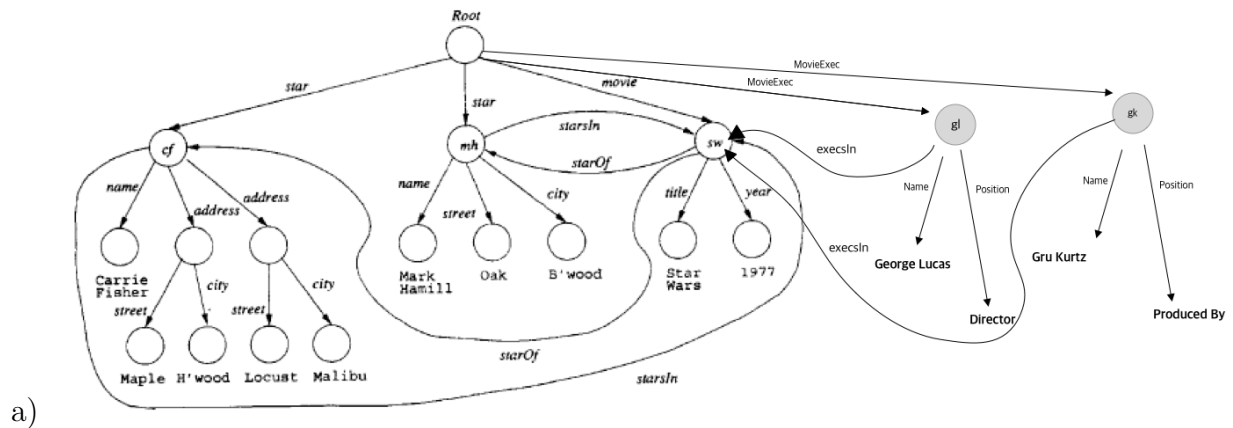


# CSC343 Worksheet 9 Solution

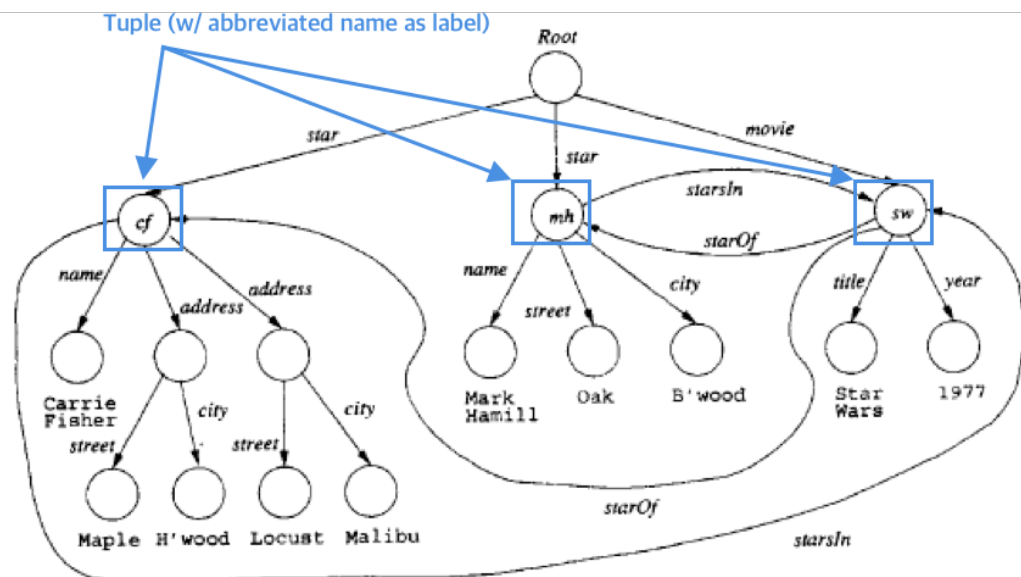
June 28, 2020

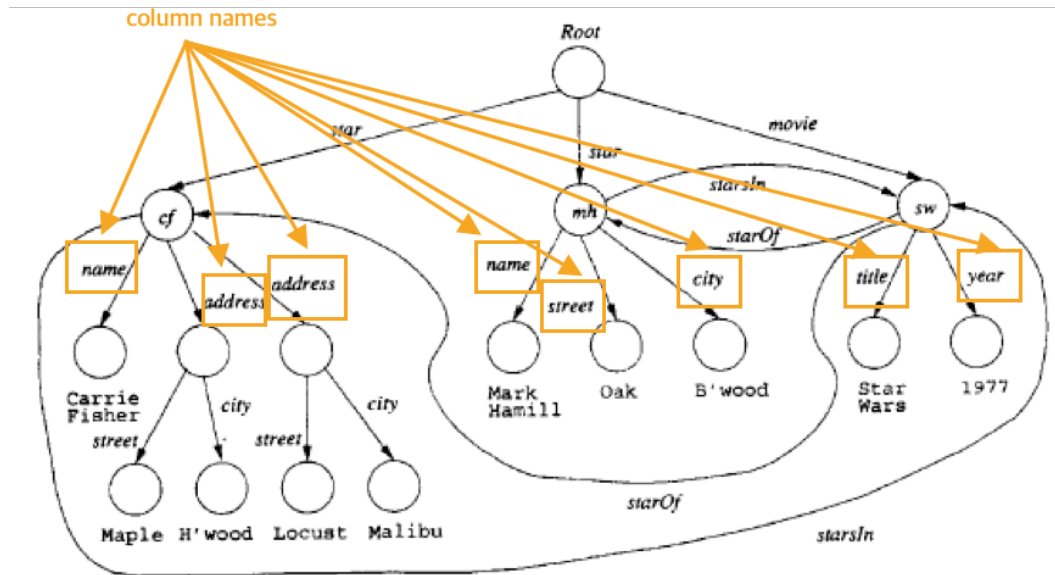
## 1. Exercise 11.1.1:



### Notes:

- Semistructured data
  - serves as a model suitable for **databases integration**, that is, for describing the data contained in two or more databases that contain similar data with different schemas
  - It serves as the underlying model for notations such as XML, to be taken up in Section 2, that are being used to share information on the web.
- Semistructured Data Representation
  - is a collection of nodes





b)



c)



2.



- 3.
4. The difference is that UML must fit data into its schema, where as the semi structured data allows whatever schema information that is appropriate to be attached to data

### Notes:

- Semi-structured Data
  - Is schemaless

- Is motivated primarily by its flexibility
- One could enter data at will, and attach to the data whatever schema information you felt was appropriate for that data.
- Makes query processing harder
- Structured Data
  - Is rigid framework into which data is placed.
  - Data must fit into schema
  - Fixed schema allows data to be organized with data structures that support efficient answering of queries
  - e.g. UML, E/R, Relational, ODL

5. a)

```

1  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
2  <StarMovieData>
3    <Star starID="cf" starredIn="sw">
4      <Name>Carrie Fisher</Name>
5      <Address>
6        <Street>123 Maple St.</Street>
7        <City>Hollywood</City>
8      </Address>
9      <Address>
10       <Street>5 Locust Ln.</Street>
11       <City>Malibu</City>
12     </Address>
13   </Star>
14   <Star starID="mh" starredIn="sw">
15     <Name>Mark Hamill</Name>
16     <Street>456 Oak Rd.</Street>
