

DATABASES

ADIT

Lab compendium – Lab 1 and 2

Institutionen för datavetenskap (IDA), Linköpings universitet

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Lab-Reports

For each lab you will have to hand in a lab-report that includes the name and LiU-id for each group-member as well as SQL-input and the database-response for each question. Also include a short description of what your query does. An example is shown below.

Refer to the course web page for further information and documentation needed for the labs.

Example of Lab-report

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Question 1, Show all tables:

```
mysql> show tables;
```

| Tables_in_dagso62 |
|-------------------|
| jbcity |
| jbdebit |
| jbdept |
| jbemployee |
| jbitem |
| jbparts |
| bsale |
| bstore |
| bsupplier |
| bsupply |

10 rows in set (0.00 sec)

Question 2, Show the fields in jbdept and what type each field is:

```
mysql> describe jbdept;
```

| Field | Type | Null | Key | Default | Extra |
|---------|-------------|------|-----|---------|-------|
| id | int(11) | NO | PRI | 0 | |
| name | varchar(20) | YES | | NULL | |
| store | int(11) | NO | MUL | NULL | |
| floor | int(11) | YES | | NULL | |
| manager | int(11) | YES | MUL | NULL | |

5 rows in set (0.01 sec)

Question 3...|

The Jonson Brothers' database

The lab exercises in lab 1 and 2 are based on a database that is used for the business of the Jonson Brothers. This section describes that database.

The Jonson Brothers is a retail company with department stores in many major US cities. The company has a large number of employees and sells a varied line of products.

The company consists of a number of stores that contain a number of departments. The company has employees, who (among other things) sell items at the different stores. Sales are registered in the sale and debit tables. Items are bought from various suppliers, who also supply parts for the company's computer equipment. Deliveries of computer parts are registered in the supply table.

Below we provide

- the contents of each table in the database,
- the ER diagram of the database.

Note that all table names are prefixed with JB so as to not enter into conflict with tables created for other courses in your MySQL account.

jbemployee

An employee is identified by an id and described by name, salary, birthyear and startyear. The id of the manager of each employee is also supplied. A null value means that the employee has no manager.

| id | name | salary | manager | birthyear | startyear |
|------|--------------------|--------|---------|-----------|-----------|
| 157 | Jones, Tim | 12000 | 199 | 1940 | 1960 |
| 1110 | Smith, Paul | 6000 | 33 | 1952 | 1973 |
| 35 | Evans, Michael | 5000 | 32 | 1952 | 1974 |
| 129 | Thomas, Tom | 10000 | 199 | 1941 | 1962 |
| 13 | Edwards, Peter | 9000 | 199 | 1928 | 1958 |
| 215 | Collins, Joanne | 7000 | 10 | 1950 | 1971 |
| 55 | James, Mary | 12000 | 199 | 1920 | 1969 |
| 26 | Thompson, Bob | 13000 | 199 | 1930 | 1970 |
| 98 | Williams, Judy | 9000 | 199 | 1935 | 1969 |
| 32 | Smythe, Carol | 9050 | 199 | 1929 | 1967 |
| 33 | Hayes, Evelyn | 10100 | 199 | 1931 | 1963 |
| 199 | Bullock, J.D. | 27000 | NULL | 1920 | 1920 |
| 4901 | Bailey, Chas M. | 8377 | 32 | 1956 | 1975 |
| 843 | Schmidt, Herman | 11204 | 26 | 1936 | 1956 |
| 2398 | Wallace, Maggie J. | 7880 | 26 | 1940 | 1959 |
| 1639 | Choy, Wanda | 11160 | 55 | 1947 | 1970 |
| 5119 | Bono, Sonny | 13621 | 55 | 1939 | 1963 |
| 37 | Raveen, Lemont | 11985 | 26 | 1950 | 1974 |
| 5219 | Schwarz, Jason B. | 13374 | 33 | 1944 | 1959 |
| 1523 | Zugnoni, Arthur A. | 19868 | 129 | 1928 | 1949 |
| 430 | Brunet, Paul C. | 17674 | 129 | 1938 | 1959 |
| 994 | Iwano, Masahiro | 15641 | 129 | 1944 | 1970 |
| 1330 | Onstad, Richard | 8779 | 13 | 1952 | 1971 |
| 10 | Ross, Stanley | 15908 | 199 | 1927 | 1945 |
| 11 | Ross, Stuart | 12067 | NULL | 1931 | 1932 |

jbdept

A department is identified by an id and described by its name as well as its which store and floor it belongs to. The employee id of the manager of the department is also supplied.

