

CMSC 330, Spring 2018 Quiz 2

Name _____

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

Discussion TA (circle one) BT Daniel Chris Alex Derek Pei-Jo Akbar Justin L.
 Tal Shriraj Cameron Eric Kesha Kameron Michael S. Michael P.

Instructions

- Do not start this quiz until you are told to do so.
- You have 15 minutes for this quiz.
- This is a closed book quiz. No notes or other aids are allowed.
- For partial credit, show all your work and clearly indicate your answers.

1. (5 points) Using the rules given below, show

$$1 * 2 + 3 \Rightarrow 5$$

In the rules, n is a metavariable that refers to an integer, while e is a metavariable that refers to an expression, whose form is according to the following grammar:

$$e ::= n \mid e+e \mid e*e$$

Here are the rules:

$$\frac{}{n \Rightarrow n} \quad \frac{e_1 \Rightarrow n_1 \quad e_2 \Rightarrow n_2 \quad n_3 \text{ is } n_1 + n_2}{e_1 + e_2 \Rightarrow n_3}$$

$$\frac{e_1 \Rightarrow n_1 \quad e_2 \Rightarrow n_2 \quad n_3 \text{ is } n_1 * n_2}{e_1 * e_2 \Rightarrow n_3}$$

$$\frac{\frac{1 \Rightarrow 1 \quad 2 \Rightarrow 2 \quad 2 \text{ is } 1 * 2}{1 * 2 \Rightarrow 2} \quad 3 \Rightarrow 3 \quad 5 \text{ is } 2 + 3}{(1 * 2) + 3 \Rightarrow 5}$$

2. (7 points) Using the rules given below, show:

$$\text{let } y = 1 \text{ in let } x = 3 \text{ in } x \Rightarrow 3$$

In the rules, x is a metavariable that refers to an identifier (variable), n is a metavariable that refers to an integer, while e is a metavariable that refers to an expression, and A is a metavariable that refers to an environment. Grammars for the latter two are as follows:

$$e ::= x \mid n \mid \text{let } x = e \text{ in } e$$

$$A ::= \cdot \mid A, x : n$$

In the above, \cdot represents an empty environment, while $A, x : n$ is the environment that extends A with a mapping from x to n (overriding any other mapping that might already be in A for x).

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

$$\frac{A; 1 \Rightarrow 1 \quad \frac{A, x : 1; 3 \Rightarrow 3 \quad \frac{A, y : 1, x : 3(x) = 3}{A, y : 1, x : 3; x \Rightarrow 3}}{A, y : 1; \text{let } x = 3 \text{ in } x \Rightarrow 3}}{A; \text{let } y = 1 \text{ in let } x = 3 \text{ in } x \Rightarrow 3}$$

3. (8 points) Give a Finite Automata that accepts a string on alphabet 0,1 if and only if it has an even number of 1's and exactly one zero.

