DATABASE MANAGEMENT SYSTEMS

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Introduction

Data and information. These two things became leading factors through the past 50 years and during the 20th and 21th century as these concepts play a significant part of our everyday life. As in our society the role of the information is being valorised, we are getting more and more pieces of information. We are continuously bombed with information from the outside world: we get the news from the television, radio, and newspapers and we are being informed about the latest happenings from the fellow human beings all day long. Of course we try to sort out and concentrate on the most important ones from the quarry of information. It is especially relevant as it seems to be impossible to memorize all the pieces of information. Sometimes we simply can't memorize or wouldn't like to memorize them. Accordingly we have to find another way of recording information instead of keeping them in mind. As the old Latin tag has it - verba volant, scripta manent – spoken words fly away, written ones remain. In addition everybody has a share in reaching the recorded information in a fast and easy way.

Information equals power as the proverb says. And actually it is right. I'm sure that explaining the importance of keeping our bank card's details at an appropriate place is not necessary. That's why it would be advisable to find the safest way of storing information. We should find the best method to be able to reach them in an easy, simple, and fast way.

So, we can easily admit that students should acquire this bunch of learning during their primary and secondary school studies (and of course during their lives). According to the National Curriculum's assumption in the field of developments, our educators should pay more attention on teaching the basic computer skills. Indeed, in this field the number of the lessons was raised. Because of the above-mentioned reasons cognition of databases and database management systems play a particularly important role. Moreover, it is useful for students (and of course for everyone) to keep up with the changes, aims, and reformations of the developments of informatics. Furthermore the number of the people working with informatics and the level of their qualification is rising mightily. Let's keep up with both aspects as the claim to well-qualified professionals is getting higher and higher.

One of the computer science's main characteristics is the following: more and more users use data, stored on more and more computers. Ready and applied software systems have to deal with always rising amount of data. In our everyday life we meet the usage of computer information systems more and more often. Computer information systems are frequently used

in factories to control different operations like production, finance, the staff's work, storage, and economization. We can mention some fields of usage in every part of our lives:

- Commercialism: registration of the stock
- Civil service: taxation
- Hygiene: registration of the sick
- Transport: system of reservations, timetables
- Engineering: designer systems
- Education: student's registration

All of them have a common feature: they all maintain a large data set, there are complicated relations between the data items, and these data sets have to be retained for a long period of time.

Of course there are other main features of these systems, but there are requirements which have to be fulfilled:

- Maintaining a large amount of data
- Supporting more users to be able to access at the same time
- Keeping integrity
- Protection
- Effective software development

Basic Elements

The first databases were established from file control services in the early ‘60s. They were extensive and expensive program systems which were run on large sized computers. The first significant usage fields of them were the systems in which huge pieces of data were stored, including numerous queries and modifies. For example: Companies’ card indexes, banks’ systems, flight booking systems.

Since 1970, the publication of Ted Codd’s article, in which he suggested that the database management systems should present the data in tables for the user, database management systems have appreciably changed.

The difference to the previously used systems is that in the relational system the user doesn’t have to deal with the structure of data storage, as queries can be expressed with such a high-level language, that its usage highly increases the efficiency of database programmers.

In this model there are no highlighted data, so the features registered about the items of the set are equal. This way the system can be used more flexible as the search strings can be drawn optionally.

The first corporation, selling both database systems supporting databases before relational models and systems supporting relational models, was IBM.

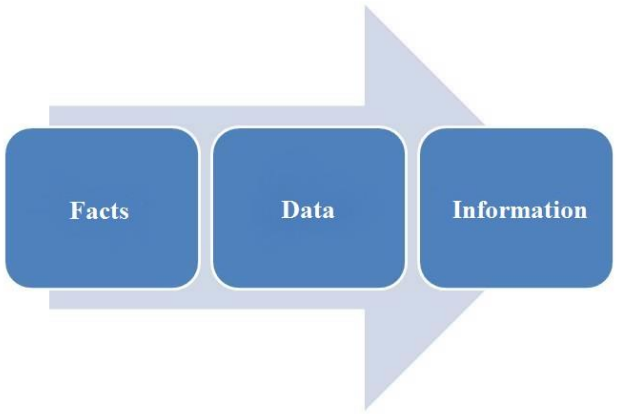
Lately database systems based on relational models are as current computer tools as word processors or spreadsheet programmes used to be.

Data and Information

Information plays the main role in our world. If we wanted to feature our society with an attributive structure, it would be evident to name it information society. I wonder if we clearly know what information means. A totally acceptable definition hasn’t been found yet, although every speciality dealing with information has formed its entity, featured with marks being important in their point of view; named information.

Information is the experienced, sensed, and understood data which is useful and new for the taker, who construes it according to their previous store of learning.

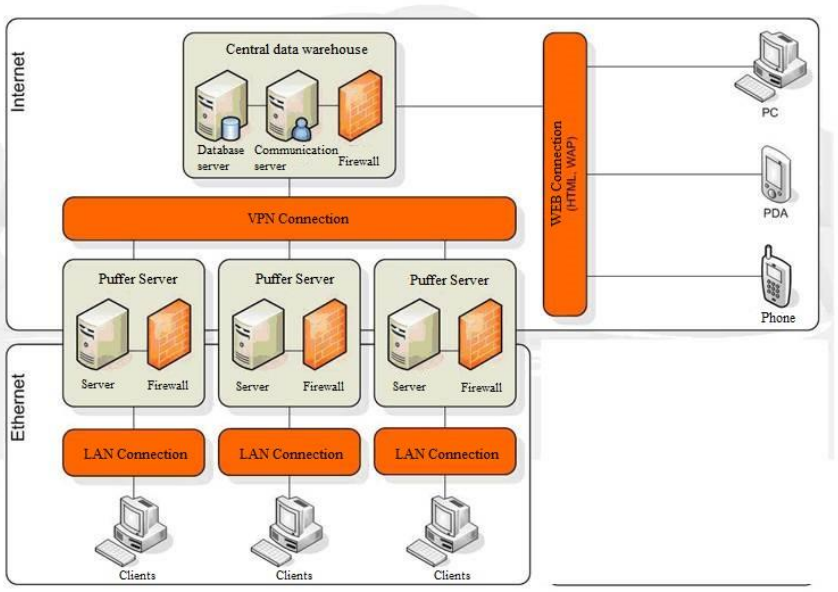
Data means the appearance of a fact which we can record, store, modify, and send on. The conception of data is not an exact idea. In the point of view of database designing, data is the meaningless series of signs from which we can earn information after processing.



Although till then it is just a meaningless series of signs. If we collect some data and we store them in a given place including the connections between them, we have created a database:
E.g.: the medical cards of the sick, details of cars at the police, notes of a telephone directory.

Database

A **database** is the whole bulk of integrated and logically connected pieces of information; the system of data and connections between them; stored abreast. To be able to work with our database effectively deliberate designing is essetial.
The concept of **database system** consists of the databases, the computer resources, moreover, in a wider sense, the database-administrators, who are the ones who put through the designing and programming of the database.



Database Management System (DBMS)

The database is a kind of data collection. It stores data, which is in connection with the given task, orderly. The access to the data is also taken care of by the database. Besides, it guarantees the protection of the data, and also protects the integration of the data.

The management of the data was also made easier by database management systems.

The ANSI/SPARC model shows the connection between the user and of the physically stored data on the computer's mass storage.

We distinguish three levels, based on that:

- Outer level, alias user view, which examines the data from user's point of view.
- Conceptual level, which includes all of the user views. In this level the database is given with logical schema.
- Inner level, alias physical level, it means the actual presentation of the data on the current computer.

When we talk about ANSI/SPARC model it is important to mention two things. These are the logical data independence and the physical independence. Physical independence means that if we change anything in the inner level it will not effect anything on the logical schema.

So, we will not have to perform changes on them. If any changes occur in the storage of data it will have no effect on the upper levels. The logical data independence is data independence between outer level and conceptual level.

Those program systems which are responsible for guaranteeing access to the database are called database management systems. Furthermore, the database management system takes care of the tasks of the inner maintenance of the database such as

- Create database
- Defining the content of the database
- Data storage
- Querying data
- Data protection
- Data encryption
- Access rights management
- Physical organization of the data structure

We must keep in mind how the architecture of the database has changed. Furthermore, it is also important how we can put these together. It is very important for the programmers, because they are in a situation where they have to choose what they are going to working with after they have got the order. Because, those are not good programmers or software developers who can only use one database management system, or those who can write programs only in one programming language. That is the expectation of an elementary school. If you get a task it is good if you can decide which route is the one you have to start. What database manager you should use and in which programming language you are going to write your program. Of course, one could not say that know all of the existing programming languages by heart. We will talk about two or three of them. But everybody knows who have tried to make web pages that it might not be a good idea to start a webpage development for example with an aspx.net. In one hand, it is possible in the case of a bigger task that aspx.net is good. On the other hand, one could possibly do a smaller task with html code without putting any dynamism in it, or maybe in php the things could be done easier. These are specific things. Returning to the database architectures, now the question is in which environment certain database managers can do good performance. Because, it is not true that every database manager can satisfy our needs in all environments.

