Tutorial on Entity-Relationship Diagrams — CPSC 304

February 2, 2007

Abstract

This tutorial consists of 4 questions of ER diagrams. Q1 is a small one so that students feel it easy to follow the specs. listed one by one. Q2 is a question used in previous course about a "Motor Vehicle Branch"'s management system. It's a small ER containing only 5 entities and 3 relationships. Students are able to do the ER diagram once in a whole. Q3 is a bigger design task, for this one, students need step by step create their ER diagrams so that they won't miss any constraints in spec. Q4 is a totally "Free" design of a "Movies4all" webservice in which basic elements are given and students need to come to their own idea of how these elements (entities) are organized together. They need to come to their own assumptions and comments for the ER diagram.

Question 1

Draw an ER diagram for the following application from the manufacturing industry:

1. Each supplier has a unique name.

2. More than one supplier can be located in the same city.

3. Each part has a unique part number.

4. Each part has a colour.

5. A supplier can supply more than one part.

6. A part can be supplied by more than one supplier.

7. A supplier can supply a fixed quantity of each part.

Answer to Question 1
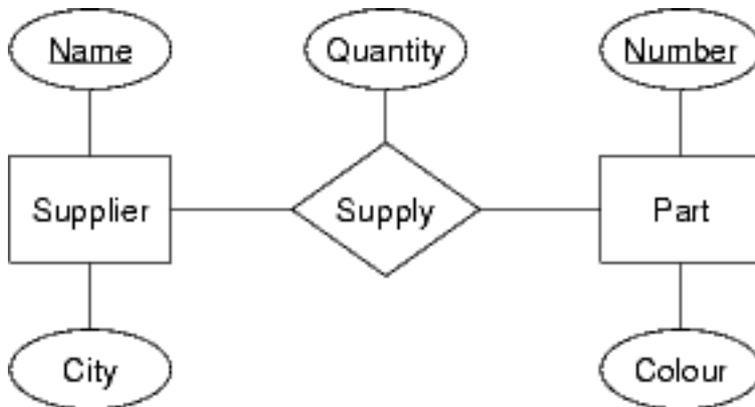
E-R diagram for Supplier-Part scenario.

Figure 1: ER-diagram for supplier-part

Question 2

The Motor Vehicle Branch administers driving tests and issues driver's licenses. Any person who wants a driver's license must first take a learner's exam at any Motor Vehicle Branch in the province. If he/she fails the exam, he can take the exam again any time after a week of the failed exam date, at any branch. If he passes the exam, he is issued a license (type = learner's) with a unique license number. A learner's license may contain a single restriction on it. The person may take his driver's exam at any branch any time before the learner's license expiry date (which is usually set at six months after the license issue date). If he passes the exam, the branch issues him a driver's license. A driver's license must also record if the driver has completed driver's education, for insurance purposes.

Create a E-R diagram following these steps.

1. Find out the entities in the spec.

2. Find out the relationships among the entities.

3. figure out attributes of the entities and (if any) of the relationships.

4. figure out constraints between entities and relationships.

5. check to see if you don't miss anything in spec.

Answer to Question 2

Step 1 Entities:

Driver: <u>driver_sin</u>, driver_name, driver_birthdata, driver_addr, driver_city, driver_postalcode, driver_phone

Branch: <u>branch_id</u>, branch_name, branch_addr, branch_phone, branch_city, branch_postalcode

License: <u>license_no</u>, license_class, license_expiry

Learner_license: drivers_ed *and the inherited attributes from the general license*

Driver_license: restrictions *and the inherited attributes from the general license*

Step 2 Relationships:

owns(license, driver) takes_exam(driver,branch):exam_date, exam_score, exam_type issues(license, branch): issue_data

The "is_a" relationshhip : Learner_license, Driver_license "is_a" license.

Step 3 constraints:

1. a [driver] must <own> (at least one) [license].
2. a [driver] must <take> at least one exam.
3. a [license] must be <owned> by one and only one [driver].
4. a [license] must be <issued> by one and only one [branch].
5. a [branch] must <issue> at least one license

Step 4 Compose ER-diagram: (For creating pretty diagrams, try "visio" for windows and "dia" for linux/unix)

Step 5 Check specification again ....

Question 3

We look at a larger design.

The Prescriptions-R-X chain of pharmacies has offered to give you a free life-time supply of medicines if you design its database. Given the rising cost of health care, you agree. Here is the information that you gather.

