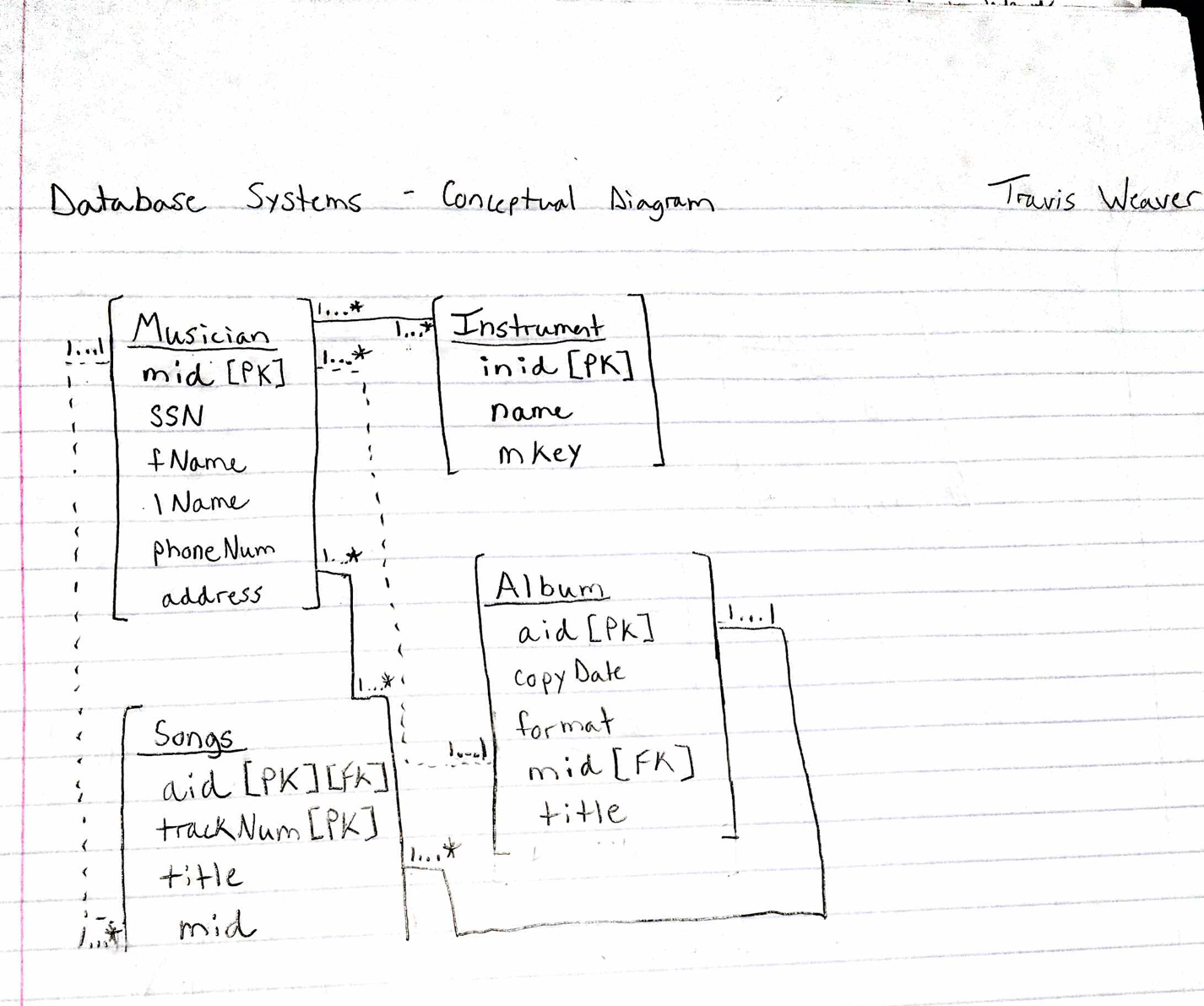
Travis Weaver

April 30 – May 5, 2017

Database Systems – Final Project

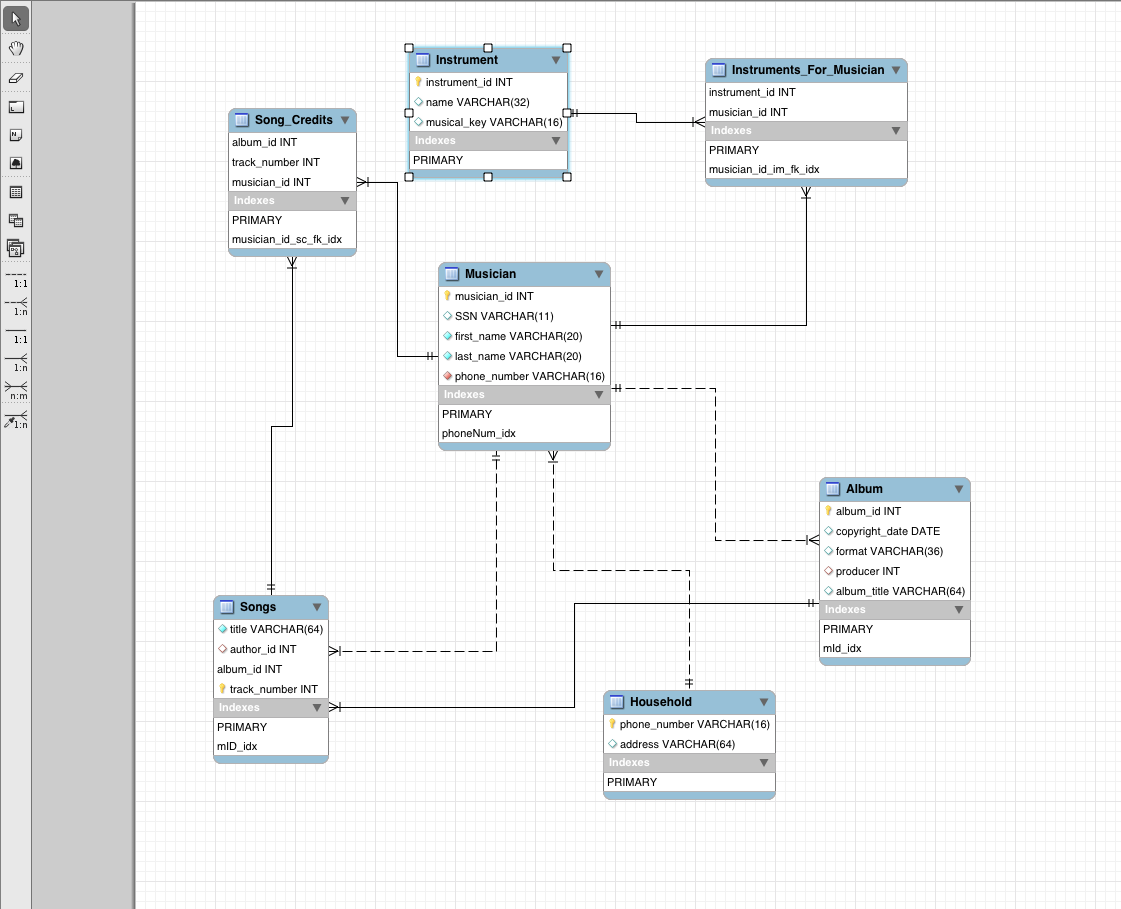
Musical Recording Information System

**Conceptual Data Model:**



Given the relationships in my conceptual model, I determined a few key changes going forward to the logical data model. Since musicians often share the same address and no address has more than one phone number, I decided to split the *phoneNum* and *address* attributes from the *Musician* entity type into their own table. This way a given address only has to be stored once in the database. Next, since a musician can play more than one instrument and an instrument can be played by more than one musician (a characteristic of many to many relationship types), I decided to introduce an intermediary table between the tables *Musician* and *Instrument*. Similarly, since musicians can play more than one song and songs can be played by more than one musician, I decided to introduce an intermediary table between the tables *Musician* and *Songs*. Taking those primary factors into account, I developed my logical data model below.

**Logical Data Model:**



In addition to the changes made from the conceptual model to normalize to 3NF, I set each foreign key to CASCADE ON UPDATE and to CASCASE ON DELETE. Aside from primary, foreign, and candidate keys, I also determined that the first name, last name, and phone number from the *Musician* table must not be NULL. The instrument name from the *Instrument* table must also not be NULL.

