MySQL Sample Databases

There are many excellent and interesting sample databases available, that you can use as a template (or pattern) to design your own databases.

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1. MySQL's Sample Employee Database

Reference: MySQL's Sample Employees Database @ http://dev.mysql.com/doc/employee/en/index.html.

This is a rather simple database with 6 tables but with millions of records.

1.1 Database and Tables

There are 6 tables as follows:

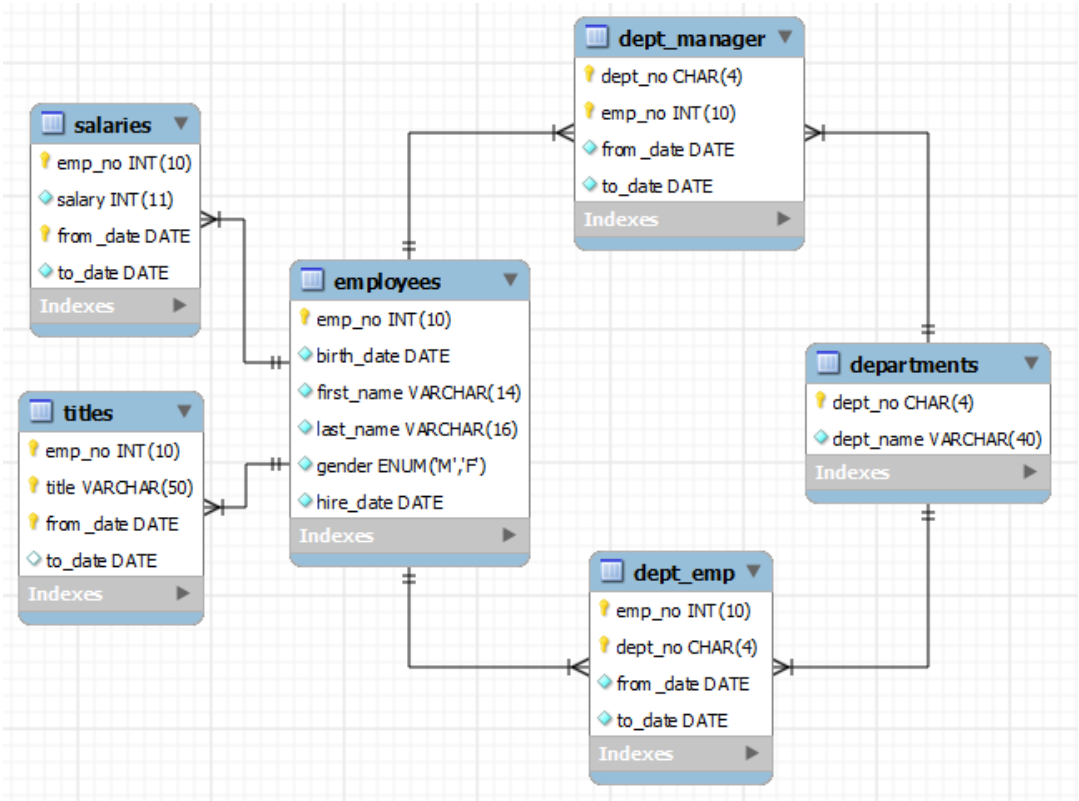


Table "employees"

```
CREATE TABLE employees (
    emp_no      INT             NOT NULL,   -- UNSIGNED AUTO_INCREMENT??
    birth_date  DATE            NOT NULL,
    first_name  VARCHAR(14)     NOT NULL,
    last_name   VARCHAR(16)     NOT NULL,
```

```
    gender      ENUM ('M','F')  NOT NULL,  -- Enumeration of either 'M' or 'F'
    hire_date   DATE            NOT NULL,
    PRIMARY KEY (emp_no)                   -- Index built automatically on primary-key column
                                           -- INDEX (first_name)
                                           -- INDEX (last_name)
);
```

There are 300,024 records for this table.

Table "departments"

```
CREATE TABLE departments (
    dept_no     CHAR(4)         NOT NULL,  -- in the form of 'dxxx'
    dept_name   VARCHAR(40)     NOT NULL,
    PRIMARY KEY (dept_no),                 -- Index built automatically
    UNIQUE  KEY (dept_name)                -- Build INDEX on this unique-value column
);
```

The keyword KEY is synonym to INDEX. An INDEX can be built on unique-value column (UNIQUE KEY or UNIQUE INDEX) or non-unique-value column (KEY or INDEX). Indexes greatly facilitates fast search. However, they deplete the performance in INSERT, UPDATE and DELETE. Generally, relational databases are optimized for retrievals, and NOT for modifications.

There are 9 records for this table.

Table "dept_emp"

Junction table to support between many-to-many relationship between employees and departments. A department has many employees. An employee can belong to different department at different dates, and possibly concurrently.

```
CREATE TABLE dept_emp (
    emp_no      INT         NOT NULL,
    dept_no     CHAR(4)     NOT NULL,
    from_date   DATE        NOT NULL,
    to_date     DATE        NOT NULL,
    KEY         (emp_no),   -- Build INDEX on this non-unique-value column
    KEY         (dept_no),  -- Build INDEX on this non-unique-value column
    FOREIGN KEY (emp_no) REFERENCES employees (emp_no) ON DELETE CASCADE,
           -- Cascade DELETE from parent table 'employee' to this child table
           -- If an emp_no is deleted from parent 'employee', all records
           --  involving this emp_no in this child table are also deleted
           -- ON UPDATE CASCADE??
    FOREIGN KEY (dept_no) REFERENCES departments (dept_no) ON DELETE CASCADE,
           -- ON UPDATE CASCADE??
    PRIMARY KEY (emp_no, dept_no)
           -- Might not be unique?? Need to include from_date
);
```

The foreign keys have ON DELETE *reference action* of CASCADE. If a record having a particular key-value from the parent table (employees and departments) is deleted, all the records in this child table having the same key-value are also deleted. Take note that the default ON DELETE reference action of is RESTRICTED, which disallows DELETE on the parent record, if there are matching records in the child table.

There are two reference actions: ON DELETE and ON UPDATE. The ON UPDATE reference action of is defaulted to RESTRICT (or disallow). It is more meaningful to set ON UPDATE to CASCADE, so that changes in parent table (e.g., change in emp_no and dept_no) can be cascaded down to the child table(s).

There are 331,603 records for this table.

Table "dept_manager"

join table to support between many-to-many relationship between employees and departments. Same structure as dept_emp.

```
CREATE TABLE dept_manager (
   dept_no      CHAR(4)  NOT NULL,
   emp_no       INT      NOT NULL,
   from_date    DATE     NOT NULL,
```

```
    to_date      DATE     NOT NULL,
    KEY         (emp_no),
    KEY         (dept_no),
    FOREIGN KEY (emp_no)  REFERENCES employees (emp_no)    ON DELETE CASCADE,
                                  -- ON UPDATE CASCADE??
    FOREIGN KEY (dept_no) REFERENCES departments (dept_no) ON DELETE CASCADE,
    PRIMARY KEY (emp_no, dept_no)  -- might not be unique?? Need from_date
);
```

There are 24 records for this table.

Table "titles"

There is a one-to-many relationship between employees and titles. One employee has many titles (concurrently or at different dates). A titles record refers to one employee (via emp_no).

```
CREATE TABLE titles (
    emp_no      INT          NOT NULL,
    title       VARCHAR(50)  NOT NULL,
    from_date   DATE         NOT NULL,
    to_date     DATE,
    KEY         (emp_no),
    FOREIGN KEY (emp_no) REFERENCES employees (emp_no) ON DELETE CASCADE,
                         -- ON UPDATE CASCADE??
    PRIMARY KEY (emp_no, title, from_date)
       -- This ensures unique combination.
       -- An employee may hold the same title but at different period
);
```

There are 443,308 records for this table.

Table "salaries"

Similar structure to titles table. One-to-many relationship between employees and salaries.

```
CREATE TABLE salaries (
    emp_no      INT    NOT NULL,
    salary      INT    NOT NULL,
    from_date   DATE   NOT NULL,
    to_date     DATE   NOT NULL,
    KEY         (emp_no),
    FOREIGN KEY (emp_no) REFERENCES employees (emp_no) ON DELETE CASCADE,
    PRIMARY KEY (emp_no, from_date)
);
```

There are 2,844,047 records for this table.

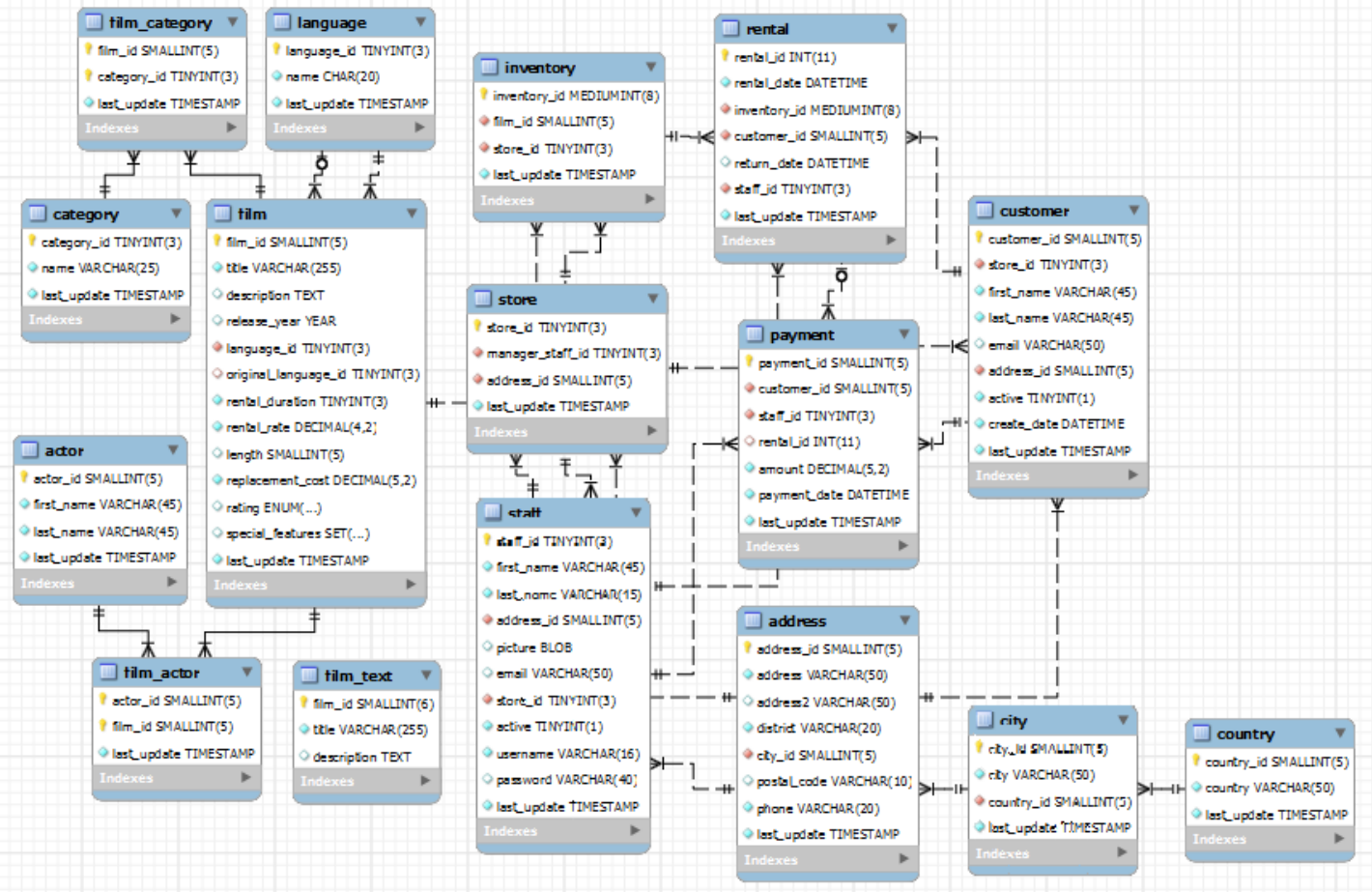
1.2 Stored Objects

No stored objects (view, procedure, function, trigger, event) defined. [Shall try!]

2. MySQL's Sample Salika (DVD Rental) Database

Reference: MySQL's Sample Sakila Database @ http://dev.mysql.com/doc/sakila/en/index.html.

The MySQL's Sample Salika (DVD Rental) Database can be downloaded fromhttp://dev.mysql.com/doc/sakila/en/index.html. It is a complex database with 16 tables. It also illustrates features such as Views, Stored Procedures and Triggers. This is probably the best sample available for studying MySQL databases.