1. Patients are identified by SSN, and their names, addresses, and also ages.

2. Doctors are identified by an SSN, for each doctor, the name, specialty and years of experience must be recorded.

3. Each pharmaceutical company is identified by name and has a phone number.

4. For each drug, the trade name and formula must be recordered. Each drug is sold by a given pharmaceutical company, and the trade name identifies a drug uniquely from among the products of that company. If a pharmaceutical company is deleted, you need not keep track of its products any longer.

5. Each pharmacy has a name, address, and phone number.

6. Every patient has a primary physician. Every doctor has at least one patient.

7. Each pharmacy sells several drugs and has a price for each. A drug could be sold at several pharmacies, and the price could vary from one pharmacy to another.

8. Doctors prescribe drugs for patients. A doctor could prescribe one or more drugs for several patients, and a patient could obtain perscriptions from several doctors. Each prescription has a date and a quantity associated with it. You can assume that if a doctor prescribes the same drug for the same patient more than once, only the last such prescription needs to be stored.
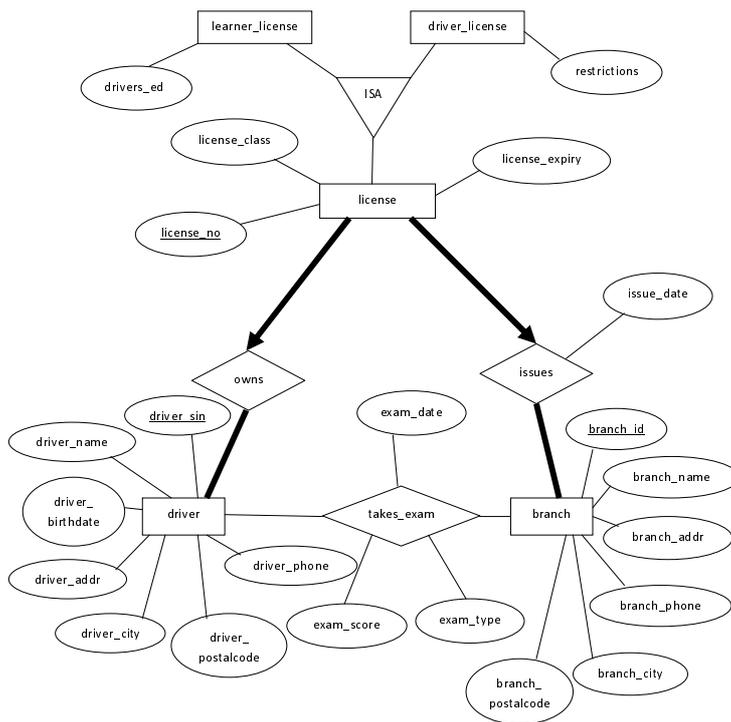
Figure 2: Q2-ER diagram for motor-branch

9. Pharmaceutical companies have long-term contracts with pharmacies. A pharmaceutical company can contract with several pharmaceutical companies. For each contract, you have to store a start date, and end date, and the text of the contract.

10. Pharmacies appoint a supervisor for each contract. There must always a supervisor for each contract.

-End of the Spec.

Tasks:

1. Draw a ER diagram that captures the above information. Identify and contraints that are not captured by your ER-diagram.

2. How would your design change if each drug must be sold at a fixed price by all the pharmacies?

3. How would your design change if the design requirements change as follows: If a doctor prescribes the same drug for the same patient more than once, several such prescriptions may have to be stored separately.

