Practical Lab 2

Web Data Models

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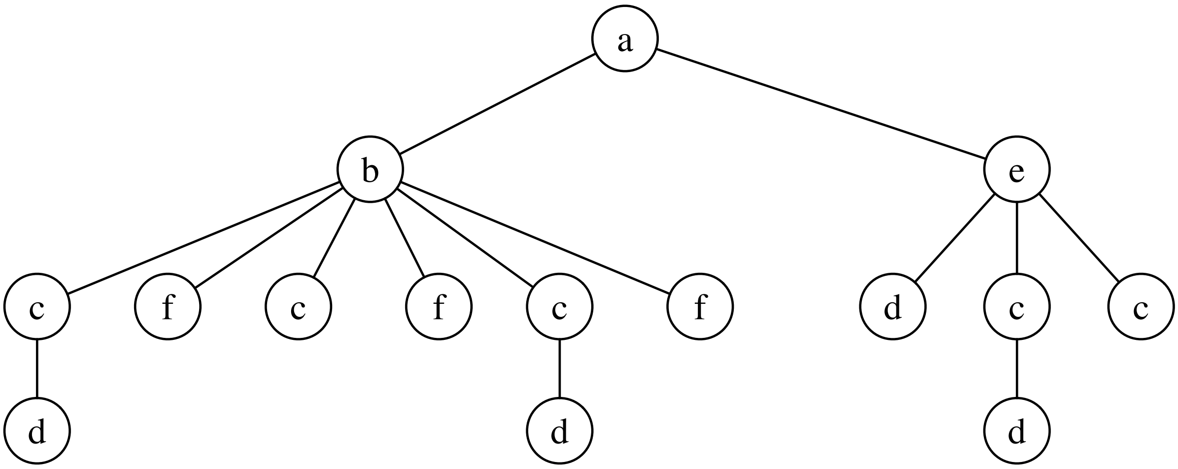
The goal of this lab sessions is to exercise the validation of XML in regards to XML and DTD, and to evaluate the differences between the two schema languages.

1 DTD Validation

Consider the following XML document t, given in tree form:



1. Provide a DTD D such that the document t is valid with regard to D. Validate it using the command `xmllint`.
2. Write D as a regular grammar G.
3. Show that t is in $L(G)$. Hint: explain how a unranked tree automaton works on t and G.
4. Generate another document that is in $L(G)$.

2 DTD and RTG

Consider the following DTD D:

```
<!ELEMENT files (file*, person*) >
<!ELEMENT file (consultation)* >
<!ELEMENT consultation (symptom+, prescription?) >
<!ELEMENT symptom (#PCDATA) >
<!ELEMENT prescription (medication)* >
<!ELEMENT medication (#PCDATA) >
<!ELEMENT person (fname, lname, telnum?) >
<!ELEMENT fname (#PCDATA) >
<!ELEMENT lname (#PCDATA) >
<!ELEMENT telnum (#PCDATA) >
```

Moreover, consider the following regular tree grammar G:

$$\begin{aligned}
files &\rightarrow files[file*, Patient*, Doctor*]\\
file &\rightarrow file[Consultation*]\\
Patient &\rightarrow person[FName, LName]\\
Doctor &\rightarrow person[FName, LName, Tel]\\
Consultation &\rightarrow consultation[Symptom+, Prescription?]\\
FName &\rightarrow fname[Pcdata]\\
LName &\rightarrow lname[Pcdata]\\
Tel &\rightarrow telnum[Pcdata]\\
Symptom &\rightarrow symptom[Pcdata]
\end{aligned}$$

1. Does every document that is valid w.r.t. the DTD D is generated by the RTG G? Justify why or give a counter-example if applicable.
2. Is every document generated by G valid w.r.t. the DTD D? Justify why or give an counter-example if applicable.

3 XML Schema

Consider the XML schema specified by:

```
<?xml version="1.0" encoding="UTF-8" ?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="shiporder">
   <xs:complexType>
       <xs:sequence>
        <xs:element name="orderperson" type="xs:string"/>
        <xs:element name="shipto">
          <xs:complexType> <xs:sequence>
            <xs:element name="name" type="xs:string"/>
            <xs:element name="address" type="xs:string"/>
```

```
      <xs:element name="city" type="xs:string"/>
      <xs:element name="country" type="xs:string"/>
     </xs:sequence> </xs:complexType>
    </xs:element>
    <xs:element name="item" maxOccurs="unbounded">
     <xs:complexType> <xs:sequence>
      <xs:element name="title" type="xs:string"/>
      <xs:element name="note" type="xs:string" minOccurs="0"/>
      <xs:element name="quantity" type="xs:positiveInteger"/>
      <xs:element name="price" type="xs:decimal"/>
     </xs:sequence></xs:complexType>
    </xs:element>
   </xs:sequence>
   <xs:attribute name="orderid" type="xs:string" use="required"/>
  </xs:complexType>
 </xs:element>
</xs:schema>
```

Give a corresponding regular tree grammar, a document valid w.r.t. the above schema, and validate using `xmllint`.

4 Properties of Regular Tree Grammars

Consider the following regular tree grammars:

G_1	G_2
$Dir \rightarrow directory[Pers+]$	
$Pers \rightarrow student[StudContact]$	$Dir \rightarrow directory[Pers+]$
$Pers \rightarrow teacher[TeachContact]$	$Pers \rightarrow student[PerContact]$
$StudContact \rightarrow contact[NameNumAdr?]$	$Pers \rightarrow teacher[PerContact]$
$TeachContact \rightarrow contact[NameAdrTel?]$	$PerContact \rightarrow contact[NameAdr?]$
$Name \rightarrow name[PCdata]$	$Name \rightarrow name[PCdata]$
$Num \rightarrow num[PCdata]$	$Adr \rightarrow address[PCdata]$
$Adr \rightarrow address[PCdata]$	
$Tel \rightarrow telnum[PCdata]$	

1. Is every document generated by G_2 also generated by G_1, i.e., $L(G_2) \subseteq L(G_1)$?
2. Is there a DTD equivalent to G_1 and/or G_2? If possible, provide the DTD(s).
3. Give an XML document generated by both regular tree grammars.

5 (Optional) Properties of Regular Tree Grammars

Consider two regular tree grammars $G_1 = (N_1, T, S_1, P_1)$ and $G_2 = (N_2, T, S_2, P_2)$, having the same terminal symbols T. Can you build the regular tree grammar $G_3 = (N_3, T, S_3, P_3)$ that captures the intersection of $L(G_1)$ and $L(G_2)$.