Homework 2: Lectures 5 - 7

CS 440: Programming Languages and Translators, Fall 2020

Due Sat Oct 31, 11:59 pm

[10/28: no Q 6-8]

How to Work; How to Submit

Use the same procedures as for Homework 1 (work in groups of 3 (self-assigned or randomly assigned) and submit your work and work reports to Blackboard.)

Problems [50 points] (half the end-of-semester credit as HW 1)

Regular Expressions [22 points]

1. [2 points] what's the minimal parenthesization of ((a|(b(c?)))d*)*? (I.e., throw out as many parens as you can without changing the meaning of the expression.)

2. [3 points] Give a string that is generated by both (aa|bb)* and (aba|bbb)*.

3. [3 points] Give a string that is generated by a(bc)*b but not ab(cb)* or argue briefly that none exist. (Recall that r* means (r r*).)

4. [6 points] Give brief English descriptions of what the following regular expressions accept.
   (Example: (aaa)* accepts all strings of a's with a length that's a multiple of 3. Another example: (a*)b(a*) accepts all strings of a's and b's with exactly one b.)
   a. (a*|b*)*
   b. (a*b)*

5. [8 points] Design an regular expression whose language is decimal numerals that don't begin with 0 except for 0 itself, plus octal numerals that begin with 0 and have at least 1 octal digit, and the first octal digit must not be 0. (So 0 is decimal zero, 7 is decimal 7, 07 is octal 7, and 00 is not included.)

[Oops, no questions 6 - 8]

Finite State Automata [28 points]

9. [4 points] Trace the execution of the DFA in Figure 1 on input aabab and say whether the string is accepted or not.

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For Problems 10 - 14, study the NFA in Figure 2.

10. [2 points] If we run the NFA on an input and one of the execution paths ends in state 2, do we accept the input or not? (Explain briefly.)

11. [4 points] What are the $\varepsilon$-closures of states 1, 2, 3, and 4?

12. [6 points] What are the states of the DFA obtained from the NFA? (Give the set of NFA states for each DFA state.)

13. [10 points] Give a trace of the execution of the DFA on input abbab.

14. [2 points] Does the DFA accept abbab?

### DFA for Problem 9

<table>
<thead>
<tr>
<th>State</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Start state = 1
Accepting states = \{1, 2, 3\}

### NFA for Problems 10 – 14

<table>
<thead>
<tr>
<th>State</th>
<th>$\varepsilon$</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
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<td>2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Start state = 1
Accepting state = \{4\}

*Figure 1*  *Figure 2*