My reasoning for allowing the social security number under the *Musician* table to be NULL is in case a foreign musician must be entered into the system. This is also why a musician id has been assigned to each musician in the database under the *Musician* table.

**Implementation of Logical Data Model:**

*SQL Source Code:*

CREATE SCHEMA `music\_rec\_info\_sys` ;

-- MySQL Workbench Synchronization

-- Generated: 2017-04-30 17:49

-- Model: New Model

-- Version: 1.0

-- Project: Name of the project

-- Author: Travis Weaver

SET @OLD\_UNIQUE\_CHECKS=@@UNIQUE\_CHECKS, UNIQUE\_CHECKS=0;

SET @OLD\_FOREIGN\_KEY\_CHECKS=@@FOREIGN\_KEY\_CHECKS, FOREIGN\_KEY\_CHECKS=0;

SET @OLD\_SQL\_MODE=@@SQL\_MODE, SQL\_MODE='TRADITIONAL,ALLOW\_INVALID\_DATES';

CREATE TABLE IF NOT EXISTS `music\_rec\_info\_sys`.`Musician` (

`musician\_id` INT(11) NOT NULL,

`SSN` INT(11) NULL DEFAULT NULL,

`first\_name` VARCHAR(20) NOT NULL,

`last\_name` VARCHAR(20) NOT NULL,

`phone\_number` VARCHAR(16) NOT NULL,

PRIMARY KEY (`musician\_id`),

INDEX `phoneNum\_idx` (`phone\_number` ASC),

CONSTRAINT `phone\_number\_m\_fk`

FOREIGN KEY (`phone\_number`)

REFERENCES `music\_rec\_info\_sys`.`Household` (`phoneNum`)

ON DELETE NO ACTION

ON UPDATE NO ACTION)

ENGINE = InnoDB

DEFAULT CHARACTER SET = utf8;

CREATE TABLE IF NOT EXISTS `music\_rec\_info\_sys`.`Instrument` (

`instrument\_id` INT(11) NOT NULL,

`name` VARCHAR(32) NULL DEFAULT NULL,

`musical\_key` VARCHAR(16) NULL DEFAULT NULL,

PRIMARY KEY (`instrument\_id`))

ENGINE = InnoDB

DEFAULT CHARACTER SET = utf8;

CREATE TABLE IF NOT EXISTS `music\_rec\_info\_sys`.`Album` (

`album\_id` INT(11) NOT NULL,

`copyright\_date` DATE NULL DEFAULT NULL,

`format` VARCHAR(36) NULL DEFAULT NULL,

`producer` INT(11) NULL DEFAULT NULL,

`album\_title` VARCHAR(64) NULL DEFAULT NULL,

PRIMARY KEY (`album\_id`),

INDEX `mId\_idx` (`producer` ASC),

CONSTRAINT `musician\_id\_a\_fk`

FOREIGN KEY (`producer`)

REFERENCES `music\_rec\_info\_sys`.`Musician` (`musician\_id`)

ON DELETE NO ACTION

ON UPDATE NO ACTION)

ENGINE = InnoDB

DEFAULT CHARACTER SET = utf8;

CREATE TABLE IF NOT EXISTS `music\_rec\_info\_sys`.`Household` (

`phoneNum` VARCHAR(16) NOT NULL,

`address` VARCHAR(64) NULL DEFAULT NULL,

PRIMARY KEY (`phoneNum`))

ENGINE = InnoDB

DEFAULT CHARACTER SET = utf8;

CREATE TABLE IF NOT EXISTS `music\_rec\_info\_sys`.`Songs` (

`title` VARCHAR(64) NOT NULL,

`author\_id` INT(11) NULL DEFAULT NULL,

`album\_id` INT(11) NOT NULL,

`track\_number` INT(11) NOT NULL,

PRIMARY KEY (`album\_id`, `track\_number`),

INDEX `mID\_idx` (`author\_id` ASC),

CONSTRAINT `album\_id\_s\_fk`

FOREIGN KEY (`album\_id`)

REFERENCES `music\_rec\_info\_sys`.`Album` (`album\_id`)

ON DELETE NO ACTION

ON UPDATE NO ACTION,

CONSTRAINT `musician\_id\_s\_fk`

FOREIGN KEY (`author\_id`)

REFERENCES `music\_rec\_info\_sys`.`Musician` (`musician\_id`)

ON DELETE NO ACTION

ON UPDATE NO ACTION)

ENGINE = InnoDB

DEFAULT CHARACTER SET = utf8;

CREATE TABLE IF NOT EXISTS `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (

`instrument\_id` INT(11) NOT NULL,

`musician\_id` INT(11) NOT NULL,

PRIMARY KEY (`instrument\_id`, `musician\_id`),

INDEX `musician\_id\_im\_fk\_idx` (`musician\_id` ASC),

CONSTRAINT `instrument\_id\_im\_fk`

FOREIGN KEY (`instrument\_id`)

REFERENCES `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`)

ON DELETE NO ACTION

ON UPDATE NO ACTION,

CONSTRAINT `musician\_id\_im\_fk`

FOREIGN KEY (`musician\_id`)

REFERENCES `music\_rec\_info\_sys`.`Musician` (`musician\_id`)

ON DELETE NO ACTION

ON UPDATE NO ACTION)

ENGINE = InnoDB

DEFAULT CHARACTER SET = utf8;

CREATE TABLE IF NOT EXISTS `music\_rec\_info\_sys`.`Song\_Credits` (

`album\_id` INT(11) NOT NULL,

`track\_number` INT(11) NOT NULL,

`musician\_id` INT(11) NOT NULL,

PRIMARY KEY (`album\_id`, `track\_number`, `musician\_id`),

INDEX `musician\_id\_sc\_fk\_idx` (`musician\_id` ASC),

CONSTRAINT `song\_info\_sc\_fk`

FOREIGN KEY (`album\_id` , `track\_number`)

REFERENCES `music\_rec\_info\_sys`.`Songs` (`album\_id` , `track\_number`)

ON DELETE NO ACTION

ON UPDATE NO ACTION,

CONSTRAINT `musician\_id\_sc\_fk`

FOREIGN KEY (`musician\_id`)

REFERENCES `music\_rec\_info\_sys`.`Musician` (`musician\_id`)

ON DELETE NO ACTION

ON UPDATE NO ACTION)

ENGINE = InnoDB

DEFAULT CHARACTER SET = utf8;

SET SQL\_MODE=@OLD\_SQL\_MODE;

SET FOREIGN\_KEY\_CHECKS=@OLD\_FOREIGN\_KEY\_CHECKS;

SET UNIQUE\_CHECKS=@OLD\_UNIQUE\_CHECKS;

INSERT INTO `music\_rec\_info\_sys`.`Household` (`phoneNum`, `address`) VALUES ('123-456-7890', '123 Cool St. Miami, FL 33133');

INSERT INTO `music\_rec\_info\_sys`.`Household` (`phoneNum`, `address`) VALUES ('112-233-4455', '217 Live Oak Ln. Altamonte Springs, FL 32714');

INSERT INTO `music\_rec\_info\_sys`.`Household` (`phoneNum`, `address`) VALUES ('305-000-1111', '3845 Beep Boop Rd. Miami FL, 33245');

INSERT INTO `music\_rec\_info\_sys`.`Household` (`phoneNum`, `address`) VALUES ('786-111-0000', '8899 Big Flood Rd. Miami Beach, FL 33341');

INSERT INTO `music\_rec\_info\_sys`.`Household` (`phoneNum`, `address`) VALUES ('407-256-4620', '3339 Virginia St. Miami, FL 33133');

INSERT INTO `music\_rec\_info\_sys`.`Household` (`phoneNum`, `address`) VALUES ('567-923-0908', '9712 Hepatitis Ct. Austin, TX 78345');

INSERT INTO `music\_rec\_info\_sys`.`Household` (`phoneNum`, `address`) VALUES ('1-800-555-0505', '675 Big Buck Rd. Billings, MT 82543');