2.1 Database and Tables

All the tables have `DEFAULT CHARSET` of `utf8` for internationalization support. All the tables, except `film_text`, use `InnoDB` engine, which supports foreign key and transaction. The table `film_text` uses `MyISAM` to support `FULLTEXT` search.

For UTF8 support, we could set the `DEFAULT CHARSET` at the database level as follows:

```
-- Enable client program to communicate with the server using utf8 character set
SET NAMES 'utf8';

DROP DATABASE IF EXISTS `sakila`;
-- Set the default charset to utf8 for internationalization, use case-insensitive (ci) collation
CREATE DATABASE IF NOT EXISTS `sakila` DEFAULT CHARACTER SET utf8 COLLATE utf8_unicode_ci;
USE `sakila`;
```

We could use "`SHOW CREATE DATABASE` *`databaseName`* `\G`" and "`SHOW CREATE TABLE` *`tableName`* `\G`" to display all the defaults used in `CREATE DATABASE` and `CREATE TABLE`.

Table "actor"

```
CREATE TABLE actor (
  actor_id    SMALLINT     UNSIGNED NOT NULL AUTO_INCREMENT,
                           -- 16-bit unsigned int in the range of [0, 65535]
  first_name  VARCHAR(45)  NOT NULL,
  last_name   VARCHAR(45)  NOT NULL,
  last_update TIMESTAMP    NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (actor_id),
  KEY idx_actor_last_name (last_name)   -- To build index (non-unique) on last_name
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
      -- Use InnoDB Engine, which supports foreign key and transaction
      -- Use Unicode 'utf8' character set for this table
```

- There can be one `TIMESTAMP` column with `DEFAULT CURRENT_TIMESTAMP`. If you wish to have both `create` and `last_update`, you need to use a `ON INSERT` trigger to set the `create TIMESTAMP`. For strict auditing, you might have `create_timestamp`, `create_by`, `last_update_timestamp` and `last_update_by`.
- InnoDB engine is used, which support foreign key and transaction.
- The default character set for this table is UTF8, which supports all languages for internationalization.
- Better to use `INT UNSIGNED` for `AUTO_INCREMENT` column `actor_id` to avoid overrun.

There are 200 records for this table.

Table "language"

Languages: such as English, Italian, Japanese, Mandrain, Cantonese, French, German.

```
CREATE TABLE language (
  language_id  TINYINT    UNSIGNED NOT NULL AUTO_INCREMENT,
                          -- 8-bit unsigned int [0, 255]
  name         CHAR(20)   NOT NULL,
  last_update  TIMESTAMP  NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (language_id)
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

May be simpler to use an `ENUM` (one choice).

There are 6 records for this table, i.e., `'English'`, `'Italian'`, `'Japanese'`, `'Mandarin'`, `'French'`, `'German'`.

Table "film"

```
CREATE TABLE film (
  film_id              SMALLINT     UNSIGNED NOT NULL AUTO_INCREMENT,
  title                VARCHAR(255) NOT NULL,
  description          TEXT         DEFAULT NULL,       -- Up to 64KB
  release_year         YEAR         DEFAULT NULL,       -- 'yyyy'
  language_id          TINYINT      UNSIGNED NOT NULL,  -- 8-bit unsigned int [0, 255]
  original_language_id TINYINT      UNSIGNED DEFAULT NULL,
  rental_duration      TINYINT      UNSIGNED NOT NULL DEFAULT 3,
  rental_rate          DECIMAL(4,2) NOT NULL DEFAULT 4.99,
                                    -- DECIMAL is precise and ideal for currency [99.99]. UNSIGNED?
  length               SMALLINT     UNSIGNED DEFAULT NULL,  -- 16-bit unsigned int [0, 65535]
  replacement_cost     DECIMAL(5,2) NOT NULL DEFAULT 19.99, -- [999.99], UNSIGNED??
  rating               ENUM('G','PG','PG-13','R','NC-17') DEFAULT 'G',
  special_features     SET('Trailers','Commentaries','Deleted Scenes','Behind the Scenes') DEFAULT NULL,
                                    -- Can take zero or more values from a SET
                                    -- But only one value from ENUM
  last_update          TIMESTAMP    NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (film_id),
  KEY idx_title (title),
  KEY idx_fk_language_id (language_id),
  KEY idx_fk_original_language_id (original_language_id),
        -- To build index on title, language_id, original_language_id and film_id (primary key)
  CONSTRAINT fk_film_language FOREIGN KEY (language_id) REFERENCES language (language_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
        -- Cannot delete parent record if there is any matching child record
        -- Update the matching child records if parent record is updated
  CONSTRAINT fk_film_language_original FOREIGN KEY (original_language_id) REFERENCES language (language_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

- Instead of hard-coding the "language" and "original language", it uses `language_id` to look up the `language` table, in a one-to-one relationship. Could use an `ENUM` for language directly for simplicity.
- `KEY`s (`INDEX`es) are defined on certain columns to facilitate fast search on these columns. We would use "`SHOW INDEX FROM` *`tableName`* `\G`" to display the details on indexes.
- Should include `UNSIGNED` for for non-negative numeric columns like `rental_rate`.

There are 1000 records for this table.

Table "film_actor"

Junction table between actor and film to support the many-to-many relationship.

```
CREATE TABLE film_actor (
  actor_id     SMALLINT UNSIGNED NOT NULL,
  film_id      SMALLINT UNSIGNED NOT NULL,
  last_update  TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (actor_id, film_id),
  KEY idx_fk_film_id (`film_id`),
  CONSTRAINT fk_film_actor_actor FOREIGN KEY (actor_id) REFERENCES actor (actor_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_film_actor_film FOREIGN KEY (film_id) REFERENCES film (film_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 5462 records for this table.

Table "category"

```
CREATE TABLE category (
  category_id  TINYINT      UNSIGNED NOT NULL AUTO_INCREMENT,
  name         VARCHAR(25)  NOT NULL,
  last_update  TIMESTAMP    NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (category_id)
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

- There are 16 records for this table, i.e., 'Action', 'Animation', 'Children', 'Classics', 'Comedy', 'Documentary', 'Drama', 'Family', 'Foreign', 'Games', 'Horror', 'Music', 'New', 'Sci-Fi', 'Sports', 'Travel'.
- May be better to use a SET to support multiple categories per film, if the number of categories is small. A SET is limited to 64 items in MySQL.

Table "film_category"

Junction table to support many-to-many relationship between film and category.

```
CREATE TABLE film_category (
  film_id      SMALLINT   UNSIGNED NOT NULL,
  category_id  TINYINT    UNSIGNED NOT NULL,
  last_update  TIMESTAMP  NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (film_id, category_id),
  CONSTRAINT fk_film_category_film FOREIGN KEY (film_id) REFERENCES film (film_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_film_category_category FOREIGN KEY (category_id) REFERENCES category (category_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 1000 records for this table. Each of the 1000 films has ONE category.

Table "film_text" - FULLTEXT Index and Search

```
CREATE TABLE film_text (
  film_id      SMALLINT      NOT NULL,
  title        VARCHAR(255)  NOT NULL,
  description  TEXT,
  PRIMARY KEY  (film_id),
  FULLTEXT KEY idx_title_description (title, description)
     -- To build index on FULLTEXT to facilitate text search
     -- FULLTEXT is supported in MyISAM engine, NOT in InnoDB engine
) ENGINE=MyISAM DEFAULT CHARSET=utf8;
```

- This table duplicates information from film table, to support FULLTEXT search. That is, user can efficiently search all the words in title and description columns.

- To ensure consistency between `film_text` and `film`, the rows are inserted/updated via a trigger on `film` table.
- `FULLTEXT` search is supported in `MyISAM` engine only, not the `InnoDB` engine. A `FULLTEXT` index is build on columns `(title, description)`. You can perform `FULLTEXT` search on the index using "`WHERE MATCH(columns) AGAINST(words)`", for example,

```
mysql> SELECT * FROM film_text
       WHERE MATCH(title, description) AGAINST ('great');
             -- search for the given word on the FULLTEXT index columns

mysql> SELECT * FROM film_text
       WHERE MATCH(title, description) AGAINST ('great good');
             -- search for either 'great' or 'good'

mysql> SELECT * FROM film_text
       WHERE MATCH(title, description) AGAINST ('"very good"' IN BOOLEAN MODE);
             -- Use BOOLEAN MODE to match exact phrase (enclosed in double-quotes)

mysql> SELECT * FROM film_text
       WHERE MATCH(title, description) AGAINST ('+good -bad' IN BOOLEAN MODE);
             -- Use BOOLEAN MODE to search for the word 'good', but NOT the word 'bad'

mysql> SELECT * FROM film_text
       WHERE MATCH(title, description) AGAINST ('great*' IN BOOLEAN MODE);
             -- In BOOLEAN MODE, wildcard * matches zero or more characters

mysql> SELECT * FROM film_text
       WHERE MATCH(title, description) AGAINST ('great' WITH QUERY EXPANSION);
             -- Do a second search on words in the most relevant rows from the first search
```

There are 1000 records for this table. Each `film` record has a `film_text` counterpart. The records in the `film_text` table is created via a `INSERT` trigger on the `film` table.

Table "inventory"

The company could have many copies of a particular film (in one store or many stores). Each copy is represented by an `inventory` record. The store is linked thru `store_id` to the table `store`.

```
CREATE TABLE inventory (
  inventory_id  MEDIUMINT  UNSIGNED NOT NULL AUTO_INCREMENT,
                           -- Simpler to use INT UNSIGNED
  film_id       SMALLINT   UNSIGNED NOT NULL,
  store_id      TINYINT    UNSIGNED NOT NULL,
  last_update   TIMESTAMP  NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (inventory_id),
  KEY idx_fk_film_id (film_id),
  KEY idx_store_id_film_id (store_id, film_id),
  CONSTRAINT fk_inventory_store FOREIGN KEY (store_id) REFERENCES store (store_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_inventory_film FOREIGN KEY (film_id) REFERENCES film (film_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 4581 records for this table.

Table "store"

Each store has a manager, linked thru `manager_staff_id` to the `staff` table. The address of the store is also linked thru `address_id` to the `address` table.

```
CREATE TABLE store (
  store_id          TINYINT    UNSIGNED NOT NULL AUTO_INCREMENT,
  manager_staff_id  TINYINT    UNSIGNED NOT NULL,
  address_id        SMALLINT   UNSIGNED NOT NULL,
  last_update       TIMESTAMP  NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (store_id),
```

```
  UNIQUE KEY idx_unique_manager (manager_staff_id),  -- one manager manages only one store
  KEY idx_fk_address_id (address_id),
  CONSTRAINT fk_store_staff FOREIGN KEY (manager_staff_id) REFERENCES staff (staff_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_store_address FOREIGN KEY (address_id) REFERENCES address (address_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 2 records for this table.

Table "staff"

```
CREATE TABLE staff (
  staff_id     TINYINT     UNSIGNED NOT NULL AUTO_INCREMENT,
  first_name   VARCHAR(45) NOT NULL,
  last_name    VARCHAR(45) NOT NULL,
  address_id   SMALLINT    UNSIGNED NOT NULL,
  picture      BLOB        DEFAULT NULL,           -- Kept a picture as BLOB (up to 64KB)
  email        VARCHAR(50) DEFAULT NULL,
  store_id     TINYINT     UNSIGNED NOT NULL,
  active       BOOLEAN     NOT NULL DEFAULT TRUE,  -- BOOLEAN FALSE (0) TRUE (non-0)
  username     VARCHAR(16) NOT NULL,
  password     VARCHAR(40) BINARY DEFAULT NULL,    -- BINARY??
  last_update  TIMESTAMP   NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (staff_id),
  KEY idx_fk_store_id (store_id),
  KEY idx_fk_address_id (address_id),
  CONSTRAINT fk_staff_store FOREIGN KEY (store_id) REFERENCES store (store_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_staff_address FOREIGN KEY (address_id) REFERENCES address (address_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 2 records for this table, with pictures (BLOB) provided.

Table "customer"

```
CREATE TABLE customer (
  customer_id  SMALLINT    UNSIGNED NOT NULL AUTO_INCREMENT,
  store_id     TINYINT     UNSIGNED NOT NULL,
  first_name   VARCHAR(45) NOT NULL,
  last_name    VARCHAR(45) NOT NULL,
  email        VARCHAR(50) DEFAULT NULL,
  address_id   SMALLINT    UNSIGNED NOT NULL,
  active       BOOLEAN     NOT NULL DEFAULT TRUE,
  create_date  DATETIME    NOT NULL,
  last_update  TIMESTAMP   DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (customer_id),
  KEY idx_fk_store_id (store_id),
  KEY idx_fk_address_id (address_id),
  KEY idx_last_name (last_name),
  CONSTRAINT fk_customer_address FOREIGN KEY (address_id) REFERENCES address (address_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_customer_store FOREIGN KEY (store_id) REFERENCES store (store_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 599 records for this table.

Table "rental"

Rental rate is kept in the `film` table.