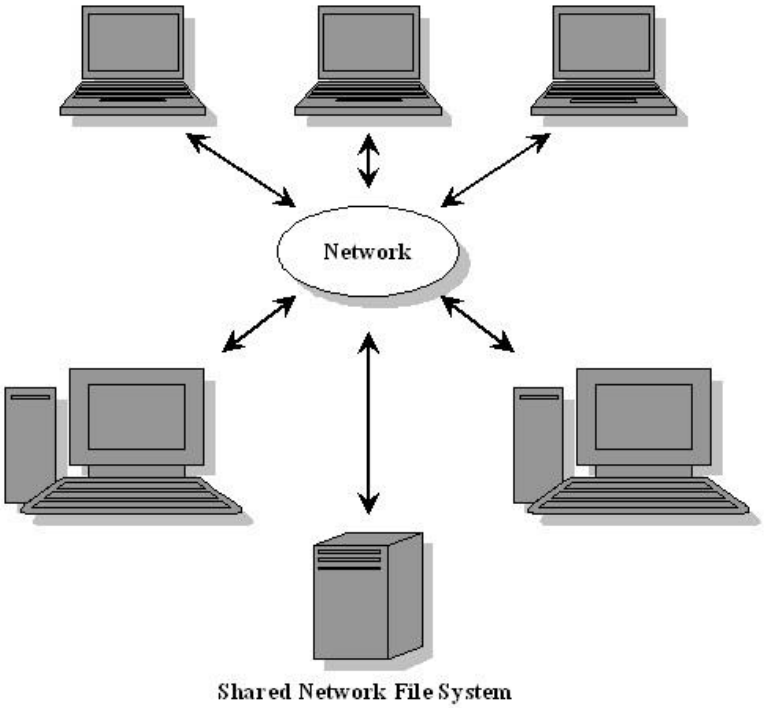
Local database

The first such architectural level is the local database: these are the "best". It contains a computer, a database, a user, nobody has any problem. The story started sometime around 1980s. Database managers have appeared in the computers. It was the world of the dBase, which was based on the Dos. (From the beginning, DOS did not allow multi users and to run on more paths.) Back then there were no such problems as web collusion or concurrent access. Such database were dBase 3, 4, 5, the developed version of this were Paradox 4, 5, 7, which had more stable data table management, but in return we have got a more damageable index table. The following things were true for all of them: one database - one file; one index - one file; one descriptor table - one file; one check term for a table – one file. If we had a database with 100 tables then there was created 100 files in a directory. These were managed by a database management engine. It worked on file levels, moved bytes and managed blocks. As it worked on file level it was damageable. There were a lot of files. So, there were already a big possibility of damage and big possibility of delete on the level of the operation system. If there was a power shortage, it was necessary to call the programmer, because the whole system has turned upside down. Something for something. I always say that these are dangerous systems, especially, if we do not use them in local database system. Nowadays, it would be very hard to use local database. The MS Access is also belonging to there. It is only more modern, because of the fact that all of the tools, data and descriptive tools are stored in the same file. From there it knows it knows the same as Paradox or dBase. It could become very damageable if we want to use under bigger stress. They are perfect for teaching (ECDL, for final examination). The LibreOffice also has the Base database. That is similar to Access. It is also free, and it is good for familiarization and teaching. These database managers have limits. In a traffic table the numbers of records are continuously growing. It can easily reach the quantity of 100000. It may seem to be more, however if somebody write a system that is also being used, it turns out to be few. One could not say that up to 100000 it works well, but at 100001 the whole system fall apart. It works well two to three hundred-thousand, but after it more and more error occurs. The system is start slowing down and index damages are coming up. So, the efficiency of the local, file-based systems has the volume of 100000. If we know that and if we know the kind of work they want to give us then it is not a problem to use them. if we have to make a database for Marika's flower shop where she would put her data. For example, she wants to store that she has got 10 tulips and 30 roses and that she has sold 9

tulips and 34 roses, and nothing more. In this case the Access is more than enough for her. Don't try to convince her that she needs Oracle.

File – server architecture

Of course, the world has developed. There is cable so we can connect any number of computers. But the problem was that the database management was young at that time. So, they have developed this wonderful file – server architecture. I have to mention it in parentheses that although the use of the Novell server is not exclusive, but its best time was then. That hasn't been so long, about 15 years. But in the information technology that had been a long time. They were worked out very well. They were robust systems, but "file-server". It is already in its name that it is for to share documents and files as source of energy. The Novell was forced to database management. They have grasped these put them under the Novell or Windows server in shared folders, and then the operation system will grant that who could reach them and who could not. After that, of course it had not worked, because it has no rights to write. So, that right has to been added. But it turned out that it had worked only then if we gave admin right to that directory. We started to share the local database files on the network. The problems have started from here. The users wanted to modify the same record of the same table for one occasion. The time of the problem of the concurrent access has come. This problem had to be solved. We started to patch database managers. We made a new programming interface for the dBase, which could say that they sequester the data table or the whole database. it is mine and no one else's. I work on it and when I'm finished, I will free it and then you may also touch it. Oh, I have forgotten. I will free it tomorrow. The source of lots of problem was the inappropriate fine granulated sequester. On top of that, it was not part of the system. It was controlled by programmers. Despite of the fact it was used for many years. In certain circumstances it was quite fast during the characteristic interface programming. But, of course the reliability of it leaves much to ask for. The concept of the consistent database that still has been locally, we can forget about that. (So, the empty database was consistent). Simply, there was not any tool for handling the concurrent access. Although, there were tries when one of the users working with it then it copies the whole database for itself, and it worked in there. It logged the differences that itself made and when it loaded it back it only carried the differences as it was in the log. But that could only been done at night when nobody has touched the database.

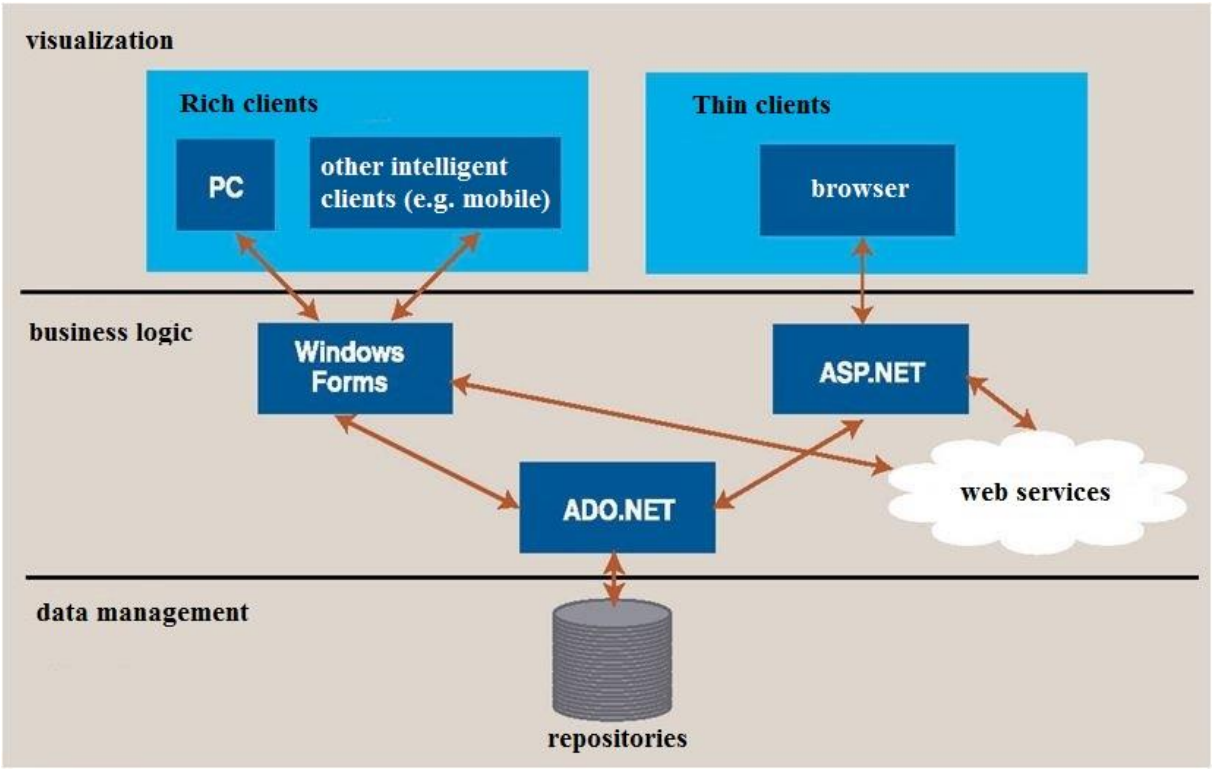


Client – server architecture

It has two sides. The first one is the hardware architecture. That is when I say that I have a server and there are clients. The server offers some kind of service and the client is using it. However, we are talking about database. In general, everybody think of a huge computer, which is the server, and some little laptops, which are the clients. But it is not true in the case of database management. Here the server is the one that offers service and the client is the one that makes use of it. If there is an MS SQL server Steve's and I would log in to his computer and use it to reach the database that was ordered to it then his laptop would be the server and mine would be the client. I remember that he has done something wrong. I tell him to look at mine. Now he will log in to my SQL server. At this point my computer is the server his computer is the client. So, it depends on the service that who is the server, who is the client. There are examples, but when we will work for a big company there the services are adjust to the hardware. It is simply, because the bigger source of energy is needed for a server to serve the requests of the few hundred or few thousands of people. Because of this an SQL server is running on the server computer, as service and here client programs are running. We are still in abstract level: What the SQL server is? Somebody is going to the MS Windows 2008 server and asking a service from it. Then the answer of the Windows is: What? I have no such

a thing. Then this person is going to the Unix and the answer is the same as it was in the case of Windows. I have no such a thing. There is no such thing in the operation systems. It is another tale that what software, what servers, and what services we are installing. I would like to put it in two big groups that are capable of doing this. It is an interesting thing that in Hungary the Oracle is the most famous "database manager". Although, in Romania they say that yes, there is Oracle, but the IBM DB2 is the "database manager". It is nothing more than marketing. Because one has to pay for it - and not little – I write here the MS SQL. it is a very nice SQL server. I always say that this is the best product of Microsoft. It can be robust, and it can work well. Therefore, I also count the IBM DB2 and Sybase among them. I have to count the Interbase among the paywares. Only the 6th version was freeware. It is the Borland Company's emphasized partner. It may be perfect SQL server of Delphi and C++ Builder. These SQL servers can be purchased for a big amount of money. The price of these can be from a couple of 100000 to manifold of 10 million. So, when we write a store management program to Mary's small shop and we tell her that we will make it to her for a couple of cakes, but she has to buy an Oracle for it, which is for 15 million. She will not want that. It is very important that when we choose SQL server we have to look for the one that is the best mach for the size of the task.

