COS126 Regular Expressions, DFAs (Chapter 5)

Part 1
Consider the regular expression \(((C|D|M|N|P|T)A)^*\)

- Is PAPA matched by this RE? Is MAMAN? Is NAPA? Is TAMPA? NAPA is, but MAMAN and TAMPA are not

- Name two counties that are matched by this RE. PANAMA and CANADA

Part 2 — RElay Race
Write regular expressions for the following languages:

1. all binary strings \((0|1)^*\)

2. all non-empty binary strings \((0|1)(0|1)^*\)

3. all binary strings beginning and ending with 1 \(1(0|1)^*1\)

4. all binary strings ending with 00 (divisible by 4) \((0|1)^*00\)

5. all binary strings with at least three 1s \(0^*10^*10^*1(0|1)^*, (0|1)^*1(0|1)^*1(0|1)^*1(0|1)^*, etc\)

Part 3
Given an English-language description of the language defined by the RE \((0^*10^*10^*)^*\)? All binary strings with both a positive and even number of 1s

Bonus
Hard bonus: is it possible to define a RE for all binary integers divisible by 3? Yes
Part 4

- Is 01101 accepted by this DFA? Is 11? 01101 is, 11 is not

- Given an English-language description of the language that this DFA recognizes. All binary strings with an odd number of 1s

- (Optional) Give a regular expression that defines the same language. $0^*10^*(0^*10^*10^*)^*$ (other formulations possible)

Part 5

Draw DFAs that recognize each of these languages from Part 2: see next page

1. all binary strings

2. all non-empty binary strings

3. all binary strings beginning and ending with 1

4. all binary strings ending with 00 (divisible by 4)

5. all binary strings with at least three 1s

<table>
<thead>
<tr>
<th>Language</th>
<th>Regular Expression</th>
<th>DFA</th>
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</thead>
<tbody>
<tr>
<td>All binary strings</td>
<td>`(0</td>
<td>1)*`</td>
</tr>
<tr>
<td>All binary strings except empty string</td>
<td>`(0</td>
<td>1)(0</td>
</tr>
<tr>
<td>Begins with 1, ends with 1</td>
<td>`1</td>
<td>1(0</td>
</tr>
<tr>
<td>Ends with 00</td>
<td>`(0</td>
<td>1)*00`</td>
</tr>
<tr>
<td>Contains at least three 1s</td>
<td>`(0</td>
<td>1)*1(0</td>
</tr>
</tbody>
</table>

**Legend**
- N: Non-Accepting State
- Y: Accepting State