Database Management Systems (COP 5725)

Spring 2016

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TAs:
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Exam 1 Solutions

Name:	
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Pledge (Must be signed according to UF Honor Code)

On my honor, I have neither given nor received unauthorized aid in doing this assignment.

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Signature

For scoring use only:

	Maximum	Received
Question 1	20	
Question 2	25	
Question 3	30	
Question 4	25	
Total	100	

Question 1 (Knowledge Questions) [20 points]

Explain the following notions as precisely as possible in your own words.

a) What is the difference between *physical data independence* and *logical data independence*? [4 points]

Physical data independence: changes of the physical schema do not have impact on the conceptual schema (and thus also not to external schemas);
Logical data independence: changes of the conceptual schema do not have impact on external schemas.

b) What is the difference between a *weak entity set* and a *strong entity set*? [4 points]

Strong entity set: the entities exist autonomously and can be uniquely identified within an entity set by their key attributes;
Weak entity set: the entities are dependent in their existence from another, superior entity and uniquely identified only in combination with the key of a superior entity (The superior entity can be a strong entity or a weak entity.)

c) What are the types of binary relationship sets? [4 points]

1:1-relationship (one-to-one relationship)
1:m-relationship (one-to-many relationship)
m:1-relationship (many-to-one relationship)
m:n-relationship (many-to-many relationship)

d) What is the difference between an *inner join* and an *outer join*? [4 points]

Inner join: the result does not contain those tuples that did not find a partner;
Outer joins: the result contains those tuples that did not find a partner. The result tuples are filled with null values

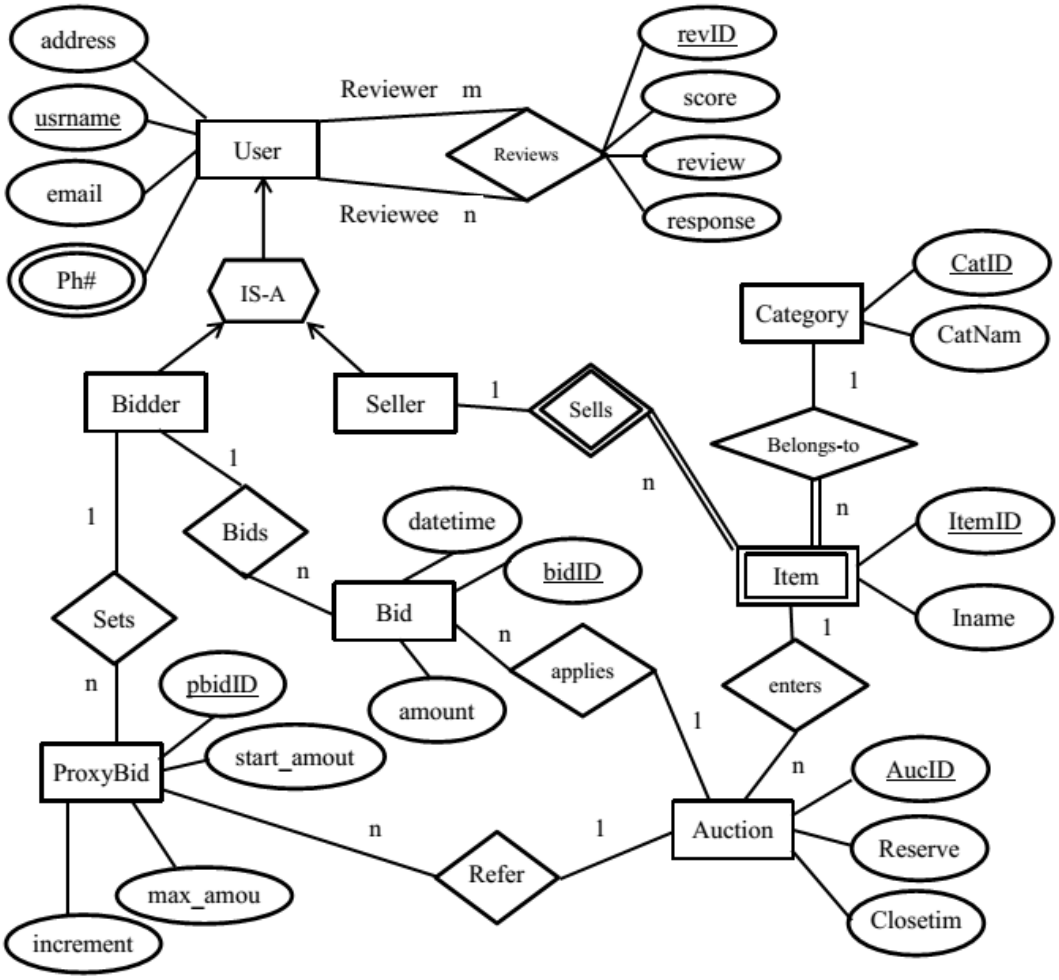
e) What is the difference between *multivalued attribute* and *composite attribute*? [4 points]