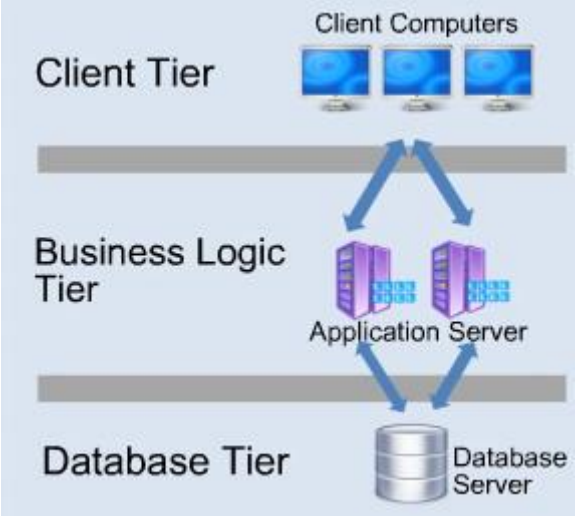
The expansion software and the manager interface that are given to the SQL servers are greatly influence their price. Of course, we get a lot and often indispensable product assistance for our money. So, these are paywares. They give service for money. If we are making a sharp system for a big company then this is important. The other group is the freeware softwares' group. A tend to count here the MYSQL, too. From the version of 5.1 it can manage stored procedures (it is a very good and it was missed from the previous ones). So, my only problem with the MYSQL was that it cannot manage transactions, and other small things that it should. So, there is a big probability that the banks will not use them, because it is not suitable for collecting money from ATM. It can't handle. But it is almost free. Another possibility is the PostgreSQL. The PostreSQL also know the stored procedures for a long time. It can handle nicely the triggers. It can also serve transactions (there are not just auto transactions in it), but it is not as wide-spread as MySQL. But it is a free system which very good. It is worth a look (I recommend it.) There is still a very interesting system by the name of Firebird. It is equal to Interbase, and it is an SQL server that is 100% compatible with it.



The Firebird is fit perfectly for the data storage and the management of the records system of a small or middle enterprise. It is not suitable where there is big data replication. These systems such as Firebird has the advantage of that if we have written a system and we would like to sell it to – small or middle enterprises the these will save them. We can also sell them in local systems without changes. So, when Mary opens a flower shop an she says she has to invoice or maybe she has to make out a bill for example five times a week and she has to make income. In this case, the Firebird would serve her well. Id doues not need a computer with 5 cores and with 100 gigabytes, because it runs on a simple laptop. The installer of the Firebird is not even having manager interface. So, it runs with six or seven megabytes. Its transaction manager is excellent. From the 6th version it also contains triggers and stored procedures. Practically, it knows everything just not in monumental scale, but in the level of the small or middle companies. I would recommend it for those who has sense for such things.

Multi-Tier

Multy-layer architecture. Here w are not only thinking to hardware, but to logical layers. There is a SQL server and there are client programs. This is the client-server architecture for sure.



One or two inner layers were put between them with the condition that the clients are sending their requests to these layer and they will also receive answer from there. Only this layer can make contact with the SQL server, and only this layer can ask questions from the SQL system. The client program can't make contact with the SQL server directly. In the server-client architecture the client program can reach the SQL server directly. There, I call the stored procedure in the database that was managed by the SQL server. But not in the multi-tier. In it there is an inner layer that is called business intelligence. It is a collection of procedure, function, method that were called by clients. The BL (Business Logic Layer) is responsible for the communication with the SQL system. The BL cannot be evaded. It was developed from the fact that how pleasant is that when a program does not have to be installed on the client. Instead of the installation the client says that, I already have an explorer. We write a web address and then we communicate that way. Some kind if data will appear on the web place. Of course it is extreme, because we could say many systems that cannot be served by an explorer. At serious systems it is sure that there are two hardware tools and there are two servers. So, that is not serious system when the web server and the database server are on the same computer. From the view of data protection that is not system. Due to the safe things

we always say that one of the computers is the database server that is placed in a so called DMZ (Demilitarized zone) that is surrounded by many firewalls. Simply, it is about that the data are values. So, these data can cause tremendous damage for a company if they are lost, or if they are leaking out. The following is a very simple example, when we have doing the EGERFOOD system (http://ektf.hu/ret/fo_profil/ and http://egerfood.eu/). They are six companies each with one product. They are all food producing companies. The factory of Detk biscuit is in Halmajugra. They have entered the EGERFOOD system with the simplest product. It is called rich tea biscuits. When we have went to the company to consult that what system we will create, how the data connections will be, the first and more important question was the data protection. We sat down. The boss came in. We have not even spoken for minutes of what we would like to when she made us stop. Then she said: Boys! Tell me that how you can assure that the recipes and the data, which we use and send through the internet between Halmajugra and the college, would not get in others' hands. We have shown them that we are using VPN (Virtual Private Network) and the encrypting system of WCF (Windows Communication Foundation). Besides, we are encoding everything with AS 128. We have showed them a three layer protection system what we have nicely drawn it for them. It has turned to reality. So, we have not spoken in vain. But the plan was plan at that time. She said that it was good, applicable, she said thanks and that we shall go. IN the industry the data protection is extremely required from the developers. Of course, when it turns out that it costs a million more for them then they grimace, but it is something they have to invest. So, nowadays is really that the database server – demilitarized zone and business logic is a separate computer. It is another computer if it is a web structure. The access to it can be made by pda, mobile phone, laptop, anyhow.

Thin client

The thin client is a client minimal tool. This type of client uses the required sources of energy at remote (host) computers. The task of the thin client is mainly get exhausted in showing graphic data send by the application server.

Basic structures

Schema: every database has an inner structure that includes the description of all data elements and the connection among them. This structure is called the schema of the database.

The most significant **metadata** contains the definition of the data's type and references to what connections and relations are between data. Furthermore, they contain information in connection with the administration of the database. So, with their help can store structural information besides the actual data.

The construction of the database be different. It depends on the applied model. However, there are some general principles which are almost used in every application based on database. These are:

The **table**, or data table is a two dimensional table which demonstrate logically closely connected data. The table consists of columns and rows.

The **record** is a row of the database. We store in a record those data which are depending on each other. The rows of the table contain the concrete values of single features.

The **field** is a column of the table. Every single column means the feature of the certain thing which has name and type.

The elementary data are the values in cell of the table that are the concrete attributes of the entity.

The **entity** is what we would like to describe and whose data we would like to store and collect in the database. We consider entity for example a person. We call those things or objects entity that can be well separated from and from which we store data, and what we feature with attributes. For example, entity can be the payment of a worker, a material, a person, etc. In this form the entity function as abstract notion.

We can also say that the entity is the abstraction of concrete things. It is a habit to use the expression of entity type to abstract entities.

The **attribute** is one of the features of the entity. The entity can be featured by the sum of attributes. For example, the name of a person can be a feature.

The entity type is the sum of given features related to entity. For example, a person can be described jointly by name, date of birth, height, the color of hair and the color of eyes.

The **entity occurrence** is the given concrete features of entity. For example, Koltai Lea Kiara is 5 years old. She has brown hair, blue eyes, her height is 110 cm, and she is in nursery schools. The occurrences of the entity are corresponding to the records. In practice, the entity type also can be called record type (record type or structure type).

When we store data in more than one place then we talk about **data redundancy**. Because, it is almost impossible to avoid the redundancy we have to endeavor to minimize the multiple occurrences. The method of that is to pick the repeated data out during the designing of the database, and store them separately referring to it in the right place.

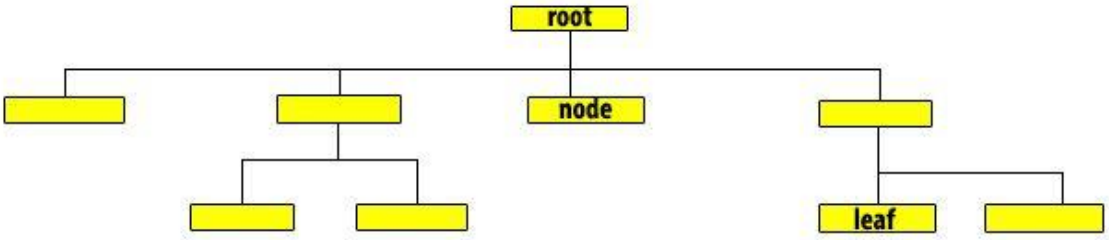
Improvement of data models

Making a model is a common method among the scientists for recognising the base of the problem. In informatics we call models data models which are to describe the structure of the data.

During database designing plenty types of data models have been evolved, three of them have gained currency. Although we must mention that, thank for the new programming methods, a new type of data model is getting in shape – the object-oriented model.

Hierarchical

This one is the most ancient data model. Datas are stored in a hierarchical structure which is similar to a tree. Every intersection of the tree refers to one type of record. There is parent-children relationship between the datas. Every data can have infinite number of children but only one parent. This model can be used to one-to-one and one-to-many relationships as well. Lately this model has been absolutely displaced by the relational model.

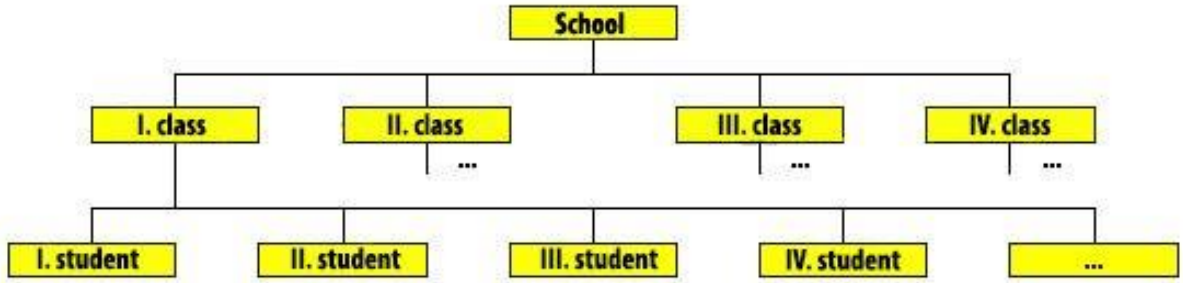


A database might consist of more trees which are not connected to each other. Datas are situated in the intersections and the leaves of the tree. The relationship between them equals with parent-child relationship so we can only make 1:n relationships. The 1:n relationship means that one type of data in the data structure is only connected with datas under it.