| <u>id</u> | name | store | floor | manager |
|-----------|-----------------|-------|-------|---------|
| 35 | Book | 5 | 1 | 55 |
| 10 | Candy | 5 | 1 | 13 |
| 19 | Furniture | 7 | 4 | 26 |
| 20 | MajorAppliances | 7 | 4 | 26 |
| 14 | Jewelry | 8 | 1 | 33 |
| 43 | Children's | 8 | 2 | 32 |
| 65 | Junior's | 7 | 3 | 37 |
| 58 | Men's | 7 | 2 | 129 |
| 60 | Sportswear | 5 | 1 | 10 |
| 99 | Giftwrap | 5 | 1 | 98 |
| 1 | Bargain | 5 | 0 | 37 |
| 26 | Linens | 7 | 3 | 157 |
| 63 | Women's | 7 | 3 | 32 |
| 49 | Toys | 8 | 2 | 35 |
| 70 | Women's | 5 | 1 | 10 |
| 73 | Children's | 5 | 1 | 10 |
| 34 | Stationary | 5 | 1 | 33 |
| 47 | JuniorMiss | 7 | 2 | 129 |
| 28 | Women's | 8 | 2 | 32 |

jbstore

A store is identified by an id and described by the city it is located within.

| <u>id</u> | city |
|-----------|------|
| 5 | 941 |
| 7 | 946 |
| 8 | 945 |
| 9 | 941 |

jbcity

A city is identified by its an id and described by its name and in which state it is located.

| <u>id</u> | name | state |
|-----------|----------------|-------|
| 900 | Los Angeles | Calif |
| 946 | Oakland | Calif |
| 945 | El Cerrito | Calif |
| 303 | Atlanta | Ga |
| 941 | San Francisco | Calif |
| 021 | Boston | Mass |
| 752 | Dallas | Tex |
| 802 | Denver | Colo |
| 106 | White Plains | Neb |
| 010 | Amherst | Mass |
| 981 | Seattle | Wash |
| 609 | Paxton | Ill |
| 100 | New York | NY |
| 921 | San Diego | Calif |
| 118 | Hickville | Okla |
| 841 | Salt Lake City | Utah |
| 537 | Madison | Wisc |

jbitem

An item is identified by an id and described by its name, the department where it is sold, its price, the quantity on hand (qoh) and the identifier of the supplier that supplied it.

| <u>id</u> | name | dept | price | qoh | supplier |
|-----------|-----------------|------|-------|------|----------|
| 26 | Earrings | 14 | 1000 | 20 | 199 |
| 118 | Towels, Bath | 26 | 250 | 1000 | 213 |
| 43 | Maze | 49 | 325 | 200 | 89 |
| 106 | Clock Book | 49 | 198 | 150 | 125 |
| 23 | 1 lb Box | 10 | 215 | 100 | 42 |
| 52 | Jacket | 60 | 3295 | 300 | 15 |
| 165 | Jean | 65 | 825 | 500 | 33 |
| 258 | Shirt | 58 | 650 | 1200 | 33 |
| 120 | Twin Sheet | 26 | 800 | 750 | 213 |
| 301 | Boy's Jean Suit | 43 | 1250 | 500 | 33 |
| 121 | Queen Sheet | 26 | 1375 | 600 | 213 |
| 101 | Slacks | 63 | 1600 | 325 | 15 |
| 115 | Gold Ring | 14 | 4995 | 10 | 199 |
| 25 | 2 lb Box, Mix | 10 | 450 | 75 | 42 |
| 119 | Squeeze Ball | 49 | 250 | 400 | 89 |
| 11 | Wash Cloth | 1 | 75 | 575 | 213 |
| 19 | Bellbottoms | 43 | 450 | 600 | 33 |
| 21 | ABC Blocks | 1 | 198 | 405 | 125 |
| 107 | The 'Feel' Book | 35 | 225 | 225 | 89 |
| 127 | Ski Jumpsuit | 65 | 4350 | 125 | 15 |

jbdebit

A debit (receipt of a sale) is identified by its id and described by the timestamp sdate when the debit took place, the employee who sold the item, and a customer account to which the amount was debited.

