

CSE 355 HOMEWORK FOUR

DUE 09 NOVEMBER 2016, START OF CLASS

The presidential election is underway!¹ There are four candidates, Aaron, Beatrice, Charlie, and Deedee. Because we are friends, we call them **a, b, c, d**, respectively.

A candidate wins by *majority* if they receive more than half the votes cast. They win by *plurality* if they receive more votes than any other candidate.

At Elections Central on Election night, we will receive one string over $\{\mathbf{a, b, c, d}\}^*$ giving all of the votes.

Let $L_M = \{w \in \{\mathbf{a, b, c, d}\}^* : \text{Charlie wins by majority}\}$.

Let $L_P = \{w \in \{\mathbf{a, b, c, d}\}^* : \text{Charlie wins by plurality}\}$.

Let $L_W = \{w \in \{\mathbf{a, b, c, d}\}^* : \text{Charlie wins by majority **and** Beatrice beats Aaron}\}$.

- (1) Is L_P regular? context-free but not regular? or not context-free? Justify your answer carefully.
- (2) (a) Show that L_M is not regular.
(b) Give a formal description of a PDA whose language is L_M .
- (3) (a) Give a context-free grammar G whose language is $\overline{L_M}$.
(b) Convert G into Chomsky normal form using the methods from class.
- (4) Is L_W regular? context-free but not regular? or not context-free? Justify your answer carefully.

¹Vote if you can and have not already done so.