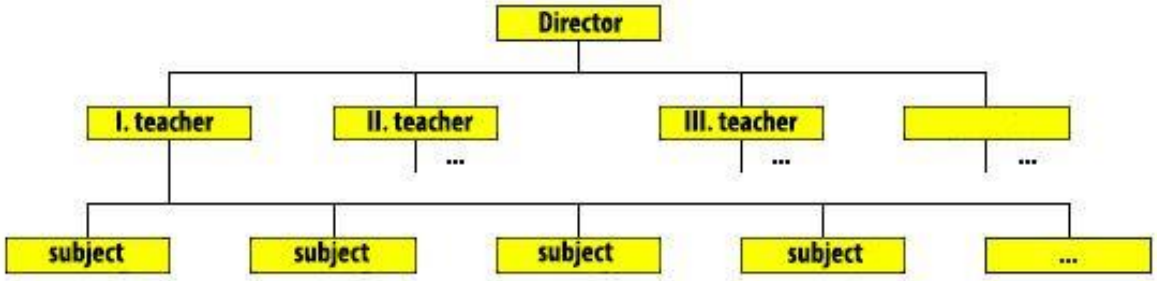
By its nature, we can't express n:m relationships with the hierarchical data model (as you can see in the net model). Moreover its other disadvantage is that datas can be only accessed in one given order which equals the order of the stored hierarchy.

The best example for the usage of the hierarchical data model is the family tree. But the employer-employee relationship or the structure of a school can be described in this model. In case of a school we can design more types of hierarchies. On the one hand the system of the

school is separated into classes which consist of students. On the other hand the school is led by a headmaster whose employees are the teachers, who teach one or more subject(s).
Hierarchical cast of the school in the students' point of view.



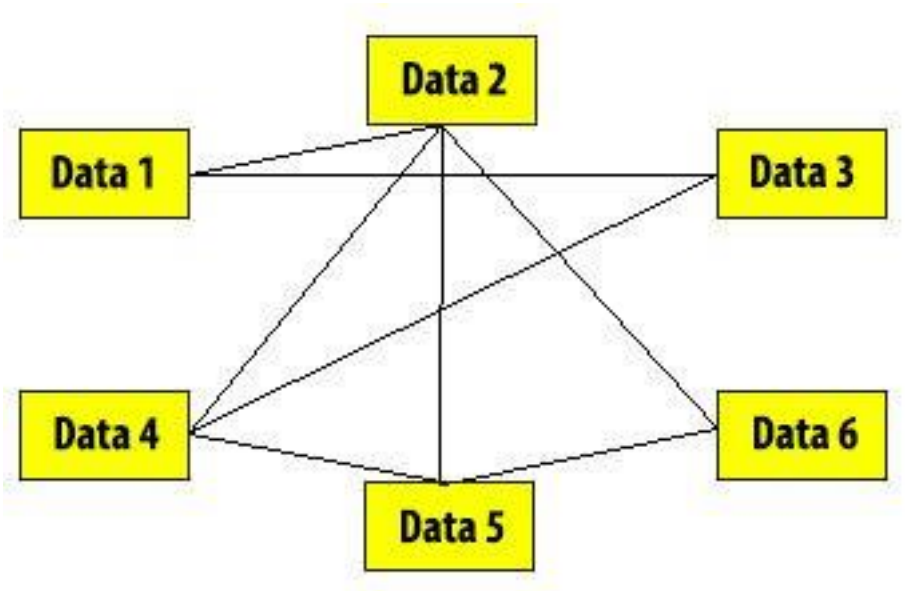
Hierarchical cast of the school in the teachers' point of view.



Network Data Model

This model is the developed version of the hierarchical model. The main difference between them is that as in the hierarchical data model the graph could be only tree-shaped; in the network model we can create every kind of graphs. So an item can have more parents, and we can create every type of relationship between the datas. We can deal with more-to-more relationships. Its disadvantage is that it requires a lot of storage space. It can be found in environments with huge computers. Nowadays this model became outmoded.
In case of a network data model the relationship between single equivalent or different pieces of data (records) can be expressed with a graph. The graph is a system of intersections, and runners connecting them to each other; where there is connection between two intersections providing that they are connected with two runners. Infinite number of runners can go from one intersection but one runner can connect only two intersections to each other. It means that every piece of data can be connected to infinite number of pieces of data. In this model n:m relationships can be described as well as 1:n ones. In case of hierarchical or network data model, only stored relationships can be used effectually to data-retrieval (more effectively

than in other type of models), resulting from the relationships fixed in the database. Its other disadvantage is that its structure is inflexible and hard to modify.



Network data model

Relational

Elaboration of the relational data model is owing to Codd (1971). Since that it plays an important role in the usage of database management systems. The advantages of relational data models are the following:

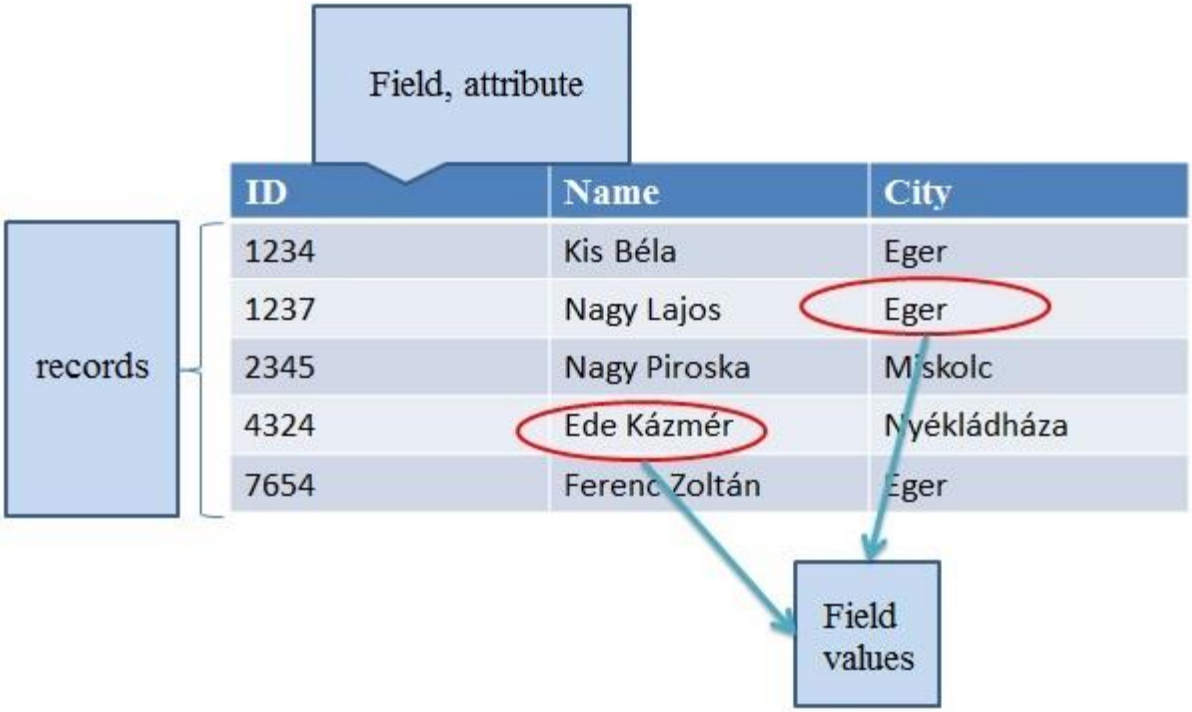
- The relational data structure is easy to construe for the user and for the application maker as well, so it can be the mean of communication between them.
- Its logical data model relations can be imported to a relational database management system without modifying.

In the relational data model database designing can be done on an exact way thank for bringing the normal forms in.

The main feature of the relational data models is that it illustrates datas in more systems connected to each other. Nowadays it seems to be the most popular data model. The base of this model means the relations which are used in mathematics as well. It practises a new method for accomplishing queries with the help of operations defined on relations. SQL (Structured Query Language) is a complex database query language in which we can take through the queries and different database managing operations. Access uses relational data model so it requires to be more specified.

In this model we illustrate datas in a 2-dimensional table in which datas are in logical assumptions with each other. Relational database is just a whole bulk of relations. Each

relation has a unique name. In the columns datas refer to the same quantities. Columns are named as well, which have to be unique within a relation, but there can be columns named the same in other relations. We store datas logically belong together in the rows of the relation. The sequence of the rows is disregardful but two rows can't be the same. In the cut of a row and a column there is a field which contains the datas. Fields contain different type of quantities (numeric, written) in different columns. We often say tables or charts instead of relations, records instead of rows, attributes instead of columns.



The following example shows a relation including personal details:

Person

ID number	Name	City	Occupation
1 650410 1256	Kiss László	Győr	mason
2 781117 0131	Nagy Ágnes	Szeged	student
1 610105 1167	Kiss László	Budapest	locksmith

Does this chart remain a relation if we leave the ID number column out of account?

As we can't pass by the chance that there can be two people who have the same name, profession, and live in the same city; without the ID number column we would have two equal rows, which is not allowed in a relation. It is suggested to name the columns of the relation to refer to their content even if it goes with more type work. Its usefulness is shown in this example:

R		
A	B	C
1206	389	274
967	2012	65
12	654	712

Material		
code	stock	unit price
1206	389	274
967	2012	65
12	654	712

These two charts contain the same pieces of data, but in case of the first one addition of more notes to describe the contents of the column will be necessary.