17     <City>Brentwood</City>
18   </Star>
19   <Movie movieID="sw" starsOf="cf", "mh">
20     <Title>Star Wars</Title>
21     <Year>1977</Year>
22   </Movie>
23   <MovieExec movieExecID="gl" execsIn="sw">
24     <Name>George Lucas</Name>
25     <Position>Director</Position>
26   </MovieExec>
27   <MovieExec movieExecID="gk" execsIn="sw">
28     <Name>Gru Kurtz</Name>
29     <Position>Produced By</Position>
30   </MovieExec>
31 </StarMovieData>
32

```

- XML
  - is called *Extensible Markup Language*
  - is an example of semistructured data
- XML with and without a Schema

- has two different types
  1. Well-formed XML
    - \* allows to invent your own tags
    - \* corresponds very-similarly to semi-structured data

### Example:

```

1  <? xml version = "1.0" encoding="utf-8" standalone = "yes
   ">
2  <StarMovieData>
3    <Star>
4      <Name>Carrie Fisher</Name>
5      <Address>
6        <Street>123 Maple St.</Street>
7        <City>Hollywood</City>
8      </Address>
9      <Address>
10       <Street>5 Locust Ln.</Street>
11       <City>Malibu</City>
12     </Address>
13   </Star>
14   <Star>
15     <Name>Mark Hamill</Name>
16     <Street>456 Oak Rd.</Street>
17     <City>Brentwood</City>
18   </Star>
19   <Movie>
20     <Title>Star Wars</Title>
21     <Year>1977</Year>
22   </Movie>
23 </StarMovieData>
24

```

2. Valid XML
  - \* Involves "Document Type Definition"
  - \* specifies allowable tags and gives a grammar for how they may be nested

- Attributes

- is used to represent connections in a semistructured data graph

### Example:

```

1  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
2  <StarMovieData>
3    <Star starID="cf" starredIn="sw">
4      <Name>Carrie Fisher</Name>
5      <Address>
6        <Street>123 Maple St.</Street>
7        <City>Hollywood</City>

