Homework 4: Unit 1 Reflection and CFG Warmup

Due 9pm, Friday, October 16, 2020 Ben Dreyer

Overview. This week's homework will be a quick turnaround but is also an easy opportunity to improve your homework grade. The first question (graded on completion only) is a relatively freeform reflection on how the course is going so far, and the second asks you to describe rules for a simple context-free grammar based on Wednesday's content. The extra credit question is an optional way to turn early practice with CFGs into homework points. As usual, turn in a modified version of this tex file with the associated compiled pdf for 5% extra credit. Recommend reading: Section 2.1 through Designing CFGs.

Question 0. What collaboration if any did you use for Q2 and the extra credit?

Solution. Just the textbook.

Question 1. (8pts) Spend a few minutes thinking about how you feel Unit 1 went in terms the effectiveness of your study strategies and your eventual comprehension of the material. What's a new strategy that you should **start** trying? What is something ineffective you've tried that you should **stop** doing? What's something that's working well that you should **continue**? Think about how use of class time, homework problems, and other aspects of test prep are and are not helpful for you. What are some suggestions you have for me to start, stop, or continue?

Solution. I think unit one went fairly well overall. Reading the book before and after class / during the homework is definitely a huge help because the examples are parallel. I think the homework's are also a good way to practice the things we've learned in class. One thing I noticed when studying for the exam is that the exam review was a little bit vague in what to prepare for. It told us the concepts we needed to know, but not really anything more specific than that. It would be nice to have some additional sample problems or a practice midterm next time so it doesn't feel like we are walking into the test blind. I was sort of surprised by the difficulty of the test because it was much harder than any home works we had worked on and I felt rushed to finished. Other than that the class is going well.

Question 2. (2pts) Give a CFG whose language is the set of of even-length palindromic binary strings:

$$\left\{ ww^{\mathcal{R}} \mid w \in \{0,1\}^n , n \geq 0 \right\}.$$

This can be done with a modification to the grammar $S \to 0S1 \mid \epsilon$, which we discussed on Wednesday for generating the language $\{0^n1^n \mid n \geq 0\}$. The first rule takes a seed S and expands it by producing a 0 on the left and a matching 1 on the right. The second rule allows expansion to stop by replacing the seed with the empty string. Palindromic binary strings can be generated similarly with a single variable associated with (different) expansion rules and a stopping rule.

Solution. $S \to 0S0 \mid 1S1 \mid \epsilon$

Extra credit. (2pts) Give a CFG that recognizes all palindromic binary strings (of even or odd length):

$$\left\{ ww^{\mathcal{R}} \mid w \in \{0,1\}^n , n \geq 0 \right\} \cup \left\{ wbw^{\mathcal{R}} \mid b \in \{0,1\} , w \in \{0,1\}^n , n \geq 0 \right\}.$$

Solution. $S \to 0S0 \mid 1S1 \mid X$
$X \to \epsilon 0 \epsilon \mid \epsilon 1 \epsilon \mid \epsilon$

Extra practice. (0pts) Give a CFG for a language we will discuss in Wednesday's class:

$$\left\{ a^i b^j c^k \mid i, j, k \geq 0, i = j \text{ or } i = k \right\}$$