-- MySQL Workbench Synchronization

-- Generated: 2017-04-30 18:02

-- Model: New Model

-- Version: 1.0

-- Project: Name of the project

-- Author: Travis Weaver

SET @OLD\_UNIQUE\_CHECKS=@@UNIQUE\_CHECKS, UNIQUE\_CHECKS=0;

SET @OLD\_FOREIGN\_KEY\_CHECKS=@@FOREIGN\_KEY\_CHECKS, FOREIGN\_KEY\_CHECKS=0;

SET @OLD\_SQL\_MODE=@@SQL\_MODE, SQL\_MODE='TRADITIONAL,ALLOW\_INVALID\_DATES';

ALTER TABLE `music\_rec\_info\_sys`.`Household`

CHANGE COLUMN `phoneNum` `phone\_number` VARCHAR(16) NOT NULL ;

SET SQL\_MODE=@OLD\_SQL\_MODE;

SET FOREIGN\_KEY\_CHECKS=@OLD\_FOREIGN\_KEY\_CHECKS;

SET UNIQUE\_CHECKS=@OLD\_UNIQUE\_CHECKS;

SET @OLD\_UNIQUE\_CHECKS=@@UNIQUE\_CHECKS, UNIQUE\_CHECKS=0;

SET @OLD\_FOREIGN\_KEY\_CHECKS=@@FOREIGN\_KEY\_CHECKS, FOREIGN\_KEY\_CHECKS=0;

SET @OLD\_SQL\_MODE=@@SQL\_MODE, SQL\_MODE='TRADITIONAL,ALLOW\_INVALID\_DATES';

ALTER TABLE `music\_rec\_info\_sys`.`Musician`

CHANGE COLUMN `SSN` `SSN` VARCHAR(11) NULL DEFAULT NULL ;

SET SQL\_MODE=@OLD\_SQL\_MODE;

SET FOREIGN\_KEY\_CHECKS=@OLD\_FOREIGN\_KEY\_CHECKS;

SET UNIQUE\_CHECKS=@OLD\_UNIQUE\_CHECKS;

INSERT INTO `music\_rec\_info\_sys`.`Musician` (`musician\_id`, `SSN`, `first\_name`, `last\_name`, `phone\_number`) VALUES ('1', '123-45-6789', 'John', 'Jacobs', '123-456-7890');

INSERT INTO `music\_rec\_info\_sys`.`Musician` (`musician\_id`, `SSN`, `first\_name`, `last\_name`, `phone\_number`) VALUES ('2', '837-89-8934', 'Bill', 'Hicks', '123-456-7890');

INSERT INTO `music\_rec\_info\_sys`.`Musician` (`musician\_id`, `SSN`, `first\_name`, `last\_name`, `phone\_number`) VALUES ('3', '228-39-9900', 'Jill', 'Butters', '567-923-0908');

INSERT INTO `music\_rec\_info\_sys`.`Musician` (`musician\_id`, `SSN`, `first\_name`, `last\_name`, `phone\_number`) VALUES ('4', '928-11-3409', 'Trevor', 'Hendricks', '112-233-4455');

INSERT INTO `music\_rec\_info\_sys`.`Musician` (`musician\_id`, `SSN`, `first\_name`, `last\_name`, `phone\_number`) VALUES ('5', '743-88-4755', 'Zach', 'Miller', '1-800-555-0505');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('1', 'Violin', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('2', 'Oboe', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('3', 'Bass', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('4', 'Piano', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('5', 'Trumpet', 'B Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('6', 'Clarinet', 'B Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('7', 'Soprano Saxophone', 'B Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('8', 'Tenor Saxophone', 'B Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('9', 'French Horn', 'F');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('10', 'English Horn', 'F');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('11', 'Flute', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('12', 'Tuba', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('13', 'Alto Saxophone', 'E Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('14', 'Baritone Saxophone', 'E Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('15', 'Guitar', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('16', 'Bass Guitar', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('17', 'Clarinet', 'B Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('18', 'Piccolo Clarinet', 'A Flat');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('19', 'Drums', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`, `name`, `musical\_key`) VALUES ('20', 'Harp', 'C');

INSERT INTO `music\_rec\_info\_sys`.`Musician` (`musician\_id`, `SSN`, `first\_name`, `last\_name`, `phone\_number`) VALUES ('6', '892-92-8495', 'Thomas', 'Bangalter', '305-000-1111');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('1', '2009-01-01', 'CD', '3', 'In Rainbows');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('2', '2000-01-01', 'Vinyl', '3', 'Kid A');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('3', '2001-01-01', 'CD', '6', 'Discovery');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('4', '1997-01-01', 'CD', '6', 'Homework');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('5', '2005-01-01', 'Vinyl', '6', 'Human After All');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('6', '2013-01-01', 'CD', '6', 'Random Access Memories');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('7', '2003-01-01', 'CD', '6', 'Daft Club');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('8', '2012-01-01', 'EP', '2', 'Moderation');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('9', '2013-01-01', 'Vinyl', '1', 'Outrun');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('10', '2010-01-01', 'EP', '1', 'Nightcall');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('11', '2008-01-01', 'CD', '4', 'Los Angeles');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('12', '2012-01-01', 'CD', '4', 'Until the Quiet Comes');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('13', '2010-01-01', 'Vinyl', '4', 'Cosmogramma');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('14', '2007-01-01', 'CD', '5', 'Oi Oi Oi');

INSERT INTO `music\_rec\_info\_sys`.`Album` (`album\_id`, `copyright\_date`, `format`, `producer`, `album\_title`) VALUES ('15', '2009-01-01', 'CD', '5', 'Power');

UPDATE `music\_rec\_info\_sys`.`Instrument` SET `name`='Banjo', `musical\_key`='C' WHERE `instrument\_id`='17';

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('1', '1');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('4', '1');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('15', '1');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('4', '2');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('19', '2');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('20', '2');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('16', '3');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('3', '3');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('4', '3');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('5', '4');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('7', '4');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('13', '4');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('15', '4');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('5', '5');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('6', '5');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('7', '5');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('8', '5');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('19', '6');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('20', '6');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('1', '6');

INSERT INTO `music\_rec\_info\_sys`.`Instruments\_For\_Musician` (`instrument\_id`, `musician\_id`) VALUES ('4', '6');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Nude', '3', '1', '3');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('All I Need', '3', '1', '5');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Jigsaw Falling Into Place', '6', '1', '9');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Everything In Its Right Place', '3', '2', '1');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Kid A', '3', '2', '2');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Idioteque', '3', '2', '8');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('One More Time', '6', '3', '1');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Harder, Better, Faster, Stronger', '6', '3', '4');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Digital Love', '6', '3', '3');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Fresh', '3', '4', '6');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Around the World', '6', '4', '7');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Television Rules the Nation', '6', '5', '8');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Giorgio By Morodor', '6', '6', '3');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Within', '5', '6', '4');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Moderation', '2', '8', '1');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Reversion', '2', '8', '2');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Blizzard', '1', '9', '2');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Protovision', '1', '9', '3');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Odd Look', '1', '9', '4');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Rampage', '1', '9', '5');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Suburbia', '6', '9', '6');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Nightcall', '1', '10', '1');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Pacific Coast Highway', '1', '10', '2');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Nightcall (Dustin N\'Guyen Remix)', '1', '10', '3');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Pacific Coast Highway (Jackson Remix)', '1', '10', '4');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Brainfeeder', '4', '11', '1');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Camel', '4', '11', '4');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('SexSlaveShip', '4', '11', '14');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('All In', '4', '12', '1');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Getting There', '4', '12', '2');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Until the Colours Come', '6', '12', '3');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Zodiac Shit', '4', '13', '5');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Table Tennis', '4', '13', '16');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('& Down', '5', '14', '1');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Shine Shine', '5', '14', '8');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Jeffer', '5', '15', '4');

INSERT INTO `music\_rec\_info\_sys`.`Songs` (`title`, `author\_id`, `album\_id`, `track\_number`) VALUES ('Transmission', '6', '15', '5');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('1', '3', '3');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('1', '3', '6');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('1', '5', '3');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('1', '5', '6');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('1', '9', '3');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('1', '9', '6');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('6', '3', '6');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('6', '3', '5');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('6', '4', '6');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('6', '4', '5');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('11', '1', '4');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('11', '1', '1');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('13', '5', '4');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('13', '5', '6');

