1. Use only closure results (no pumping lemma) to prove that the language

\[ A = \{0^k1^m2^n \mid (k = m) \lor (m = n)\} \]

over the alphabet \( \Sigma = \{0, 1, 2\} \) is not regular.

2. Prove that the language \( L = \{0^m1^n \mid m \text{ is a multiple of } n\} \) over the alphabet \( \Sigma = \{0, 1\} \) is not regular.

3. Problem 1.46(c) [1st Ed: Problem 1.23(d)].

4. Problem 1.53 [1st Ed: Problem 1.36]. Now you know why Assignment 1, problem 4 used such a funny representation for its arithmetic.

5. Let \( P = \{a^n \mid n \text{ is a prime number}\} \) over the alphabet \( \Sigma = \{a\} \). Prove that \( P \) is not regular. (Hint: the challenge is to make the right choice for \( i \) in the pumping lemma. This distinguishes this problem from most other applications of the pumping lemma.)