In usual it is require in case of relations not to contain any information which could be calculated from other details. For example, in the material relation (chart 2.3) it would be completely unnecessary to add a column named value as it can be calculated by multiplying the in stock and the one-price columns. This way if we have an ID number column it is needless to make a column named date of birth as this detail can be figured out from the ID number.

Basic requirements in connection with the charts:

- Every chart has a unique identifier

- Details in the cut of the columns and rows are single-valued; these are called primary data fields
- Datas stored in a column are connatural
- Every column has a unique name
- There is the same amount of data in the rows of a chart
- A chart mustn’t contain two rows which are the same
- The sequence of columns and rows is disregardful

KEY.

Those properties play important role, which determine the values of other properties clearly. That means, when we give such properties value that defines an occurrence clearly. Those properties, which determine clearly an element of an individual type, we call key. Keys are playing an important role during the creation of the data model. During design, in general we imply which attributes are making the keys. Theoretically an individual could have more keys, but in the most cases it is common to choose one, which is the best suitable to the clear identification. We call this primary key.

Key-featured property could always be found. If there is no such property among the real data, we can introduce a new property which values are ordinal numbers, codes, special identifiers. This can play the role of the primary key. We can see, the identifiers, codes can be found almost every application. Due to the nature of the computer, these are suitable to determine the occurrences precisely. In particular cases for a non-advanced user could be difficult to pay attention for slight mistypes. This could cause a significantly different output or results. Who works with computers should be extra careful about codes, and should work accurately.

Relations

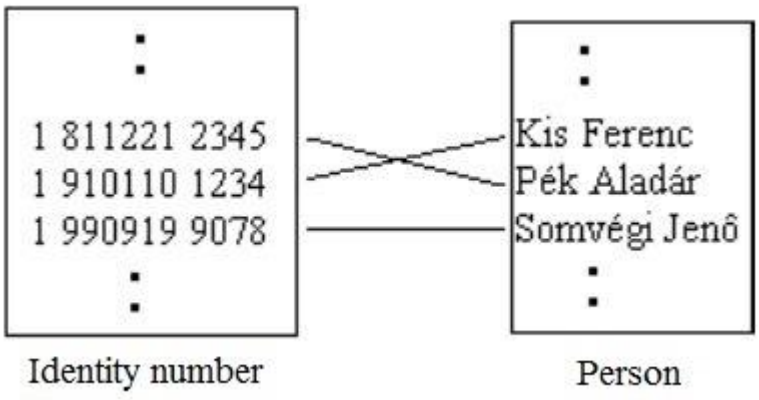
The third important elements of the data model are the connections. We call a relation the affairs and contexts between the individuals. For example in the well-known payroll system there is a natural relation between the employee and the payment individuals. This tells us, which payments relate to the individual employees.

Like this way relations can be made between the elements of the individual sets. We can classify the relations according to how many elements belongs for each element. This is significant in the computer representation aspect of the relation.

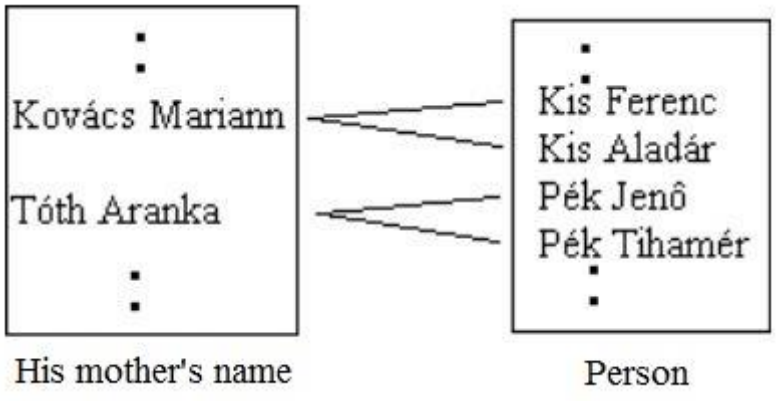
It is way simple to implement a relation where to one individual belong only one another individual occurrence, than another one, where there could be more. In the first case a pointer could do the job, but in the second case we need a complex data structure for example a set or list. Relationships can be organized into three groups:

- One-to-one
- One-to-many
- Many-to-many

In case of one-to-one relation for one individual occurrence belongs only one occurrence of another individual. One-to-one relation is for example between a man and a women individuals the marriage relationship.



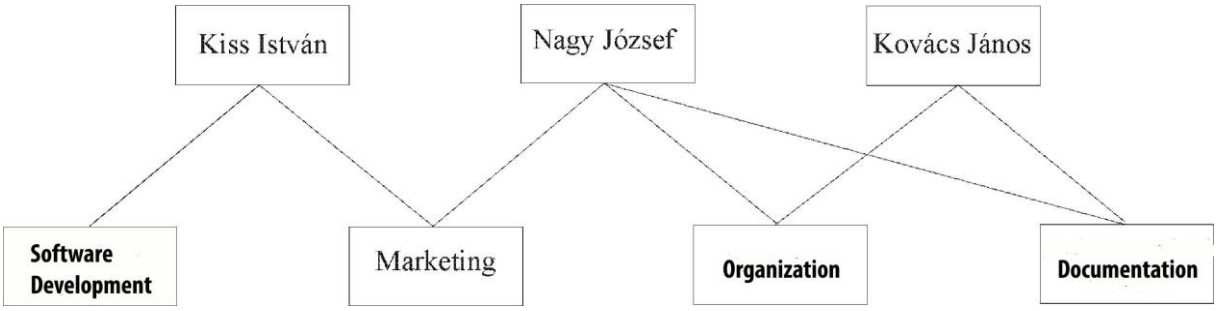
The next group is made of the one-to-many relations. In this one for an individual occurrence can belong more occurrences of another individual.



For example in the payroll system there is one-to-more relationship between the employees and the payments. The base of the relation is which payment belongs to which employee. It is clear, for one employee can belong more payments, but one payment can belong for only one employee.

The most generic form of a relationship is the many-to-many relationship. In case of many to many relation both individual occurrences may belong another individuals many occurrences. Let's suppose in our system we record which employee works on which themes. In this case we have a many-to-many relationship. That illustrates the following figure.

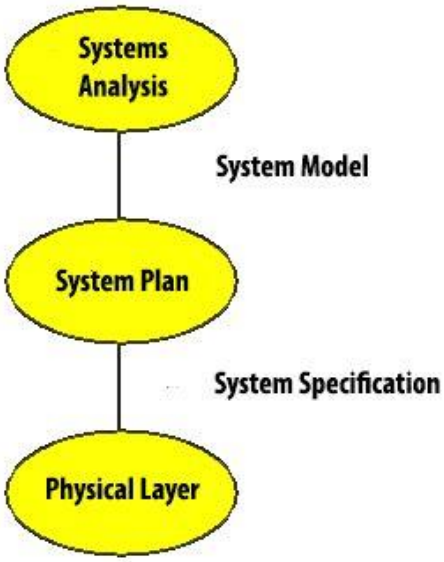
Many-to-many relations rely on one-to-many relations. From any individual point of view we can discover an one-to-many relationship. Therefore every many-to-many relationship can be split to two one-to-many relationship. So far we talked about such relations which could be made between two individuals. These are so-called binary relations.



Database planning and its contrivances

The very first step of database designing is that we have to know what type of database management system we use. The use of Access database management system goes with subdividing data into groups, taking the items being close to each other into one table, then specifying the relations between the tables – just like in relational database management systems. So designing and creating a database is a quite complicated job and it requires some creativity as well. During designing a database we have to pay attention to make our database be able to fulfil some requirements like minimizing data redundancy or proving all data independences to be expressed, ect. There is no general method which can be used during designing all kinds of databases but there's a procession which is advisable to be followed. Above all, we have to determine our aims which have to stand close to the user's demands. Meanwhile designing it is essential for the planner to have the required knowledge in connection with the field the user deals with. This is the section of defining the information needs as well as developing the details, formats and algorithms. In usual designing is not brought off by the programmer but the organizer who is familiar with designing and who will investigate the exact demands of the user. The organizer will do a well-founded research with the help of different reports and documents which can be used as sources during designing.
Therefore we can go on with the logical database designing. In this section the data and the relations between them are highlighted. Now comes defining the database objects, describing their features, and mapping the relations between them while taking care of minimizing the data redundancy. The physical database designing is separated from the first two steps as in this section the databases are created on the computer according to our previous plans. After all we are done with the prototype, which is only the first version of the system as a lot of changes and improvements are still needed.

Main steps of database designing



1. Analyzing the requirements: First of all we have to determine the aim of the database. We have to do some research to be of use for designing the database. We also have to think over what kind of information we would like to get from the database, and which are the details should be stored in connection with the objects.
2. Determining the objects and tables: the collected data have to be sorted into an information system. This information system is dealing with objects. Physically the objects are stored in tables, where the objects go to the lines (records) and attributes go to the columns (record's fields). It is advisable to keep one piece of data in only one table – this way later if we have to modify it; we will be able to do it at one place. Information referring to one topic has to be stored in one table.
3. Determining fields and attributes: this is the concrete section of designing. Here we design the tables and determine the tables including the fields. We can sort the attributes according to these aspects:
    a) simple attributes, which can't be divided anymore ; and composite ones which consist of simple attributes
    b) equivalent: it has one value at its every occurrence. Multivalued ones have more values at their occurrences.
    c) the stored attribute's values are stored by the database. Its derived value is determined by right of other attributes.

4. Determining identifiers: It is significant to identify the data stored in tables clearly. Using primary keys is necessary in every table in which we would like to identify the records one by one. The primary key is a kind of identifier, which's values can't be repeated within a table. Primary keys have an important role in the relational database management systems. By the help of them we can increase the level of efficacy, fasten searching and collecting data.