```
CREATE TABLE rental (
  rental_id     INT         NOT NULL AUTO_INCREMENT,
  rental_date   DATETIME    NOT NULL,
```

```
  inventory_id  MEDIUMINT  UNSIGNED NOT NULL,
  customer_id   SMALLINT   UNSIGNED NOT NULL,
  return_date   DATETIME   DEFAULT NULL,
  staff_id      TINYINT    UNSIGNED NOT NULL,
  last_update   TIMESTAMP  NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (rental_id),
  UNIQUE KEY  (rental_date, inventory_id, customer_id),
  KEY idx_fk_inventory_id (inventory_id),
  KEY idx_fk_customer_id (customer_id),
  KEY idx_fk_staff_id (staff_id),
  CONSTRAINT fk_rental_staff FOREIGN KEY (staff_id) REFERENCES staff (staff_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_rental_inventory FOREIGN KEY (inventory_id) REFERENCES inventory (inventory_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_rental_customer FOREIGN KEY (customer_id) REFERENCES customer (customer_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 16,044 records for this table.

Table "payment"

An rental can have multiple payments?

```
CREATE TABLE payment (
  payment_id    SMALLINT     UNSIGNED NOT NULL AUTO_INCREMENT,
  customer_id   SMALLINT     UNSIGNED NOT NULL,
  staff_id      TINYINT      UNSIGNED NOT NULL,
  rental_id     INT          DEFAULT NULL,
  amount        DECIMAL(5,2) NOT NULL,
  payment_date  DATETIME     NOT NULL,
  last_update   TIMESTAMP    DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (payment_id),
  KEY idx_fk_staff_id (staff_id),
  KEY idx_fk_customer_id (customer_id),
  CONSTRAINT fk_payment_rental FOREIGN KEY (rental_id) REFERENCES rental (rental_id)
    ON DELETE SET NULL ON UPDATE CASCADE,
  CONSTRAINT fk_payment_customer FOREIGN KEY (customer_id) REFERENCES customer (customer_id)
    ON DELETE RESTRICT ON UPDATE CASCADE,
  CONSTRAINT fk_payment_staff FOREIGN KEY (staff_id) REFERENCES staff (staff_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 16,049 records for this table, more than `rental` table.

Table "address"

It is unlikely that two persons share the same address. Address is often a required field for a rental transaction. So it is probably better to store directly inside the `customers` table.

```
CREATE TABLE address (
  address_id   SMALLINT    UNSIGNED NOT NULL AUTO_INCREMENT,
  address      VARCHAR(50) NOT NULL,
  address2     VARCHAR(50) DEFAULT NULL,
  district     VARCHAR(20) NOT NULL,
  city_id      SMALLINT    UNSIGNED NOT NULL,
  postal_code  VARCHAR(10) DEFAULT NULL,
  phone        VARCHAR(20) NOT NULL,
  last_update  TIMESTAMP   NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (address_id),
  KEY idx_fk_city_id (city_id),
  CONSTRAINT `fk_address_city` FOREIGN KEY (city_id) REFERENCES city (city_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 603 records for this table.

Table "city"

```
CREATE TABLE city (
  city_id      SMALLINT    UNSIGNED NOT NULL AUTO_INCREMENT,
  city         VARCHAR(50) NOT NULL,
  country_id   SMALLINT    UNSIGNED NOT NULL,
  last_update  TIMESTAMP   NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (city_id),
  KEY idx_fk_country_id (country_id),
  CONSTRAINT `fk_city_country` FOREIGN KEY (country_id) REFERENCES country (country_id)
    ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 600 records for this table.

Table "country"

Having a `country` table may facilitate the creation of pull-down menu. Alternatively, you could consider using an `ENUM` (number of countries may exceed `ENUM`'s limit). For `city`, there are just too many cities in the world that the list can never be exhaustive. Probably better to keep inside the `address` table.

```
CREATE TABLE country (
  country_id   SMALLINT    UNSIGNED NOT NULL AUTO_INCREMENT,
  country      VARCHAR(50) NOT NULL,
  last_update  TIMESTAMP   NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY  (country_id)
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 109 records for this table.

2.2 Views

A `VIEW` is a virtual table (without data) that provides an alternate way to look at the data. It could be a consolidated set of columns from multiple table, or include derived column (such as total price).

We could use "`SHOW CREATE VIEW viewName \G`" to show all the defaults.

View "staff_list"

```
CREATE VIEW staff_list
AS
SELECT
  s.staff_id AS ID,
  CONCAT(s.first_name, _utf8' ', s.last_name) AS name,
  a.address AS address,
  a.postal_code AS `zip code`,
  a.phone AS phone,
  city.city AS city,
  country.country AS country,
  s.store_id AS SID
FROM staff AS s
  JOIN address AS a ON s.address_id = a.address_id
  JOIN city ON a.city_id = city.city_id
  JOIN country ON city.country_id = country.country_id;
```

- String literal can be expressed with optional introducer and collation in the form of:

```
-- Syntax
[_charsetName]'stringLiteral' [COLLATE collationName]

-- Example
SELECT _utf8' ';   -- space in UTF8
```

For Example,

```
mysql> SELECT * FROM staff_list;
+----+--------------+----------------------+----------+-------------+------------+-----------+-----+
| ID | name         | address              | zip code | phone       | city       | country   | SID |
+----+--------------+----------------------+----------+-------------+------------+-----------+-----+
|  1 | Mike Hillyer | 23 Workhaven Lane    |          | 14033335568 | Lethbridge | Canada    |   1 |
|  2 | Jon Stephens | 1411 Lillydale Drive |          | 6172235589  | Woodridge  | Australia |   2 |
+----+--------------+----------------------+----------+-------------+------------+-----------+-----+
```

View "customer_list"

```
CREATE VIEW customer_list
AS
SELECT
  cu.customer_id AS ID,
  CONCAT(cu.first_name, _utf8' ', cu.last_name) AS name,
  a.address AS address,
  a.postal_code AS `zip code`,
  a.phone AS phone,
  city.city AS city,
  country.country AS country,
  IF(cu.active, _utf8'active', _utf8'') AS notes,
  cu.store_id AS SID
FROM customer AS cu
  JOIN address AS a ON cu.address_id = a.address_id
  JOIN city ON a.city_id = city.city_id
  JOIN country ON city.country_id = country.country_id;
```

View "film_list"

```
CREATE VIEW film_list
AS
SELECT
  film.film_id AS FID,
  film.title AS title,
  film.description AS description,
  category.name AS category,
  film.rental_rate AS price,
  film.length AS length,
  film.rating AS rating,
  GROUP_CONCAT(CONCAT(actor.first_name, _utf8' ', actor.last_name) SEPARATOR ', ') AS actors
FROM category
  LEFT JOIN film_category ON category.category_id = film_category.category_id
  LEFT JOIN film ON film_category.film_id = film.film_id
  JOIN film_actor ON film.film_id = film_actor.film_id
  JOIN actor ON film_actor.actor_id = actor.actor_id
GROUP BY film.film_id;
```

- The `GROUP_CONCAT(col SEPARATOR str) GROUP BY` aggregate function can be used to produce a concatenate string for each group returned by the `GROUP BY` clause. Each `film_id` (in `GROUP BY`) has many actors.
- For example,

```
mysql> SELECT * FROM film_list LIMIT 1 \G
*************************** 1. row ***************************
        FID: 1
      title: ACADEMY DINOSAUR
description: A Epic Drama of a Feminist And a Mad Scientist who must Battle
             a Teacher in The Canadian Rockies
   category: Documentary
      price: 0.99
     length: 86
     rating: PG
     actors: PENELOPE GUINESS, CHRISTIAN GABLE, LUCILLE TRACY, SANDRA PECK, JOHNNY CAGE,
             MENA TEMPLE, WARREN NOLTE, OPRAH KILMER, ROCK DUKAKIS, MARY KEITEL
```

View "nicer_but_slower_film_list"

```
CREATE VIEW nicer_but_slower_film_list
AS
SELECT
  film.film_id AS FID,
  film.title AS title,
  film.description AS description,
  category.name AS category,
  film.rental_rate AS price,
  film.length AS length,
  film.rating AS rating,
  GROUP_CONCAT(
    CONCAT(
       CONCAT(UCASE(SUBSTR(actor.first_name, 1, 1)),    -- first_name initial-cap
              LCASE(SUBSTR(actor.first_name, 2, LENGTH(actor.first_name))),
       _utf8' ',                                        -- space
       CONCAT(UCASE(SUBSTR(actor.last_name, 1, 1)),     -- last_name initial-cap
              LCASE(SUBSTR(actor.last_name, 2, LENGTH(actor.last_name))))))  -- end of outer CONCAT
    SEPARATOR ', ') AS actors
FROM category
  LEFT JOIN film_category ON category.category_id = film_category.category_id
  LEFT JOIN film ON film_category.film_id = film.film_id
  JOIN film_actor ON film.film_id = film_actor.film_id
  JOIN actor ON film_actor.actor_id = actor.actor_id
GROUP BY film.film_id;
```

- The complex `CONCAT()` is used to produce camel-case (initial-capitalized) for the `first_name` and `last_name`, e.g., "Penelope Guiness".
- `LENGTH(str)` returns the length of the string.
- `SUBSTR(str, fromIndex, length)` returns the substring from index of length (index begins at 1).
- `UCASE(str)` and `LCASE(str)` returns the uppercase and lowercase.
- This view is exactly the same as `film_list` view. Why is it called `nicer_but_slower_film_list`?

View "sales_by_store"

```
CREATE VIEW sales_by_store
AS
SELECT
  CONCAT(c.city, _utf8',', cy.country) AS store,
  CONCAT(m.first_name, _utf8' ', m.last_name) AS manager,
  SUM(p.amount) AS total_sales
FROM payment AS p
  INNER JOIN rental AS r ON p.rental_id = r.rental_id
  INNER JOIN inventory AS i ON r.inventory_id = i.inventory_id
  INNER JOIN store AS s ON i.store_id = s.store_id
  INNER JOIN address AS a ON s.address_id = a.address_id
  INNER JOIN city AS c ON a.city_id = c.city_id
  INNER JOIN country AS cy ON c.country_id = cy.country_id
  INNER JOIN staff AS m ON s.manager_staff_id = m.staff_id
GROUP BY s.store_id
ORDER BY cy.country, c.city;
```

The `SUM() GROUP BY` aggregate function applies to each group of `store_id`, i.e., per store.

For example,

```
+---------------------+--------------+-------------+
| store               | manager      | total_sales |
+---------------------+--------------+-------------+
| Woodridge,Australia | Jon Stephens |    33726.77 |
| Lethbridge,Canada   | Mike Hillyer |    33679.79 |
+---------------------+--------------+-------------+
```

View "sales_by_film_category"

```
CREATE VIEW sales_by_film_category
AS
SELECT
  c.name AS category,
  SUM(p.amount) AS total_sales
FROM payment AS p
  INNER JOIN rental AS r ON p.rental_id = r.rental_id
  INNER JOIN inventory AS i ON r.inventory_id = i.inventory_id
  INNER JOIN film AS f ON i.film_id = f.film_id
  INNER JOIN film_category AS fc ON f.film_id = fc.film_id
  INNER JOIN category AS c ON fc.category_id = c.category_id
GROUP BY c.name
ORDER BY total_sales DESC;
```

The `GROUP BY` aggregate function `SUM()` applies to each group of `c.name`, i.e., per `category`'s `name`.

