

Homework 3: Relational Database Design Theory (100 points)

Due Date: Friday, Feb 3 (5:00 PM)

Submission

All HW assignments should contain both your student ID and your name and must be submitted online, as a SQL script text file (not PDF this time!), via the associated dropbox on EEE. See the table below for the HW submission opportunities. Note that after 5 PM on Sunday no further HW submissions will be accepted. (We will be releasing the solution at that time.) Please strive to get all your work in on time! If possible, try to save the one dropped assignment for the end of the term when you are most likely to want/need it.

Date / Time	Grade Implications
Friday, Feb 3 (5:00 PM)	Full credit will be available
Saturday, Feb 4 (5:00PM)	20 points will be deducted
Sunday, Feb 5 (5:00 PM)	40 points will be deducted

Relational Design Theory [100 pts]

While creating the DDL for the TopicalBirds.com relations, you realized that there are a few more features that you really should have implemented. For example, it would be nice to keep information about your users' mobile devices. However, as a co-founder of the company, you are also partly responsible for helping to build the actual business and to raise more venture capital, so it's hard for you to spend much more time on grunt work. Thus, you have hired a team of UCI undergraduate students as interns to add additional features to your relational database design. Unfortunately, your startup budget is limited, so you can't afford CS122a alumni – instead, your interns are hackers who've never taken an actual database course. If nothing else, though, they're quick – they have already completed their design for the new features. They've just handed you the script attached to the end of this document to serve as the documentation for their design. The script shows their new tables as well as providing a snippet of example data for each one. Analyze each of the new tables using your newly gained knowledge of relational database design theory. That is, based on combining the initial HW1 information with the schemas for these new tables and the comments that their script includes, your job here is to carefully review their relational design(s) by figuring out what the resulting functional dependencies and keys are and normalizing their new tables if necessary. (Each new table can be analyzed independently of the others.)

1. BirdDevice [25pts]

(a) [5pts] List all of the functional dependencies involving the attributes of the relation in question. (Just give the basic list, not the closure of that list. 😊)

(b) [12pts] Identify which normal form their relation is in by answering the following questions:

b-1> [4pts] Does their relation satisfy 1NF [Yes/No]? Show your reasoning.

b-2> [4pts] Does their relation satisfy 2NF [Yes/No]? Show your reasoning.

b-3> [4pts] Does their relation satisfy 3NF [Yes/No]? Show your reasoning.

(c) [8pts] Normalize their relation, putting it in either BCNF or into 3NF if BCNF is not possible. Say which normal form your final answer is in, and briefly explain why that's the case.

2. AdShown [25pts]

(a) [5pts] List all of the functional dependencies involving the attributes of the relation in question. (Just give the basic list, not the closure of that list. ☺)

(b) [12pts] Identify which normal form their relation is in by answering the following questions:

b-1> [4pts] Does their relation satisfy 1NF [Yes/No]? Show your reasoning.

b-2> [4pts] Does their relation satisfy 2NF [Yes/No]? Show your reasoning.

b-3> [4pts] Does their relation satisfy 3NF [Yes/No]? Show your reasoning.

(c) [8pts] Normalize their relation, putting it in either BCNF or into 3NF if BCNF is not possible. Say which normal form your final answer is in, and briefly explain why that's the case.

3. Address [25pts]

(a) [5pts] List all of the functional dependencies involving the attributes of the relation in question. (Just give the basic list, not the closure of that list. ☺)

(b) [12pts] Identify which normal form their relation is in by answering the following questions:

b-1> [4pts] Does their relation satisfy 1NF [Yes/No]? Show your reasoning.

b-2> [4pts] Does their relation satisfy 2NF [Yes/No]? Show your reasoning.

b-3> [4pts] Does their relation satisfy 3NF [Yes/No]? Show your reasoning.

(c) [8pts] Normalize their relation, putting it in either BCNF or into 3NF if BCNF is not possible. Say which normal form your final answer is in, and briefly explain why that's the case.

4. BirdCall [25pts]

(a) [5pts] List all of the functional dependencies involving the attributes of the relation in question. (Just give the basic list, not the closure of that list. ☺)

(b) [12pts] Identify which normal form their relation is in by answering the following questions:

b-1> [4pts] Does their relation satisfy 1NF [Yes/No]? Show your reasoning.

b-2> [4pts] Does their relation satisfy 2NF [Yes/No]? Show your reasoning.

b-3> [4pts] Does their relation satisfy 3NF [Yes/No]? Show your reasoning.

(c) [8pts] Normalize their relation, putting it in either BCNF or into 3NF if BCNF is not possible. Say which normal form your final answer is in, and briefly explain why that's the case.

