REs & DFAs WORKSHEET - SOLUTIONS

1. Consider the regular expression ((C|D|M|N|P|T)A)*
      PAPA & NAPA
   b. Name two countries that are matched by this RE.
      PANAMA & CANADA

2. RElay Race - Write regular expressions for the following languages:
   a. all binary strings
      \((0|1)^*\)
   b. all non-empty binary strings
      \((0|1)^+\) OR \((0|1)(0|1)^*\)
   c. all binary strings beginning and ending with 1
      \(1|1(0|1)^*1\)
   d. all binary strings ending with 00 (divisible by 4)
      \((0|1)^*00\)
   e. 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

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

4. BONUS: is it possible to define a RE for all binary integers divisible by 3?
   \(0 \mid 0^*(10^*1 \mid 01^*0)^*10^*\)
5. Consider this DFA:

![DFA Diagram]

a. Is 01101 accepted by this DFA? **YES**

b. Is 11? **NO**

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

   d. (Optional) Give a regular expression that defines the same language

   \[ 0^*1(0^*10^*)^* \]
   
   (other formulations possible)

6. Draw DFAs that recognize each of these languages from Question 2:

<table>
<thead>
<tr>
<th>Language</th>
<th>Regular Expression</th>
<th>DFA</th>
</tr>
</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)</td>
</tr>
<tr>
<td>Begins with 1, ends with 1</td>
<td>((0</td>
<td>1)^*1</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>

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