View "actor_info"

```
CREATE
  DEFINER=CURRENT_USER
  SQL SECURITY INVOKER
  VIEW actor_info
AS
SELECT
  a.actor_id,
  a.first_name,
  a.last_name,
  GROUP_CONCAT(
     DISTINCT
     CONCAT(c.name, ': ',
        (SELECT
           GROUP_CONCAT(f.title ORDER BY f.title SEPARATOR ', ')
           FROM sakila.film f
           INNER JOIN sakila.film_category fc ON f.film_id = fc.film_id
           INNER JOIN sakila.film_actor fa ON f.film_id = fa.film_id
           WHERE fc.category_id = c.category_id AND fa.actor_id = a.actor_id)
        )  -- end CONCAT
     ORDER BY c.name
     SEPARATOR '; ') AS film_info
FROM sakila.actor a
LEFT JOIN sakila.film_actor fa ON a.actor_id = fa.actor_id
LEFT JOIN sakila.film_category fc ON fa.film_id = fc.film_id
LEFT JOIN sakila.category c ON fc.category_id = c.category_id
GROUP BY
  a.actor_id,
  a.first_name,
  a.last_name;
```

- `SQL SECURITY INVOKER` specifies that the it executes with the privileges of the user who invoke it (instead of the `DEFINER`).
- `GROUP_CONCAT([DISTINCT] col [ORDER BY ...] [SEPARATOR ...])`: You can apply optional `DISTINCT` and `ORDER BY` to `GROUP_CONCAT()`.
- For example,

```
mysql> SELECT * FROM actor_info LIMIT 1 \G
*************************** 1. row ***************************
  actor_id: 1
first_name: PENELOPE
 last_name: GUINESS
 film_info: Animation: ANACONDA CONFESSIONS;
            Children: LANGUAGE COWBOY;
            Classics: COLOR PHILADELPHIA, WESTWARD SEABISCUIT;
            ......
```

2.3 Stored Routines: Procedures and Functions

Procedure "rewards_report"

```
-- Change the MySQL statement delimiter to // as it crashes with procedure's delimiter ';'
DELIMITER //

CREATE PROCEDURE rewards_report (
   IN min_monthly_purchases TINYINT UNSIGNED,              -- min number of purchases
   IN min_dollar_amount_purchased DECIMAL(10,2) UNSIGNED,  -- min dollar amount purchased
   OUT count_rewardees INT                                 -- number of customers to be rewarded
)
LANGUAGE SQL
NOT DETERMINISTIC
READS SQL DATA
SQL SECURITY DEFINER
COMMENT 'Provides a customizable report on best customers'

proc: BEGIN
   DECLARE last_month_start DATE;
   DECLARE last_month_end DATE;

   /* Some sanity checks... */
   IF min_monthly_purchases = 0 THEN
      SELECT 'Minimum monthly purchases parameter must be > 0';
      LEAVE proc;
   END IF;
   IF min_dollar_amount_purchased = 0.00 THEN
      SELECT 'Minimum monthly dollar amount purchased parameter must be > $0.00';
      LEAVE proc;
   END IF;

   /* Determine start and end time periods */
   SET last_month_start = DATE_SUB(CURRENT_DATE(), INTERVAL 1 MONTH);
   SET last_month_start = STR_TO_DATE(
                            CONCAT(YEAR(last_month_start), '-', MONTH(last_month_start), '-01'),
                            '%Y-%m-%d');
   SET last_month_end = LAST_DAY(last_month_start);

   /* Create a temporary storage area for Customer IDs */
   CREATE TEMPORARY TABLE tmpCustomer (customer_id SMALLINT UNSIGNED NOT NULL PRIMARY KEY);

   /* Find all customers meeting the monthly purchase requirements */
   INSERT INTO tmpCustomer (customer_id)
     SELECT p.customer_id
     FROM payment AS p
     WHERE DATE(p.payment_date) BETWEEN last_month_start AND last_month_end
     GROUP BY customer_id
     HAVING
       SUM(p.amount) > min_dollar_amount_purchased
       AND COUNT(customer_id) > min_monthly_purchases;

   /* Populate OUT parameter with count of found customers */
   SELECT COUNT(*) FROM tmpCustomer INTO count_rewardees;

   /* Output ALL customer information of matching rewardees.
      Customize output as needed. */
   SELECT c.*
     FROM tmpCustomer AS t
     INNER JOIN customer AS c ON t.customer_id = c.customer_id;

   /* Clean up */
   DROP TABLE tmpCustomer;
END //
```

```
-- Change the MySQL delimiter back to ';'
DELIMITER ;
```

To test the procedure,

```
mysql> CALL rewards_report(2, 10, @numRewardees);

mysel> SELECT @numRewardees;
```

Function "get_customer_balance"

```
DELIMITER $$

CREATE FUNCTION get_customer_balance(p_customer_id INT, p_effective_date DATETIME) RETURNS DECIMAL(5,2)
   DETERMINISTIC
   READS SQL DATA
BEGIN
   # OK, WE NEED TO CALCULATE THE CURRENT BALANCE GIVEN A CUSTOMER_ID AND A DATE
   # THAT WE WANT THE BALANCE TO BE EFFECTIVE FOR. THE BALANCE IS:
   #   1) RENTAL FEES FOR ALL PREVIOUS RENTALS
   #   2) ONE DOLLAR FOR EVERY DAY THE PREVIOUS RENTALS ARE OVERDUE
   #   3) IF A FILM IS MORE THAN RENTAL_DURATION * 2 OVERDUE, CHARGE THE REPLACEMENT_COST
   #   4) SUBTRACT ALL PAYMENTS MADE BEFORE THE DATE SPECIFIED

   DECLARE v_rentfees DECIMAL(5,2);  # FEES PAID TO RENT THE VIDEOS INITIALLY
   DECLARE v_overfees INTEGER;       # LATE FEES FOR PRIOR RENTALS
   DECLARE v_payments DECIMAL(5,2);  # SUM OF PAYMENTS MADE PREVIOUSLY

   SELECT IFNULL(SUM(film.rental_rate), 0) INTO v_rentfees
     FROM film, inventory, rental
     WHERE film.film_id = inventory.film_id
      AND inventory.inventory_id = rental.inventory_id
      AND rental.rental_date <= p_effective_date
      AND rental.customer_id = p_customer_id;

   SELECT IFNULL(
             SUM(
                IF((TO_DAYS(rental.return_date) - TO_DAYS(rental.rental_date)) > film.rental_duration,
                   ((TO_DAYS(rental.return_date) - TO_DAYS(rental.rental_date)) - film.rental_duration), 0)),
             0)
          INTO v_overfees
   FROM rental, inventory, film
   WHERE film.film_id = inventory.film_id
      AND inventory.inventory_id = rental.inventory_id
      AND rental.rental_date <= p_effective_date
      AND rental.customer_id = p_customer_id;

   SELECT IFNULL(SUM(payment.amount), 0) INTO v_payments
   FROM payment
   WHERE payment.payment_date <= p_effective_date
      AND payment.customer_id = p_customer_id;

   RETURN v_rentfees + v_overfees - v_payments;
END $$
DELIMITER ;
```

Procedure "film_in_stock"

```
DELIMITER $$
-- Given the film_id and store_id, find the film count
CREATE PROCEDURE film_in_stock(
   IN  p_film_id INT,
   IN  p_store_id INT,
   OUT p_film_count INT)
READS SQL DATA
BEGIN
```

```
   SELECT inventory_id
     FROM inventory
     WHERE film_id = p_film_id
       AND store_id = p_store_id
       AND inventory_in_stock(inventory_id);

   SELECT FOUND_ROWS() INTO p_film_count;
END $$
DELIMITER ;
```

Procedure "film_not_in_stock"

```
DELIMITER $$
CREATE PROCEDURE film_not_in_stock(IN p_film_id INT, IN p_store_id INT, OUT p_film_count INT)
READS SQL DATA
BEGIN
   SELECT inventory_id
   FROM inventory
   WHERE film_id = p_film_id
   AND store_id = p_store_id
   AND NOT inventory_in_stock(inventory_id);

   SELECT FOUND_ROWS() INTO p_film_count;
END $$
DELIMITER ;
```

Function "inventory_held_by_customer"

```
DELIMITER $$
CREATE FUNCTION inventory_held_by_customer(p_inventory_id INT) RETURNS INT
READS SQL DATA
BEGIN
   DECLARE v_customer_id INT;
   DECLARE EXIT HANDLER FOR NOT FOUND RETURN NULL;

   SELECT customer_id INTO v_customer_id
   FROM rental
   WHERE return_date IS NULL AND inventory_id = p_inventory_id;

   RETURN v_customer_id;
END $$
DELIMITER ;
```

Function "inventory_in_stock"

```
DELIMITER $$
CREATE FUNCTION inventory_in_stock(p_inventory_id INT) RETURNS BOOLEAN
READS SQL DATA
BEGIN
   DECLARE v_rentals INT;
   DECLARE v_out     INT;

   # AN ITEM IS IN-STOCK IF THERE ARE EITHER NO ROWS IN THE rental TABLE
   # FOR THE ITEM OR ALL ROWS HAVE return_date POPULATED
   SELECT COUNT(*) INTO v_rentals
   FROM rental
   WHERE inventory_id = p_inventory_id;

   IF v_rentals = 0 THEN
      RETURN TRUE;
   END IF;

   SELECT COUNT(rental_id) INTO v_out
   FROM inventory LEFT JOIN rental USING(inventory_id)
   WHERE inventory.inventory_id = p_inventory_id AND rental.return_date IS NULL;
```

```
   IF v_out > 0 THEN
      RETURN FALSE;
   ELSE
      RETURN TRUE;
   END IF;
END $$
DELIMITER ;
```

2.4 Triggers

The `film_text` table duplicates information from `film` table to build a `FULLTEXT` search index. To ensure consistency between the two tables, triggers are used for `INSERT`, `UPDATE` and `DELETE` on each row of `film` table, that perform corresponding actions in the `film_text` table.

Trigger "ins_film"

```
DELIMITER $$
-- Trigger for INSERT INTO film table
-- Copy information to film_text table
CREATE TRIGGER `ins_film` AFTER INSERT ON `film` FOR EACH ROW
BEGIN
   INSERT INTO film_text (film_id, title, description)
      VALUES (new.film_id, new.title, new.description);
END$$
DELIMITER ;
```

Trigger "upd_film"

```
-- Trigger for UPDATE film table
-- Update the film_text table
DELIMITER $$
CREATE TRIGGER `upd_film` AFTER UPDATE ON `film` FOR EACH ROW
BEGIN
   IF (old.title != new.title) or (old.description != new.description)
   THEN
      UPDATE film_text
      SET title=new.title,
          description=new.description,
          film_id=new.film_id
      WHERE film_id=old.film_id;
   END IF;
END$$
DELIMITER ;
```

Trigger "del_film"

```
-- Trigger for DELECT FROM film table
-- DELETE from film_text table as well
DELIMITER $$
CREATE TRIGGER `del_film` AFTER DELETE ON `film` FOR EACH ROW
BEGIN
   DELETE FROM film_text WHERE film_id = old.film_id;
END$$
DELIMITER ;
```

3. Microsoft Northwind Trader Database

For MS SQL Server, you can download the Northwind database from "Northwind and Pubs Sample Databases for SQL Server 2000". Run the downloaded "`.msi`" file, it will extract the files into "`C:\SQL Server 2000 Sample Databases`". The SQL statements are

kept in "`instnwnd.sql`".

For MS Access ⇒ Launch Access ⇒ Choose "Sample" ⇒ Northwind Sample Database ⇒ Download.

There are various MySQL ports available. For example, "northwindextended" project @ http://code.google.com/p/northwindextended.