INSERT INTO `music\_rec\_info\_sys`.`Song\_Credits` (`album\_id`, `track\_number`, `musician\_id`) VALUES ('13', '5', '2');

-- MySQL Workbench Synchronization

-- Generated: 2017-05-05 19:19

-- Model: New Model

-- Version: 1.0

-- Project: Name of the project

-- Author: Travis Weaver

SET @OLD\_UNIQUE\_CHECKS=@@UNIQUE\_CHECKS, UNIQUE\_CHECKS=0;

SET @OLD\_FOREIGN\_KEY\_CHECKS=@@FOREIGN\_KEY\_CHECKS, FOREIGN\_KEY\_CHECKS=0;

SET @OLD\_SQL\_MODE=@@SQL\_MODE, SQL\_MODE='TRADITIONAL,ALLOW\_INVALID\_DATES';

ALTER TABLE `music\_rec\_info\_sys`.`Musician`

DROP FOREIGN KEY `phone\_number\_m\_fk`;

ALTER TABLE `music\_rec\_info\_sys`.`Album`

DROP FOREIGN KEY `musician\_id\_a\_fk`;

ALTER TABLE `music\_rec\_info\_sys`.`Instruments\_For\_Musician`

DROP FOREIGN KEY `instrument\_id\_im\_fk`,

DROP FOREIGN KEY `musician\_id\_im\_fk`;

ALTER TABLE `music\_rec\_info\_sys`.`Song\_Credits`

DROP FOREIGN KEY `musician\_id\_sc\_fk`;

ALTER TABLE `music\_rec\_info\_sys`.`Musician`

ADD CONSTRAINT `phone\_number\_m\_fk`

FOREIGN KEY (`phone\_number`)

REFERENCES `music\_rec\_info\_sys`.`Household` (`phone\_number`)

ON DELETE CASCADE

ON UPDATE CASCADE;

ALTER TABLE `music\_rec\_info\_sys`.`Album`

ADD CONSTRAINT `musician\_id\_a\_fk`

FOREIGN KEY (`producer`)

REFERENCES `music\_rec\_info\_sys`.`Musician` (`musician\_id`)

ON DELETE SET NULL

ON UPDATE CASCADE;

ALTER TABLE `music\_rec\_info\_sys`.`Instruments\_For\_Musician`

ADD CONSTRAINT `instrument\_id\_im\_fk`

FOREIGN KEY (`instrument\_id`)

REFERENCES `music\_rec\_info\_sys`.`Instrument` (`instrument\_id`)

ON DELETE CASCADE

ON UPDATE CASCADE,

ADD CONSTRAINT `musician\_id\_im\_fk`

FOREIGN KEY (`musician\_id`)

REFERENCES `music\_rec\_info\_sys`.`Musician` (`musician\_id`)

ON DELETE CASCADE

ON UPDATE CASCADE;

ALTER TABLE `music\_rec\_info\_sys`.`Song\_Credits`

DROP FOREIGN KEY `song\_info\_sc\_fk`;

ALTER TABLE `music\_rec\_info\_sys`.`Song\_Credits` ADD CONSTRAINT `song\_info\_sc\_fk`

FOREIGN KEY (`album\_id` , `track\_number`)

REFERENCES `music\_rec\_info\_sys`.`Songs` (`album\_id` , `track\_number`)

ON DELETE CASCADE

ON UPDATE CASCADE,

ADD CONSTRAINT `musician\_id\_sc\_fk`

FOREIGN KEY (`musician\_id`)

REFERENCES `music\_rec\_info\_sys`.`Musician` (`musician\_id`)

ON DELETE CASCADE

ON UPDATE CASCADE;

SET SQL\_MODE=@OLD\_SQL\_MODE;

SET FOREIGN\_KEY\_CHECKS=@OLD\_FOREIGN\_KEY\_CHECKS;

SET UNIQUE\_CHECKS=@OLD\_UNIQUE\_CHECKS;

**Database Application:**

*Python Source Code:*

#!/usr/bin/python

#

# Name: Travis Weaver

# Date: April 30, 2017

# Last Updated: May 1, 2017

#

# Command to install mysql connector for Python 2.7:

#

# sudo apt-get install python-pip

# pip install [--egg] mysql-connector-python-rf

from \_\_future\_\_ import print\_function

from enum import Enum

import sys

import mysql.connector

import numpy as np

connection = mysql.connector.connect(host = '104.196.222.235',

port = '3306',

user = 'root',

password = 'root',

db = 'music\_rec\_info\_sys')

class TableNames(Enum):

Album = 1

Household = 2

Instrument = 3

Instruments\_For\_Musician = 4

Musician = 5

Song\_Credits = 6

Songs = 7

def welcome\_message():

print("\t--- ABC Records ---")

print("Musical Recording Information System")

print("------------------------------------")

print()

def main\_menu():

print("\t--- Main Menu ---")

print("Please select a category below by entering the corresponding integer.")

print("---------------------------------------------------------------------")

print("")

print("(Option) Category")

print("-----------------")

print("(1) View All Records")

print("(2) Sample Queries")

print("(3) Insert, Update, and Delete Records")

print("(0) Exit")

print("")

def view\_all\_records\_menu():

print("\t--- View All Records ---")

print("Please select a table to view all corresponding records.")

print("--------------------------------------------------------")

print("")

print("(Option) Table")

print("-----------------")

print("(1) Album")

print("(2) Household")

print("(3) Instrument")

print("(4) Instruments\_For\_Musician")

print("(5) Musician")

print("(6) Song\_Credits")

print("(7) Songs")

# print("(9) Main Menu")

print("(0) Exit")

print("")

def view\_record(user\_choice):

table = TableNames(user\_choice).name

cursor = connection.cursor()

cursor.execute("SELECT \* FROM %s" % table)

print("")

col\_names = cursor.column\_names

col\_length = len(col\_names)

if col\_length == 1:

print("%-20s" % (col\_names[0]))

print("%-20s" % ("----------"))

elif col\_length == 2:

print("%-20s\t %-20s" % (col\_names[0], col\_names[1]))

print("%-20s\t %-20s" % ("----------", "----------"))

elif col\_length == 3:

print("%-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2]))

print("%-20s\t %-20s\t %-20s" % ("----------", "----------", "----------"))

elif col\_length == 4:

print("%-40s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3]))

print("%-40s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------"))

elif col\_length == 5:

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3], col\_names[4]))

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------", "----------"))

elif col\_length == 6:

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3], col\_names[4], col\_names[5]))

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------", "----------", "----------"))

else:

print("Error: Unsupported number of columns")

for row in cursor:

length = len(row)

if length == 1:

print("%-20s" % (row[0]))

elif length == 2:

print("%-20s\t %-20s" % (row[0], row[1]))

elif length == 3:

print("%-20s\t %-20s\t %-20s" % (row[0], row[1], row[2]))

elif length == 4:

print("%-40s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3]))

elif length == 5:

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3], row[4]))

elif length == 6:

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3], row[4], row[5]))

else:

print("Error: Unsupported number of columns")

def view\_query\_menu():

print("\t--- Sample Queries ---")

print("Please select a query to perform.")

print("---------------------------------")

print("")

print("(Option) Query")

print("--------------")

print("(1) View album info for given musician")

print("(2) View details of musicians, sorted by last name, who can play given instrument")

print("(3) View details of songs in given album")

print("(4) View total number of albums with given copyright date")

print("(5) View most prolific producers in the company (greater than average produced albums)")

print("(6) View musicians who play more than two instruments")

print("(7) View total number of songs played by each musician")

# print("(9) Main Menu")

print("(0) Exit")

print("")

def view\_query(user\_choice):

cursor = connection.cursor()

if user\_choice == 1:

mid = input("Enter musician\_id: ")

cursor.execute("SELECT \* FROM Album WHERE producer = %d" % mid)

col\_names = cursor.column\_names

print("")

print("%-40s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3]))

print("%-40s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------"))

for row in cursor:

print("%-40s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3]))

elif user\_choice == 2:

iid = input("Enter instrument\_id: ")

cursor.execute("SELECT m.\* FROM Musician m, Instruments\_For\_Musician i WHERE i.instrument\_id = %d AND i.musician\_id = m.musician\_id ORDER BY m.last\_name;" % iid)

col\_names = cursor.column\_names

print("")

