Assignment 4  
CIS 451/551 Fall 2005  
due 5 pm, November 15th

Chapter 9 Problems

(15) 1. Redesign the following schema into first normal form. List any functional or multivalued dependencies that you assume. Also list all referential-integrity constraints that should be present in the first-normal-form schema.

\[
\begin{align*}
\text{Emp} &= (\text{ename}, \text{ChildrenSet} \text{ multiset}(\text{Children}), \text{SkillSet} \text{ multiset}(\text{Skills})) \\
\text{Children} &= (\text{name}, \text{birthday}) \\
\text{Skills} &= (\text{type}, \text{ExamSet setof}(\text{Exams})) \\
\text{Exams} &= (\text{year}, \text{city})
\end{align*}
\]

Answer  To put the schema into first normal form, we flatten all the attributes into a single relation schema.

\[
\text{Employee-details} = (\text{ename}, \text{name}, \text{bday}, \text{bmonth}, \text{byear}, \text{stype}, \text{xyear}, \text{xcity})
\]

We rename the attributes for the sake of clarity. \text{name} is \text{Children.name}, and \text{bday}, \text{bmonth}, \text{byear} are the \text{Birthday} attributes. \text{stype} is \text{Skills.type}, and \text{xyear} and \text{xcity} are the \text{Exams} attributes. The FDs and multivalued dependencies we assume are:

\[
\begin{align*}
\text{ename}, \text{name} &\rightarrow \text{bday}, \text{bmonth}, \text{byear} \\
\text{ename} &\rightarrow \rightarrow \text{name}, \text{bday}, \text{bmonth}, \text{byear} \\
\text{ename}, \text{stype} &\rightarrow \rightarrow \text{xyear}, \text{xcity}
\end{align*}
\]

The FD captures the fact that a child has a unique birthday, under the assumption that one employee cannot have two children of the same name. The MVDs capture the fact there is no relationship between the children of an employee and his or her skills-information.

(15) 2. Consider the schemas for the table people, and the tables students and teachers, which were created under people using the following SQL. Give a relational schema in 3NF that represents the same information. Recall the constraints on subtables, and give all constraints that must be imposed on the relational schema so that every database instance of the relational schema can also be represented by an instance of the schema with inheritance.

\[
\begin{align*}
\text{create type Person (name varchar(20), address varchar(20))} \\
\text{create type Student under Person (degree varchar(20), department varchar(20))} \\
\text{create type Teacher under Person (salary integer, department varchar(20))} \\
\text{create table people of Person}
\end{align*}
\]
**create table** students of Student under people
**create table** teachers of Teacher under people

**Answer**  A corresponding relational schema in third normal form is given below:

People = (name, address)
Students = (name, degree, student – department)
Teachers = (name, salary, teacher – department)

name is the primary key for all the three relations, and it is also a foreign key referring to People, for both Students and Teachers. Instead of placing only the name attribute of People in Students and Teachers, both its attributes can be included. In that case, there will be a slight change, namely — (name, address) will become the foreign key in Students and Teachers. The primary keys will remain the same in all tables.

(15) 3. Explain the distinction between a type x and a reference type ref(x). Under what circumstances would you choose to use a reference type?

**Answer**  If the type of an attribute is x, then in each tuple of the table, corresponding to that attribute, there is an actual object of type x. If its type is ref(x), then in each tuple, corresponding to that attribute, there is a reference to some object of type x. We choose a reference type for an attribute, if that attribute’s intended purpose is to refer to an independent object.
Chapter 10 Problems

(10) 4. Give a DTD to represent the Non-1NF books relation from the following XML relation.