3.1 Database and Tables

There are 13 tables as follows:

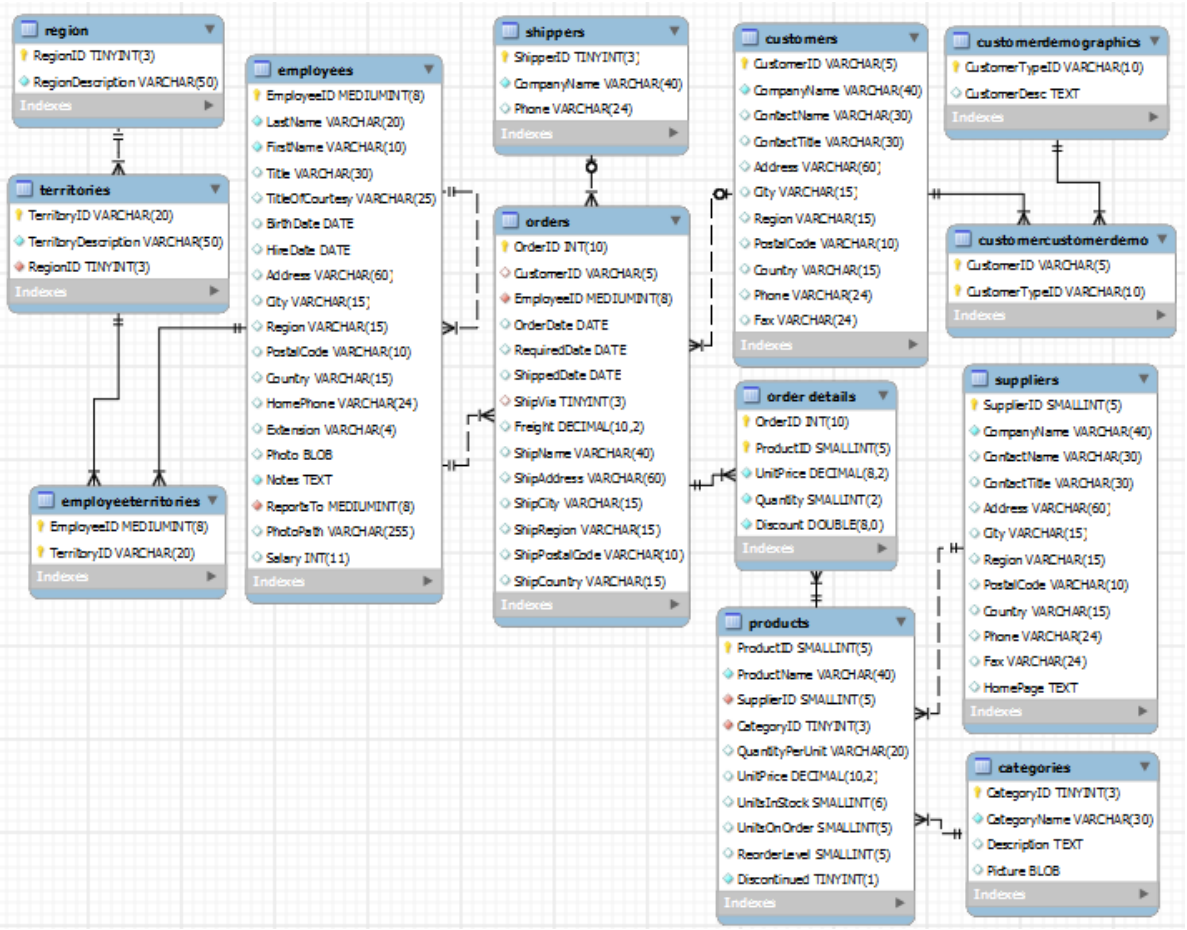


Table "Customers"

```
CREATE TABLE `Customers` (
   `CustomerID`    VARCHAR(5)   NOT NULL,
      -- First 5 letters of CompanyName
      -- Probably better to use an UNSIGNED INT
   `CompanyName`   VARCHAR(40)  NOT NULL,
   `ContactName`   VARCHAR(30),
   `ContactTitle`  VARCHAR(30),
   `Address`       VARCHAR(60),
   `City`          VARCHAR(15),
   `Region`        VARCHAR(15),
   `PostalCode`    VARCHAR(10),
   `Country`       VARCHAR(15),
   `Phone`         VARCHAR(24),
   `Fax`           VARCHAR(24),
   PRIMARY KEY (`CustomerID`),
   INDEX (`City`),
   INDEX (`CompanyName`),
   INDEX (`PostalCode`),
   INDEX (`Region`)
```

```
        -- Build indexes on these columns for fast search
);
```

There are 93 records for this table.

Table "Employees"

```
CREATE TABLE `Employees` (
   `EmployeeID`      MEDIUMINT UNSIGNED  NOT NULL AUTO_INCREMENT,
                     -- [0, 65535]
   `LastName`        VARCHAR(20)         NOT NULL,
   `FirstName`       VARCHAR(10)         NOT NULL,
   `Title`           VARCHAR(30),  -- e.g., 'Sales Coordinator'
   `TitleOfCourtesy` VARCHAR(25),  -- e.g., 'Mr.' 'Ms.' (ENUM??)
   `BirthDate`       DATE,         -- 'YYYY-MM-DD'
   `HireDate`        DATE,
   `Address`         VARCHAR(60),
   `City`            VARCHAR(15),
   `Region`          VARCHAR(15),
   `PostalCode`      VARCHAR(10),
   `Country`         VARCHAR(15),
   `HomePhone`       VARCHAR(24),
   `Extension`       VARCHAR(4),
   `Photo`           BLOB,                          -- 64KB
   `Notes`           TEXT                NOT NULL,  -- 64KB
   `ReportsTo`       MEDIUMINT UNSIGNED  NULL,  -- Manager's ID
                                                -- Allow NULL for boss
   `PhotoPath`       VARCHAR(255),
   `Salary`          INT,
   INDEX (`LastName`),
   INDEX (`PostalCode`),
   PRIMARY KEY (`EmployeeID`),
   FOREIGN KEY (`ReportsTo`) REFERENCES `Employees` (`EmployeeID`)
);
```

To load this table with the sample data provided, you need to move the second record as the first record and hardcode the `employeeID`. There are 9 records for this table. The photos are included as hex data.

To list the worker names under the manager names, you need to join the `employee` table to itself. Use `LEFT JOIN` to retrieve `ReportsTo` of `NULL`.

```
-- List the worker names under the managers' ID
SELECT reportsTo AS `Manager ID`, CONCAT(employees.FirstName, ' ', employees.LastName) AS `Workers`
FROM employees
ORDER BY reportsTo;
+------------+------------------+
| Manager ID | Workers          |
+------------+------------------+
|       NULL | Andrew Fuller    |
|          2 | Nancy Davolio    |
|          2 | Janet Leverling  |
|          2 | Margaret Peacock |
|          2 | Steven Buchanan  |
|          2 | Laura Callahan   |
|          5 | Michael Suyama   |
|          5 | Robert King      |
|          5 | Anne Dodsworth   |
+------------+------------------+

-- List the worker name under the managers' name
-- Need to use a LEFT JOIN
SELECT
  CONCAT(managers.FirstName, ' ', managers.LastName) AS `Managers`,
  CONCAT(employees.FirstName, ' ', employees.LastName) AS `Workers`
FROM
  employees LEFT JOIN employees AS managers ON employees.ReportsTo = managers.employeeID
```

```
ORDER BY
  managers.employeeID;
+-----------------+------------------+
| Managers        | Workers          |
+-----------------+------------------+
| NULL            | Andrew Fuller    |
| Andrew Fuller   | Margaret Peacock |
| Andrew Fuller   | Laura Callahan   |
| Andrew Fuller   | Nancy Davolio    |
| Andrew Fuller   | Steven Buchanan  |
| Andrew Fuller   | Janet Leverling  |
| Steven Buchanan | Robert King      |
| Steven Buchanan | Anne Dodsworth   |
| Steven Buchanan | Michael Suyama   |
+-----------------+------------------+
```

Table "Region"

```
CREATE TABLE `Region` (
   `RegionID`           TINYINT UNSIGNED  NOT NULL AUTO_INCREMENT,
                        -- [0,255]
   `RegionDescription`  VARCHAR(50)       NOT NULL,
                        -- e.g., 'Eastern','Western','Northern','Southern'
                        -- Could use an ENUM and eliminate this table
   PRIMARY KEY (`RegionID`)
);
```

There are 4 records for this table ('Eastern', 'Western', 'Northern', 'Southern').

Table "Territories"

```
-- e.g., ('02116', 'Boston', 1)
CREATE TABLE `Territories` (
   `TerritoryID`           VARCHAR(20)       NOT NULL,  -- ZIP code
   `TerritoryDescription`  VARCHAR(50)       NOT NULL,  -- Name
   `RegionID`              TINYINT UNSIGNED  NOT NULL,
                           -- Could use an ENUM to eliminate `Region` table
   PRIMARY KEY (`TerritoryID`),
   FOREIGN KEY (`RegionID`) REFERENCES `Region` (`RegionID`)
);
```

There are 53 records for this table.

Table "EmployeeTerritories"

```
-- Many-to-many Junction table between Employee and Territory
CREATE TABLE `EmployeeTerritories` (
   `EmployeeID`  MEDIUMINT UNSIGNED  NOT NULL,
   `TerritoryID` VARCHAR(20) NOT NULL,
   PRIMARY KEY (`EmployeeID`, `TerritoryID`),
   FOREIGN KEY (`EmployeeID`) REFERENCES `Employees` (`EmployeeID`),
   FOREIGN KEY (`TerritoryID`) REFERENCES `Territories` (`TerritoryID`)
);
```

There are 49 records for this table. Each employee has more than one territories. Some territories are not covered (53-49=4).

```
SELECT EmployeeID, COUNT(*) from EmployeeTerritories GROUP BY EmployeeID WITH ROLLUP;
+------------+----------+
| EmployeeID | COUNT(*) |
+------------+----------+
|          1 |        2 |
|          2 |        7 |
|          3 |        4 |
|          4 |        3 |
|          5 |        7 |
|          6 |        5 |
```

```
|          7 |       10 |
|          8 |        4 |
|          9 |        7 |
|       NULL |       49 |
+------------+----------+

SELECT TerritoryID, TerritoryDescription
FROM Territories LEFT JOIN EmployeeTerritories using (TerritoryID)
WHERE EmployeeID IS NULL;
+-------------+----------------------+
| TerritoryID | TerritoryDescription |
+-------------+----------------------+
| 29202       | Columbia             |
| 72716       | Bentonville          |
| 75234       | Dallas               |
| 78759       | Austin               |
+-------------+----------------------+
```

Table "Categories"

```
CREATE TABLE `Categories` (
   `CategoryID`   TINYINT UNSIGNED  NOT NULL AUTO_INCREMENT,
                  -- [0, 255], not expected to be large
   `CategoryName` VARCHAR(30)       NOT NULL,
                  -- e.g., 'Beverages','Condiments',etc
   `Description`  TEXT,        -- up to 64KB characters
   `Picture`      BLOB,        -- up to 64KB binary
   PRIMARY KEY  (`CategoryID`),
   UNIQUE INDEX (`CategoryName`)
      -- Build index on this unique-value column for fast search
);
```

There are 8 records for the table, with pictures in hex code.

Table "Suppliers"

```
CREATE TABLE `Suppliers` (
   `SupplierID`   SMALLINT UNSIGNED  NOT NULL AUTO_INCREMENT,
                                     -- [0, 65535]
   `CompanyName`  VARCHAR(40)        NOT NULL,
   `ContactName`  VARCHAR(30),
   `ContactTitle` VARCHAR(30),
   `Address`      VARCHAR(60),
   `City`         VARCHAR(15),
   `Region`       VARCHAR(15),
   `PostalCode`   VARCHAR(10),
   `Country`      VARCHAR(15),
   `Phone`        VARCHAR(24),
   `Fax`          VARCHAR(24),
   `HomePage`     TEXT,          -- 64KB?? VARCHAR(255)?
    PRIMARY KEY (`SupplierID`),
    INDEX (`CompanyName`),       -- UNIQUE?
    INDEX (`PostalCode`)
);
```

There are 29 records for this table.

Table "Products"

```
CREATE TABLE `Products` (
   `ProductID`       SMALLINT UNSIGNED       NOT NULL AUTO_INCREMENT,
   `ProductName`     VARCHAR(40)             NOT NULL,
   `SupplierID`      SMALLINT UNSIGNED       NOT NULL,  -- one supplier only
   `CategoryID`      TINYINT UNSIGNED        NOT NULL,
   `QuantityPerUnit` VARCHAR(20),            -- e.g., '10 boxes x 20 bags'
   `UnitPrice`       DECIMAL(10,2) UNSIGNED  DEFAULT 0,
```

```
   `UnitsInStock`    SMALLINT               DEFAULT 0,  -- Negative??
   `UnitsOnOrder`    SMALLINT UNSIGNED      DEFAULT 0,
   `ReorderLevel`    SMALLINT UNSIGNED      DEFAULT 0,
   `Discontinued`    BOOLEAN                NOT NULL DEFAULT FALSE,
   PRIMARY KEY (`ProductID`),
   INDEX (`ProductName`),
   FOREIGN KEY (`CategoryID`) REFERENCES `Categories` (`CategoryID`),
   FOREIGN KEY (`SupplierID`) REFERENCES `Suppliers` (`SupplierID`)
);
```

There are 77 records for this table.

Table "Shippers"

```
CREATE TABLE `Shippers` (
   `ShipperID`   TINYINT UNSIGNED  NOT NULL AUTO_INCREMENT,
   `CompanyName` VARCHAR(40)       NOT NULL,
   `Phone`       VARCHAR(24),
   PRIMARY KEY (`ShipperID`)
);
```

There are 3 records for this table.

