

## Quiz 4 - CFGs, Lambda Calc, OpSem

### Q1 CFGs

7 Points

#### Q1.1 Ambiguous

3 Points

Prove that the following grammar is ambiguous:

$$\begin{aligned} S &\rightarrow bS \mid Sb \mid T \\ T &\rightarrow Sa \mid Sb \mid Sc \mid \epsilon \end{aligned}$$

Save Answer

#### Q1.2 Modify The CFG

4 Points

Given the following ambiguous CFG, modify it so that it produces the same strings but is not ambiguous. You can use  $\epsilon$ , e, or epsilon.

$$\begin{aligned} S &\rightarrow SaS \mid T \\ T &\rightarrow bT \mid V \\ V &\rightarrow c \mid \epsilon \end{aligned}$$

Save Answer

## Q2 Operational Semantics

10 Points

Given the following operational semantics rules:

$$\frac{}{A; n \Rightarrow n} \quad \frac{A(x) = v}{A; x \Rightarrow v}$$

$$\frac{A; e_1 \Rightarrow v_1 \quad A; e_2 \Rightarrow v_2 \quad v_3 \text{ is } v_1 = v_2}{A; e_1 = e_2 \Rightarrow v_3}$$

$$\frac{A; e_1 \Rightarrow v_1 \quad A, x : v_1; e_2 \Rightarrow v_2}{A; \text{let } x = e_1 \text{ in } e_2 \Rightarrow v_2}$$

$$\frac{A; e_1 \Rightarrow v_1 \quad A; e_2 \Rightarrow v_2 \quad v_3 \text{ is } v_1 + v_2}{A; e_1 + e_2 \Rightarrow v_3}$$

### Q2.1 Complete the OpSem

10 Points

Fill the blanks so that the following is valid

$$\begin{array}{c}
 \text{(Blank \#5)} \\
 \hline
 A, a:3; 3 \Rightarrow 3 \quad A, a:3; 4 \Rightarrow 4 \quad \text{(Blank \#4)} \\
 \hline
 \text{(Blank \#1)} \quad \text{(Blank \#2)} \quad A, a:3; 6 \Rightarrow 6 \quad \text{(Blank \#3)} \\
 \hline
 A, a : 3; a + 4 = 6 \Rightarrow \text{false} \\
 \hline
 A; \text{ let } a = 3 \text{ in } a + 4 = 6 \Rightarrow \text{false}
 \end{array}$$

Blank #1:

Blank #2:

Blank #3:

Blank #4:

Blank #5:

Save Answer

### Q3 Lambda Calculus

3 Points

What does this evaluate to?

$((\lambda x. \lambda a. \lambda b. x \ b \ a) (\lambda x. \lambda y. x)) (\lambda y. y)$

- $(\lambda y.(\lambda y.y))$
- $(\lambda b.b)$
- $(\lambda x.\lambda y.x)$
- None of the above

Save Answer

Save All Answers

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