

CS3331 – Assignment 2 due
Oct. 24, 2024
2-day no-penalty extension until: Oct. 26, 11:59pm¹

1. For each of the following languages, L , prove whether L is (i) regular, (ii) context-free but not regular, or (iii) not context-free:

(a) $L = \{xyx^R \mid x, y \in \{0, 1\}^+\}$.

(b) $L = \{w \in \{0, 1\}^* \mid \text{every second character of } w \text{ is a } 0 \text{ and every third character of } w \text{ is a } 1\}$.

(c) $L = \{xay \mid x, y \in \{0, 1\}^*\}$.

(d) $L = \{(abb)^n a(bbb)^m \mid n, m \geq 0\}$.

(e) $L = \text{Pref}(\{a^n b^m \mid n, m \geq 0\})$.

(f) $L = \emptyset$.

(g) For each regular language L , describe the classes of \approx_L .

2. For two languages L_1 and L_2 , give an example of a language C such that C is in R_1 but not in R_2 .

3. Show that the following languages are not regular.

(a) $L = \{0^n 1^n \mid n \geq 0\}$.

(b) $L = \{0^n 1^m \mid n, m \geq 0\}$.

(c) $L = \{0^n 1^m \mid n, m \geq 0, n \neq m\}$.

(d) $L = \{0^n 1^m \mid n, m \geq 0, n \leq m\}$.

(e) $L = \{0^n 1^m \mid n, m \geq 0, n \geq m\}$.

(f) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{2}\}$.

(g) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{3}\}$.

(h) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{4}\}$.

(i) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{5}\}$.

(j) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{6}\}$.

(k) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{7}\}$.

(l) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{8}\}$.

(m) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{9}\}$.

(n) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{10}\}$.

(o) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{11}\}$.

(p) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{12}\}$.

(q) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{13}\}$.

(r) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{14}\}$.

(s) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{15}\}$.

(t) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{16}\}$.

(u) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{17}\}$.

(v) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{18}\}$.

(w) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{19}\}$.

(x) $L = \{0^n 1^m \mid n, m \geq 0, n \equiv m \pmod{20}\}$.

Notes: !!! Submit your solutions by Oct. 24, 11:59pm.

but high-quality handwritten solutions are preferred.

JFLAP: You are allowed to use JFLAP to simulate your solutions.

clearly your solution is correct.

during exams!

LLMs: You are allowed to use LLMs (Large Language Models), such as ChatGPT, but, again, they will not be available during exams.

LATEX: For those interested, the best program for scientific writing is LATEX. It is far superior to all the other programs, it is free, and you can start using it in minutes; here is an introduction: <https://tobi.oetiker.ch/lshort/lshort.pdf>. It is also available online at <https://www.overleaf.com/>.

¹No extension can be given, to be able to post the solutions before the midterm exam.