Table "Orders"

```
CREATE TABLE `Orders` (
   `OrderID`        INT UNSIGNED        NOT NULL AUTO_INCREMENT,
                    -- Use UNSIGNED INT to avoid run-over
   `CustomerID`     VARCHAR(5),
   `EmployeeID`     MEDIUMINT UNSIGNED  NOT NULL,
   `OrderDate`      DATE,
   `RequiredDate`   DATE,
   `ShippedDate`    DATE,
   `ShipVia`        TINYINT UNSIGNED,
   `Freight`        DECIMAL(10,2) UNSIGNED  DEFAULT 0,
   `ShipName`       VARCHAR(40),
   `ShipAddress`    VARCHAR(60),
   `ShipCity`       VARCHAR(15),
   `ShipRegion`     VARCHAR(15),
   `ShipPostalCode` VARCHAR(10),
   `ShipCountry`    VARCHAR(15),
   PRIMARY KEY (`OrderID`),
   INDEX (`OrderDate`),
   INDEX (`ShippedDate`),
   INDEX (`ShipPostalCode`),
   FOREIGN KEY (`CustomerID`) REFERENCES `Customers` (`CustomerID`),
   FOREIGN KEY (`EmployeeID`) REFERENCES `Employees` (`EmployeeID`),
   FOREIGN KEY (`ShipVia`)    REFERENCES `Shippers`  (`ShipperID`)
);
```

There are 830 records for this table.

Table "Order Details"

```
-- Many-to-many Junction table between Orders and Products
CREATE TABLE `Order Details` (
   `OrderID`   INT UNSIGNED           NOT NULL,
   `ProductID` SMALLINT UNSIGNED      NOT NULL,
   `UnitPrice` DECIMAL(8,2) UNSIGNED  NOT NULL DEFAULT 999999.99,
                                      -- max value as default
   `Quantity`  SMALLINT(2) UNSIGNED   NOT NULL DEFAULT 1,
   `Discount`  DOUBLE(8,0)            NOT NULL DEFAULT 0, -- e.g., 0.15
   PRIMARY KEY (`OrderID`, `ProductID`),
   FOREIGN KEY (`OrderID`)   REFERENCES `Orders`   (`OrderID`),
   FOREIGN KEY (`ProductID`) REFERENCES `Products` (`ProductID`)
);
```

There are 2155 records for this table.

```
-- List the number of `Order Details` for each OrderID
SELECT OrderID, COUNT(OrderID)
FROM Orders INNER JOIN `Order Details` USING (OrderID)
GROUP BY OrderID
WITH ROLLUP;
```

Table "CustomerDemographics"

```
CREATE TABLE `CustomerDemographics` (
   `CustomerTypeID`  VARCHAR(10)  NOT NULL,
   `CustomerDesc`    TEXT,        -- 64KB
   PRIMARY KEY (`CustomerTypeID`)
);
```

No record is provided for this table?!

Table "CustomerCustomerDemo"

```
CREATE TABLE `CustomerCustomerDemo` (
   `CustomerID`     VARCHAR(5)   NOT NULL,
   `CustomerTypeID` VARCHAR(10)  NOT NULL,
   PRIMARY KEY (`CustomerID`, `CustomerTypeID`),
   FOREIGN KEY (`CustomerTypeID`) REFERENCES `CustomerDemographics` (`CustomerTypeID`),
   FOREIGN KEY (`CustomerID`) REFERENCES `Customers` (`CustomerID`)
);
```

No record is provided for this table too?!

3.2 Views

There are 16 views defined.

View "Current Product List"

```
-- List current products (not discontinued)
CREATE VIEW `Current Product List`
AS
SELECT
   ProductID,
   ProductName
FROM Products
WHERE Discontinued = 0;
```

View "Alphabetical list of products"

```
-- List products (with category) order by ProductID
-- which is arranged alphabetically in ProductName
CREATE VIEW `Alphabetical list of products`
AS
SELECT
   Products.*,
   Categories.CategoryName
FROM Categories
   INNER JOIN Products ON Categories.CategoryID = Products.CategoryID
WHERE Products.Discontinued = 0;  -- FALSE
```

```
-- Example
mysql> SELECT * FROM `Alphabetical list of products` LIMIT 1 \G
*************************** 1. row ***************************
      ProductID: 1
    ProductName: Chai
     SupplierID: 1
```

```
     CategoryID: 1
QuantityPerUnit: 10 boxes x 20 bags
      UnitPrice: 18.00
   UnitsInStock: 39
   UnitsOnOrder: 0
   ReorderLevel: 10
   Discontinued: 0
   CategoryName: Beverages
```

View "Products by Category"

```
-- List all products grouped by category
CREATE VIEW `Products by Category`
AS
SELECT
   Categories.CategoryName,
   Products.ProductName,
   Products.QuantityPerUnit,
   Products.UnitsInStock,
   Products.Discontinued
FROM Categories
   INNER JOIN Products ON Categories.CategoryID = Products.CategoryID
WHERE Products.Discontinued = 0;  -- FALSE
```

```
-- Example
mysql> SELECT * FROM `Products by Category`;
+----------------+---------------------------------+---------------------+--------------+--------------+
| CategoryName   | ProductName                     | QuantityPerUnit     | UnitsInStock | Discontinued |
+----------------+---------------------------------+---------------------+--------------+--------------+
| Beverages      | Chai                            | 10 boxes x 20 bags  |           39 |            0 |
| Beverages      | Chang                           | 24 - 12 oz bottles  |           17 |            0 |
| Beverages      | Sasquatch Ale                   | 24 - 12 oz bottles  |          111 |            0 |
 .......
```

View "Products Above Average Price"

```
CREATE VIEW `Products Above Average Price`
AS
SELECT
   Products.ProductName,
   Products.UnitPrice
FROM Products
WHERE Products.UnitPrice > (SELECT AVG(UnitPrice) From Products);  -- subquery
```

```
mysql> SELECT * FROM `Products Above Average Price` ORDER BY UnitPrice DESC;
+---------------------------------+-----------+
| ProductName                     | UnitPrice |
+---------------------------------+-----------+
| Cte de Blaye                    |    263.50 |
| Thringer Rostbratwurst          |    123.79 |
| Mishi Kobe Niku                 |     97.00 |
 ......
```

View "Customer and Suppliers by City"

```
-- List all customers and suppliers (with an union)
-- order by City and CompanyName
CREATE VIEW `Customer and Suppliers by City`
AS
SELECT
   City,
   CompanyName,
   ContactName,
   'Customers' AS Relationship
```

```
FROM Customers
UNION  -- Union two result sets (of same column numbers), remove duplicates
SELECT City,
   CompanyName,
   ContactName,
   'Suppliers'
FROM Suppliers
ORDER BY City, CompanyName;
```

```
mysql> SELECT * FROM `Customer and Suppliers by City` LIMIT 10;
+--------------+---------------------------+------------------+--------------+
| City         | CompanyName               | ContactName      | Relationship |
+--------------+---------------------------+------------------+--------------+
| NULL         | IT                        | Val2             | Customers    |
| NULL         | IT                        | Valon Hoti       | Customers    |
| Aachen       | Drachenblut Delikatessen  | Sven Ottlieb     | Customers    |
| Albuquerque  | Rattlesnake Canyon Grocery | Paula Wilson     | Customers    |
| Anchorage    | Old World Delicatessen    | Rene Phillips    | Customers    |
| Ann Arbor    | Grandma Kelly's Homestead | Regina Murphy    | Suppliers    |
 ......
```

View "Order Details Extended"

```
-- Extend `Order Details` to include ProductName and TotalPrice
CREATE VIEW `Order Details Extended`
AS
SELECT
   `Order Details`.OrderID,
   `Order Details`.ProductID,
   Products.ProductName,
   `Order Details`.UnitPrice,
   `Order Details`.Quantity,
   `Order Details`.Discount,
   ROUND(`Order Details`.UnitPrice*Quantity*(1-Discount)) AS ExtendedPrice
FROM Products
   JOIN `Order Details` ON Products.ProductID = `Order Details`.ProductID;
```

```
mysql> SELECT * FROM `Order Details Extended`;
+---------+-----------+--------------+-----------+----------+----------+---------------+
| OrderID | ProductID | ProductName  | UnitPrice | Quantity | Discount | ExtendedPrice |
+---------+-----------+--------------+-----------+----------+----------+---------------+
|   10265 |        17 | Alice Mutton |     31.20 |       30 |        0 |           936 |
|   10279 |        17 | Alice Mutton |     31.20 |       15 |        0 |           468 |
|   10294 |        17 | Alice Mutton |     31.20 |       15 |        0 |           468 |
 ......
```

View "Invoices"

```
-- All information (order, customer, shipper)
-- for each `Order Details` line.
-- An invoice is supposed to be per order?!
CREATE VIEW `Invoices`
AS
SELECT
   Orders.ShipName,
   Orders.ShipAddress,
   Orders.ShipCity,
   Orders.ShipRegion,
   Orders.ShipPostalCode,
   Orders.ShipCountry,
   Orders.CustomerID,
   Customers.CompanyName AS CustomerName,
   Customers.Address,
   Customers.City,
   Customers.Region,
```

```
   Customers.PostalCode,
   Customers.Country,
   (Employees.FirstName + ' ' + Employees.LastName) AS Salesperson,
   Orders.OrderID,
   Orders.OrderDate,
   Orders.RequiredDate,
   Orders.ShippedDate,
   Shippers.CompanyName As ShipperName,
   `Order Details`.ProductID,
   Products.ProductName,
   `Order Details`.UnitPrice,
   `Order Details`.Quantity,
   `Order Details`.Discount,
   FLOOR(`Order Details`.UnitPrice*Quantity*(1-Discount)) AS ExtendedPrice,
         -- truncate to nearest dollars
   Orders.Freight
FROM Customers
   JOIN Orders ON Customers.CustomerID = Orders.CustomerID
   JOIN Employees ON Employees.EmployeeID = Orders.EmployeeID
   JOIN `Order Details` ON Orders.OrderID = `Order Details`.OrderID
   JOIN Products ON Products.ProductID = `Order Details`.ProductID
   JOIN Shippers ON Shippers.ShipperID = Orders.ShipVia;
```

```
-- Example
mysql> SELECT * FROM `Invoices` LIMIT 2 \G
*************************** 1. row ***************************
      ShipName: Ernst Handel
      ......
    CustomerID: ERNSH
  CustomerName: Ernst Handel
      ......
   Salesperson: 0
       OrderID: 10258
     OrderDate: 1996-07-17
  RequiredDate: 1996-08-14
   ShippedDate: 1996-07-23
   ShipperName: Speedy Express
     ProductID: 2
   ProductName: Chang
     UnitPrice: 15.20
      Quantity: 50
      Discount: 0
 ExtendedPrice: 760
       Freight: 140.51
*************************** 2. row ***************************
      ShipName: Ernst Handel
      ......
    CustomerID: ERNSH
  CustomerName: Ernst Handel
      ......
   Salesperson: 0
       OrderID: 10258
     OrderDate: 1996-07-17
  RequiredDate: 1996-08-14
   ShippedDate: 1996-07-23
   ShipperName: Speedy Express
     ProductID: 5
   ProductName: Chef Anton's Gumbo Mix
     UnitPrice: 17.00
      Quantity: 65
      Discount: 0
 ExtendedPrice: 1105
       Freight: 140.51
```

View "Orders Qry"

```
-- List details (order and customer) of each order
--   for customer query
CREATE VIEW `Orders Qry`
AS
SELECT
   Orders.OrderID,
   Orders.CustomerID,
   Orders.EmployeeID,
   Orders.OrderDate,
   Orders.RequiredDate,
   Orders.ShippedDate,
   Orders.ShipVia,
   Orders.Freight,
   Orders.ShipName,
   Orders.ShipAddress,
   Orders.ShipCity,
   Orders.ShipRegion,
   Orders.ShipPostalCode,
   Orders.ShipCountry,
   Customers.CompanyName,
   Customers.Address,
   Customers.City,
   Customers.Region,
   Customers.PostalCode,
   Customers.Country
FROM Customers
   JOIN Orders ON Customers.CustomerID = Orders.CustomerID;
```

```
-- Example
mysql> SELECT * FROM `Orders Qry` LIMIT 1 \G;
*************************** 1. row ***************************
       OrderID: 10643
    CustomerID: ALFKI
    EmployeeID: 6
     OrderDate: 1997-08-25
  RequiredDate: 1997-09-22
   ShippedDate: 1997-09-02
       ShipVia: 1
       Freight: 29.46
      ShipName: Alfreds Futterkiste
      ......
   CompanyName: Alfreds Futterkiste
      ......
```

View "Product Sales for 1997"

```
-- List sales for each productName for 1997
CREATE VIEW `Product Sales for 1997`
AS
SELECT
   Categories.CategoryName,
   Products.ProductName,
   Sum(ROUND(`Order Details`.UnitPrice*Quantity*(1-Discount))) AS ProductSales
FROM Categories
   JOIN Products On Categories.CategoryID = Products.CategoryID
   JOIN `Order Details` on Products.ProductID = `Order Details`.ProductID
   JOIN `Orders` on Orders.OrderID = `Order Details`.OrderID
WHERE Orders.ShippedDate BETWEEN '1997-01-01' And '1997-12-31'
GROUP BY Categories.CategoryName, Products.ProductName;
```

```
-- Example
mysql> SELECT * FROM `Product Sales for 1997`;
+----------------+----------------------------------+--------------+
| CategoryName   | ProductName                      | ProductSales |
+----------------+----------------------------------+--------------+
```

```
| Beverages      | Chai                          |         5296 |
| Beverages      | Chang                         |         7600 |
| Beverages      | Chartreuse verte              |         4928 |
 ......
```

