

Policy on homeworks

- *Collaboration:* You may discuss a question with any other student currently taking CS81 provided: (i) both of you contribute equally; (ii) you come away from any discussion with an understanding in your mind (and no archived solution of any form is retained); (iii) your submission is your own work prepared by yourself on a separate occasion.
- *Reference materials:* You should only refer to materials from this semester of CS81 (class notes, handouts, textbooks, grutors, instructor, etc).
- *Submission:* Your submission should be legible or is prepared using TeX.

Consider the following requirements for “safe” passwords. Assume that the alphabet consists of numeric and lower-case alphabetical ASCII letters. For each description (or requirement), decide if it is regular, context-free or neither. Mark each question with **REG** (for regular), **CFL** (for context-free but not regular) and **NON** (for not context-free).

Provide justifications for your answers separately:

- if **REG**, show either a finite automata or a regular expression.
- if **CFL**, show both a context-free grammar and a proof of non-regularity.
- if **NON**, show a proof of not being context-free.

Let $\Sigma = \mathbf{d} \cup \mathbf{a}$, where $\mathbf{d} = \{0, \dots, 9\}$ and $\mathbf{a} = \{a, \dots, z\}$.

1. The password must be at least 8 characters long.
2. The password must contain at least 3 digits and at least 5 letters.
3. The password must contain two non-overlapping palindromes.
4. The password must contain the same number of digits and letters.
5. The password must contain the same number of digits, vowels and consonants.
6. The password has letters followed by digits where the number of letters should be no more than the number of digits, but the number of digits should be no more than twice the number of letters.
7. If the password contains a vowel, then it has to have the same number of even digits, odd digits, and consonants; otherwise, it may contain any number of even digits, odd digits, and consonants.
8. The length of the password must be a square.