

CSci 311 : Models of Computation
CSci 500 : Fundamental Concepts of Computing
Fall Semester 2015, Assignment #1
Due in class, Tuesday, 8 September 2015

1. **Assume** the following facts. Let Σ be an alphabet.

- (a) For all strings $w \in \Sigma^*$, $w\lambda = \lambda w = w$.
(λ is the identity element for string concatenation.)
- (b) For all strings $w \in \Sigma^*$, $w^0 = \lambda$.
- (c) For all strings $w \in \Sigma^*$ and integers $n \geq 0$, $w^{n+1} = w^n w$.
- (d) For all strings $u \in \Sigma^*$, $v \in \Sigma^*$, and $w \in \Sigma^*$, $u(vw) = (uv)w$.
(Associativity of concatenation.)
- (e) $|\lambda| = 0$.
- (f) For all strings $w \in \Sigma^*$ and symbols $a \in \Sigma$, $|wa| = |w| + 1$.
- (g) $\lambda^R = \lambda$.
- (h) For all strings $w \in \Sigma^*$ and symbols $a \in \Sigma$, $(wa)^R = aw^R$.
- (i) Basic properties of integer arithmetic such as associativity and commutativity of addition and multiplication, identity elements for addition (i.e., 0) and multiplication (i.e., 1), and distribution of multiplication over addition.

Prove $(uv)^R = v^R u^R$ for all strings $u \in \Sigma^*$ and $v \in \Sigma^*$. Give justifications for each of your steps (e.g., facts from the above list).

- 2. Exercise 4 on page 28 of Linz5 (i.e, Linz textbook, 5th edition)
- 3. Exercise 11, parts (a) and (c), on page 28 of Linz5
- 4. Exercise 14, parts (a) and (c), on page 28 of Linz5
- 5. Exercise 2 on page 34 of Linz5
- 6. Exercise 3 on page 34 of Linz5
- 7. **Required for CSci 500 students, optional for CSci 311 students:**
Exercise 10 on page 35 of Linz5