```



```

8         </Address>
9         <Address>
10            <Street>5 Locust Ln.</Street>
11            <City>Malibu</City>
12        </Address>
13    </Star>
14    <Star starID="mh" starredIn="sw">
15        <Name>Mark Hamill</Name>
16        <Street>456 Oak Rd.</Street>
17        <City>Brentwood</City>
18    </Star>
19    <Movie starID="sw" starOf="cf", "mh">
20        <Title>Star Wars</Title>
21        <Year>1977</Year>
22    </Movie>
23 </StarMovieData>
24

```

- Namespaces

- **Syntax:** xmlns:name:URI
- Is similar to import numpy as np in python
- Is used to distinguish tags coming from different sources, i.e. HTML

### Example:

Retrieving element *StarMovieData* from document [infolab.stanford.edu/movies](http://infolab.stanford.edu/movies).  
Set md as the name of import

```

1    <md:StarMovieData xmlns:md="http://infolab.stanford.edu/
    movies">
2

```

b)

```

2    <? xml version = "1.0" encoding="utf-8" standalone = "yes">
3    <StarMovieData>
4        <Star starID="cf" starredIn="sw">
5            <Name>Carrie Fisher</Name>
6            <Address>
7                <Street>123 Maple St.</Street>
8                <City>Hollywood</City>
9            </Address>
10           <Address>
11               <Street>5 Locust Ln.</Street>
12               <City>Malibu</City>
13           </Address>
14       </Star>
15       <Star starID="mh" starredIn="sw">
16           <Name>Mark Hamill</Name>
17           <Street>456 Oak Rd.</Street>
18           <City>Brentwood</City>
19       </Star>
20       <Movie movieID="sw" starsOf="cf", "mh">
21           <Title>Star Wars</Title>
22           <Year>1977</Year>

```

```

22     </Movie>
23     <Movie movieID="esb" starOf="cf", "mh">
24         <Title>Empire Strikes Back</Title>
25         <Year>1980</Year>
26     </Movie>
27     <Movie movieID="roj" starOf="cf", "mh">
28         <Title>Return of Jedi</Title>
29         <Year>1983</Year>
30     </Movie>
31 </StarMovieData>
32

```

c)

```

2  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
3  <StarMovieData>
4      <Star starID="cf" starredIn="sw">
5          <Name>Carrie Fisher</Name>
6          <Address>
7              <Street>123 Maple St.</Street>
8              <City>Hollywood</City>
9          </Address>
10         <Address>
11             <Street>5 Locust Ln.</Street>
12             <City>Malibu</City>
13         </Address>
14     </Star>
15     <Star starID="mh" starredIn="sw">
16         <Name>Mark Hamill</Name>
17         <Street>456 Oak Rd.</Street>
18         <City>Brentwood</City>
19     </Star>
20     <Movie movieID="sw" starsOf="cf", "mh" movieIn="fx">
21         <Title>Star Wars</Title>
22         <Year>1977</Year>
23     </Movie>
24     <Movie movieID="esb" starOf="cf", "mh" movieIn="fx">
25         <Title>Empire Strikes Back</Title>
26         <Year>1980</Year>
27     </Movie>
28     <Movie movieID="roj" starOf="cf", "mh" movieIn="fx">
29         <Title>Return of Jedi</Title>
30         <Year>1983</Year>
31     </Movie>
32     <Studio studioID="fx" movieOf="esb", "roj", "sw">
33         <Name>Fox</Name>
34         <Address>Hollywood</Address>
35     </Studio>
36 </StarMovieData>

```

6. Consider the following relation Classes:

<i>class</i>	<i>type</i>	<i>country</i>	<i>numGuns</i>	<i>bore</i>	<i>displacement</i>
Bismarck	bb	Germany	8	15	42000
Iowa	bb	USA	9	16	46000
Kongo	bc	Japan	8	14	32000
North Carolina	bb	USA	9	16	37000
Renown	bc	Gt. Britain	6	15	32000
Revenge	bb	Gt. Britain	8	15	29000
Tennessee	bb	USA	12	14	32000
Yamato	bb	Japan	9	18	65000