Three types of primary keys are applicable:

a) auto-number primary key: this is the simplest primary key. We only have to create an auto number field. Then the Access will generate a unique ordinal number for every new record.
b) single field primary key: the key isn't counter-type if it doesn't consist of any recurring values (e.g. VAT number)
c) multi-field primary key: we make this key with the use of more fields. This one comes on when we can't insure any of the field's uniqueness.

5. Determining relationships: Relate the records of the tables with the help of the primary keys. Relationship means that two objects belong together.

We can subdivide relationships into three groups in the view of multiplicity (we will deal with them later):

a) one-to-one relationship
b) one-to-many relationship
c) many-to-many relationship

6. Control: After designing the fields, tables, and relationships we have to check the plan whether there is a mistake or not. It is easier to modify our database directly after designing than if it is filled in with details.
7. Data input: Since we are done with the needed corrections and controls we can entry the data into the previously prepared tables. Furthermore we have a chance to create other objects like forms, reports and queries (we will deal with them later)

Normalisation

The base of the relational database management system is the normalisation –meaning a method which gives the optimum way of the data's placement. In case of an inefficiently designed database there will be contradictions and anomalies in the data structure. Normalisation allows you to structure data appropriately, and it helps you to eliminate the anomalies and lower data redundancy.

Anomalies:

- Insertion anomaly: Adding a record wishes another record's enrolment which is not logically related to the record.
- Deletion anomaly: During deleting the item some instance of data is removed as well
- Update anomaly: Because of a change of a data we have to update it at its every place of occurrence

Normal Forms:

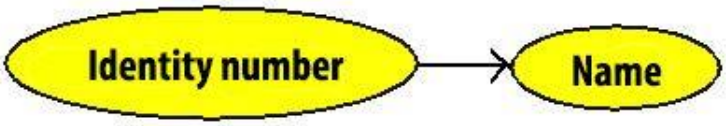
First Normal Form: there are no repeating elements or groups of elements. In every row of the relations one and only one value takes place in a column, the order of the values is the same in every row, and every row is different. There is always at least one or more feature(s) which make(s) the rows individually distinguishable.

Second Normal Form: the relation is in first normal form, and none of its secondary attributes depend on any of the genuine subset of its keys. (Primary attributes are the ones which belong to a key; in case of secondary attributes this is not true.)

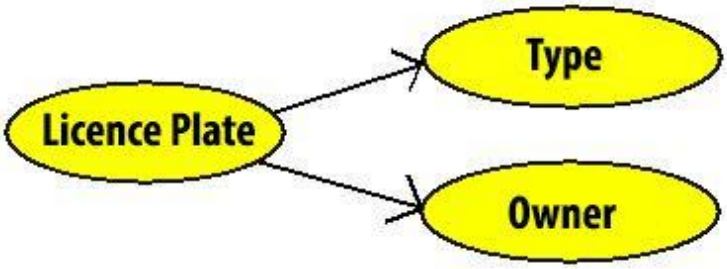
Third Normal Form: the relation is in second normal form and there is no functional dependence among the secondary attributes. If the value of "B" attribute depends on the value of "A" attribute, and the value of "C" attribute transitively depends on the value of "A" attribute. Elimination of these transitively dependences is an essential requirement of the third normal form. If the table of the database is not in third normal form we have to divide it into two tables, each of them in third normal form.

Dependences

Functional dependency: when any values of a feature of the system can be assigned to only one value of another feature. E.g.: one personal identity number can be connected to one person but a person is able to have more personal identity numbers.



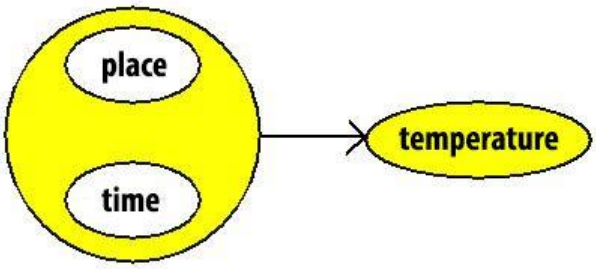
One-to-many relationship.



Mutual Functional Dependency: when the above-mentioned requirements come true in both directions. e.g.: registration number- number of the engine. One-to-one relationship.

Functionally Independents: when the above-mentioned requirements don't come true. e.g.: the colour of the student's eyes – the place of their school.

Transitive Functional Dependency: when some concrete values of a describing feature of an element determine other values of a describing feature.



Relation key

The relation key unambiguously identifies a row of the relation. The relation – as it is in the definition – cannot include two identical rows. Therefore, there is a key in every relation. The relation key must carry out the following terms:

- it is a group of such attributes, that identifies only one row (unambiguously)
- none of the attributes that are included in the key can form subset
- the value of attributes that are included in the key cannot undefined (NULL)

The storage of undefined (NULL) values is being specially solved by the relation database managers. In case of numerical values, the value of NULL and 0 are not equals.

Let's keep a record of the personal data of students of the class in a relation.

Id number	Date of birth	Name

PERSONAL_DATA=({ ID_NUMBER, DATE_OF_BIRTH, NAME}).

In the PERSONAL_DATA relation the ID_NUMBER attribute is a key. It is, because there cannot be two different people with same id numbers. The date of birth or the name cannot identify unambiguously a row of the relation, because there have been born students on the same day or there may be students with same names in the class. Together they identify a row of the relation. But they cannot satisfy the condition related to the keys that the subset of the attribute, that is included in them, cannot be a key. In this case, the id number is already a key. This way, combined it with any other attribute it cannot form key already.

There might also be such relation that in it the key can be formed by connecting more value for the attributes. Let's make a record of the given marks the students got with the following relation:

DIARY=({ID_NUMBER, SUBJECT, DATE, MARK)}

Id number	Subject	Date	Mark

In the DIARY relation the ID_NUMBER does not identify a row, because there can be marks for a student, even from the same subject. Because of this, even the ID_NUMBER and the SUBJECT cannot form key. Even the ID_NUMBER, SUBJECT and the DATE can only form key if we preclude the possibility of that that a student can get two marks from the same subject on the same day. In this case, if that condition could not be kept, then there must be stored not only the acquisition date of the mark, but also its point of time. In such cases the DIARY relation has to be extended with that new column. There are not just complex keys that can take place in the relation. There are also such relations that in it there can be found not just one, but more keys. To illustrate this let's see the next relation.

Consultation=({Teacher, POINT_OF_TIME, STUDENT)}

Teacher	**Point of time**	**Student**

Relation with more keys

In the CONSULTATION relation we imagine such identifier in the teacher and student columns that unambiguously identify the person (for example ID number). Every single student can take part in more consultation, and every teacher can hold more consultations. What is more, the same student can take part in the same teacher's consultation in different points of time. As a consequence, neither the TEACHER nor the STUDENT nor the two identifiers together are keys of the relation. But one person in one time can only be in one place. As a consequence the TEACHER, POINT_OF_TIME attributes are forming key, and with the same reasons the STUDENT, POINT_OF_TIME attributes are forming key as well. We have to notice that the keys are not being made by as a result of arbitrary decisions, but they come from the nature of the data as well as the functional dependence or the polyvalent dependence. In the relation we differentiate foreign/outer key, too. These attributes form key not in the certain relation, but in another relation of the database. For example, in the CONSULTATION relation if we use the ID number to the identification of the STUDENT then it is a foreign key to the relation record personal data.

Data model mistakes

Anomalies:

They are mistakes, because of inadequately designed data model. They may lead to the inconsistency of the database (because we are not storing only one entity's features or we store certain features multiple times).

Types

- insertion anomaly: The entry of new record cannot be done to one table, because in the table there are such attribute values which are available during entry or not available even later.
- modification anomaly: We store one in more tables, but during the modification of the attribute values we have not done the modification everywhere, or we have not done it the same way.
- deletion anomaly: We are deleting in a table and we are losing such important information that we would need later.

Redundancy:

It means overlap. In practice we refer physical overlapping to it – multiple data storage in the database – at designing it is also important paying attention to the logical overlaps.

Types

- Logical overlap:

Open logical overlap: the same attribute type with the same name is included in more entities. It results multiple storage. They may be necessary due to safety or efficiency, or for example to carry out connections (as foreign key). The lack of the logical overlap is also count as a mistake.

Hidden logical overlap (synonym phenomenon): We mark the same attribute with different name.

Apparent logical overlap (homonym phenomenon): We use the same name to different attributes.

- Physical overlap: the multiple store of the same attribute or – with synonym name – entity in the database.

Let's see the next relation.

Teacher	Subject	Total_number_of_lessons	Lessons_taught
Kiss Péter	Database management	64	12
Nagy Andrea	Mathematics	32	8
Szabó Miklós	Database management	64	4
Kovács Rita	Mathematics	32	5
	English	48	

Relation that contains redundancy

In the above mentioned relation we store the total number of lessons as many times as many teacher are teaching the certain subject. For example, let us suppose that a subject is being taught by more teachers. The redundancy has the following disadvantages:

- If the total number of lessons of a subject is changing, it has to be modified in the relation.
- Every time when a new teacher gets in the relation the total number of lessons data has to be taken out from the previous rows of the same subject.
- In the case of the subject in the last row (English) it has not been filled out who the teacher is. During the inclusion of new teacher to the list this case has to be managed in another way. In this case we just have to rewrite two empty values.

Redundancy can also occur if we store derived or derivable quantity in the relation.