| <u>id</u> | sdate | employee | account |
|-----------|--------------------|----------|----------|
| 100581 | 15-JAN-95 12:06:03 | 157 | 10000000 |
| 100582 | 15-JAN-95 17:34:27 | 1110 | 14356540 |
| 100586 | 16-JAN-95 13:53:55 | 35 | 14096831 |
| 100592 | 17-JAN-95 09:35:23 | 129 | 10000000 |
| 100593 | 18-JAN-95 12:34:56 | 35 | 11652133 |
| 100594 | 19-JAN-95 10:10:10 | 215 | 12591815 |

jbsale

Each debit can contain a number of items, each represented as a sale. Each sale is identified by the debit to which it belongs and the id of the item that was sold and also describes the quantity of items sold. For example: Debit transaction 100581 consists of two items: item 118 with a quantity of 5 and item 120 with quantity 1.

| <u>debit</u> | <u>item</u> | quantity |
|--------------|-------------|----------|
| 100581 | 118 | 5 |
| 100581 | 120 | 1 |
| 100582 | 26 | 1 |
| 100586 | 127 | 3 |
| 100586 | 106 | 2 |
| 100592 | 258 | 1 |
| 100593 | 23 | 2 |
| 100594 | 52 | 1 |

jbsupplier

A supplier (of items and parts) is identified by its id and described by its name and the city in which it is located.

| <u>id</u> | name | city |
|-----------|--------------|------|
| 199 | Koret | 900 |
| 213 | Cannon | 303 |
| 33 | Levi-Strauss | 941 |
| 89 | Fisher-Price | 021 |
| 125 | Playskool | 752 |
| 42 | Whitman's | 802 |
| 15 | White Stag | 106 |
| 475 | DEC | 010 |
| 122 | White Paper | 981 |
| 440 | Spooley | 609 |
| 241 | IBM | 100 |
| 62 | Data General | 303 |
| 5 | Amdahl | 921 |
| 20 | Wormley | 118 |
| 67 | Edger | 841 |
| 999 | A E Neumann | 537 |

jbparts

A part, used internally by the store, not sold to customers, is identified by its id and described by its name, color, weight, and the quantity on hand (qoh).

| <u>id</u> | name | color | weight | qoh |
|-----------|-------------------|--------|--------|-----|
| 1 | central processor | pink | 10 | 1 |
| 2 | memory | gray | 20 | 32 |
| 3 | disk drive | black | 685 | 2 |
| 4 | tape drive | black | 450 | 4 |
| 5 | tapes | gray | 1 | 250 |
| 6 | line printer | yellow | 578 | 3 |
| 7 | l-p paper | white | 15 | 95 |
| 8 | terminals | blue | 19 | 15 |
| 13 | paper tape reader | black | 107 | 0 |
| 14 | paper tape punch | black | 147 | 0 |
| 9 | terminal paper | white | 2 | 350 |
| 10 | byte-soap | clear | 0 | 143 |
| 11 | card reader | gray | 327 | 0 |
| 12 | card punch | gray | 427 | 0 |

