CS81 Spring 2012  REGULAR EXERCISES

1. (REG2NFA) Convert \((ab \cup a)^*\) to a NFA using the general construction (see Rich: Theorem 6.1, page 133).

2. (NFA2DFA) Use the subset construction to convert the following NFA to a DFA (see Rich: Theorem 5.3, page 74).

3. (DFA2REG) Convert the following DFA to a regular expression. Use the Generalized NFA construction (see Rich: Theorem 6.2, page 139).

4. (MIN-DFA) See Example 5.28 in Rich (page 93) for an application of the minimization algorithm.

5. (NOT-REG) Prove that \(L = \{a^n b^n c^n : n \geq 0\}\) is not regular (see Rich: Theorem 8.6, page 170).

   Proof. Assume \(L\) is regular. By the Pumping Lemma, there is a constant \(N\) so that for any string \(w \in L\) with \(|w| \geq N\), there are strings \(x, y, z\) so that \(w = xyz\), \(y \neq \epsilon\), \(|xy| \leq N\), and \(xy^iz \in L\), for any \(i \geq 0\). So, we choose \(w = a^N b^N c^N \in L\) and let \(x, y, z\) be the strings guaranteed to exist by the Pumping Lemma where \(w = xyz\). Since \(|xy| \leq N\) and \(y \neq \epsilon\), we have \(y = a^k\), for some \(k\) with \(0 < k \leq N\). Therefore, \(xz = a^{N-k} b^N c^N\) which is clearly not an element of \(L\). This is a contradiction to the third condition \(xy^iz \in L\), for any \(i \geq 0\), of the Pumping Lemma. Thus, \(L\) is not regular.

Some of the above alternate problems are from Sipser.

Suggested exercises from Rich’s text:

1. Chapter 5: 2,6,9,11,12.
2. Chapter 6: 2,3,8,9,15,16,20.
4. Chapter 8: 1, 6, 7, 21.