

Homework 7

Due: 19 Mar 2024

Problem 7.1 — theoretical

Consider the following languages, all over the alphabet $\Sigma = \{a, b, c\}$. For each, prove that it is a regular language or prove that it is not a regular language.

- All strings starting with a where every group of one or more a is followed by either exactly one b or exactly one c .
- All strings where every group of one or more c is preceded by a longer group of either a or b .
- All strings where every group of one or more b is preceded by exactly one a and followed by exactly one c (and a and c only occur when bracketing groups of b in this fashion).

Problem 7.2 — theoretical

Consider the language S specified by the following BNF grammar.

$$\begin{aligned} S &\rightarrow P S \\ S &\rightarrow N P \\ S &\rightarrow N \\ P &\rightarrow @ N \\ P &\rightarrow \# N \\ P &\rightarrow N * \\ N &\rightarrow N N \\ N &\rightarrow a|b|c|d \end{aligned}$$

Show derivations for each of the following “sentences” in the language, or explain why it’s not part of the language:

- a. `a b a @ c`
- b. `a c * d`
- c. `# a b c *`
- d. `a c * # d`

Problem 7.3 — practical

Write a program in C[#] that gets a number from the command line and, starting with that number, prints lines of the form

```
42 bottles of beer on the wall!  
41 bottles of beer on the wall!
```

and so on until it gets to `1 bottle` and then no bottles.

The one-bottle line should print correctly (i.e. using singular “bottle”). Both zero and one should work correctly as the initial count. If the user runs the program without a command line argument, the program should print a polite error and exit, rather than crashing.

Hand in the file(s) containing the C[#] code using the handin script:

```
handin cmsc208 hwk7 myfile.cs
```

If you want to put the proofs and derivations in electronic form too I’ll accept them that way, but I think they’ll be mostly easier to do on paper.

Collaboration policy: **For Problem 7.1–7.2:** group work! If you work with other people on this homework, you can just hand in one copy and put all your names on top. There will be a revision cycle for this. **For Problems 7.3:** collaborative. You each have to hand in your own version of the assignment, but you can talk to other people about the problems. Mention in a comment or readme who you worked with. (Still no copying, though.)