A single relation can also contain derived data in that case if the value of certain attributes can be unambiguously determined based on the rest of the attribute. For example if we recorded the district beside the postal code. There are two methods to stop the redundant data. We have

to leave those relations or attributes that contain derived data. The redundant facts that are being stored in relations can be ended by taking the table apart, but we are doing it with its composition. We take to two pieces the relation that is in the 3.10 example
Lessons = {Teacher, Subject, Lessons_taught} and Total_number_of_lessons = {Subject, Total_number_of_lessons }

Stopping the redundancy

The goal of the logical design is a relation system, relation database without redundancy. The relation theory contains methods to stop redundancy with the help of the so called normal forms. From now on we will shot the definition of normal forms of the relations through examples. We will use notion of functional dependence, multivalued dependence and the relation key to make normal forms. During forming of normal form the goal is simply to write down such relations that we store facts which are related to the relation key. We differentiate five normal forms. The different normal forms build upon each other. The relation in the second normal form is also in first normal form. During designing the goal is to reach the biggest normal form. The first three normal forms concentrate on stopping redundancies in functional dependences. The fourth and fifth normal forms concentrate on stopping redundancies in multivalued dependences.
We have to get acquainted with two new notions that are connected to the relations. We call primary attributes that are at least in one relation key. The other attributes are called not primary.

Normal forms:

First normal form: All values are elementary in the relation. The relation cannot include data group. In every row per column of the relation there can be only one value. In every row the order of values are the same. All rows are different. There is at least one or more attribute that the rows can be unambiguously differentiated from each other.
For example, let it be here such kind of a relation that the attributes of it are also relations.

Study group	**Teacher**	**Students**	
Computer technology	Nagy Pál	**Name**	**Class**

		Kiss Rita III.b Álmos Éva II.c
Video	Gál János	**Name** **Class** Réz Ede I.a Vas Ferenc II.b

Study group	**Teacher**	**Student**	**Class**
Computer technology	Nagy Pál	Kiss Rita	III.b
Computer technology	Nagy Pál	Álmos Éva	II.c
Video	Gál János	Réz Ede	I.a
Video	Gál János	Vas Ferenc	II.b

Second normal form: The relation is n first normal form. Furthermore, none of its secondary attributes depend on any of its key's subset. (The primary attributes are those attribute that belonging to some of the keys. Those attributes, which are not belonging to any of the keys, are secondary attributes.)

Conference			
Room	**Point of time**	**Presentation**	**Place**
B	10:00	Mythology	250
A	8:30	Literature	130
B	11:30	Theater	250
A	11:00	Painting	130
A	13:15	Archeology	130

Conference		
Room	**Point of time**	**Presentation**
B	10:00	Mythology
A	8:30	Literature

B	11:30	Theater
A	11:00	Painting
A	13:15	Archeology

Conference		
Room	**Point of time**	**Presentation**
B	10:00	Mythology
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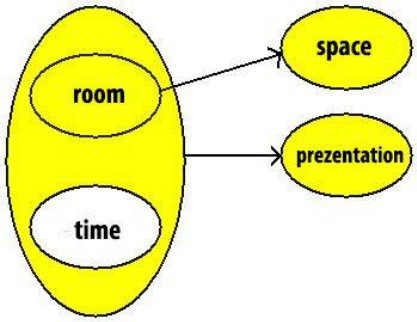


Dependency diagram

Let’s see another example for the relation that breaks the term of the second normal form. For the check of the energy management of a building the temperature in the certain rooms is being regularly measured. For the evaluation of the measured results we are also recording the number of radiators in the certain rooms.

Temperature			
Room	**Point of time**	**Temperature**	**Radiator**
213	98.11.18	23	2

213	98.11.24	22	2
213	98.12.05	21	2
214	98.12.05	21	3
214	98.12.15	20	3

Conference		
Room	**Point of time**	**Temperature**
213	98.11.18	23
213	98.11.24	22
213	98.12.05	21
214	98.12.05	21
214	98.12.15	20

Rooms	
Room	**Radiator**
213	2
214	3

Third normal form:

The relation is in second normal form. Furthermore, there are not any functional dependence among the secondary attributes. If the value of attribute “B” depends on the value of attribute “A” as well as the value of attribute “C” transitively depends on the value of “A”. The elimination of such transitive dependences is inevitable requirements of the third normal form. If the table of the database is not in third normal form then it must be broken to two tables so that the certain tables separately are in third normal form.
This will be demonstrated with the help of an example again.

Study groups		
Study group	**Teacher**	**Date of birth**
Képzőművész	Sár Izodor	1943
Iparművész	Sár Izodor	1943
Karate	Erős János	1972

Study groups	
Study group	**Teacher**
Képzőművész	Sár Izodor
Iparművész	Sár Izodor
Karate	Erős János

Teachers	
Teacher	**Date of birth**
Erős János	1972
Sár Izodor	1943

Boyce/Codd normal form (BCNF)

During the discussion of the normal forms we showed examples to such relations which only have one relation key. Of course, the definition of the normal forms can be applied to those relations that have more keys. In this case, every attribute that is part some of the keys are primary attribute. But this attribute can depend on another key that does not include it as part of the key. If that is the case then the relation contains redundancy. The recognition of this led to a more strict definition of the third normal form that is called Boyce/Codd normal form.

• All primary attributes are in complete functional dependence with those keys that this is not part of it.

As an example, let's see the following relation:

Subjects

Teacher	Point_of_time	Subject	Semester	Number_of_students
Kiss Pál	93/1	Database	1	17
Jó Péter	93/1	Unix	1	21
Kiss Pál	93/2	Database	2	32
Jó Péter	93/1	Unix	2	19
Kiss Pál	93/1	Database	3	25

The relation's third normal form and the decomposition of the Boyce/Codd normal form

Let us suppose that every teacher is teaching only one subject, but they are teaching it in different semesters. Based on this the following functional dependence can be written down: Teacher, Semester Subject, and Semester Teacher. The relation has two keys. They are the (Teacher, Point of time, Semester) and the (Subject, Point of time, Semester). In the relation there is only one non-primary attribute which is the Number_of_students. That is complete functional dependence with both of the relation keys. There is no dependence relation between the primary attributes. Based on these the relation is in third normal form. However, it contains redundancy, because beside the same teacher we store the subject multiple times in the same points of time. The reason for the redundancy is due to the fact that the teacher attribute depends on the relation key that does not include the teacher attribute (Subject, Point of time, Semester) only the part of it (Subject, Semester).

Fourth normal form (4NF)

Unfortunately, even the Boyce/Codd normal form can contain redundancy. Up to this point we have only examined the functional dependences, but not the polyvalent dependences. The following two normal forms serve to eliminate the redundancy from polyvalent dependences. A relation is in fourth normal form if in an XY polyvalent dependence it only contains those attributes that can be found in X and Y.

Fifth normal form (5NF)

For a long time the fourth normal form was considered the last step of the normalization. However, we can lose information due to the storage of the polyvalent dependences in separate relations. Let's see an example to show this. An Ltd, which is specialized in teaching computer knowledge, has more, well qualified teachers. The teachers are suitable for educate in various courses. The courses are being held in different parts of the country.
Let's make the Teacher-Course-Place relation based on these facts.
The only relation key contains all of the attributes (Teacher, Course, Place). It comes from that the relation is in Boyce/Codd normal form, but despite of that, it contains redundancy. For example, there can be found in two rows that Kiss Pál is teaching Database 1 course. By breaking the relation down in two - that only contains one polyvalent dependence – relation (Teacher, Course) and (Teacher, Place). If we stop the redundancy, that would also lead to information loss. After the break down we already do not know which subject is being taught in the certain place by the teacher. For example, is Kiss Éva holding database I. or database II. course in Pécs. Breaking the original relation in three, we will get the fifth normal form. The original relations can be produced from the connection of three relations that we have got as a result, but the connection of any of the two relations is not enough. At the end of the discussion of the normal forms we mention that it is recommended to normalize the relations by all means up to the third normal form. This eliminates much of the redundancy. Those cases are rarer that requires the use of the fourth and fifth normal form. In the case of the fifth normal form, it is possible to stop the redundancy we use bigger storage space. So, the designer of the database can decide whether he/she choose the fifth normal form and the bigger database, or the redundancy and the more complicated refresh and modification algorithms.

Physical designing

In case of the relation database, during the logical designing the relations can already adopt their final form which can be easily formed down in the database manager. During the physical designing we are rather concentrating on that, is the logical structure suitable for the terms of the effective implementation, and what indexes should we summon to the certain relation. The jointly implemented operations on the relation are called transaction. In general, we would like to reach fast implementation of transactions.

During the physical design it may occur that we build redundancies intentionally in relations for more efficient transaction management. It may seem a step back compared to the redundancy stop manipulations that was followed during the logical design. But the most important difference is that the redundancy is getting in the relation in a checked mode, and it was not just left there, because of the incomplete designing. For example, it often occurs that we store frequently together necessary data in one relation, because of the fastest possible check.

Supporting the design with software

Designing does not differ from the well-known practices. In every case it follows the software-developing standards which are the following:

1. Designing the requirements
2. Design of the database, the database tables and their fields
3. Defining the tables between the database
4. Stress and normal tests

Designing requirements:

Before this section we determined the requirements. It is important that requirements should determine those expectations that should meet the database. If there is any difference between the requirements and design, one should not go further in process until every difference was not thought through and fixed.

Design of the database, the database tables and their fields:

When we determine a requirement, comparing the information and the aim of the database, we can determine the kind of the table structure to create. So everytime we should consider that the data - what is necessary to achieve the requirements – should create a structure that meets the foundations of general database theorem. When we can project the structure we can go on with creating the fields of the database. In this phase we mark the primary keys too. In this particular task the primary key in every case is the table (uid) identifier which identifies the series. On the other hand introducing the historic data handling model we identify the individual by the reference identifier (rid). Like this, we can achieve that in the system we

have more rid yet they made unique records. The uniqueness should made of understanding together the rid and the dtm_ValidTo fields.

Defining the tables between the database:
When we use the technical identifier (uid) the individual and the historic data handling will be lost. Therefore the relationships in every case should assigned to the reference identifier.
When we don't do this, the historic data-handling could not be realized.