Answers to Question 3

Step 1 Identify entities.
    Patient: <u>SSN</u>,name,address,age
    Doctor: <u>phy_ssn</u>, name, specialty, exp_years
    Pharm_Company: <u>name</u>, phone
    Drug: <u>tradename</u>, formula
    Pharmacy: name, address, phone
Step 2 Identify relationships
    Primary_Physican(Patient, Doctor)
    Prescribe(Patient, Doctor, Drug): date, qty
    Sell(Pharmacy, Drug): Price
    Contract(Pharmacy, Pharm_Co):start_date, end_date, text, supervisor
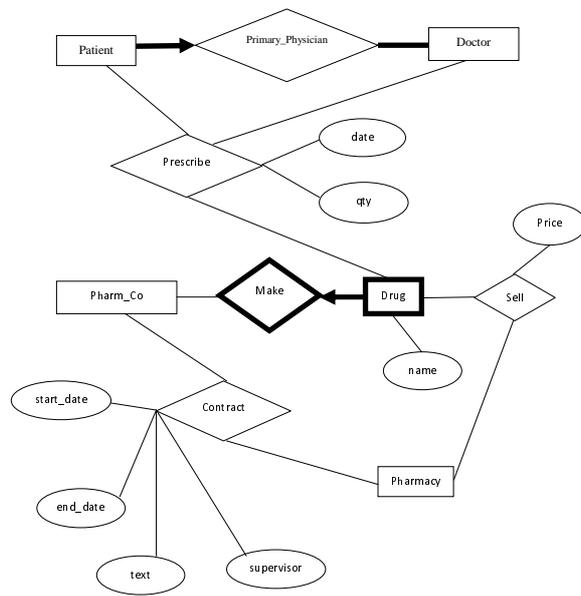   Make(Drug, Pharm_Co)
Step 3 Constraints
    1. a [patient] must and can only have one <Primary_Physician >
    2. a [drug] must be ¡made¿ by a [pharm_co], and only have one maker.
Step 4 ER-Diagram
Step 5 Check spec ....
    Discuss Answers 2. put the attribute "price" to drug.
    3. add a prescribe_ID to relationship prescribe

Question 4

Imagine that you are a consultant called into the office of a new Australian start-up called Movies4All. This company admires the success of the Internet Movie Database (IMDb) in collecting and publishing movie-related information via the web and thinks that it can set up its own database to rival the IMDb. The payback to Movies4All, they hope, will be advertising revenue once thousands of people-per-day start to visit their site looking for movie information/trivia/etc.

Putting aside your scepticism of this kind of business model, you ask them precisely what content and functionality they want in their on-line database. They suggest that looking at the IMDb (http://www.imdb.com/) would be a good start.

If you press them further, they'll tell you that Movies4All should maintain the following kinds of information:

1. movies: title, cast, crew, story-line, genre, studio, year made/released

2. actors: biographical, photos, films they appeared in, ...

3. crew: occupation (director,cameraman,...), biographical, films, ...

4. studios: contact information, historical information (e.g. heads), ...

5. awards: given to movies or people who work in/on them

6. movie jobs: information about what people like "gaffers" actually do

7. session times: for movies being screened in cinemas all over the world

All information in the system should be accessible (readable) to anyone on the Internet. However, Movies4All staff are the only ones who are allowed to update the database. They also want to provide for registered users of the system, who can rate movies and post movie reviews. Registered users are also allowed to provide new information to the Movies4All staff, who will check its validity and then incorporate it into the site.

Some ideas on the functionality that the system should provide:

1. Movies4All staff and registered users have a username and password for login authentication

2. Movies4All staff can add, update and (infrequently) delete any information in the database

3. registered users can rate movies, post reviews, and post suggested changes to Movies4All staff

4. anyone can search for movies, actors, crew, ... via keyword

5. an advanced search facility allows search by individual aspects of movies/actors/crew/studios

6. every reference to a person/movie/studio is a hyperlink to a page giving the details

Tasks: You need to analyse the challenge in this design and come up to an ER-diagram.

Answer to question 4

For big ER-diagram task. It's good to do it in a "divide-and-conquer" way.

We come with entity to entity, relationship to relationship.
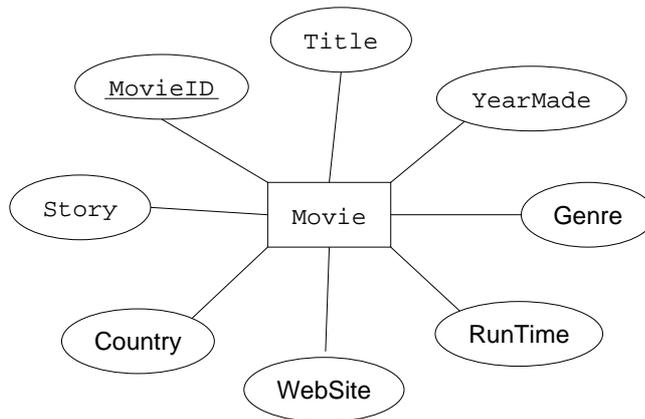
Movies

Figure 3: Movies

Write your comments just with the modeling.