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3], col\_names[4]))

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------", "----------"))

for row in cursor:

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3], row[4]))

elif user\_choice == 3:

aid = input("Enter album\_id: ")

cursor.execute("SELECT s.\* FROM music\_rec\_info\_sys.Album a, music\_rec\_info\_sys.Songs s WHERE a.album\_id = s.album\_id AND a.album\_id = %d;" % aid)

col\_names = cursor.column\_names

print("")

print("%-40s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3]))

print("%-40s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------"))

for row in cursor:

print("%-40s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3]))

elif user\_choice == 4:

cpd = input("Enter copyright\_date: ")

cpd = str(cpd)

query = "SELECT \* FROM music\_rec\_info\_sys.Album WHERE copyright\_date LIKE %s;"

cursor.execute(query, ("%" + cpd + "%",))

col\_names = cursor.column\_names

print("")

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3], col\_names[4]))

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------", "----------"))

for row in cursor:

print("%-20s\t %-20s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3], row[4]))

elif user\_choice == 5:

cursor.execute("SELECT m.last\_name, m.first\_name, COUNT(m.musician\_id) AS num\_produced FROM music\_rec\_info\_sys.Musician m, music\_rec\_info\_sys.Album a WHERE m.musician\_id = a.producer GROUP BY m.musician\_id HAVING num\_produced > AVG(num\_produced);")

col\_names = cursor.column\_names

print("")

print("%-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2]))

print("%-20s\t %-20s\t %-20s" % ("----------", "----------", "----------"))

for row in cursor:

print("%-20s\t %-20s\t %-20s" % (row[0], row[1], row[2]))

elif user\_choice == 6:

cursor.execute("SELECT m.last\_name, m.first\_name, COUNT(i.instrument\_id) AS num\_instruments FROM music\_rec\_info\_sys.Musician m, music\_rec\_info\_sys.Instruments\_For\_Musician i WHERE m.musician\_id = i.musician\_id GROUP BY m.musician\_id HAVING num\_instruments > 2;")

col\_names = cursor.column\_names

print("")

print("%-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2]))

print("%-20s\t %-20s\t %-20s" % ("----------", "----------", "----------"))

for row in cursor:

print("%-20s\t %-20s\t %-20s" % (row[0], row[1], row[2]))

elif user\_choice == 7:

cursor.execute("SELECT m.last\_name, m.first\_name, COUNT(s.track\_number) AS num\_songs, m.musician\_id FROM music\_rec\_info\_sys.Musician m, music\_rec\_info\_sys.Song\_Credits s WHERE m.musician\_id = s.musician\_id GROUP BY m.musician\_id ORDER BY m.last\_name;")

col\_names = cursor.column\_names

print("")

print("%-40s\t %-20s\t %-20s\t %-20s" % (col\_names[0], col\_names[1], col\_names[2], col\_names[3]))

print("%-40s\t %-20s\t %-20s\t %-20s" % ("----------", "----------", "----------", "----------"))

for row in cursor:

print("%-40s\t %-20s\t %-20s\t %-20s" % (row[0], row[1], row[2], row[3]))

elif user\_choice == 0:

print("Exiting...")

else:

print("Error: Invalid choice")

def change\_record\_menu():

print("\t--- Change Records ---")

print("Please select a record to change.")

print("---------------------------------")

print("")

print("(Option) Query")

print("--------------")

print("(1) Insert a new musician")

print("(2) Delete an existing song")

print("(3) Update the address of a musician")

# print("(9) Main Menu")

print("(0) Exit")

print("")

def change\_record(user\_choice):

cursor = connection.cursor()

if user\_choice == 1:

mid = int(raw\_input("Enter musician\_id: ")) # Could change raw\_input to input sans int casting

ssn = raw\_input("Enter SSN: ")

f\_name = raw\_input("Enter first name: ")

l\_name = raw\_input("Enter last name: ")

phone\_num = raw\_input("Enter phone number: ")

address = raw\_input("Enter address: ")

cursor.execute("INSERT INTO `music\_rec\_info\_sys`.`Household`(`phone\_number`, `address`) VALUES ('%s', '%s');" % (phone\_num, address))

cursor.execute("INSERT INTO `music\_rec\_info\_sys`.`Musician`(`musician\_id`, `SSN`, `first\_name`, `last\_name`, `phone\_number`) VALUES ('%d', '%s', '%s', '%s', '%s');" % (mid, ssn, f\_name, l\_name, phone\_num))

connection.commit()

print("")

print("Musician added to database")

elif user\_choice == 2:

aid = input("Enter album\_id: ")

tid = input("Enter track number: ")

cursor.execute("DELETE FROM `music\_rec\_info\_sys`.`Songs` WHERE album\_id = %d AND track\_number = %d;" % (aid, tid))

connection.commit()

print("")

print("Song deleted from database")

elif user\_choice == 3:

mid = input("Enter musician\_id: ")

address = raw\_input("Enter new address: ")

cursor.execute("SELECT m.phone\_number FROM music\_rec\_info\_sys.Musician m WHERE musician\_id = %d;" % mid)

row = cursor.fetchone()

cursor.execute("UPDATE `music\_rec\_info\_sys`.`Household` SET `address`='%s' WHERE `phone\_number`='%s';" % (address, row[0]))

connection.commit()

print("")

print("Address updated for musician")

elif user\_choice == 0:

print("Exiting...")

else:

print("Error: Invalid option")

### Main ###

welcome\_message()

user\_choice = 1

while user\_choice != 0:

main\_menu()

user\_choice = input("Enter category: ")

print("")

if user\_choice == 1:

view\_all\_records\_menu()

user\_choice = input("Enter table: ")

view\_record(user\_choice)

print("")

elif user\_choice == 2:

view\_query\_menu()

user\_choice = input("Enter query: ")

view\_query(user\_choice)

print("")

elif user\_choice == 3:

change\_record\_menu()

user\_choice = input("Enter option: ")

change\_record(user\_choice)

print("")

elif user\_choice == 0:

break;

else:

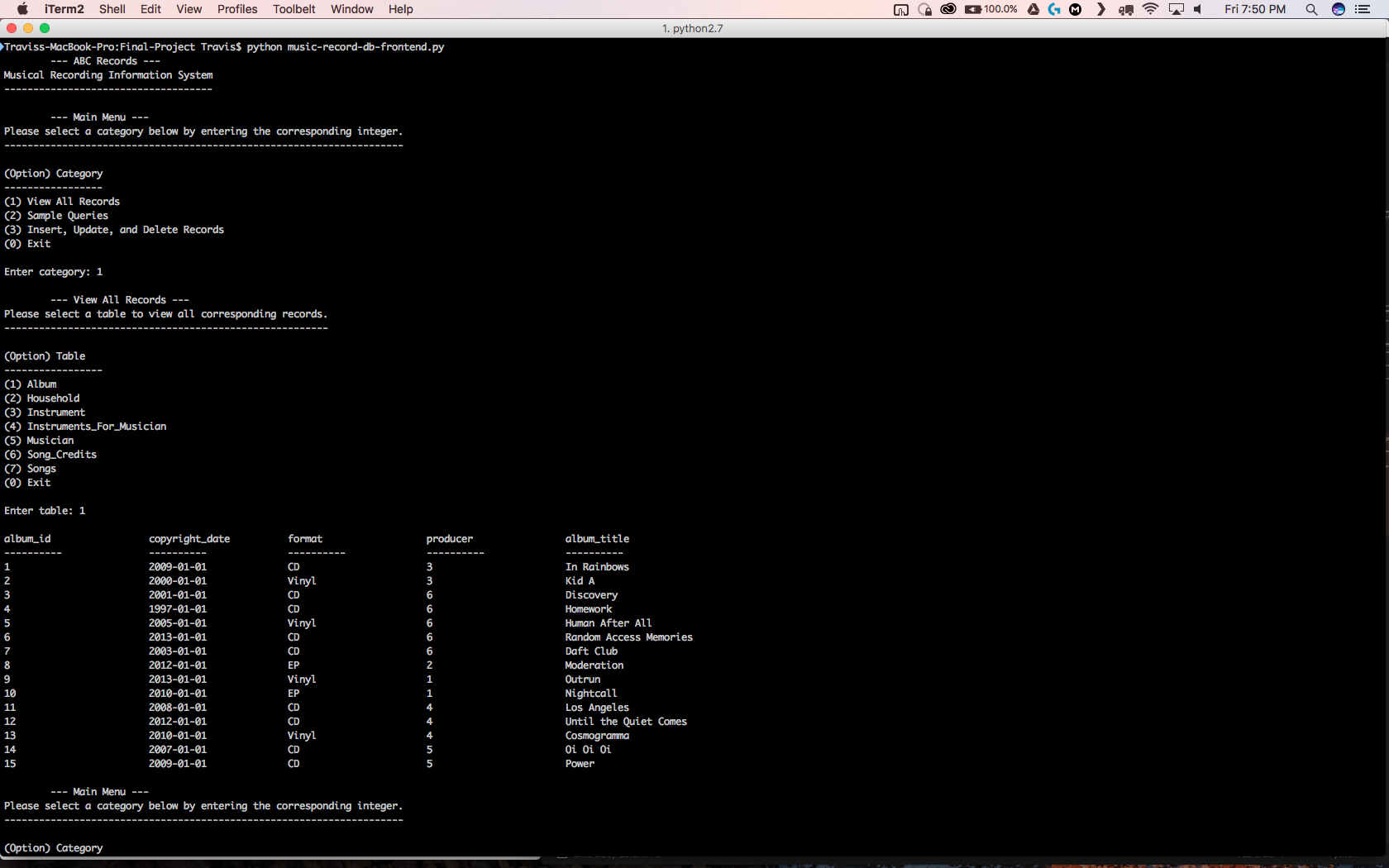
print("Error: Invalid category choice")

