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 | 0*1(0*1 | 01*0)*10*
5. Consider this DFA:

   ![DFA Diagram]

   - a. Is 01101 accepted by this DFA? **YES**
   - b. Is 1? **NO**
   - c. Give 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
     \[0^*10^*(0^*10^*10^*)^*\]
     **(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>1</td>
<td>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) *</td>
</tr>
</tbody>
</table>

![DFA Diagram]