$E_1 \text{ op } E_2 \Rightarrow v_1 \text{ op } v_2$

$E_1 \Rightarrow ff \quad E_3 \Rightarrow v_3$
$\text{if } E_1 \text{ then } E_2 \text{ else } E_3 \Rightarrow v_3$

Answer:

$n: \text{-----}$	$n: \text{-----}$	$n: \text{-----}$	$n: \text{-----}$
$0 \rightarrow 0$	$1 \rightarrow 1$	$2 \rightarrow 2$	$3 \rightarrow 3$
$eq: \text{-----}$		$sub: \text{-----}$	
$0 = 1 \rightarrow \text{false}$		$2 - 3 \rightarrow -1$	
$if-f: \text{-----}$			
$\text{if } 0 = 1 \text{ then } 2+3 \text{ else } 2 - 3 \rightarrow -1$			

2. (5 pts) Given these parse functions, write the corresponding CFG (S and L are nonterminals, and a,b,c, ϵ are terminals)

```

parse_S( ) {
    match("c");
    match("a");
    parse_L( );
}
parse_L( ) {
    if (lookahead == "c") {
        match("c");
        parse_L( );
        match("c");
    } else if (lookahead == "b") {
        match("b");
        parse_L( );
    } else ;
}

```

Answer:

S \rightarrow caL

L \rightarrow cLc|bL| ϵ

3. Evaluate the following lambda-expressions as much as possible. Show each beta-reduction/alpha conversion explicitly.

(1) (2 pts) $(\lambda x. \lambda y. y) a b$

Answer:

$(\lambda y. y) b \quad \Rightarrow$ beta reduction (parameter x \Rightarrow argument a)

$b \quad \Rightarrow$ beta reduction (parameter y \Rightarrow argument b)

(2) (4 pts) $(\lambda x. \lambda y. \lambda z. y z x) y a b$

Answer:

$(\lambda x. \lambda r. \lambda z. r z x) y a b \quad \Rightarrow$ alpha conversion (parameter y \Rightarrow parameter r)

$(\lambda r. \lambda z. r z y) a b \quad \Rightarrow$ beta reduction (parameter x \Rightarrow argument y)

$(\lambda z. a z y) b \quad \Rightarrow$ beta reduction (parameter r \Rightarrow argument a)

$a b y \quad \Rightarrow$ beta reduction (parameter z \Rightarrow argument b)

(3) (4 pts) $(\lambda z. z z) (\lambda x. x) b c$

Answer:

$((\lambda x. x) (\lambda x. x)) b c \quad \Rightarrow$ beta reduction (parameter z \Rightarrow argument $(\lambda x. x)$)

$(\lambda x. x) b c \quad \Rightarrow$ beta reduction (parameter x \Rightarrow argument $(\lambda x. x)$)

$b c \quad \Rightarrow$ beta reduction (parameter x \Rightarrow argument b)