-- SCRIPT FILE FOR TOPICALBIRDS.COM EXTENSIONS

-- Clean-up statements to allow for repeated script testing

DROP TABLE IF EXISTS BirdDevice;

DROP TABLE IF EXISTS AdShown;

DROP TABLE IF EXISTS Address;

DROP TABLE IF EXISTS BirdCall;

-- Skeletal tables from the main TopicalBirds schema to allow testing

DROP TABLE IF EXISTS Bird;

DROP TABLE IF EXISTS Ad;

DROP TABLE IF EXISTS Watcher;

CREATE TABLE Watcher(wtag VARCHAR(30) PRIMARY KEY);

INSERT INTO Watcher VALUES ('9876');

CREATE TABLE Bird(btag VARCHAR(30) PRIMARY KEY);

INSERT INTO Bird VALUES ('1234'), ('2341'), ('3412');

CREATE TABLE Ad(aid INTEGER PRIMARY KEY);

INSERT INTO Ad VALUES (5678), (6785), (7856);

-- New tables:

-- New table for recording information about Birds' mobile devices.

-- At a particular point in time, a given device will be on a network

-- with an assigned phone number that will ring through to the device.

-- Device types are given by their manufacturer (make) and model number.

-- Each device made by a manufacturer has a serial number whose

-- value will be set using a coding scheme defined by its manufacturer.

-- Certain devices (e.g., expensive ones) may be shared by several Birds.

CREATE TABLE BirdDevice(

 btag VARCHAR(30),

 phonenum VARCHAR(20),

 network VARCHAR(10),

 serialno VARCHAR(40),

 make VARCHAR(20),

 model VARCHAR(40),

 PRIMARY KEY (btag, phonenum),

 UNIQUE (btag, make, serialno),

 FOREIGN KEY (btag) REFERENCES Bird(btag)

);

INSERT INTO BirdDevice(btag, phonenum, network, serialno, make, model)

VALUES

 ('1234', '(321) 456-0987', 'Verizon', 'SN1234567890', 'Samsung', 'Note 7'),

 ('2341', '(123) 465-9078', 'Sprint', 'XX98733', 'HTC', 'One'),

 ('3412', '(321) 456-0987', 'Verizon', 'SN1234567890', 'Samsung', 'Note 7');

-- New table for keeping track of when Birds are shown ads by a given watcher.

-- Used to avoid the annoyance of showing a given Bird the same ads too often.

```
CREATE TABLE AdShown(  
    aid INTEGER,  
    wtag VARCHAR(30),  
    wbnam VARCHAR(50),  
    btag VARCHAR(30),  
    shown_at DATETIME,  
    PRIMARY KEY (aid, btag, shown_at),  
    FOREIGN KEY (aid) REFERENCES Ad (aid),  
    FOREIGN KEY (wtag) REFERENCES Watcher (wtag)  
    FOREIGN KEY (btag) REFERENCES Bird (btag)  
);  
INSERT INTO AdShown(aid, wtag, wbnam, btag, shown_at)  
VALUES (5678, '9876', 'Best Buy', '1234', '2017-01-26 23:10:10');
```

-- New table to separate addresses from Users to allow address sharing.
-- Under a new Trump executive order, designed to make it easier for DHS
-- to track immigrants' locations, states must now ensure that all of their
-- street names are unique throughout the entire state (or else risk losing
-- federal funding). For example, only one city in New York state can have
-- a street named Broadway now.

```
CREATE TABLE Address(  
    loc_id BIGINT,  
    bldg_number VARCHAR(20),  
    street_name VARCHAR(50),  
    city VARCHAR(20),  
    state VARCHAR(20),  
    country VARCHAR(20),  
    mailcode CHAR(5),  
    PRIMARY KEY (loc_id)  
);  
INSERT INTO Address(loc_id, bldg_number, street_name, city, state, country, mailcode)  
VALUES (1234567890, '513', 'Woodside Terrace', 'Madison', 'Wisconsin', 'USA', '53711');
```

-- New table added to keep track of all Bird-to-Bird phone calls.
-- Added to secure a round of venture capital funding from In-Q-Tel.

```
CREATE TABLE BirdCall(  
    phone1 VARCHAR(20),  
    phone2 VARCHAR(20),  
    start_time DATETIME,  
    duration TIME,  
    PRIMARY KEY (phone1, phone2, start_time)  
);  
INSERT INTO BirdCall (phone1, phone2, start_time, duration)  
VALUES ('(321) 456-0987', '(123) 465-9078', '2017-01-26 23:10:10', '00:06:11');
```