

### CMSC 330, Summer 2018 Quiz 3

Name \_\_\_\_\_

#### 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 your work and clearly indicate your answers.

1. (4 points) Write a grammar for:

$$a^x c^z b^y \text{ where } z = 2x \ (x \geq 0, y \geq 0)$$

$$\begin{aligned} S &\rightarrow TU \\ T &\rightarrow aTcc \mid \varepsilon \\ U &\rightarrow bU \mid \varepsilon \end{aligned}$$

2. (4 points) Write a left-most derivation of “i ♡ cats ♡ i” from the following grammar:

$$S \Rightarrow S \heartsuit S \mid i \mid cats$$

$$\begin{aligned} S &\Rightarrow S \heartsuit S \\ &\Rightarrow S \heartsuit S \heartsuit S \\ &\Rightarrow i \heartsuit S \heartsuit S \\ &\Rightarrow i \heartsuit cats \heartsuit S \\ &\Rightarrow i \heartsuit cats \heartsuit i \end{aligned}$$

3. (2 points) Is the grammar from (2) ambiguous? If so, give a different left-most derivation of the same string. If it's unambiguous, explain why.

It is ambiguous. Here is a distinct left-most derivation.

$$\begin{aligned} S &\Rightarrow S \heartsuit S \\ &\Rightarrow i \heartsuit S \\ &\Rightarrow i \heartsuit S \heartsuit S \\ &\Rightarrow i \heartsuit cats \heartsuit S \\ &\Rightarrow i \heartsuit cats \heartsuit i \end{aligned}$$

4. (6 points) Give a regular expression that is equivalent to the following CFG.

$$S \Rightarrow T \mid U$$

$$T \Rightarrow abT \mid \varepsilon$$

$$U \Rightarrow cU \mid d$$

$((ab)^*)(c^*d)$

5. (4 points) Write a finite automaton that recognizes the same language as the CFG from (4).