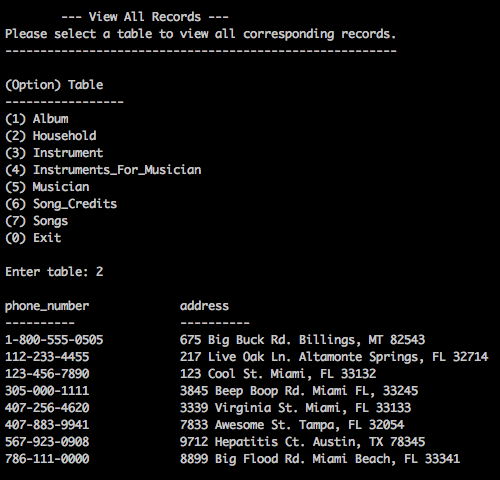
print("")

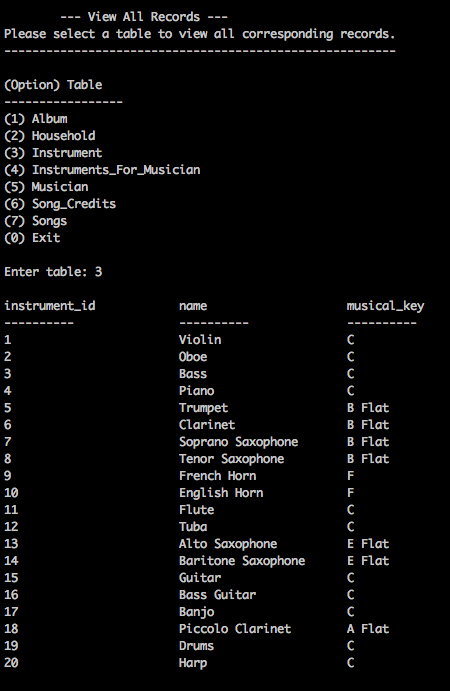
connection.close()

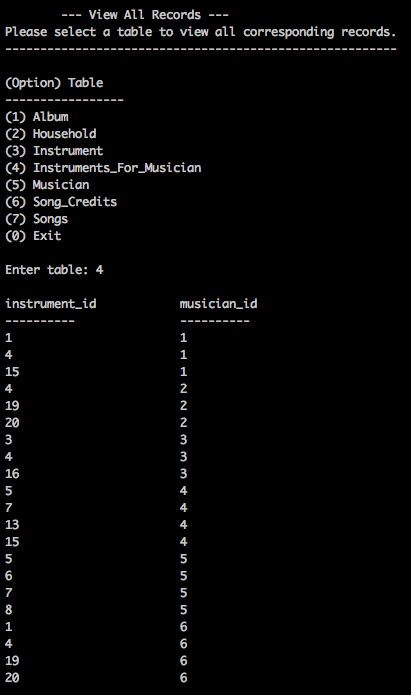
**Test Data and Sample Output:** *Results from application interacting with the database hosted on Google Cloud*