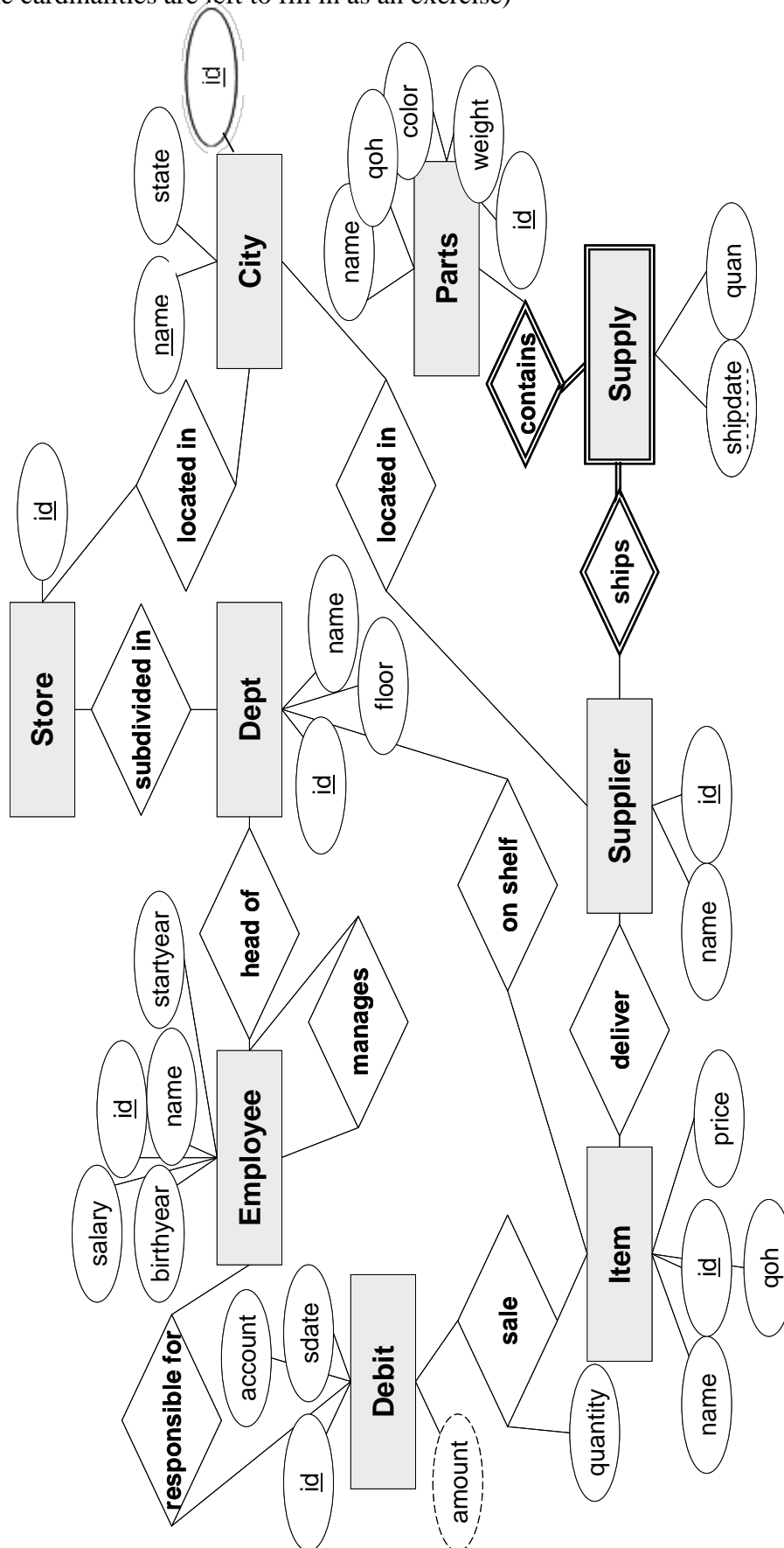
jbsupply

A supplier supplies the different parts. Each part is supplied separately (even though they may be transported together) and each supply is identified by the supplier, the part id and the date it was shipped. Its quantity of items supplied in each supply is also described.

| <u>supplier</u> | <u>part</u> | <u>shipdate</u> | quan |
|-----------------|-------------|-----------------|------|
| 475 | 1 | 1993-12-31 | 1 |
| 475 | 2 | 1994-05-31 | 32 |
| 475 | 3 | 1993-12-31 | 2 |
| 475 | 4 | 1994-05-31 | 1 |
| 122 | 7 | 1995-02-01 | 144 |
| 122 | 7 | 1995-02-02 | 48 |
| 122 | 9 | 1995-02-01 | 144 |
| 440 | 6 | 1994-10-10 | 2 |
| 241 | 4 | 1993-12-31 | 1 |
| 62 | 3 | 1994-06-18 | 3 |
| 475 | 2 | 1993-12-31 | 32 |
| 475 | 1 | 1994-07-01 | 1 |
| 5 | 4 | 1994-11-15 | 3 |
| 5 | 4 | 1995-01-22 | 6 |
| 20 | 5 | 1995-01-10 | 20 |
| 20 | 5 | 1995-01-11 | 75 |
| 241 | 1 | 1995-06-01 | 1 |
| 241 | 2 | 1995-06-01 | 32 |
| 241 | 3 | 1995-06-01 | 1 |
| 67 | 4 | 1995-07-01 | 1 |
| 999 | 10 | 1996-01-01 | 144 |
| 241 | 8 | 1995-07-01 | 1 |
| 241 | 9 | 1995-07-01 | 144 |
| 89 | 3 | 1995-07-04 | 1000 |
| 89 | 4 | 1995-07-04 | 1000 |

The Jonson Brothers' ER-Diagram

(The cardinalities are left to fill in as an exercise)



Lab 1; SQL-Queries and Views

Objectives

The purpose of this exercise is to practise writing queries in SQL, including the use of aggregate functions and views.