(a) Sample data for relation Classes

```

1  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
2  <shipsData>
3    <Classes>
4      <Class>Bismarck</Class>
5      <Type>bb</Type>
6      <Country>Germany</Country>
7      <NumGuns>8</NumGuns>
8      <Bore>15</Bore>
9      <Displacement>42000</Displacement>
10   </Classes>
11   <Classes>
12     <Class>Iowa</Class>
13     <Type>bb</Type>
14     <Country>USA</Country>
15     <NumGuns>9</NumGuns>
16     <Bore>16</Bore>
17     <Displacement>46000</Displacement>
18   </Classes>
19   <Classes>
20     <Class>Kongo</Class>
21     <Type>bc</Type>
22     <Country>Japan</Country>
23     <NumGuns>8</NumGuns>
24     <Bore>14</Bore>
25     <Displacement>32000</Displacement>
26   </Classes>
27   <Classes>
28     <Class>North Carolina</Class>
29     <Type>bb</Type>
30     <Country>USA</Country>
31     <NumGuns>9</NumGuns>
32     <Bore>16</Bore>
33     <Displacement>37000</Displacement>
34   </Classes>
35   <Classes>
36     <Class>Renown</Class>

```

```

37         <Type>bc</Type>
38         <Country>Gt. Britain</Country>
39         <NumGuns>6</NumGuns>
40         <Bore>15</Bore>
41         <Displacement>32000</Displacement>
42     </Classes>
43     <Classes>
44         <Class>Revenge</Class>
45         <Type>bb</Type>
46         <Country>Gt. Britain</Country>
47         <NumGuns>8</NumGuns>
48         <Bore>15</Bore>
49         <Displacement>29000</Displacement>
50     </Classes>
51     <Classes>
52         <Class>Tennessee</Class>
53         <Type>bb</Type>
54         <Country>USA</Country>
55         <NumGuns>12</NumGuns>
56         <Bore>14</Bore>
57         <Displacement>32000</Displacement>
58     </Classes>
59     <Classes>
60         <Class>Yamato</Class>
61         <Type>bb</Type>
62         <Country>Japan</Country>
63         <NumGuns>9</NumGuns>
64         <Bore>18</Bore>
65         <Displacement>65000</Displacement>
66     </Classes>
67 </shipsData>
68

```

## 7. • DocRoot

```

1     <DocRoot docID="" rootElementID="" />
2

```

## • SubElement

```

1     <Subelement parentID="" childID="" position="" />
2

```

## • ElementAttribute

```

1     <ElementAttribute elementID="" name="" value="" />
2

```

## • ElementValue

```

1     <ElementValue elementID="" name="" value="" />
2

```

## Notes:

- Empty element
  - is an element that is complete by itself
  - rather than being composed of a start tag, data and an end tag, the empty element is a combined start and end tag.

### Example:

```

1  <phone>
2    <entry>
3      <name>Chip</name>
4      <extension number="3"/>
5    </entry>
6  </phone>
7

```

- \* Phone is not an empty element
- \* extension is an empty element

8. The following will be used as an example.



```

1  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
2  <DocRoot docID="root" rootElementID="">
3    <SubElement parentID="root" childID="cf" position="1">
4      <ElementAttribute elementID="cf-starsIn" name="starsIn"
value="sw"/>

```

```

5      <ElementValue elementID="cf-name" name="name" value="Carrie
Fisher"/>
6      <SubElement parentID="cf" childID="cf-add_1" position="1">
7          <City elementID="cf-add_1-city" value="Hollywood">
8              <Street elementID="cf-add_1-street" value="Maple">
9                  </SubElement>
10             <SubElement parentID="cf" childID="cf-add_2" position="2">
11                 <ElementValue elementID="cf-add_2-city" value="Malibu">
12                     <ElementValue elementID="cf-add_1-street" value="Locust"
>
13             </SubElement>
14         </SubElement>
15     <SubElement parentID="root" childID="mh" position="2">
16         <ElementAttribute elementID="mh-starsIn" name="starsIn"
value="sw"/>
17         <ElementValue elementID="mh-name" value="Mark Hamill"/>
18         <SubElement parentID="mh" childID="mh-add_2" position="1">
19             <ElementValue elementID="mh-add_2-city" value="Bollywood
">
20                 <ElementValue elementID="mh-add_2-street" value="Oak">
21                     </SubElement>
22                 </SubElement>
23             <SubElement parentID="root" childID="sw" position="3">
24                 <ElementAttribute elementID="mh-starsOf_1" name="starsOf"
value="cf"/>
25                 <ElementAttribute elementID="mh-starsOf_2" name="starsOf"
value="mh"/>
26                 <ElementValue elementID="sw-title" value="Star Wars" />
27                 <ElementValue elementID="sw-year" value="1977" />
28             </SubElement>
29         </DocRoot>
30

```

9. a)

```

1  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
2  <StarMovieData>
3      <Star starID="cf" starredIn="sw">
4          <Name>Carrie Fisher</Name>
5          <Address>
6              <Street>123 Maple St.</Street>
7              <City>Hollywood</City>
8          </Address>
9          <Address>
10             <Street>5 Locust Ln.</Street>
11             <City>Malibu</City>
12          </Address>
13      </Star>
14      <Star starID="mh" starredIn="sw">
15          <Name>Mark Hamill</Name>
16          <Address>
17              <Street>456 Oak Rd.</Street>
18              <City>Brentwood</City>
19          </Address>
20      </Star>
21      <Movie movieID="sw" starsOf="cf mh">

