

CMPE 350 - Spring 2017

PS 2 - 21.02.17

1.7 Give state diagrams of NFAs with the specified number of states recognizing each of the following languages. In all parts the alphabet is $\{0, 1\}$.

b) $\{w | w \text{ contains the substring } 0101 \text{ i.e } w = x0101y \text{ for some } x \text{ and } y\}$

c) $\{w | w \text{ contains an even number of 0s or contains exactly two 1s}\}$

1.12 Let $D = \{w | w \text{ contains an even number of } a\text{'s and an odd number of } b\text{'s and does not contain the substring } ab\}$. Give a DFA with five states that recognizes D and a regular expression that generates D . (Suggestion: Describe D more simply.)

1.14 a) Show that if M is a DFA that recognizes language B , swapping the accept and nonaccept states in M yields a new DFA recognizing the complement of B . Conclude that the class of regular languages is closed under complement.

b) Show by giving an example that if M is an NFA that recognizes language C , swapping the accept and nonaccept states in M doesn't necessarily yield a new NFA that recognizes the complement of C . Is the class of languages recognized by NFAs closed under complement? Explain your answer.

1.18 Give regular expressions generating the languages of Exercise 1.6.

b) $\{w | w \text{ contains at least three 1s}\}$

g) $\{w | w \text{ the length of } w \text{ is at most 5}\}$

l) $\{w | w \text{ contains at least two 0s and at most one 1}\}$

1.20 For each of the following languages, give two strings that are members and two strings that are not members—a total of four strings for each part. Assume the alphabet $\Sigma = \{a, b\}$ in all parts

b) $a(ba)^*b$

c) $a^* \cup b^*$

e) $\Sigma^* a \Sigma^* b \Sigma^* a \Sigma^*$

h) $(a \cup ba \cup bb) \Sigma^*$

1.31 For any string $w_1 w_2 \dots w_n$ the reverse of w , written w^R , is the string w in reverse order, $w_n \dots w_2 w_1$. For any language A , let $A^R = \{w^R | w \in A\}$. Show that if A is regular, so is A^R .

1.40 Recall that string x is a prefix of string y if a string z exists where $xz = y$, and that x is a proper prefix of y if in addition $x \neq y$. In each of the following parts, we define an operation on a language A . Show that the class of regular languages is closed under that operation.

b) $\text{NOEXTEND}(A) = \{w \in A \mid w \text{ is not the proper prefix of any string in } A\}$.

1.43 Let A be any language. Define $\text{DROP-OUT}(A)$ to be the language containing all strings that can be obtained by removing one symbol from a string in A . Thus, $\text{DROP-OUT}(A) = \{xz|xyz \in A \text{ where } x, z \in \Sigma^*, y \in \Sigma\}$. Show that the class of regular languages is closed under the DROP-OUT operation. Give both a proof by picture and a more formal proof by construction as in Theorem 1.47.