

## Individual Tutorial Exercise 2:

### Questions:

- a. Consider the universal relation  $R = \{A, B, C, D, E, F, G, H\}$  and the set of functional dependencies  $F = \{\{A, B\} \rightarrow \{C\}, \{A\} \rightarrow \{D\}, \{E\} \rightarrow \{F\}, \{D\} \rightarrow \{G, H\}\}$ .

1. What is the key for  $R$ ?

The key for  $R$  is  $\{A, E\}$ .

2. If  $R$  is not in 2NF, first decompose it into 2NF and then 3NF relations; if  $R$  is in 2NF but not in 3NF, decompose it into 3NF relations; otherwise, do nothing.

$R$  is not in 2NF although it has a candidate key  $\{A, E\}$ . This is because  $\{A, B\} \rightarrow \{C\}$  and  $\{A\} \rightarrow \{D\}$  violate 2NF as  $C$  and  $D$  are not fully functionally dependent on the entire candidate key  $\{A, E\}$ .

Decomposing  $R$  into two relations:

1.  $R_1(A, B, C)$  with the dependency  $\{A, B\} \rightarrow \{C\}$
2.  $R_2(A, D, E, F, G, H)$  with the dependencies  $\{A\} \rightarrow \{D\}$ ,  $\{E\} \rightarrow \{F\}$ , and  $\{D\} \rightarrow \{G, H\}$

$R_2$  has non-prime attributes  $D, G, H$  where  $D$  is determining  $G, H$  which might cause a transitive dependency.

Decomposing into 3NF:

1.  $R'_2(D, G, H)$  with the dependency  $\{D\} \rightarrow \{G, H\}$
2.  $R_3(A, D, E, F)$  with the dependencies  $\{A\} \rightarrow \{D\}$  and  $\{E\} \rightarrow \{F\}$

*b. Design a proper DTD for the FitnessCenter XML document.*

```

1  <?xml version="1.0"?>
2  <!DOCTYPE FitnessCenter[
3      <!ELEMENT Member (Name, Phone, FavoriteColor)>
4      <!ATTLIST Member
5          |   |   id CDATA #REQUIRED
6          |   |   level CDATA #REQUIRED>
7      <!ELEMENT Name (#PCDATA)>
8      <!ELEMENT Phone (#PCDATA)>
9      <!ATTLIST Phone
10         |   |   type CDATA #REQUIRED>
11      <!ELEMENT FavoriteColor (#PCDATA)>
12  ]>
13
14  <FitnessCenter>
15      <Member id="1" level="gold">
16          <Name>Jeff</Name>
17          <Phone type="home">555-1234</Phone>
18          <Phone type="work">555-4321</Phone>
19          <FavoriteColor>lightgrey</FavoriteColor>
20      </Member>
21      <Member id="2" level="gold">
22          <Name>David</Name>
23          <Phone type="home">383-1234</Phone>
24          <Phone type="work">383-4321</Phone>
25          <FavoriteColor>lightblue</FavoriteColor>
26      </Member>
27      <Member id="3" level="platinum">
28          <Name>Roger</Name>
29          <Phone type="home">888-1234</Phone>
30          <Phone type="work">888-4321</Phone>
31          <FavoriteColor>lightyellow</FavoriteColor>
32      </Member>
33  </FitnessCenter>

```

c. For the following queries on the XML document below for FitnessCenter, write the corresponding XPath expressions.

1. Find the home phone number of Jeff.

**XPath Expression:**

```
/FitnessCenter/Member[Name='Jeff']/Phone[@type='home']/text()
```

**XPath Result:**

Text='555-1234'

2. *Find the id of all members at the platinum level.*

XPath Expression:

/FitnessCenter/Member[@level='platinum']/@id

XPath Result:

Attribute='id=3'

3. *When pointing to the level attribute of "David", find the level attribute of the member next to "David".*

XPath Expression:

/FitnessCenter/Member[Name='David']/following-sibling::Member[1]/@level

XPath Result:

Attribute='level=platinum'