Comments:

1. the information here represents the core data about a movie

2. we use a numeric ID as a primary key, since Movies will be heavily referred to throughout the database

3. every movie must at least have a known title

4. information about classification, etc. (data that is related to a specific release of a movie) is pushed off into the MovieRelease entity

Movie Releases
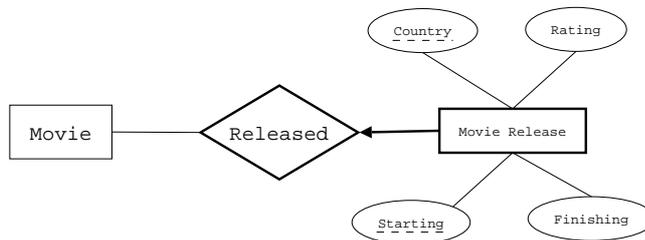
Figure 4: Movie Releases

Comments:

1. a Movie Release is a version of a movie that is issued for showing in some region of the world

2. it may be changed in various ways from the original in the release (e.g. it may have sub-titles added, or have scenes cut to fit in with a particular culture)

3. movies are rated to indicate which kind of audience thy are suitable for, and to indicate restrictions on who is allowed to view the movie

4. movie ratings are determined by an organisation (e.g. Censorship Board) within each country

5. no Box Office aspects of Movie Releases were included in this model (but if they had been, they would have been associated with Movie Relseases)

Movie People
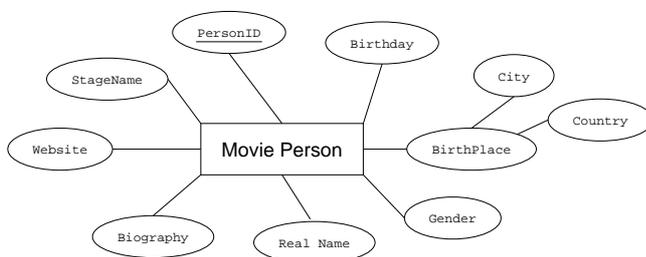
Figure 5: Move People

Comments:

1. this Entity contains core personal information about people who are involved in the making of movies

2. we use a numeric ID for people, since they are heavily referenced through the rest of the database

3. the public is interested in biographical details of Movie People, and so that is the primary information here

4. every person must at least have a know StageName

5. details about their involvement in particular movies and awards won is handled via relationships with Movies and Awards entities

Photographs
Comments:

1. each photograph may be associated with either a single individual or a specific movie (but must be associated to at least one)

2. a photo of an actor in a given movie could be involved in both relationships

Movie People and Movies
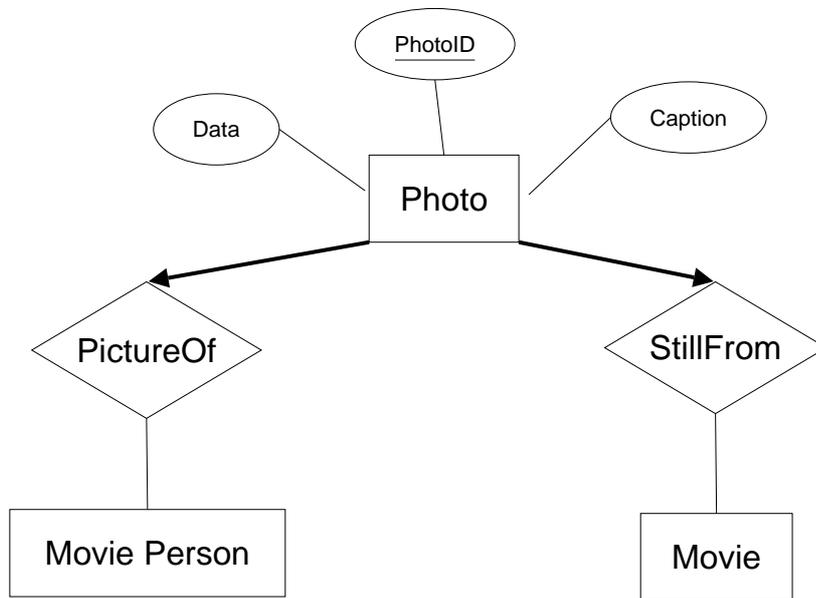**Awards**
Movie Companies
Cinemas