```

```

22         <Title>Star Wars</Title>
23         <Year>1977</Year>
24     </Movie>
25     <Movie movieID="esb" starsOf="cf mh">
26         <Title>The Empire Strikes Back</Title>
27         <Year>1980</Year>
28     </Movie>
29     <Movie movieID="roj" starsOf="cf mh">
30         <Title>Return of the Jedi</Title>
31         <Year>1983</Year>
32     </Movie>
33 </StarMovieData>
34

```

```

1  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
2  <StarMovieData>
3      <Star starID="cf" starredIn="sw">
4          <Name>Carrie Fisher</Name>
5          <Address>
6              <Street>123 Maple St.</Street>
7              <City>Hollywood</City>
8          </Address>
9          <Address>
10             <Street>5 Locust Ln.</Street>
11             <City>Malibu</City>
12         </Address>
13     </Star>
14     <Star starID="hf" starredIn="sw fw">
15         <Name>Harrison Ford</Name>
16     </Star>
17
18     <Star starID="mh" starredIn="sw">
19         <Name>Mark Hamill</Name>
20         <Address>
21             <Street>456 Oak Rd.</Street>
22             <City>Brentwood</City>
23         </Address>
24     </Star>
25     <Movie movieID="sw" starsOf="cf mh hf">
26         <Title>Star Wars</Title>
27         <Year>1977</Year>
28     </Movie>
29     <Movie movieID="esb" starsOf="cf mh hf">
30         <Title>The Empire Strikes Back</Title>
31         <Year>1980</Year>
32     </Movie>
33     <Movie movieID="roj" starsOf="cf mh hf">
34         <Title>Return of the Jedi</Title>
35         <Year>1983</Year>
36     </Movie>
37     <Movie movieID="fw" starsOf="hf">
38         <Title>Firewall</Title>
39         <Year>2006</Year>
40     </Movie>

```

```

41     </StarMovieData>
42

```

```

b)  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
    <StarMovieData>
      <Star starID="cf" starredIn="sw">
        <Name>Carrie Fisher</Name>
        <Address>
          <Street>123 Maple St.</Street>
          <City>Hollywood</City>
        </Address>
        <Address>
          <Street>5 Locust Ln.</Street>
          <City>Malibu</City>
        </Address>
      </Star>
      <Star starID="hf" starredIn="sw fw">
        <Name>Harrison Ford</Name>
      </Star>

      <Star starID="mh" starredIn="sw">
        <Name>Mark Hamill</Name>
        <Address>
          <Street>456 Oak Rd.</Street>
          <City>Brentwood</City>
        </Address>
      </Star>
      <Movie movieID="sw" starsOf="cf mh hf">
        <Title>Star Wars</Title>
        <Year>1977</Year>
      </Movie>
      <Movie movieID="esb" starsOf="cf mh hf">
        <Title>The Empire Strikes Back</Title>
        <Year>1980</Year>
      </Movie>
      <Movie movieID="roj" starsOf="cf mh hf">
        <Title>Return of the Jedi</Title>
        <Year>1983</Year>
      </Movie>
      <Movie movieID="fw" starsOf="hf">
        <Title>Firewall</Title>
        <Year>2006</Year>
      </Movie>
      <Movie movieID="hhs" starsOf="cf">
        <Title>Hannah and Her Sisters</Title>
        <Year>1985</Year>
      </Movie>
    </StarMovieData>

```

```

d)  <? xml version = "1.0" encoding="utf-8" standalone = "yes">
    <StarMovieData>

```



```

3      <Star starID="cf" starredIn="sw">
4          <Name>Carrie Fisher</Name>
5          <Address>
6              <Street>123 Maple St.</Street>
7              <City>Hollywood</City>
8          </Address>
9          <Address>
10             <Street>5 Locust Ln.</Street>
11             <City>Malibu</City>
12         </Address>
13     </Star>
14     <Star starID="hf" starredIn="sw fw">
15         <Name>Harrison Ford</Name>
16     </Star>
17     <Star starID="mh" starredIn="sw">
18         <Name>Mark Hamill</Name>
19         <Address>
20             <Street>456 Oak Rd.</Street>
21             <City>Brentwood</City>
22         </Address>
23     </Star>
24     <Star starID="md" starredIn="bi">
25         <Name>Matt Damon</Name>
26     </Star>
27     <Movie movieID="sw" starsOf="cf mh hf">
28         <Title>Star Wars</Title>
29         <Year>1977</Year>
30     </Movie>
31     <Movie movieID="esb" starsOf="cf mh hf">
32         <Title>The Empire Strikes Back</Title>
33         <Year>1980</Year>
34     </Movie>
35     <Movie movieID="roj" starsOf="cf mh hf">
36         <Title>Return of the Jedi</Title>
37         <Year>1983</Year>
38     </Movie>
39     <Movie movieID="fw" starsOf="hf">
40         <Title>Firewall</Title>
41         <Year>2006</Year>
42     </Movie>
43     <Movie movieID="hhs" starsOf="cf">
44         <Title>Hannah and Her Sisters</Title>
45         <Year>1985</Year>
46     </Movie>
47     <Movie movieID="bi" starsOf="md">
48         <Title>The Bourne Identity</Title>
49         <Year>2002</Year>
50     </Movie>
51 </StarMovieData>
52

