Prework 1.4c: Regular vs. Nonregular

Write your preliminary solutions to each problem and submit a PDF on Canvas. The names in brackets indicate the subset responsible for presenting the problem.

1. [Todd, Allie] Let $A = \{0^k u 0^k \mid k \geq 1 \text{ and } u \in \{0,1\}^*\}$. Prove that A is regular.

2. [Joshua, David] Let $B = \{0^k 1 u 0^k \mid k \geq 1 \text{ and } u \in \{0,1\}^*\}$. Prove that B is nonregular.

3. [Ben, Meghan, Levi] Let $\Sigma = \{0,1\}$. For each $k \geq 1$, let C_k be the language consisting of all strings that contain a 0 exactly k places from the right-hand end. Build a DFA that recognizes C_k. What is the fewest number of states required?

4. [Curtis, Andrew, Connor] How could the solution to Problem 3 be different if C_k were the language consisting of all strings that contain a 0 exactly k places from the *left*-hand end?

5. [Grace, Ky, Micah] Consider $\Sigma = \left\{ \frac{0}{0}, \frac{0}{1}, \frac{1}{0}, \frac{1}{1} \right\}$. A string in Σ^* consists of a top binary string t and a bottom binary string b of equal lengths. For this problem, we regard t and b as numbers expressed in binary notation. Prove that the following language F is regular.

$$F = \left\{ w = \frac{t}{b} \in \Sigma^* \mid b = 3t \right\}$$

Hint: It might be easier to prove that F^R is regular, and use closure.

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