CMSC 330 Spring 2017 Quiz #4

Name __________________________________________

Discussion Time (circle one) 10am 11am 12noon 1pm 2pm 3pm
Discussion TA (circle one) Aaron Alex Austin Ayman Daniel Eric
Greg Jake JT Sam Tal Tim Vitung

Instructions
• Do not start this quiz until you are told to do so.
• You have 20 minutes for this quiz.
• This is a closed book quiz. No notes or other aids are allowed.
• For partial credit, show all of your work and clearly indicate your answers.

1. (4 points) Circle ALL expressions that are equivalent to the following lambda expression
   \[(\lambda x. z) \lambda y. w \lambda w. w y x z\]

   i. \[(\lambda x. z) (\lambda y. w) (\lambda w. w y x z)\]

   ii. \[(\lambda x. (x z)) \lambda y. w \lambda w. w y x z\]

   iii. \[(\lambda x. z) \lambda y. (w (\lambda w. (w y x z)))\]

   iv. \[(\lambda x. z) \lambda y. w \lambda w. (w (y (x z)))\]

2. (2 points) Are the following two terms alpha equivalent? (Circle One) YES NO
   \[(\lambda x. x (\lambda y. x y) y) z\]  \[(\lambda x. x (\lambda a. x a) a) z\]

3. (4 points) Reduce the following lambda expression:
   \[(\lambda a. \lambda c. c b a) c (\lambda d. \lambda e. e)\]

   \[(\lambda a. \lambda c. c b a) c (\lambda d. \lambda e. e) \] // Alpha Conversion \lambda c. c becomes \lambda f.
   (\lambda f. b c) (\lambda d. \lambda e. e)
   (\lambda d. \lambda e. e) b c
   (\lambda e. e) c
   c
4. (5 points) Given the following language, provide a parse tree for “true and true or true”

\[
S \rightarrow S \text{ or } S \mid L \\
L \rightarrow \text{true and } L \mid \text{true}
\]

```
   S
  /   |
S or S
 /   |
true and L
 |   |
   true
   |
   true
```

5. (5 points) Make the following grammar left associative with “( )” having higher precedence than “and”. You can introduce new non-terminals if necessary.

\[
S \rightarrow (S) \mid S \text{ and } S \mid \text{true} \mid \text{false}
\]

```
S -> S and E | E
E -> (S) | true | false
```