```

```

10< !DOCTYPE BankData [
2    < !ELEMENT BankData (Accounts*, Customers*)>
3    < !ELEMENT Accounts(acctNo, type, balance)>

```

```

4      <!--ATTLIST Accounts
5          acctNo ID #REQUIRED
6          acctIn IDREFS #IMPLIED
7      >
8      <!--ELEMENT Customers(firstName, lastName, idNo, account)>
9          <!--ATTLIST Accounts
10             idNo ID #REQUIRED
11             account IDREFS #IMPLIED
12         >
13         <!--ELEMENT acctNo (#PCDATA)>
14         <!--ELEMENT type (#PCDATA)>
15         <!--ELEMENT balance (#PCDATA)>
16         <!--ELEMENT firstName (#PCDATA)>
17         <!--ELEMENT lastName (#PCDATA)>
18         <!--ELEMENT idNo (#PCDATA)>
19         <!--ELEMENT account (#PCDATA)>
20     ]>
21

```

### Correct Solution:

```

1      <!--DOCTYPE BankData [
2          <!--ELEMENT BankData (Accounts*, Customers*)>
3          <!--ELEMENT Accounts(acctNo, type, balance)>
4              <!--ATTLIST Accounts
5                  acctNo ID #REQUIRED
6                  acctIn IDREFS #IMPLIED
7              >
8          <!--ELEMENT Customers(firstName, lastName, idNo, account)>
9              <!--ATTLIST Accounts
10                  idNo ID #REQUIRED
11                  account IDREFS #IMPLIED
12              >
13          <!--ELEMENT acctNo (#PCDATA)>
14          <!--ELEMENT type (#PCDATA)>
15          <!--ELEMENT balance (#PCDATA)>
16          <!--ELEMENT firstName (#PCDATA)>
17          <!--ELEMENT lastName (#PCDATA)>
18          <!--ELEMENT idNo (#PCDATA)>
19          <!--ELEMENT account (#PCDATA)>
20      ]>
21

```

```

11     <!--DOCTYPE TeamData [
12         <!--ELEMENT TeamData (Players*, Teams*, Fans*)>
13         <!--ELEMENT Players(FirstName, LastName, Team)>
14             <!--ATTLIST Players
15                 playerId ID #REQUIRED
16                 playerIn IDREFS #IMPLIED
17             >
18         <!--ELEMENT FirstName (#PCDATA)>

```

```

9      <![ELEMENT LastName (#PCDATA)]>
10     <![ELEMENT Team (#PCDATA)]>
11     <![ELEMENT Teams(Name)]>
12         <![ATTLIST Teams
13             teamId ID #REQUIRED
14             playerOf IDREFS #IMPLIED
15             fanOf IDREFS #IMPLIED
16         >
17     <![ELEMENT Name (#PCDATA)]>
18     <![ELEMENT Fans(FirstName, LastName)]>
19         <![ATTLIST Fans
20             faId ID #REQUIRED
21             fanIn IDREFS #IMPLIED
22         >
23 ]>
24

```

**Notes:**

- There is no need to write same tags twice. (e.g. FirstName, LastName)

```

12<![DOCTYPE GenealogyData [
2    <![ELEMENT GenealogyData (Person)]>
3    <![ELEMENT Person(FirstName, LastName, Age)]>
4        <![ATTLIST Person
5            personId ID #REQUIRED
6            spouse IDREFS #IMPLIED
7            husband IDREFS #IMPLIED
8            child IDREFS #IMPLIED
9            brother IDREFS #IMPLIED
10        >
11    <![ELEMENT FirstName (#PCDATA)]>
12    <![ELEMENT LastName (#PCDATA)]>
13 ]>
14