View "Sales by Category"

```
-- List Sales by ProductName
CREATE VIEW `Sales by Category`
AS
SELECT
   Categories.CategoryID,
   Categories.CategoryName,
   Products.ProductName,
   Sum(`Order Details Extended`.ExtendedPrice) AS ProductSales
FROM Categories
   JOIN Products ON Categories.CategoryID = Products.CategoryID
   JOIN `Order Details Extended` ON Products.ProductID = `Order Details Extended`.ProductID
   JOIN Orders ON Orders.OrderID = `Order Details Extended`.OrderID
WHERE Orders.OrderDate BETWEEN '1997-01-01' And '1997-12-31'
GROUP BY
   Categories.CategoryID,
   Categories.CategoryName,
   Products.ProductName;
```

```
mysql> SELECT * FROM `Sales by Category`;
+------------+----------------+---------------------------------+--------------+
| CategoryID | CategoryName   | ProductName                     | ProductSales |
+------------+----------------+---------------------------------+--------------+
|          1 | Beverages      | Chai                            |         5296 |
|          1 | Beverages      | Chang                           |         7600 |
|          1 | Beverages      | Chartreuse verte                |         4928 |
 ......
```

View "Category Sales for 1997"

```
CREATE VIEW `Category Sales for 1997`
AS
SELECT
   `Product Sales for 1997`.CategoryName,   -- Use `Product Sales for 1997` view
   Sum(`Product Sales for 1997`.ProductSales) AS CategorySales
FROM `Product Sales for 1997`
GROUP BY `Product Sales for 1997`.CategoryName;
```

```
mysql> SELECT * FROM `Category Sales for 1997`;
+----------------+---------------+
| CategoryName   | CategorySales |
+----------------+---------------+
| Beverages      |        108547 |
| Condiments     |         59586 |
| Confections    |         85678 |
 ......
```

View "Quarterly Orders"

```
-- List sales by customers in 1997
CREATE VIEW `Quarterly Orders`
AS
SELECT DISTINCT
   Customers.CustomerID,
   Customers.CompanyName,
   Customers.City,
   Customers.Country
FROM Customers
```

```
   JOIN Orders ON Customers.CustomerID = Orders.CustomerID
WHERE Orders.OrderDate BETWEEN '1997-01-01' And '1997-12-31';
```

```
mysql> SELECT * FROM `Quarterly Orders`;
+------------+----------------------------------+-----------------+-------------+
| CustomerID | CompanyName                      | City            | Country     |
+------------+----------------------------------+-----------------+-------------+
| ALFKI      | Alfreds Futterkiste              | Berlin          | Germany     |
| ANATR      | Ana Trujillo Emparedados y helados | Mxico D.F.      | Mexico      |
| ANTON      | Antonio Moreno Taquera           | Mxico D.F.      | Mexico      |
 .......
```

View "Order Subtotals"

```
-- List the total amount for each order
CREATE VIEW `Order Subtotals`
AS
SELECT
   `Order Details`.OrderID,
   Sum(ROUND(`Order Details`.UnitPrice*Quantity*(1-Discount))) AS Subtotal
FROM `Order Details`
GROUP BY `Order Details`.OrderID;
```

```
-- Example
mysql> SELECT * FROM `Order Subtotals` LIMIT 5;
+---------+----------+
| OrderID | Subtotal |
+---------+----------+
|   10248 |      440 |
|   10249 |     1863 |
|   10250 |     1813 |
|   10251 |      671 |
|   10252 |     3730 |
+---------+----------+
```

View "Sales Totals by Amount"

```
CREATE VIEW `Sales Totals by Amount`
AS
SELECT
   `Order Subtotals`.Subtotal AS SaleAmount,   -- `Order Subtotals` is a view
   Orders.OrderID,
   Customers.CompanyName,
   Orders.ShippedDate
FROM Customers
   JOIN Orders ON Customers.CustomerID = Orders.CustomerID
   JOIN `Order Subtotals` ON Orders.OrderID = `Order Subtotals`.OrderID
WHERE (`Order Subtotals`.Subtotal > 2500)
   AND (Orders.ShippedDate BETWEEN '1997-01-01' And '1997-12-31');
```

```
-- Example
mysql> SELECT * FROM `Sales Totals by Amount`;
+------------+---------+------------------------------+-------------+
| SaleAmount | OrderID | CompanyName                  | ShippedDate |
+------------+---------+------------------------------+-------------+
|       3302 |   10393 | Save-a-lot Markets           | 1997-01-03  |
|       2736 |   10398 | Save-a-lot Markets           | 1997-01-09  |
|       3063 |   10400 | Eastern Connection           | 1997-01-16  |
 ......
```

View "Summary of Sales by Quarter"

```
CREATE VIEW `Summary of Sales by Quarter`
AS
```

```
SELECT
   Orders.ShippedDate,
   Orders.OrderID,
   `Order Subtotals`.Subtotal  -- Use `Order Subtotals` view
FROM Orders
   INNER JOIN `Order Subtotals` ON Orders.OrderID = `Order Subtotals`.OrderID
WHERE Orders.ShippedDate IS NOT NULL;
```

```
-- Example
mysql> SELECT * FROM `Summary of Sales by Quarter`;
+-------------+---------+----------+
| ShippedDate | OrderID | Subtotal |
+-------------+---------+----------+
| 1996-07-16  |   10248 |      440 |
| 1996-07-10  |   10249 |     1863 |
| 1996-07-12  |   10250 |     1813 |
 ......
```

View "Summary of Sales by Year"

```
-- List each order
CREATE VIEW `Summary of Sales by Year`
AS
SELECT
   Orders.ShippedDate,
   Orders.OrderID,
   `Order Subtotals`.Subtotal
FROM Orders
   INNER JOIN `Order Subtotals` ON Orders.OrderID = `Order Subtotals`.OrderID
WHERE Orders.ShippedDate IS NOT NULL;
```

```
-- Example
mysql> SELECT * FROM `Summary of Sales by Year`;
+-------------+---------+----------+
| ShippedDate | OrderID | Subtotal |
+-------------+---------+----------+
| 1996-07-16  |   10248 |      440 |
| 1996-07-10  |   10249 |     1863 |
| 1996-07-12  |   10250 |     1813 |
 ......
```

3.3 Stored Routines: Procedures and Functions

There are 7 procedures defined.

Procedure "CustOrdersDetail"

```
-- Given an OrderID, print `Order Details`
DELIMITER $$
CREATE PROCEDURE `CustOrdersDetail`(IN AtOrderID INT)
BEGIN
   SELECT ProductName,
      `Order Details`.UnitPrice,
      Quantity,
      Discount * 100 AS `Discount`,
      ROUND(Quantity * (1 - Discount) * `Order Details`.UnitPrice) AS ExtendedPrice
   FROM Products INNER JOIN `Order Details` USING (ProductID)
   WHERE `Order Details`.OrderID = AtOrderID;
END$$
DELIMITER ;
```

```
mysql> CALL `CustOrdersDetail`(10250);
+---------------------------------+-----------+----------+----------+---------------+
| ProductName                     | UnitPrice | Quantity | Discount | ExtendedPrice |
```

```
+---------------------------------+-----------+----------+----------+---------------+
| Jack's New England Clam Chowder |      7.70 |       10 |        0 |            77 |
| Manjimup Dried Apples           |     42.40 |       35 |        0 |          1484 |
| Louisiana Fiery Hot Pepper Sauce |     16.80 |       15 |        0 |           252 |
+---------------------------------+-----------+----------+----------+---------------+
```

Procedure "CustOrdersOrders"

```
DELIMITER $$
CREATE PROCEDURE `CustOrdersOrders`(IN AtCustomerID VARCHAR(5))
BEGIN
   SELECT
      OrderID,
      OrderDate,
      RequiredDate,
      ShippedDate
   FROM Orders
   WHERE CustomerID = AtCustomerID
   ORDER BY OrderID;
END $$
DELIMITER ;
```

```
mysql> CALL `CustOrdersOrders`('ANTON');
+---------+------------+--------------+-------------+
| OrderID | OrderDate  | RequiredDate | ShippedDate |
+---------+------------+--------------+-------------+
|   10365 | 1996-11-27 | 1996-12-25   | 1996-12-02  |
|   10507 | 1997-04-15 | 1997-05-13   | 1997-04-22  |
|   10535 | 1997-05-13 | 1997-06-10   | 1997-05-21  |
 ......
```

Procedure "CustOrderHist"

```
DELIMITER $$
CREATE PROCEDURE `CustOrderHist`(IN AtCustomerID VARCHAR(5))
BEGIN
   SELECT
      ProductName,
      SUM(Quantity) as TOTAL
   FROM Products
      INNER JOIN `Order Details` USING(ProductID)
      INNER JOIN Orders USING (OrderID)
      INNER JOIN Customers USING (CustomerID)
   WHERE Customers.CustomerID = AtCustomerID
   GROUP BY ProductName;
END $$
DELIMITER ;
```

```
mysql> CALL `CustOrderHist`('ANTON');
+------------------------------+-------+
| ProductName                  | TOTAL |
+------------------------------+-------+
| Alice Mutton                 |    18 |
| Boston Crab Meat             |    10 |
| Chang                        |    20 |
 ......
```

Procedure "Ten Most Expensive Products"

```
DROP PROCEDURE IF EXISTS `Ten Most Expensive Products`;
DELIMITER $$
CREATE PROCEDURE `Ten Most Expensive Products`()
BEGIN
   SELECT
```

```
      Products.ProductName AS TenMostExpensiveProducts,
      Products.UnitPrice
   FROM Products
   ORDER BY Products.UnitPrice DESC
   LIMIT 10;
END $$
DELIMITER ;
```

```
mysql> CALL `Ten Most Expensive Products`;
+--------------------------+-----------+
| TenMostExpensiveProducts | UnitPrice |
+--------------------------+-----------+
| Cte de Blaye             |    263.50 |
| Thringer Rostbratwurst   |    123.79 |
| Mishi Kobe Niku          |     97.00 |
 ......
```

Procedure "Employee Sales by Country"

```
DELIMITER $$
CREATE PROCEDURE `Employee Sales by Country`(IN AtBeginning_Date DATE, IN AtEnding_Date DATE)
BEGIN
   SELECT
      Employees.Country,
      Employees.LastName,
      Employees.FirstName,
      Orders.ShippedDate,
      Orders.OrderID,
      `Order Subtotals`.Subtotal AS SaleAmount
   FROM Employees
      INNER JOIN Orders ON Employees.EmployeeID = Orders.EmployeeID
      INNER JOIN `Order Subtotals` ON Orders.OrderID = `Order Subtotals`.OrderID
   WHERE Orders.ShippedDate BETWEEN AtBeginning_Date AND AtEnding_Date;
END $$
DELIMITER ;
```

```
mysql> CALL `Employee Sales by Country`('1997-01-01', '1997-01-31');
+---------+-----------+-----------+-------------+---------+------------+
| Country | LastName  | FirstName | ShippedDate | OrderID | SaleAmount |
+---------+-----------+-----------+-------------+---------+------------+
| USA     | Callahan  | Laura     | 1997-01-16  |   10380 |       1420 |
| USA     | Fuller    | Andrew    | 1997-01-01  |   10392 |       1440 |
| USA     | Davolio   | Nancy     | 1997-01-03  |   10393 |       3302 |
 ......
```

Procedure "Sales by Year"

```
DELIMITER $$
CREATE PROCEDURE `Sales by Year`(IN AtBeginning_Date DATE, IN AtEnding_Date DATE)
BEGIN
   SELECT
      Orders.ShippedDate,
      Orders.OrderID,
      `Order Subtotals`.Subtotal,
      ShippedDate AS Year
   FROM Orders
      JOIN `Order Subtotals` ON Orders.OrderID = `Order Subtotals`.OrderID
   WHERE Orders.ShippedDate BETWEEN AtBeginning_Date AND AtEnding_Date;
END $$
DELIMITER ;
```

```
mysql> CALL `Sales by Year`('1997-01-01', '1997-01-31');
+-------------+---------+----------+------------+
| ShippedDate | OrderID | Subtotal | Year       |
+-------------+---------+----------+------------+
```

```
| 1997-01-16  |   10380 |     1420 | 1997-01-16 |
| 1997-01-01  |   10392 |     1440 | 1997-01-01 |
| 1997-01-03  |   10393 |     3302 | 1997-01-03 |
 ......
```