Multivalued attribute: maximal cardinality of the attribute is equal to n;
Composite attribute: grouping of attributes of the same entity set or relationship set which are closely related

Question 2 (ER Model) [25 points]

Based on the following requirements, design an ER diagram for the database of the following Online Auction System. For each entity set, mark clearly the primary key (If the primary key is not specified by requirement, use your best knowledge to add your own key or use existing attributes). For each relationship you identified, state the cardinalities (1:1, 1:m or m:n) on the entities participating in this relationship.

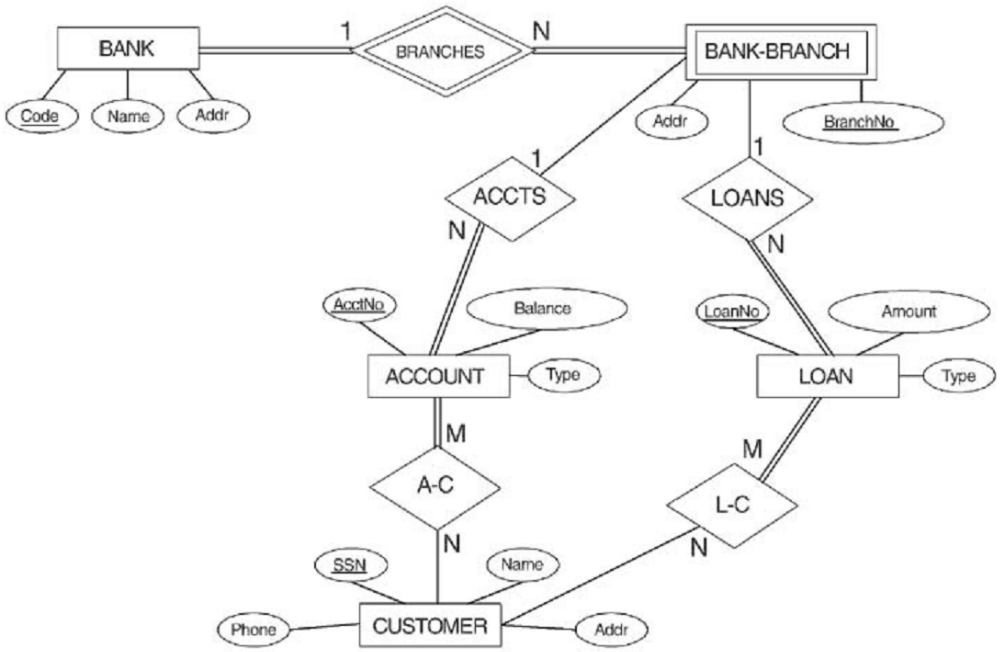
- There are two types of users: Bidders and Sellers
- Both types of users exist as users (identified by a username) that represent individuals. Individuals have email, address, and up to 3 contact phone numbers.
- One individual can exist as both bidder and seller.
- Items to be auctioned are categorized. Each category has a unique ID and a name. Each item also has an ID and a name. The item id alone is not enough to distinguish different items from each other; instead, it must be associated with its seller.
- Auctions can have a reserve price and an item can be auctioned more than once either by a different user or if the reserve price in previous auctions was not met.
- Regular bids are entered by bidders before auction close time.
- Bidder can also set proxy bids for an auction. Proxy bids are automatically incrementing bids that define a maximum amount, a starting amount and an increment over the max bid so that the amount can automatically be updated whenever a higher bid is entered. Every time a higher bid is entered the system parses through the proxy bids and enters regular bids depending on the proxy bids found for that item.
- Bidders and sellers can provide reviews of other individuals only if they have been related through any auction. Reviews include a score (min 0, max 5) and detailed comments from the individual that inputs the review plus a response from the individual who is targeted by the review.



[Each entity set needs to have a primary key / partial key. Grading criteria:
* Missing keys/attributes: -1 each, -5 max
* Bad design: -1~10, depending on how bad it is.
* Missing relationship/entity: -2 each.
* Missing/incorrect cardinalities: -1 each, -5 max.]