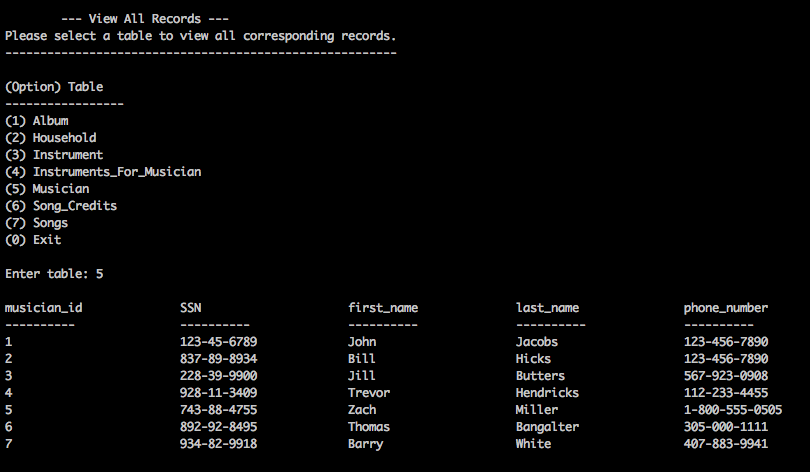
*Test Data:*

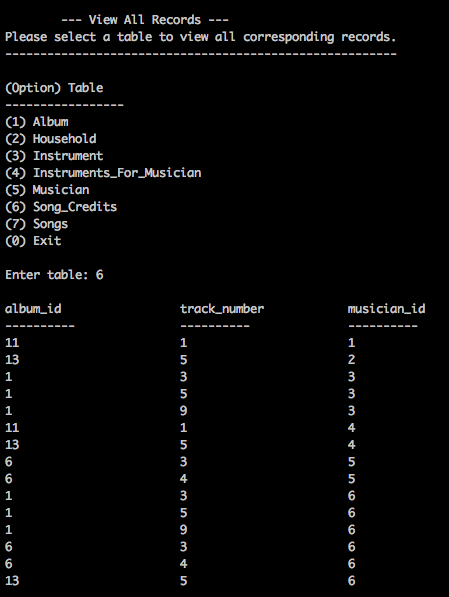
****

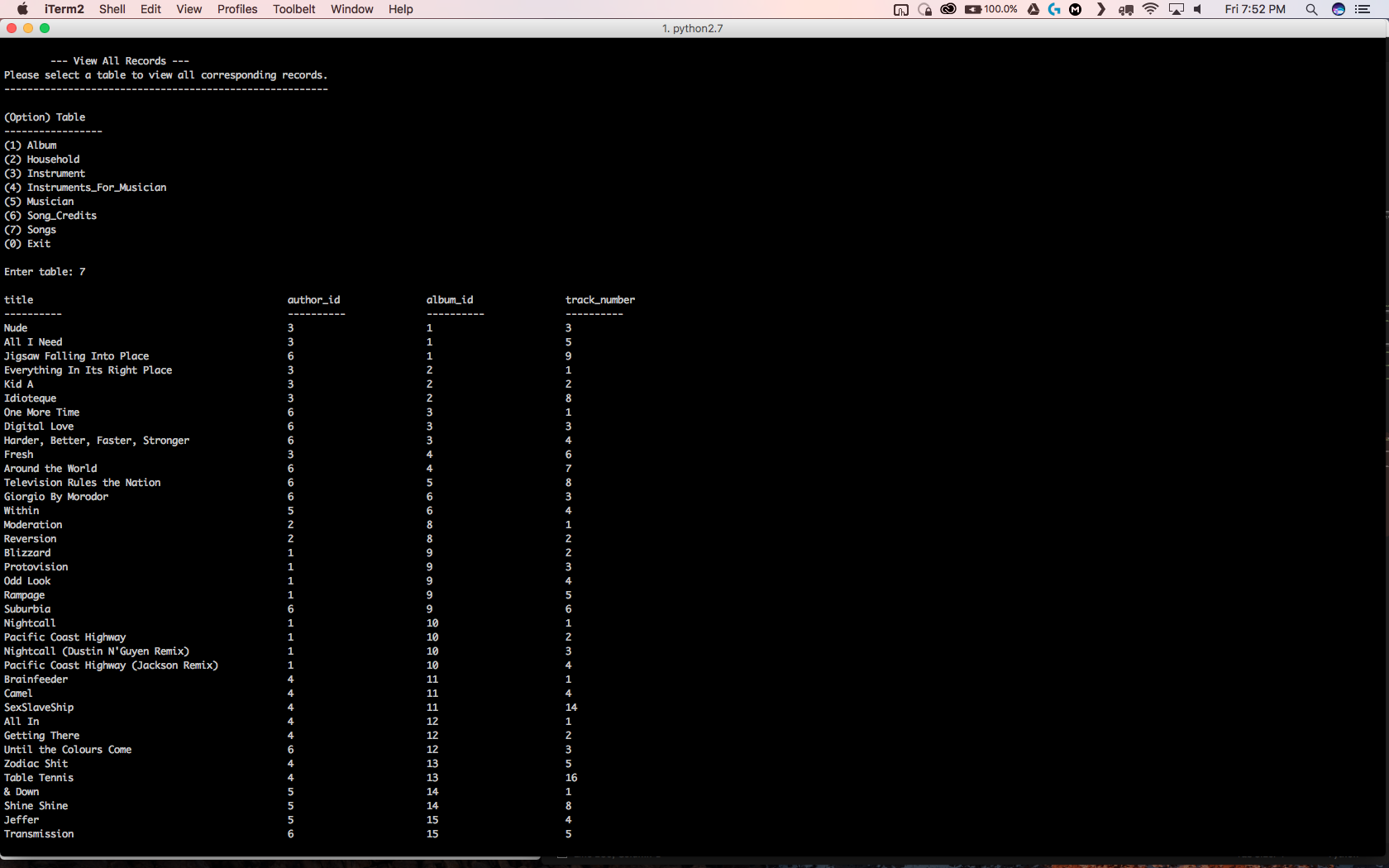




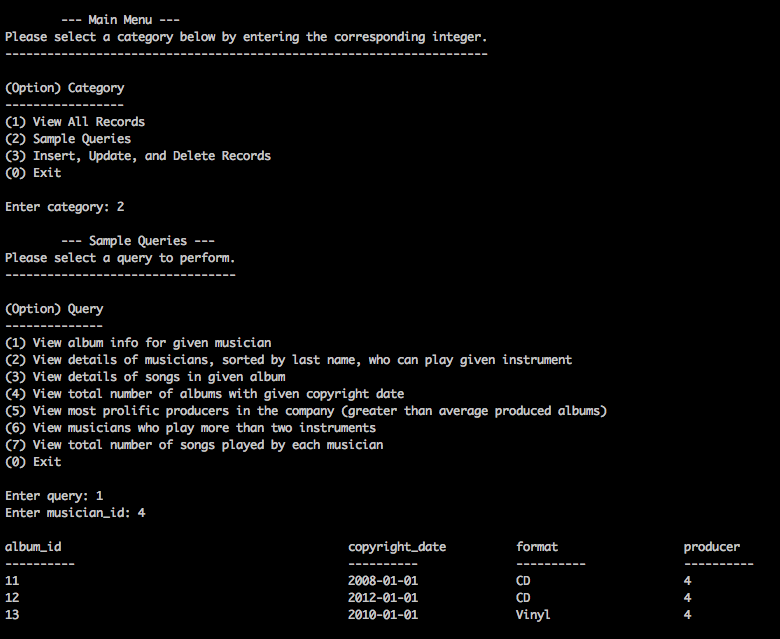


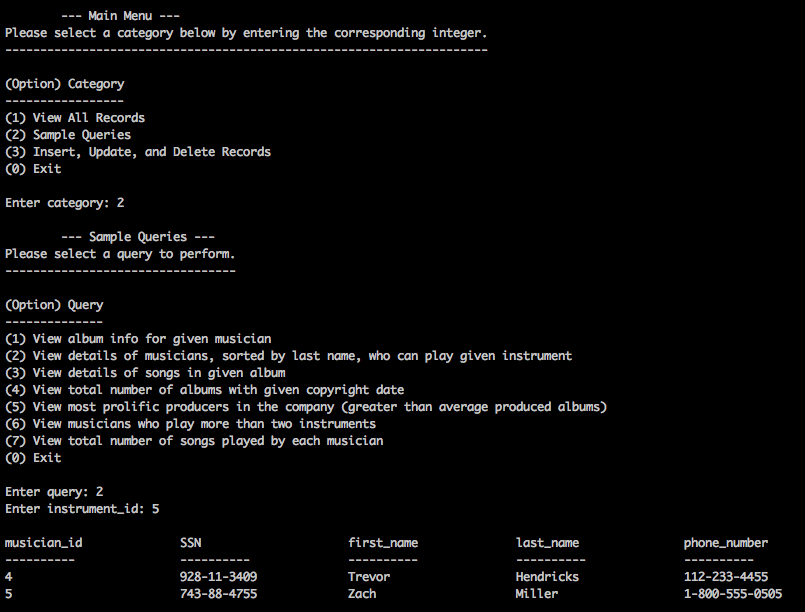


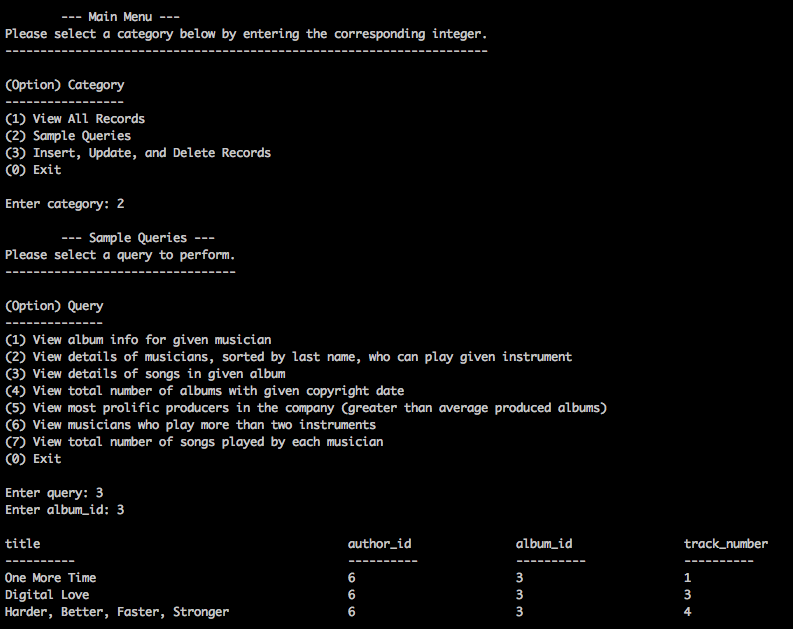


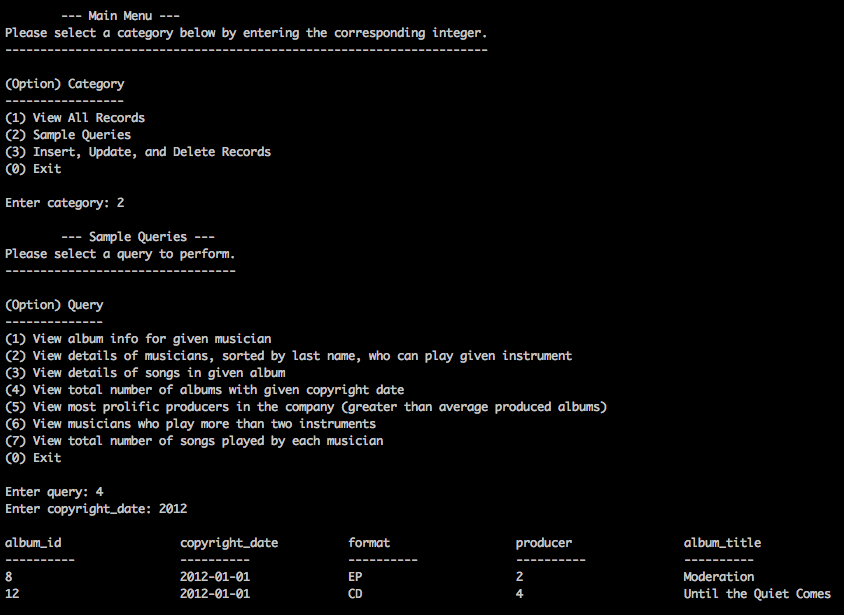


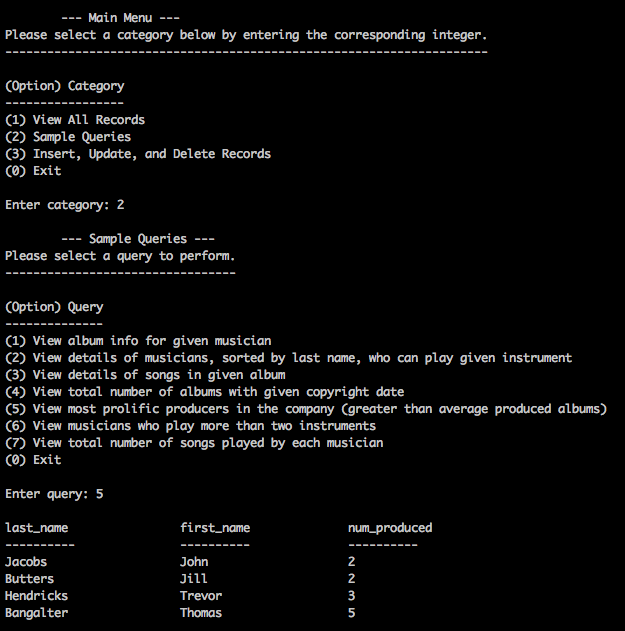
*Sample Query Output:*

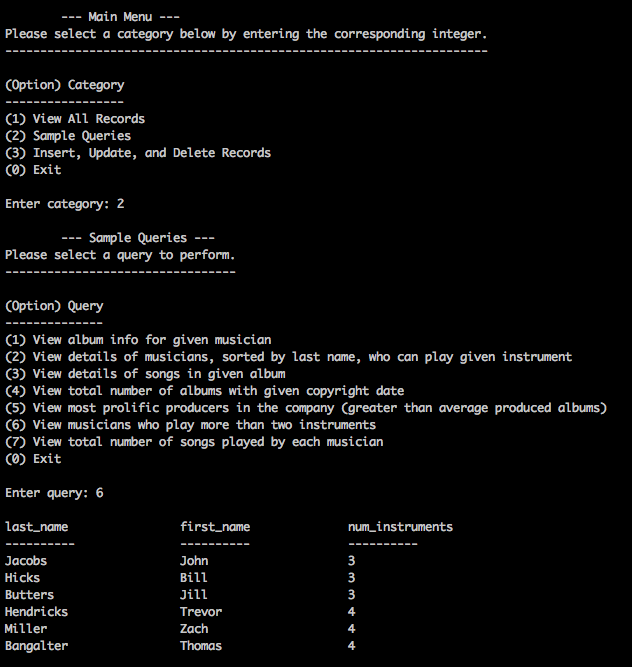


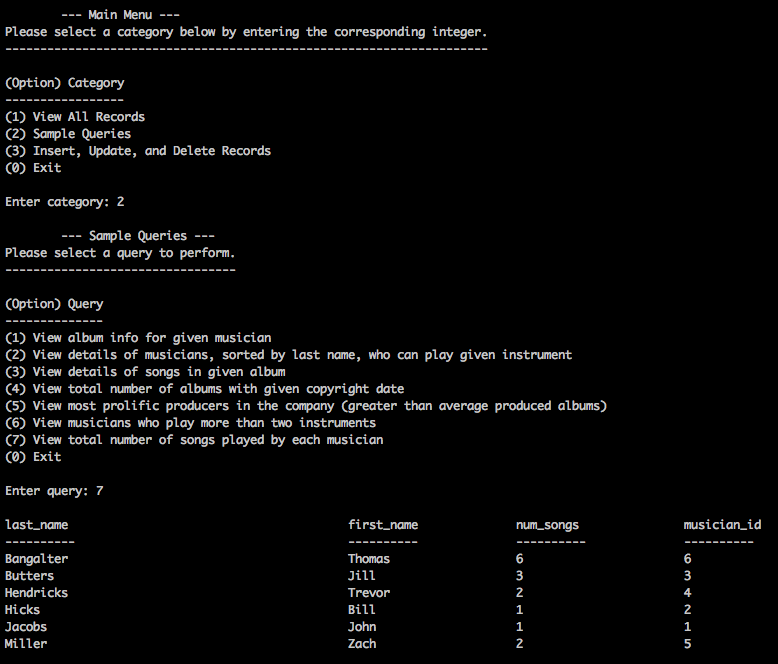


