This homework covers Sections 3.2 and 3.3. It is due on Monday, November 1. The class will meet in Lansing 310, on Wednesday, October 27, for a lab on regular expressions; there will also be a new programming assignment at that time.

1. Find the language that is generated by each of the following regular expressions over the alphabet $\Sigma = \{a, b\}$. Specify the language clearly, and *justify your answers.*

    a) $(ab)^*$

    b) a^*b^*

    c) aa^*bb^*

    d) $a^*(ba^*b)^*a^*$

    e) $a^*(ba^*b)^*a^*ba^*$

    f) $(a|ba)^*bba^*$

    g) $(a|ba)^*(\varepsilon|bb)a^*$

2. Find a regular expression that generates each of the following languages. *Justify your answers* by explaining how your expression works.

    a) $L_1 = \{w \in \{a\}^* \mid |w| \text{ is not divisible by 4 }\}$

    b) $L_2 = \{w \in \{a, b\}^* \mid |w| > 2 \text{ and the first and last characters of } w \text{ are different }\}$

    c) $L_3 = \{w \in \{a, b, c\}^* \mid w \text{ contains } abc \text{ as a substring }\}$

    d) $L_4 = \{w \in \{a, b, c\}^* \mid w \text{ does not contain } abc \text{ as a substring }\}$

    e) $L_5 = \{w \in \{a, b, c\}^* \mid n_a(w) = 1 \wedge n_b(w) < 3\}$

3. This problem uses the extended regular expression syntax from Section 3.4, and the exercises come from that section.

    a) Write a regular expression that will match a ten-digit phone number written in the form (xxx)xxx-xxxx, where each "x" is one of the digits 0 through 9, except that the very first x cannot be 0 or 1.

    b) Write a search pattern and a corresponding replace pattern that can be used to replace a ten-digit phone number in the form (xxx)xxx-xxxx with the name number written using the syntax xxx-xxx-xxxx. (For the search pattern, you can use your answer from part *a*, with parentheses added for grouping.)

    c) Write a regular expression that will match a Java comment consisting of // and everything following it on the same line.

    d) Write a search pattern and a corresponding replace pattern that can be used to replace a comment consisting of the characters between // and end of line with a comment consisting of the same characters between /* and */.