Background Reading

Check the lecture material and study the SQL chapter(s) in your database book. Note that small discrepancies might exist between some SQL interpreters and some books, as they follow slightly different SQL standards.

Setting up your environment and database

To set up your computer and load the database on which you will work for the two coming labs, follow the instructions available at the course web page.

The Lab

Formulate in SQL.

- 1) List all employees, i.e. all tuples in the *jbemployee* relation.
- 2) List the name of all departments in alphabetical order. Note: by “name” we mean the name attribute for all tuples in the *jbdept* relation.
- 3) What parts are not in store, i.e. qoh = 0? (qoh = Quantity On Hand)
- 4) Which employees have a salary between 9000 (included) and 10000 (included)?
- 5) What was the age of each employee when they started working (startyear)?
- 6) Which employees have a last name ending with “son”?
- 7) Which items (note **items**, not parts) have been delivered by a supplier called *Fisher-Price*? Formulate this query using a subquery in the where-clause.
- 8) Formulate the same query as above, but without a subquery.
- 9) Show all cities that have suppliers located in them. Formulate this query using a subquery in the where-clause.
- 10) What is the name and color of the parts that are heavier than a card reader? Formulate this query using a subquery in the where-clause. (The SQL query must not contain the weight as a constant.)
- 11) Formulate the same query as above, but without a subquery. (The query must not contain the weight as a constant.)
- 12) What is the average weight of black parts?
- 13) What is the total weight of all parts that each supplier in Massachusetts (“Mass”) has delivered? Retrieve the name and the total weight for each of these suppliers. Do not forget to take the quantity of delivered parts into account. Note that one row should be returned for each supplier.

- 14) Create a new relation (a table), with the same attributes as the table items using the CREATE TABLE syntax where you define every attribute explicitly (i.e. not as a copy of another table). Then fill the table with all items that cost less than the average price for items. Remember to define primary and foreign keys in your table!
- 15) Create a view that contains the items that cost less than the average price for items.
- 16) What is the difference between a table and a view? One is static and the other is dynamic. Which is which and what do we mean by static respectively dynamic?
- 17) Create a view, using only the implicit join notation, i.e. only use *where* statements but no *inner join*, *right join* or *left join* statements, that calculates the total cost of each debit, by considering price and quantity of each bought item. (To be used for charging customer accounts). The view should contain the sale identifier (debit) and total cost.
- 18) Do the same as in (17), using only the explicit join notation, i.e. using only *left*, *right* or *inner* joins but no *where* statement. Motivate why you use the join you do (left, right or inner), and why this is the correct one (unlike the others).
- 19) Oh no! An earthquake!
 - a) Remove all suppliers in Los Angeles from the table **jbsupplier**. This will not work right away (you will receive error code 23000) which you will have to solve by deleting some other related tuples. However, do not delete more tuples from other tables than necessary and do not change the structure of the tables, i.e. do not remove foreign keys. Also, remember that you are only allowed to use "Los Angeles" as a constant in your queries, not "199" or "900".
 - b) Explain what you did and why.
- 20) An employee has tried to find out which suppliers that have delivered items that have been sold. He has created a view and a query that shows the number of items sold from a supplier.

```
mysql> CREATE VIEW jbsale_supply(supplier, item, quantity) AS
-> SELECT jbsupplier.name, jbitem.name, jbsale.quantity
-> FROM jbsupplier, jbitem, jbsale
-> WHERE jbsupplier.id = jbitem.supplier
-> AND jbsale.item = jbitem.id;
Query OK, 0 rows affected (0.01 sec)
```

```
mysql> SELECT supplier, sum(quantity) AS sum FROM jbsale_supply
-> GROUP BY supplier;
```

| supplier | sum(quantity) |
|--------------|---------------|
| Cannon | 6 |
| Levi-Strauss | 1 |
| Playskool | 2 |
| White Stag | 4 |
| Whitman's | 2 |

```
5 rows in set (0.00 sec)
```