9

Figure 6: Photographs

Screenings
Users(staff and Members)
News and User Feedback

We gratefully acknowledge that some of the materials are based on those created by instructors of the equivalent lectures at the University of New South Wales.
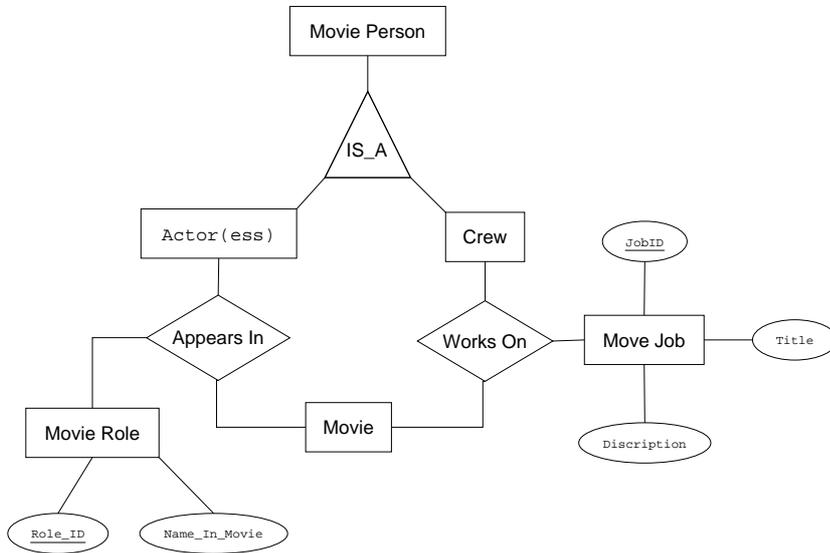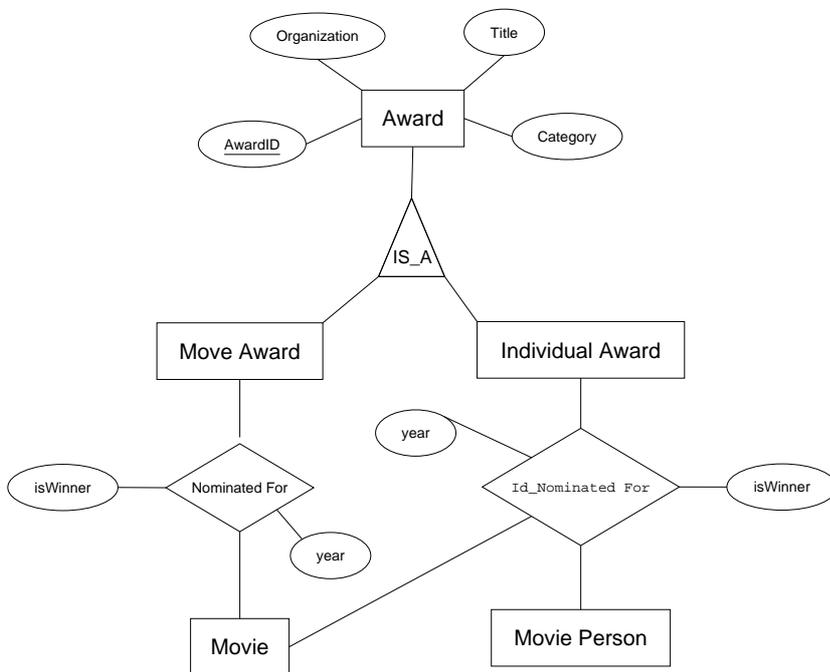
Figure 7: Movie People and Movies
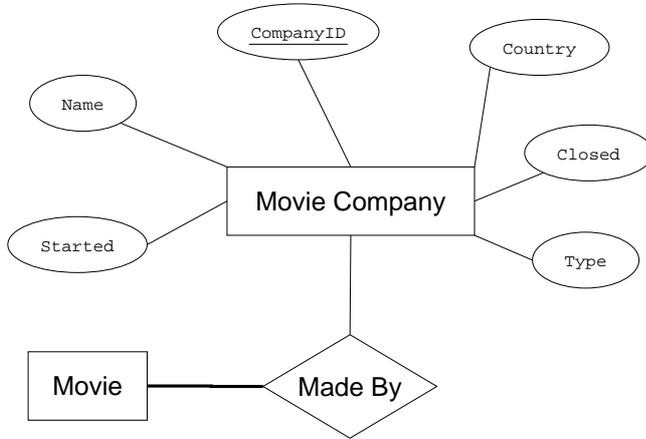

