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ComS 363 Fall 2022

Practice problems on relational database design from an Entity Relationship (ER) diagram; see class participation on WK5, relational database design from the ER diagram in the solution of CP-WK3, and Q2 of the homework 2.

Instruction:
Convert the ER diagram in Figures 1 and 2 to corresponding relational schemas. **For each schema, indicate the name of the relation, all the attributes, the primary key, and all the foreign keys.**

Example: R1(A,B,C,D, primary key(A), foreign key(C) references R2(C)).

Be sure to use the least number of relations but avoid creating unnecessary data redundancy that causes update anomalies, insertion anomalies, and deletion anomalies. The schema design must enforce the constraints in the ER diagram as much as possible. Indicate all the constraints that cannot be enforced with schema design using primary key, foreign keys, unique, and not null constraints.

Answer for the ER diagram in Figure 1.

Relational schema design

- Regular entity sets with no key constraints (no outgoing arrow lines)
  - pharmacy(name, address, phoneno, primary key(name));
  - pharm_co(name, phone_num, primary key(name));
  - doctor(phy_ssn, name, specialty, exp_years, primary key(phy_ssn));
- regular entity sets with a key constraint going from it with total participation (outgoing bold arrow line from the entity set)

  An additional attribute, myphysician, is used to store the value of the primary physician since each patient does not have more than one primary physician due to the key constraint. The not null on this attribute is to ensure the total participation (bold line) that every patient must have a primary physician.

  patient(ssn, dob, name, address, myphysician not null,
  primary key(ssn),
  foreign key (myphysician) references doctor(phy_ssn));
- weak entity set (bold rectangle with outgoing bold arrow to a bold diamond shape)

  drug(pharmco_name, trade_name, formula,
  primary key(pharmco_name, trade_name),
  foreign key(pharmco_name) references pharm_co(name) on delete cascade);
- relationship sets with no constraints (the diamond shape with thin lines connecting to rectangles)

  contract(pharmacy_name, pharm_co_name, start_date, end_date, text, supervisor,
  primary key(pharmacy_name, pharm_co_name),

foreign key(pharmacy_name) references pharmacy(name),
foreign key(pharm_co_name) references pharm_co(name));

- relationship sets with no constraints with a weak entity set.

  Drug is a weak entity set. Notice that the partial key of a weak entity set is not sufficient to uniquely identify individual drugs among all drugs. An owner entity set's primary key is required to be used with the partial key to uniquely identify each weak entity. Notice the order of attributes for the foreign key and the referenced primary key.

  sell(pharmacy_name, pharmco_name, trade_name, price,
  primary key(pharmacy_name, pharmco_name, trade_name),
  foreign key(pharmacy_name) references pharmacy(name),
  foreign key(pharmco_name, trade_name) references drug(pharmco_name, trade_name));

  prescription(patient_ssn, phy_ssn, pharmco_name, trade_name, date, quantity,
  primary key(patient_ssn, phy_ssn, pharmco_name, trade_name),
  foreign key(patient_ssn) references patient(ssn),
  foreign key(phy_ssn) references doctor(phy_ssn),
  foreign key(pharmco_name, trade_name) references drug(pharmco_name, trade_name));

Constraints that cannot be enforced using schema design:

- Total participation of the Doctor entity set into Pri_physician relationship set. (bold line without an arrow).

Answer for the ER diagram in Figure 2.
Relational schema design

- Regular entity sets with no key constraints (no outgoing arrow lines)

  advertisers(aid, name, regulatoryID unique not null, primary key(aid))

  date(dateTime, primary key(dateTime)); you may drop this table since it is not used with any other relationship sets.

  youtube_videos(id, channel, primary key(id))

- Regular entity sets with a key constraint going from it with total participation

  creatives(cid, endDate, startDate, targettedGender, ageRange, aid not null, primary key(cid),
  foreign key(aid) references advertisers(aid));

- ISA hierarchy: Three options are possible. You can use either option, but must be sure to indicate what constraints can be enforced and what cannot be.

  - Due to the covering constraint, we can use one table for each child entity set without needing the table for the parent entity set. However, the non-overlapping constraint cannot be enforced as the same avid value can be entered into the child tables.

    thirdpartyads(avid, title, filename, OCR, creativeID not null, url, primary key(avid), foreign

key(creativeID) references creatives(cid));

youtube_ads(avid, title, filename, OCR, creativeID not null, youtubeVidID, primary key(avid), foreign key(creativeID) references creatives(cid));

- The one table design can also be used like so.

  videoads(avid, , title, filename, OCR, creativeID not null, adType, non-youtube-url, youtubevidID, primary key(avid), foreign key(creativeID) references creaties(cid));

  The values of the adType for each row are either 1 or 2 where 1 indicates a third-party-ad and 2 indicates a youtube ad. For the covering constraint, some checks are needed to make sure that there are no other values for adType beyond the pre-defined values.

  The default no overlapping constraint is satisfied by the design. However, this design cannot ensure that only YouTube video ads are involved in the airedwith without extra checking.

- two way relationship sets with no constraints (the diamond shape with thin lines connecting to two rectangles)

  The below solution is for the ISA hierarchy that has one table per child entity set.

  airedwith(date, avid, id, for_howlong, clicked_or_not, primary key(date, avid, id),
  foreign key(date) references date(dateTime),
  foreign key(avid) references youtube_ads(avid),
  foreign key(id) references youtube_videos(id));

  If the date table is dropped due to further optimization, still keep the date attribute as part of the primary key.
  airedwith(date, avid, id, for_howlong, clicked_or_not, primary key(date, avid, id),
  foreign key(avid) references youtube_ads(avid),
  foreign key(id) references youtube_videos(id))

  The below solution is for the ISA hierarchy that has one table for all the entity sets in the ISA hierarchy.

  airedwith(date, avid, id, for_howlong, clicked_or_not, primary key(date, avid, id),
  foreign key(date) references date(dateTime),
  foreign key(avid) references videoads(avid),
  foreign key(id) references youtube_videos(id));

  If the date table is dropped, the date attribute needs to be kept as part of the primary key.
  airedwith(date, avid, id, for_howlong, clicked_or_not, primary key(date, avid, id),
  foreign key(avid) references videoads(avid),
  foreign key(id) references youtube_videos(id));

Constraints that cannot be enforced using schema design:

- Total participation of the creatives entity set into the belongs relationship set (bold line without any arrows)
- If two-table design is used for the ISA hierarchy, the default no-overlapping constraint of the ISA hierarchy cannot be enforced as the same avid value can be entered into the two child tables.