The employee would also like include the suppliers which has delivered some items, although for whom no items have been sold so far. In other words he wants to list all suppliers, which has supplied any item, as well as the number of these

items that have been sold. Help him! Drop and redefine `jbsale_supply` to consider suppliers that have delivered items that have never been sold as well. **Hint:** The above definition of `jbsale_supply` uses an (implicit) inner join that removes suppliers that have not had any of their delivered items sold.

Handing in

- For each problem in the lab, list the query followed by the result of the query.
- Written answers for questions (16), 18 and (19b).

Lab 2; Database Design and Entity-Relationship Modelling

Objectives

The purpose of this exercise is to give a good understanding of database design and entity-relationship modelling.

Background Reading

Read lecture material on ER- and EER-modelling, on the translation of EER-diagrams into relational tables, and SQL for creating tables and managing constraints.

The Lab

The Jonson Brothers' business is expanding and the database is continuously being extended with new information. The current state of the company database can be seen in the ER-diagram provided on page 8. The management of Jonson Brothers' has hired you to help them extend their database. The work requires extensions to support a bonus system where managers can be given an extra bonus (e.g. if their department have met their sale predictions). The management also wants to encourage customers to shop more by creating a credit card that users can use when paying for items that they buy.

- 1) **(At home)** Analyze the ER-diagram on page 8 (available electronically from the course web page) and the relational database and add information about the cardinality of the relationships such as one-to-one, one-to-many, many-to-one, and many-to-many to the ER-diagram.
- 2) **(At home)** Extend the ER-diagram with an entity type *manager* that is a subclass of *employee*. Add support for a manager bonus that is added to the salary by giving the manager entity a bonus attribute. Use the manager-entity (instead of employee) in appropriate, existing relationships. Note that some managers are managers of departments, some managers are managers of other employees, and some are both. Draw your extensions to the ER-diagram and translate them to the relational model.
- 3) Implement your extensions in the database by first creating tables, if any, then populating them with existing manager data, then adding/modifying foreign key constraints. *Do you have to initialize the bonus attribute to a value? Why?*
- 4) All departments showed good sales figures last year! Give all current department managers \$10,000 in bonus. This bonus is an addition to other possible bonuses they have.

Hint: Not all managers are department managers. Update all managers that are referred in the *jbdept* relation.

5) **(Partly at home)** In the existing database, customers can buy items and pay for them, as reflected by the sale and debit tables. Now, you want to create support for storing customer information. The customers will have accounts, where they can deposit and withdraw money. The requirements are:

- Customers are stored with name, street address, city, and state. Use existing city information!
- A customer can have several accounts.
- Accounts are stored with account number, and balance.
- Information about transactions such as the type (withdrawal/deposit/sale), transaction number, account number, date and time of the transaction, amount, and the employee responsible for the transaction (that is, the employee that registers the transaction, not the customer that owns the account) should be stored in a transaction-entity. Use subclasses to distinguish between the different types of transactions (withdrawals/deposits/sales). This means that the new transaction entity will be a superclass of the existing debit-entity.

a) **(At home)** Extend the EER-diagram with your new entities, relationships, and attributes.

b) Implement your extensions in your database. Add primary key constraints, foreign key constraints and integrity constraints to your table definitions. Do not forget to correctly set up the new and existing foreign keys.

- Use `alter table t1 drop foreign key constraint_name;`
and
`alter table t2`
`add constraint constraint_name`
`foreign key (t2_attribute) references t1(t1_attribute);`
to change existing foreign keys.
- You may delete table data from the *jbsale*-table in order to properly link the new transaction-table into the existing schema.

Handing in

- ER diagram with *cardinalities* and the *extensions* required by questions 2) and 5.a).
- Relational model corresponding to both ER diagram and the implemented database.
- The SQL commands to create, modify and delete tables and constraints (such as foreign keys), as well as the results of these commands.
- A written answer for question 3).

You are now ready to work with the EER-diagram part and the EER-diagram-to-table translation part of the project.