Figure 8: awards
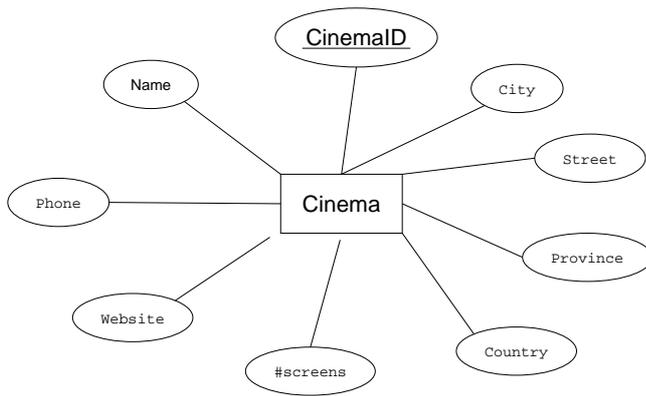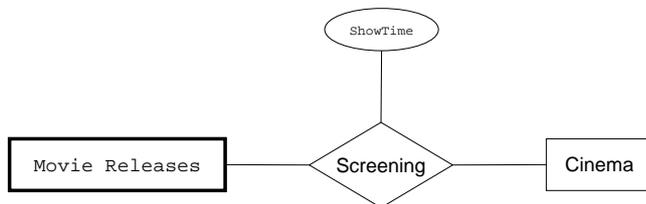
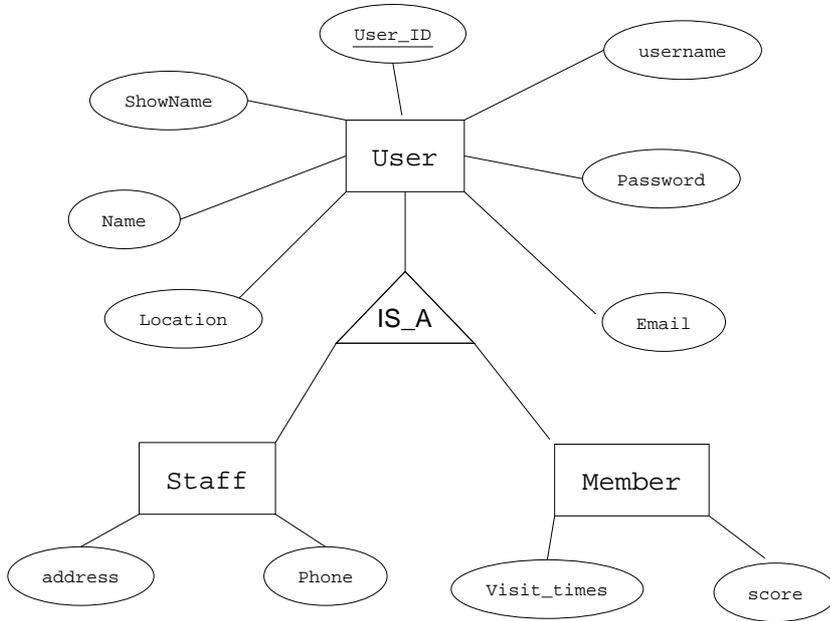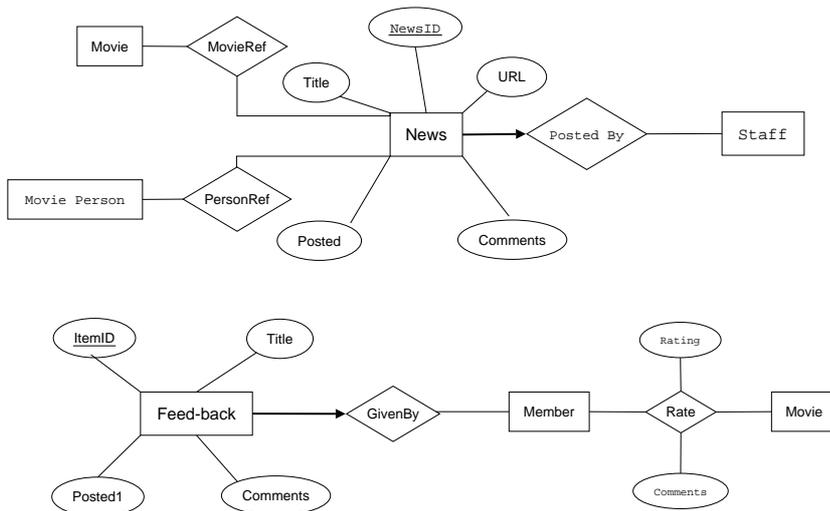Figure 9: Movie Companies

Figure 10: Cinema

Figure 11: Screenings

Figure 12: Users

Figure 13: News and User feedback