UNIVERSITÉ LIBRE DE BRUXELLES
Faculté des Sciences Appliquées

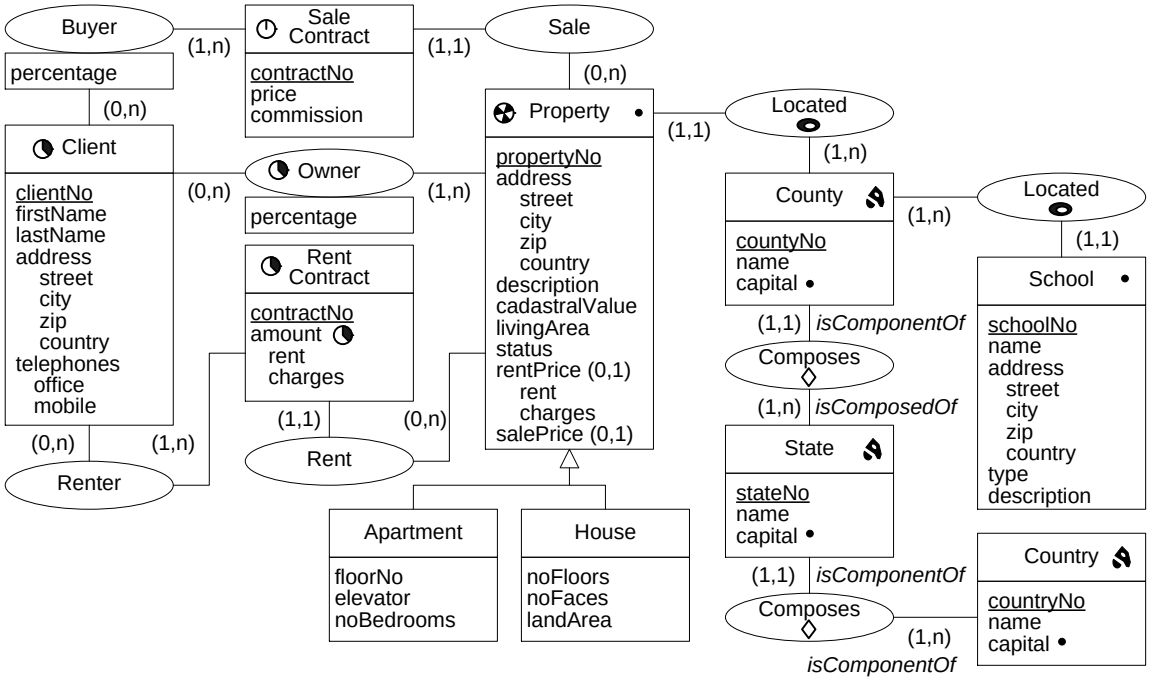
January 24, 2017

INFO-H-415 – Advanced databases

First session examination

The exam is divided in four main sections. All subquestions are worth the same amount of points, despite the fact that some of these subquestions are more complex than others. Make the best use of your time. You are required to provide comments along with your answers.

Schema



Consider the entity-relationship diagram above used by a real estate company for its web site. The spatial and temporal characteristics of various schema elements are represented by pictograms. The unique identifiers of clients, properties, contracts, etc., are underlined. The meaning of most attributes are self-explanatory. The possible values of attribute Property.status are {'To Rent', 'Rented', 'To Sell', 'Sold'}. Further, the attributes Property.rentPrice and Property.salePrice are exclusive, depending on whether the property is for sale or for rent. Notice that a property may be owned by several clients, each one with a corresponding percentage. Similarly, a property may be rented by several clients.

0 Preliminary question (1 pt)

0.1 Define a relational schema corresponding to the conceptual schema given above. The relational schema should integrate attributes for both temporal and spatial features.

