In-class Exercises: DTDs

Through the questions below, you will build up a DTD for XML files that store data about a music library. There will be many alternative ways to represent this data. Just try to make reasonable choices.

- A **music library** consists of any number of songs and albums in any order.
- A **song** must have a title and may have a year. It may also have information about who wrote it. This could be one or more composers, or it could separately list one or more people who wrote the music, and one or more people who wrote the lyrics. Represent all songwriters as plain text with no structure.
- An **album** must have a title, artist, year, and three or more tracks. An album may have one or more producers. Represent each producer as plain text with no structure. Although the “artist” for an album could be more complex (one name, several names, a band name), represent it as plain text also.
- Each **track** on an album must have a song and a length.

1. Write a small example of XML data for a single song, and DTD rules that will accept this XML. Enforce any constraints on songs that you can.

<table>
<thead>
<tr>
<th>XML data</th>
<th>DTD rules</th>
</tr>
</thead>
</table>
   | ⟨SONG title =“t1” year=“2015”⟩  
   | ⟨COMPOSER⟩c1⟨/COMPOSER⟩  
   | ⟨COMPOSER⟩c2⟨/COMPOSER⟩  
   | ⟨/SONG⟩  
   | or  
   | ⟨SONG title =“t1” year=“2015”⟩  
   | ⟨MUSICIAN⟩m1⟨/MUSICIAN⟩  
   | ⟨LYRICIST⟩l1⟨/LYRICIST⟩  
   | ⟨LYRICIST⟩l2⟨/LYRICIST⟩  
   | ⟨/SONG⟩ |  

   ![ATTLIST SONG title CDATA #REQUIRED year CDATA #IMPLIED]  
   ![ELEMENT SONG (COMPOSER+ | MUSICIAN +, LYRICIST+)]  

   ![ATTLIST MUSICIAN #PCDATA]  
   ![ELEMENT LYRICIST #PCDATA]  
   ![ELEMENT COMPOSER #PCDATA]  

2. Write DTD rules that will accept a music library that consists only of songs. (We’ll revise it later to include albums.)

   ⟨ELEMENT LIBRARY (SONG*)⟩

3. Write a small example of XML data for an album. For now, let’s say that an album consists merely of a title (we’ll expand it later). Write DTD rules to accept this XML.

<table>
<thead>
<tr>
<th>XML data</th>
<th>DTD rules</th>
</tr>
</thead>
</table>
   | ⟨ALBUM title =“a1/⟩  
   | ⟨ALBUM title =“a2/⟩ | ⟨ATTLIST ALBUM title CDATA #REQUIRED⟩  
   | ⟨ELEMENT ALBUM EMPTY⟩ |
4. Modify your DTD rules for a music library so that it accepts any number of songs and albums in any order.

\[ \text{<!ELEMENT LIBRARY (SONG | ALBUM)*} \]

5. Now revise your XML and DTD for an album so that it includes all the data listed above.

<table>
<thead>
<tr>
<th>XML data</th>
<th>DTD rules</th>
</tr>
</thead>
</table>
| ⟨ALBUM title="a1 year="2015⟩
  ⟨ARTIST⟩artist1(／COMPOSER)
  ⟨TRACK length =“4:30⟩
    ⟨SONG title =“st1 year="2015⟩
      ⟨COMPOSER⟩c1(／COMPOSER)
      ⟨COMPOSER⟩c2(／COMPOSER)
    ⟨／SONG⟩
  ⟨／TRACK⟩
  ⟨TRACK length =“3:15⟩
    ⟨SONG title =“st2 year="2015⟩
      ⟨MUSICIAN⟩m1(／MUSICIAN)
      ⟨LYRICIST⟩l1(／LYRICIST)
      ⟨LYRICIST⟩l2(／LYRICIST)
    ⟨／SONG⟩
  ⟨／TRACK⟩
  ⟨TRACK length =“4:55⟩
    ⟨SONG title =“st3 year="2014⟩
      ⟨MUSICIAN⟩m2(／MUSICIAN)
      ⟨LYRICIST⟩l2(／LYRICIST)
      ⟨LYRICIST⟩l3(／LYRICIST)
    ⟨／SONG⟩
  ⟨／TRACK⟩
  ⟨TRACK length =“3:55⟩
    ⟨SONG title =“st4 year="2014⟩
      ⟨MUSICIAN⟩m2(／MUSICIAN)
      ⟨LYRICIST⟩l2(／LYRICIST)
      ⟨LYRICIST⟩l3(／LYRICIST)
    ⟨／SONG⟩
  ⟨／TRACK⟩
  ⟨PRODUCER⟩producer1(／PRODUCER)
 ⟨／ALBUM⟩ | \[ \text{<!ELEMENT ALBUM (ARTIST, TRACK, TRACK, TRACK+, PRODUCER*)} \]
      \[ \text{<!ATTLIST ALBUM title CDATA #REQUIRED} \]
      \[ \text{year CDATA #REQUIRED} \]
  \[ \text{<!ELEMENT ARTIST #PCDATA} \]
  \[ \text{<!ELEMENT PRODUCER #PCDATA} \]
  \[ \text{<!ELEMENT TRACK (SONG)} \]
  \[ \text{<!ATTLIST TRACK length CDATA #REQUIRED} \] |

6. We’ve been treating people’s names as plain text. Write new rules that require a name to be either a first and last name, or a single name (for artists like Bono or Kesha), and give each person a unique identifier. Revise your other DTD rules to refer to people by their identifier.
<!ELEMENT PERSON (NAME)>
<!ELEMENT NAME ((FIRST, LAST)|(FULL))>
<!ATTLIST PERSON pID ID #REQUIRED>
<!ATTLIST MUSICIAN mID IDREF>
<!ATTLIST LYRICIST lID IDREF>
<!ATTLIST COMPOSER cID IDREF>
<!ATTLIST ARTIST aID IDREF>
<!ATTLIST PRODUCER prID IDREF>