Procedure "SalesByCategory"

```
DELIMITER $$
CREATE PROCEDURE `SalesByCategory`(IN AtCategoryName VARCHAR(15), IN AtOrdYear VARCHAR(4))
BEGIN
   SELECT
      ProductName,
             ROUND(SUM(OD.Quantity * (1-OD.Discount) * OD.UnitPrice)) AS TotalPurchase
   FROM `Order Details` AS OD
      INNER JOIN Orders AS O USING (OrderID)
      INNER JOIN Products AS P USING (ProductID)
      INNER JOIN Categories AS C USING (CategoryID)
   WHERE C.CategoryName = AtCategoryName
      AND YEAR(O.OrderDate) = AtOrdYear
   GROUP BY ProductName
   ORDER BY ProductName;
END $$
DELIMITER ;
```

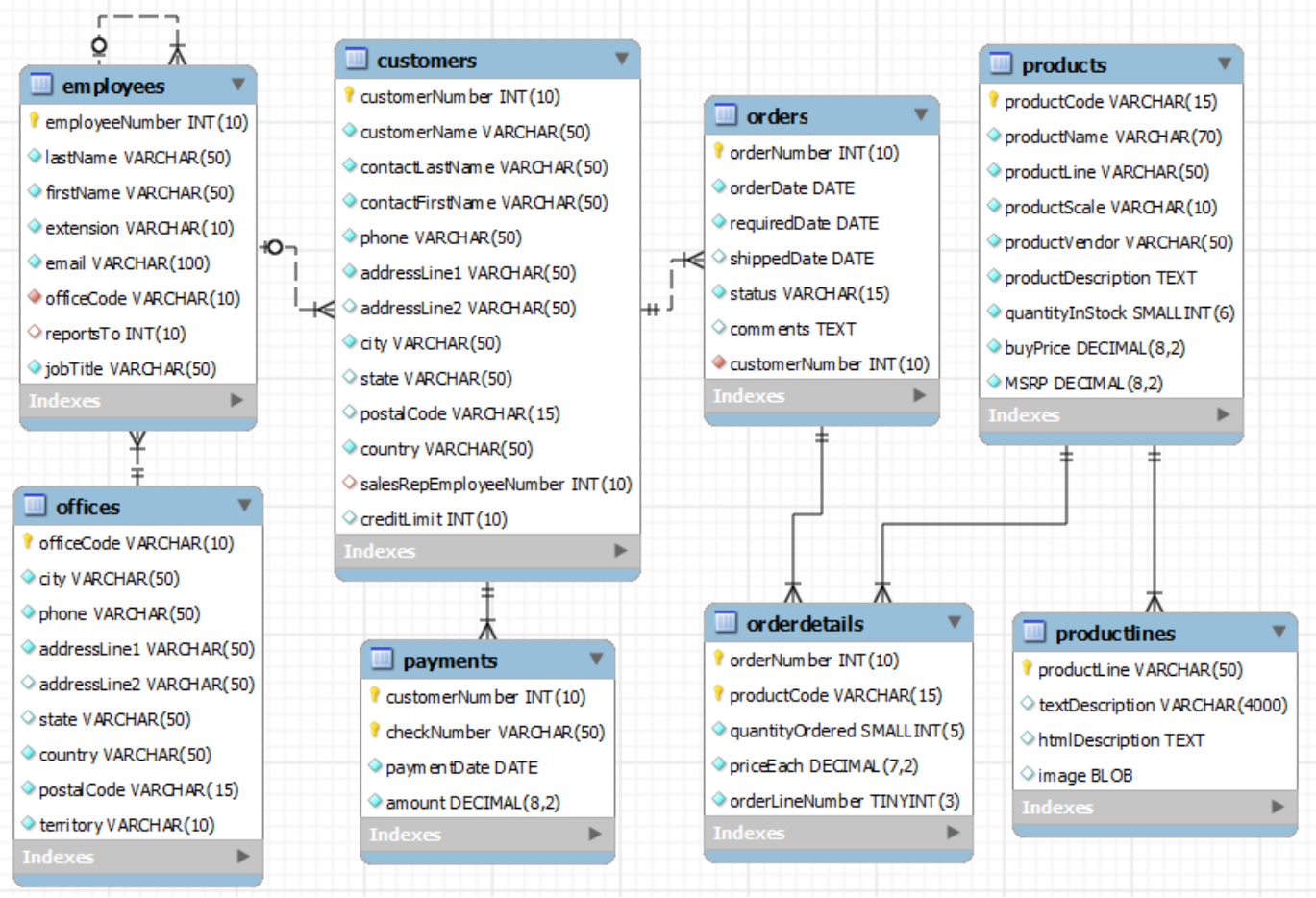
```
mysql> CALL `SalesByCategory`('Beverages', 1997);
+---------------------------+---------------+
| ProductName               | TotalPurchase |
+---------------------------+---------------+
| Chai                      |          5296 |
| Chang                     |          7600 |
| Chartreuse verte          |          4928 |
 ......
```

Try: i18n and UTF8 on MySQL Workbench.

4. MySQLTutorial.org's Sample Retailer Database

Reference: The "Classic Models" Retailer database of http://www.mysqltutorial.org.

4.1 Database and Tables



There are 8 tables, with no stored objects (view, procedure, function, trigger and event) defined.

I made some modifications to the data type, and added in the foreign keys and indexes.

Table "offices"

```
CREATE TABLE `offices` (
   `officeCode`    VARCHAR(10)  NOT NULL,
   `city`          VARCHAR(50)  NOT NULL,
   `phone`         VARCHAR(50)  NOT NULL,
   `addressLine1`  VARCHAR(50)  NOT NULL,
   `addressLine2`  VARCHAR(50)  DEFAULT NULL,
   `state`         VARCHAR(50)  DEFAULT NULL,
   `country`       VARCHAR(50)  NOT NULL,
   `postalCode`    VARCHAR(15)  NOT NULL,
   `territory`     VARCHAR(10)  NOT NULL,
   PRIMARY KEY  (`officeCode`),
   INDEX (`phone`),
   INDEX (`city`)
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 7 records for this table.

Table "employees"

```
CREATE TABLE `employees` (
   `employeeNumber`  INT UNSIGNED  NOT NULL AUTO_INCREMENT,
   `lastName`        VARCHAR(50)   NOT NULL,
   `firstName`       VARCHAR(50)   NOT NULL,
   `extension`       VARCHAR(10)   NOT NULL,
   `email`           VARCHAR(100)  NOT NULL,
   `officeCode`      VARCHAR(10)   NOT NULL,
   `reportsTo`       INT UNSIGNED  DEFAULT NULL,
   `jobTitle`        VARCHAR(50)   NOT NULL,
```

```
   PRIMARY KEY  (`employeeNumber`),
   INDEX (`lastName`),
   INDEX (`firstName`),
   FOREIGN KEY (`reportsTo`) REFERENCES `employees` (`employeeNumber`)
      ON DELETE RESTRICT ON UPDATE CASCADE,
   FOREIGN KEY (`officeCode`) REFERENCES `offices` (`officeCode`)
      ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 23 records for this table.

Table "customers"

```
CREATE TABLE `customers` (
   `customerNumber`   INT UNSIGNED  NOT NULL AUTO_INCREMENT,
   `customerName`     VARCHAR(50)   NOT NULL,
   `contactLastName`  VARCHAR(50)   NOT NULL,
   `contactFirstName` VARCHAR(50)   NOT NULL,
   `phone`            VARCHAR(50)   NOT NULL,
   `addressLine1`     VARCHAR(50)   NOT NULL,
   `addressLine2`     VARCHAR(50)   DEFAULT NULL,
   `city`             VARCHAR(50)   NOT NULL,
   `state`            VARCHAR(50)   DEFAULT NULL,
   `postalCode`       VARCHAR(15)   DEFAULT NULL,
   `country`          VARCHAR(50)   NOT NULL,
   `salesRepEmployeeNumber`  INT UNSIGNED  DEFAULT NULL,
   `creditLimit`      INT UNSIGNED  DEFAULT NULL,
   PRIMARY KEY (`customerNumber`),
   INDEX (`customerName`),
   INDEX (`contactLastName`),
   INDEX (`contactFirstName`),
   INDEX (`phone`),
   INDEX (`postalCode`),
   FOREIGN KEY (`salesRepEmployeeNumber`) REFERENCES `employees` (`employeeNumber`)
      ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 122 records for this table.

Table "products"

```
CREATE TABLE `products` (
   `productCode`         VARCHAR(15)  NOT NULL,
   `productName`         VARCHAR(70)  NOT NULL,
   `productLine`         VARCHAR(50)  NOT NULL,
   `productScale`        VARCHAR(10)  NOT NULL,
   `productVendor`       VARCHAR(50)  NOT NULL,
   `productDescription`  TEXT         NOT NULL,  -- 64KB
   `quantityInStock`     SMALLINT     NOT NULL,  -- Allow negative
   `buyPrice`            DECIMAL(8,2) UNSIGNED  NOT NULL,
   `MSRP`                DECIMAL(8,2) UNSIGNED  NOT NULL,
   PRIMARY KEY (`productCode`),
   INDEX (`productName`),
   INDEX (`productVendor`),
   INDEX (`productLine`)    -- needed to be indexed to be used as foreign key
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 110 records for this table.

Table "productlines"

```
CREATE TABLE `productlines` (
   `productLine`      VARCHAR(50)   NOT NULL,
   `textDescription`  VARCHAR(4000) DEFAULT NULL,
   `htmlDescription`  TEXT          DEFAULT NULL,  -- 64 KB
   `image`            BLOB          DEFAULT NULL,  -- 64 KB
```

```
   PRIMARY KEY (`productLine`),
   FOREIGN KEY (`productLine`) REFERENCES `products` (`productLine`)
      ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

You need to index the `productLine` column of the `products` table to use the column as a foreign key here.

There are 7 records for this table.

Table "orders"

```
CREATE TABLE `orders` (
   `orderNumber`     INT UNSIGNED  NOT NULL AUTO_INCREMENT,
   `orderDate`       DATE          NOT NULL,
   `requiredDate`    DATE          NOT NULL,
   `shippedDate`     DATE          DEFAULT NULL,
   `status`          VARCHAR(15)   NOT NULL,  -- use ENUM
   `comments`        TEXT          DEFAULT NULL,
   `customerNumber`  INT UNSIGNED  NOT NULL,
   PRIMARY KEY  (`orderNumber`),
   INDEX (`orderDate`),
   INDEX (`customerNumber`),
   FOREIGN KEY (`customerNumber`) REFERENCES `customers` (`customerNumber`)
      ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 326 records for this table.

Table "orderdetails"

```
CREATE TABLE `orderdetails` (
   `orderNumber`      INT UNSIGNED       NOT NULL,
   `productCode`      VARCHAR(15)        NOT NULL,
   `quantityOrdered`  SMALLINT UNSIGNED  NOT NULL,  -- [0, 65535]
   `priceEach`        DECIMAL(7,2)       NOT NULL,
   `orderLineNumber`  TINYINT UNSIGNED   NOT NULL,   -- [0,255]
   PRIMARY KEY  (`orderNumber`,`productCode`),
   FOREIGN KEY (`orderNumber`) REFERENCES `orders` (`orderNumber`)
      ON DELETE RESTRICT ON UPDATE CASCADE,
   FOREIGN KEY (`productCode`) REFERENCES `products` (`productCode`)
      ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

There are 2996 records for this table.

Table "payments"

```
CREATE TABLE `payments` (
   `customerNumber`  INT UNSIGNED           NOT NULL,
   `checkNumber`     VARCHAR(50)            NOT NULL,
   `paymentDate`     DATE                   NOT NULL,
   `amount`          DECIMAL(8,2) UNSIGNED  NOT NULL,
   PRIMARY KEY  (`customerNumber`,`checkNumber`),
   FOREIGN KEY (`customerNumber`) REFERENCES `customers` (`customerNumber`)
      ON DELETE RESTRICT ON UPDATE CASCADE
) ENGINE=InnoDB DEFAULT CHARSET=utf8;
```

This payment table does not reflect the order paid?! Could also provide a `VIEW` for `invoices`.

There are 273 records for this table.

Link to MySQL References & Resources

Latest version tested: MySQL 5.5.28, MySQL Workbench 5.2.44
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Feedback, comments, corrections, and errata can be sent to Chua Hock-Chuan (ehchua@ntu.edu.sg) | HOME