1 Active Databases (4 pt)

Questions

Write triggers ensuring the following **integrity constraints**. Whenever multiple triggers are needed to enforce a single integrity constraint, write the code in full for **only one of them** and list the remaining ones. Throughout the

entire question you should provide at least one example for each of ON INSERT, ON UPDATE, and ON DELETE triggers.

1. The intervals defining the lifespan of a property are disjoint.
2. The time frame of the attribute RentContract.amount must be included in the lifespan of RentContract.
3. The lifespan of a rent contract must be covered by the intersection of the lifespans of the participating renters and property.
4. Clients cannot own and rent a property at the same time.

2 Temporal Databases (5 pt)

Questions

For the following questions suppose there is a table Month corresponding to a time dimension in a data warehouse with a month granularity as follows.

Month

Year	MonthNo	MonthName	FromDate	ToDate	NoDays
2016	1	January	1/1/2016	31/1/2016	31
2016	2	February	1/2/2016	29/2/2016	29
...	...	...	...	...	...

Write the following SQL queries.

1. Give the total rent amount per property type and month in 2016.
2. For each property, give the periods during which it was rented.
3. For each property, give the periods during which the property was not rented.
4. Give the evolution of the number of properties owned by clients (independently of the percentage).
5. For the clients such that all properties they own are in Ixelles, give the client number, the client name, and the associated time period during which the condition is true.

3 Spatial Databases (5 pt)

Note. For this question, assume that we are using a PostgreSQL database with the PostGIS extension loaded. In addition, unless explicitly specified, you do not need to take the temporality into account. Furthermore, we suppose a spatial clustering algorithm was applied to create a table of properties clustered by distance. The schema of this table is Cluster(ClusterNo, PropertyNo). The clusters are not overlapping and all the properties are included in a cluster, i.e., every property is related to exactly one cluster.

1. List the 5 apartments on sale with a living area greater than 100 m^2 that are closest to the European School in Ixelles.
2. For each county, find the centroid of all the properties in the county and determine whether the centroid is contained in that county.
3. Give the couple(s) of clusters that have the minimum distance between their centroids. Note that several couples might have the same minimum distance.
4. For each cluster give its overall area (e.g., using the ST_ConvexHull) and the percentage of its area in its containing counties.
5. List the apartments that are available for rent in a 3 km radius of the centroid of the most expensive cluster. To compute the most expensive cluster, we take the average of the current rent amount of **all** apartments that are to rent.

Command references

- float ST_Area(geometry)
  returns the area of the surface of the input geometry.

- geometry ST_Buffer(geometry,radius)
  returns a geometry covering all points within a given distance from the input geometry.
- geometry ST_Centroid(geometry)
  returns the geometric center of the input geometry.
- float ST_Distance(geometry,geometry)
  returns the 2D Cartesian distance between two input geometries.
- boolean ST_Intersects(geometry,geometry)
  returns TRUE if the two input geometries "spatially intersect in 2D" (i.e., share any portion of space) and FALSE if they don't (i.e., they are disjoint).
- geometry ST_Intersection(geometry,geometry)
  returns the geometry resulting from the intersection of the two input geometries.
- geometry ST_Union(geometry_set)
  returns a geometry that represents the union of the input geometries.
- geometry ST_ConvexHull(geometry)
  returns a geometry that represents the minimum convex geometry that encloses the input geometry.

4 Object Databases (5 pt)

1. Define an UML class diagram corresponding to the conceptual schema given above.

Write in Linq the following queries with respect to the class diagram given in question (1) above. You can obtain the current date in Linq by using the expression DateTime.Today.

2. List the property number and the address of the apartments on sale in Uccle which have a living area bigger than 100m^2, and have an elevator or are located in the ground floor.
3. What is the percentage of the apartments in (2) above among all the available apartments in Uccle.
4. Give the client number of the three owners who have the greatest number of apartments being currently on rent.
5. For apartments with three of more bedrooms currently rented by more than one client (i.e., shared apartments), give the number of such apartments, and the minimum, maximum, and average rent amount.