```

**Notes:**

- PCDATA
  - Is text that will be parsed by a parser.
  - Tags inside the text will be treated as markup and entities will be expanded.
- CDATA
  - Is text that will not be parsed by a parser.
  - Tags inside the text will not be treated as markup and entities will not be expanded
  - e.g. attributes

```

1      <Movie title="Star Wars" year="1977" genre="sciFi">
2
3      <!--ELEMENT Movie EMPTY-->
4          <!--ATTLIST Movie
5              title CDATA #REQUIRED
6              year CDATA #REQUIRED
7              genre (comedy | drama | sciFi | teen) #IMPLIED
8          -->
9
10

```

```

13_1 <!--DOCTYPE ShipBattleData [
2
3     ]>
4

```

14. • An example of a document that conforms to the XML Schema

```

1      <? xml version = "1.0" encoding = "utf-8" ?>
2      <Movies>
3          <Movie>
4              <Title>Star Wars</Title>
5              <Year>1977</Year>
6          </Movie>
7          <Movie>
8              <Title>Return of the Jedi</Title>
9              <Year>1983</Year>
10         </Movie>
11     </Movies>
12

```

- An example of one that has all the elements mentioned, but does not conform to definition

```

1      <? xml version = "1.0" encoding = "utf-8" ?>
2      <Movies>
3          <Movie>
4              <Title>Star Wars</Title>
5              <Year>1977</Year>
6          </Movie>
7          <Movie>
8              <Title>Return of the Jedi</Title>
9              <Year>This is not correct</Year>
10         </Movie>
11     </Movies>
12

```

### Notes:

- XML Schema
  - is an alternative way to provide a schema for XML documents

- is more powerful than DTD
  - \* allows to declare types such as integer or float
  - \* gives ability to declare keys and foreign keys

- The Form of an XML Schema

- Each XML-Schema document has the form

```
<? xml version = "1.0" encoding = "utf-8" ?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  ...
</xs:schema>
```

- Elements

- **Syntax:**

```
<xs:element name = element name type = element type>
  constraints and / or structure information
</xs:element>
```

**Example:**

```
1 <xs:element name = "title" type = "xs:string" />
2 <xs:element name = "Year" type = "xs:integer" />
3
4
```

- Complex Types

- is an XML element that contains other elements and/or attributes. <sup>[1]</sup>
- **Syntax:**

```
<xs:complexType name = type name>
  <xs:sequence>
    list of element definitions
  </xs:sequence>
</xs:complexType>
```

**Example:**

```
1 <? xml version = "1.0" encoding = "utf-8" ?>
2 <xs:schema xmlns:xs = "http://www.w3.org/2001/XMLSchema">
3
4   <xs:complexType name = "movieType">
5     <xs:sequence>
6       <xs:element name = "Title" type = "xs:string" />
7       <xs:element name = "year" type = "xs:integer" />
8     </xs:sequence>
9   </xs:complexType>
```

```

10
11     <xs:element name = "Movies">
12         <xs:complexType>
13             <xs:sequence>
14                 <xs:element name="Movie" type="movieType"
minOccurs="0" maxOccurs = "unbounded" />
15             </xs:sequence>
16         </xs:complexType>
17     </xs:element>
18 </xs:schema>
19

```

- Complex Types Attributes

- **Syntax:**

`<xs:attribute name = attribute name type = type name other information about the attribute />`

\* *other information* includes

1. default value
2. required
3. type

Example:

```

1) <? xml version = "1.0" encoding = "utf-8" ?>
2) <xs:schema xmlns:xs = "http://www.w3.org/2001/XMLSchema">

3)   <xs:complexType name = "movieType">
4)       <xs:attribute name = "title" type = "xs:string"
        use = "required" />
5)       <xs:attribute name = "year" type = "xs:integer"
        use = "required" />
6)   </xs:complexType>

7)   <xs:element name = "Movies">
8)       <xs:complexType>
9)         <xs:sequence>
10)            <xs:element name = "Movie" type = "movieType"
minOccurs = "0" maxOccurs = "unbounded" />
11)        </xs:sequence>
12)    </xs:complexType>
13) </xs:element>

14) </xs:schema>

```

Above allows us to have the tag `<Movies title="value" year="1">`

- Restricted Simple Types

- Can be used as an attribute or element

1. Restricting numerical values by setting lower bound and upperbound

\* **Syntax:**

`<xs:simpleType name = type name>`

```

    <xs:restriction base = base type >
        upper and/or lower bounds
    </xs:restriction >
</xs:simpleType>
* Use minInclusive to state the lower bound
* Use maxInclusive to state the upper bound

```

**Example:**

```

1      <xs:simpleType name = "movieYearType">
2          <xs:restriction base = "xs:integer">
3              <xs:minInclusive value = "1915" />
4          </xs:restriction>
5      </xs:simpleType>
6