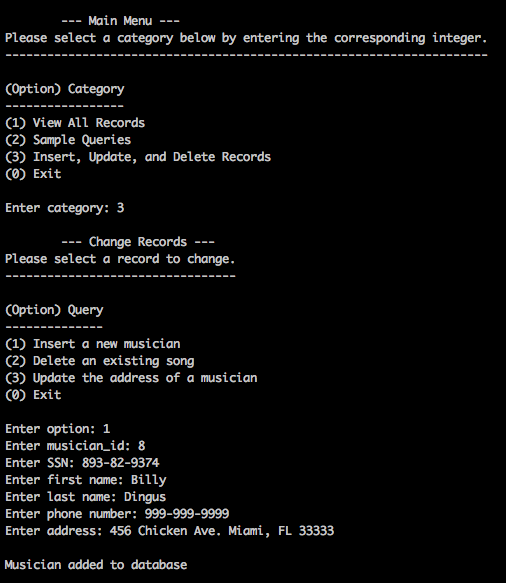


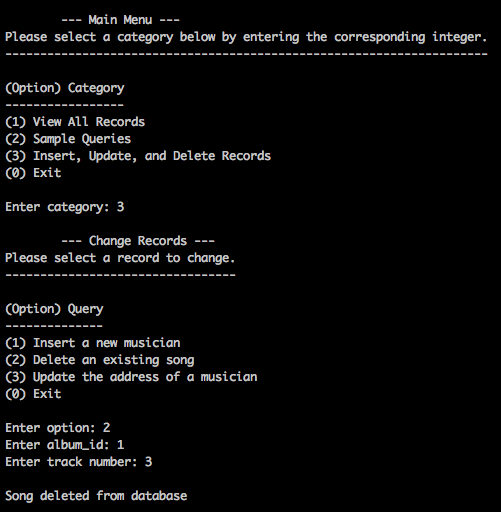


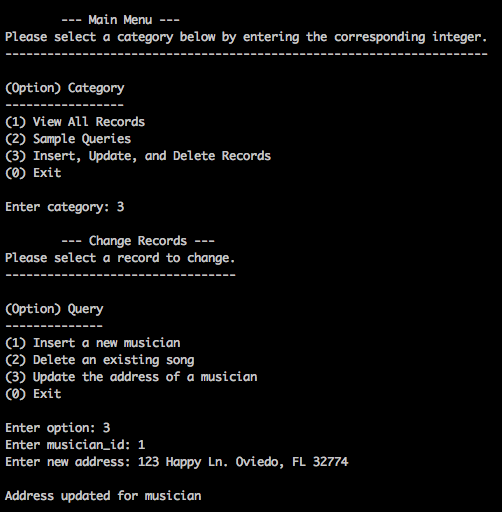












**Conclusion:**

The database and application built for the musical recording information system works very well and seems to fulfill all the necessary requirements in the third normal form. Overall, I’m very pleased with how the application turned out and it could be easily scaled up to be more feature rich, while still maintaining its ease of use.