<table>
<thead>
<tr>
<th>title</th>
<th>author_array</th>
<th>publisher</th>
<th>keyword_set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compilers</td>
<td>[Smith, Jones]</td>
<td>(McGraw-Hill, NewYork)</td>
<td>parsing, analysis</td>
</tr>
<tr>
<td>Networks</td>
<td>[Jones, Frick]</td>
<td>(Oxford, London)</td>
<td>Internet, Web</td>
</tr>
</tbody>
</table>

Answer

```xml
<!DOCTYPE bib[
  <!ELEMENT book(title,author+,publisher,keyword+)>
  <!ELEMENT publisher(pub-name,pub-branch)>
  <!ELEMENT title(#PCDATA)>
  <!ELEMENT author(#PCDATA)>
  <!ELEMENT keyword(#PCDATA)>
  <!ELEMENT pub-name(#PCDATA)>
  <!ELEMENT pub-branch(#PCDATA)>
]>```

(15) 5. Provide an XML Schema for the following XML, which describes a neural network. A neural network can be thought of as a digraph with continuous values that has nodes with properties, and weighted edges. Neural networks may be of different sizes. Additionally, weights not included in the xml are 0. The neural network must have at least two nodes.

```xml
<?xml version="1.0"?>
<network size="3">
  <node nodeNumber="0">
    <bias>-15.2771</bias>
    <tau>3.84902</tau>
    <vinit>0.5</vinit>
  </node>
  <node nodeNumber="1">
    <bias>9.55711</bias>
    <tau>3.5345</tau>
    <vinit>0.5</vinit>
  </node>
  <node nodeNumber="2">
    <bias>-26.118</bias>
    <tau>4.19973</tau>
    <vinit>0.5</vinit>
  </node>
  <weight nodefrom="0" nodeto="0" weight="17.1104"/>
  <weight nodefrom="0" nodeto="2" weight="-25.9018"/>
  <weight nodefrom="1" nodeto="1" weight="-20.5925"/>
  <weight nodefrom="1" nodeto="2" weight="22.8681"/>
  <weight nodefrom="2" nodeto="2" weight="3.60292"/>
</network>
```
Answer

<?xml version="1.0"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://www.w3schools.com"
xmlns="http://www.w3schools.com"
elementFormDefault="qualified">
  <xsd:element name="network" type="NeuralNetworkType"/>
  <xsd:element name="node">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="bias" type="xsd:decimal"/>
        <xsd:element name="tau" type="xsd:decimal"/>
        <xsd:element name="vinit" type="xsd:decimal"/>
      </xsd:sequence>
      <xsd:attribute name="nodeNumber" type="xsd:integer" />
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="weight">
    <xsd:complexType>
      <xsd:attribute name="nodefrom" type="xsd:integer"/>
      <xsd:attribute name="nodeto" type="xsd:integer"/>
      <xsd:attribute name="weight" type="xsd:decimal"/>
    </xsd:complexType>
  </xsd:element>
  <xsd:complexType name="NeuralNetworkType">
    <xsd:sequence>
      <xsd:element ref="node" minOccurs="2" maxOccurs="unbounded"/>
      <xsd:element ref="weight" minOccurs="0" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="size" type="xsd:string" />
  </xsd:complexType>
</xsd:schema>

A DTD for the xml file (appended to beginnning of xml or attached separately),
which was not part of this assignment:

<!DOCTYPE network [
  <!ELEMENT network (node+,weight+)> 
  <!ATTLIST network size CDATA "0" > 
  <!ELEMENT node (bias,tau,vinit)> 
  <!ATTLIST node nodeNumber CDATA "0" > 
  <!ELEMENT bias (#PCDATA)> 
  <!ELEMENT tau (#PCDATA)> 
  <!ELEMENT vinit (#PCDATA)> 
  <!ELEMENT weight EMPTY > 
  <!ATTLIST weight nodefrom CDATA "0" > 
  <!ATTLIST weight nodeto CDATA "0"> 
]>

(15) 6. Produce an html page with tables from the XML in problem 5. 
You are free to use whatever method you want, though I would recommend
using an external library, such as javax.xml.parsers.DocumentBuilder. If you 
validate your schema via the xml schema in problem 5, I will give 10 bonus
points.

Answer  Example given.