```

2. Restricting values to an enumerated type\* **Syntax:**

```

<xs:simpleType name = "movieYearType" >
    <xs:restriction base = "xs:string">
        <xs:enumeration value = "comedy" / >
        <xs:enumeration value = "drama" / >
        <xs:enumeration value = "sciFi" / >
        <xs:enumeration value = "teen" / >
    </xs:restriction>
</xs:simpleType>

```

**Example:**

```

1      <xs:simpleType name = "genreType">
2          <xs:restriction base = "xs:string">
3              <xs:enumeration value = "comedy"/>
4              <xs:enumeration value = "drama"/>
5              <xs:enumeration value = "sciFi"/>
6              <xs:enumeration value = "teen"/>
7          </xs:restriction>
8      </xs:simpleType>
9

```

## • Keys in XML Schema

– **Syntax:**

```

<xs:key name = key name>
    <xs:selector xpath= path description >
    <xs:field xpath = path description >
</xs:key>

```

**Example:**

```

1) <? xml version = "1.0" encoding = "utf-8" ?>
2) <xs:schema xmlns:xs = "http://www.w3.org/2001/XMLSchema">

3) <xs:simpleType name = "genreType">
4)   <xs:restriction base = "xs:string">
5)     <xs:enumeration value = "comedy" />
6)     <xs:enumeration value = "drama" />
7)     <xs:enumeration value = "sciFi" />
8)     <xs:enumeration value = "teen" />
9)   </xs:restriction>
10) </xs:simpleType>

11) <xs:complexType name = "movieType">
12)   <xs:sequence>
13)     <xs:element name = "Title" type = "xs:string" />
14)     <xs:element name = "Year" type = "xs:integer" />
15)     <xs:element name = "Genre" type = "genreType"
16)       minOccurs = "0" maxOccurs = "1" />
17)   </xs:sequence>
18) </xs:complexType>

19) <xs:element name = "Movies">
20)   <xs:complexType>
21)     <xs:sequence>
22)       <xs:element name = "Movie" type = "movieType"
23)         minOccurs = "0" maxOccurs = "unbounded" />
24)     </xs:sequence>
25)   </xs:complexType>
26)   <xs:key name = "movieKey">
27)     <xs:selector xpath = "Movie" />
28)     <xs:field xpath = "Title" />
29)     <xs:field xpath = "Year" />
30)   </xs:key>
31) </xs:element>

32) </xs:schema>

```

where key is attached to (e.g. Movies)

the values which are set as primary key

– XPath of element → *element name*



```

11)    <xs:complexType name = "movieType">
12)      <xs:sequence>
13)        <xs:element name = "Title" type = "xs:string" />
14)        <xs:element name = "Year" type = "xs:integer" />
15)        <xs:element name = "Genre" type = "genreType"
16)          minOccurs = "0" maxOccurs = "1" />
17)      </xs:sequence>
18)    </xs:complexType>

```

```

24)    <xs:key name = "movieKey">
25)      <xs:selector xpath = "Movie" />
26)      <xs:field xpath = "Title" />
27)      <xs:field xpath = "Year" />
28)    </xs:key>

```

xpath of element  
uses name of element

– XPath of attribute → @*attribute name*

```

<xs:complexType>
  <xs:attribute name = "title"
    type = "xs:string" />
  <xs:attribute name = "year"
    type = "xs:integer" />
</xs:complexType>

```

```

22)    <xs:keyref name = "movieRef" refers = "movieKey">
23)      <xs:selector xpath = "Star/StarredIn" />
24)      <xs:field xpath = "@title" />
25)      <xs:field xpath = "@year" />
26)    </xs:keyref>

```

xpath of attribute name  
has @ at front

- Foreign Keys in XML Schema

– Syntax:

```

<xs:keyref name = foreign-key name refer = key name >
  <xs:selector xpath = path description >
  <xs:field xpath = path description >

```

</xs:keyref >

### References:

1. w3School : Complex Type, link

```
151 <? xml version = "1.0" encoding = "utf-8" ?>
2   <xs:schema xmlns:xs = "http://www.w3.org/2001/XMLSchema">
3
4       <xs:complexType name = "movieType">
5           <xs:sequence>
6               <xs:element name = "Title" type = "xs:string" />
7               <xs:element name = "year" type = "xs:integer" />
8           </xs:sequence>
9       </xs:complexType>
10
11       <xs:element name = "Movies">
12           <xs:complexType>
13               <xs:sequence>
14                   <xs:element name="NotMovie" type="movieType"
minOccurs="0" maxOccurs = "unbounded" /> // <- Corrected
15               </xs:sequence>
16           </xs:complexType>
17       </xs:element>
18   </xs:schema>
19
```