Question 3 (ER Model) [30 points]

Consider the following ER model in a bank database:



a) Transform the ER model into a corresponding database schema. Identify the primary keys and foreign keys. You need not include data types in the schema [14 points]

[Grading criteria: 2 points for each schema. incorrect key: -1. Incorrect attribute: -2]

Bank(code, name, addr)
BankBranch(branchNum, code, addr)
Customer(ssn, name, phone, addr)
Account(accNum, balance, accType, code, branchNum)
Loan(loanNum, type, amount, code, branchNum)
AccntsCust(accNum, ssn)
LoansCust(loanNum, ssn)

b) Using SQL, create the table BANK. Your answer should be recognized by oracle [4 points].

```
CREATE TABLE BANK(
      Code INTEGER PRIMARY KEY,
      Name VARCHAR(50),
      Addr VARCHAR(1000)
)
```

c) Is there any weak entity set? If so, give its name(s), partial key and identifying

relationship. [6 points]

Weak entity set: Bank-Branch
Partial key: BranchNo
Identifying relationship: Branches

d) Suppose that every customer must have at least one account but is restricted to at most two loans at a time, and that a bank branch cannot have more than 1000 loans. How does this show up on the (min, max) constraints? [6 points]
Write the answer in this form, i.e. [Relationship -> Entity1(min, max), Entity2(min, max)]

A-C -> ACCOUNT (1, *), CUSTOMER (1, *)
L-C -> CUSTOMER (0, 2), LOAN (1, *)
LOANS->BANK-BRANCH (0, 1000), LOAN (1, 1)

Question 4 (Relational Algebra) [25 points]

Consider the following database schema:

CUSTOMER (customer_name, company)
ITEM (item_name, category, price)
SALE (customer_name, item_name, date_sold)

Write relational algebra expressions that will answer the following questions:
(1) Which customers have bought something from a category other than "food"? [3 points]

$$\text{ANSWER} \leftarrow \pi_{\text{customer\_name}}(\sigma_{\text{category} \neq \text{'food'}}(\text{SALE} \triangleright\triangleleft \text{ITEM}))$$

(2) Which customers bought something costing more than $500 that was not in the category "furniture"? [3 points]

$$\text{ANSWER} \leftarrow \pi_{\text{customer\_name}}(\sigma_{\text{category} \neq \text{'furniture'} \wedge \text{price} > 500}(\text{SALE} \triangleright\triangleleft \text{ITEM}))$$

(3) Which customers working at Motorola bought something on '05-12-08'? [3 points]

$$\text{ANSWER} \leftarrow \pi_{\text{customer\_name}}(\sigma_{\text{company='furniture'} \wedge \text{date\_sold='05-12-08'}}(\text{SALE} \rhd\lhd \text{CUSTOMER}))$$

(4) Which customers from the "Rent-A-Car" bought an item from the category "parts of automobile" on 10-31-08? [3 points]

$$\text{R1} \leftarrow (\text{SALE} \rhd\lhd \text{CUSTOMER} \rhd\lhd \text{ITEM})$$
$$\text{ANSWER} \leftarrow \pi_{\text{customer\_name}}(\sigma_{\text{company='Rent-A-Car'} \wedge \text{category='parts'} \wedge \text{date\_sold='10-31-08'}}(\text{R1}))$$

(5) What category has the customer "United Airlines" never purchased an item in? [3 points]

$$\text{R1} \leftarrow \pi_{\text{category}}(\sigma_{\text{customer\_name='United Airlines'}}(\text{SALE} \rhd\lhd \text{ITEM}))$$
$$\text{ANSWER} \leftarrow \pi_{\text{category}}(\text{ITEM}) - \text{R1}$$

(6) Which customers from the "Delta Airline" did not buy something on 05-12-08? [3 points]

$$\text{R1} \leftarrow \pi_{\text{customer\_name}}(\sigma_{\text{company='Delta Airline'} \wedge \text{date\_sold='05-12-08'}}(\text{SALE} \rhd\lhd \text{CUSTOMER}))$$
$$\text{ANSWER} \leftarrow \pi_{\text{customer\_name}}(\sigma_{\text{company='Delta Airline'}}(\text{CUSTOMER})) - \text{R1}$$

(7) Which customers are associated with more than one company? [3 points]

$$\pi_{\text{R1.customer\_name}}(\sigma_{\text{R1.customer\_name=R2.customer\_name} \wedge \text{R1.company\_name=R2.company\_name}}(\rho_{\text{R1}}(\text{Customer}) \times \rho_{\text{R2}}(\text{Customer}))$$

(8) What category has the most expensive item? [4 points]

$$\pi_{\text{category}}(\text{ITEM} - \pi_{\text{R1}}(\sigma_{\text{R1.price} < \text{R2.price}}(\rho_{\text{R1}}(\text{ITEM}) \times \rho_{\text{R2}}(\text{ITEM}))))$$