Stress and normal tests:
Testing is a key part of the development. Since in the data structure there could be found multiple records on the same time, it is important after the development part during the physical implementation we should testing the database structure continuously. The database structure should be tested by not only with normal data input, modifying, delete methods, but with stress tests too. That means we should do an intensive data input, in order to set the limits. Those limits could be the following:

- An interface in what detail could be computed?
- Connection between the quantity of data and quickness of the queries
- Input the proper data

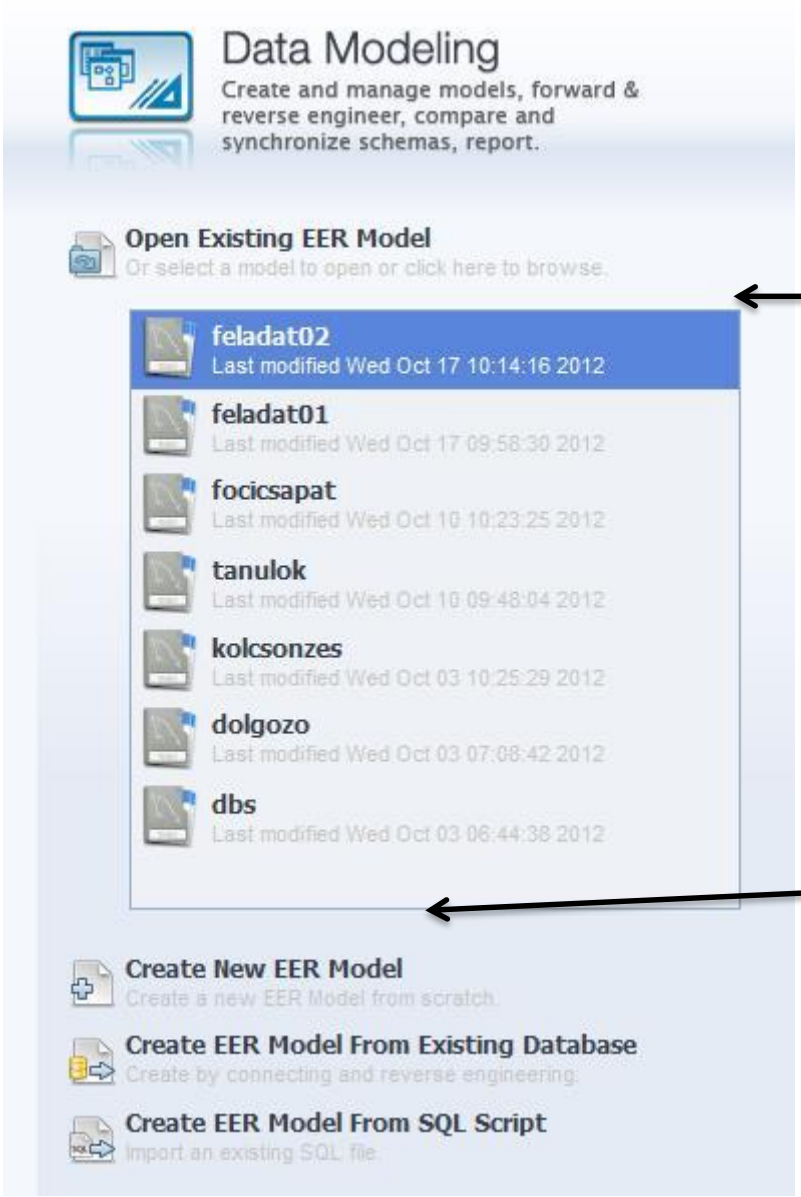
For the stress test we use the JMeter application which could queries run in multiple threads.

The MySQL WorkBench

First steps: Introducing the user interface

Data Modeling

In the model there are tables, connections keys and so on.

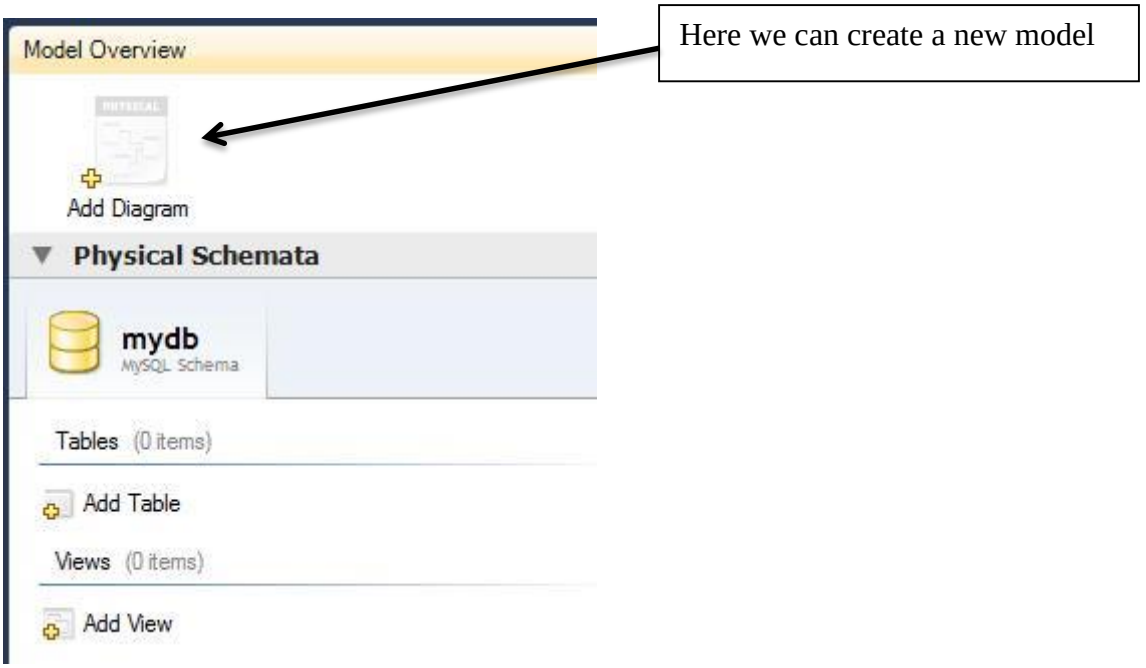


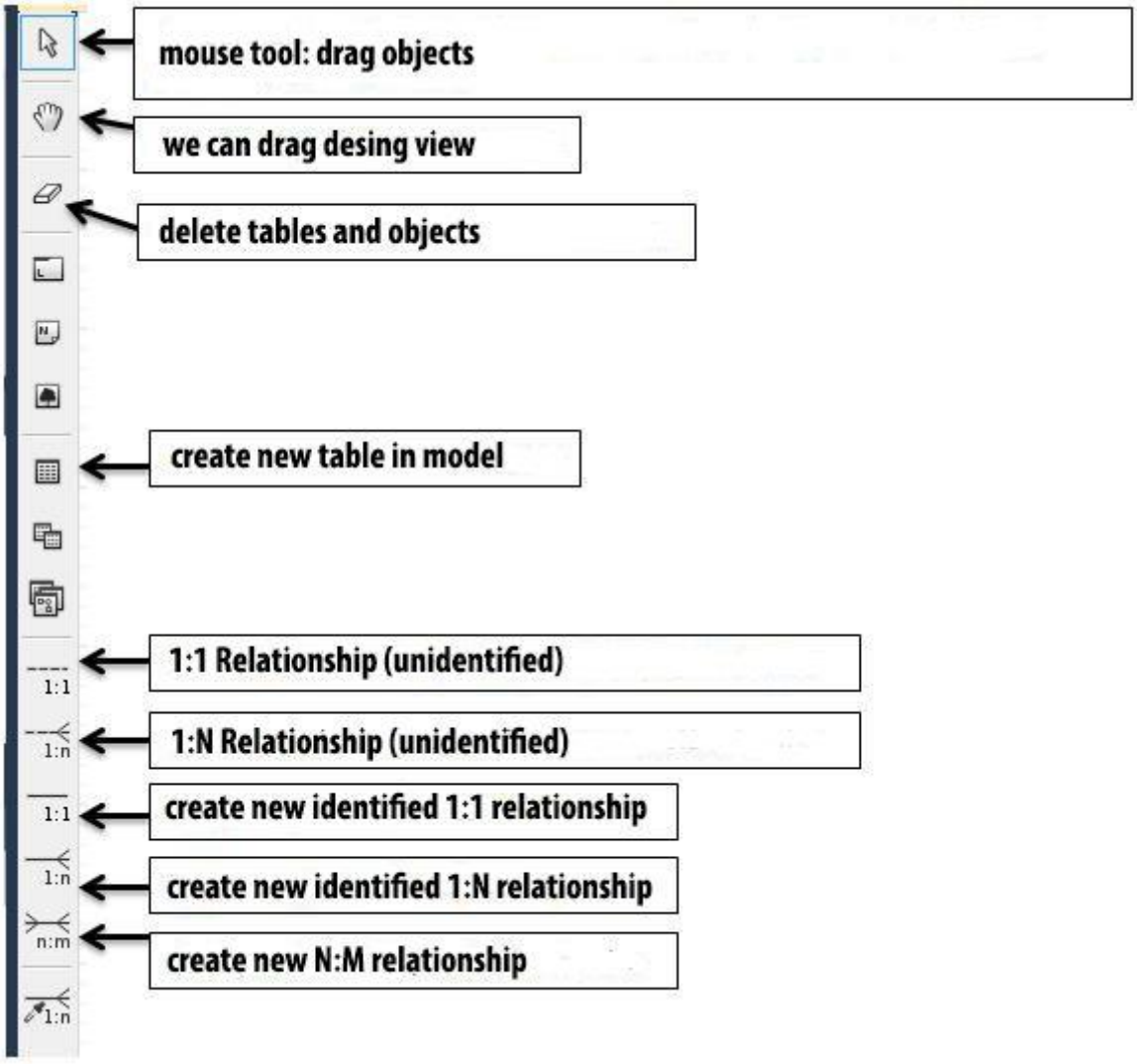
Here are the created models. They could be reopened and changed.

In model view we could design easily the tables in database and the relationships, and field types.

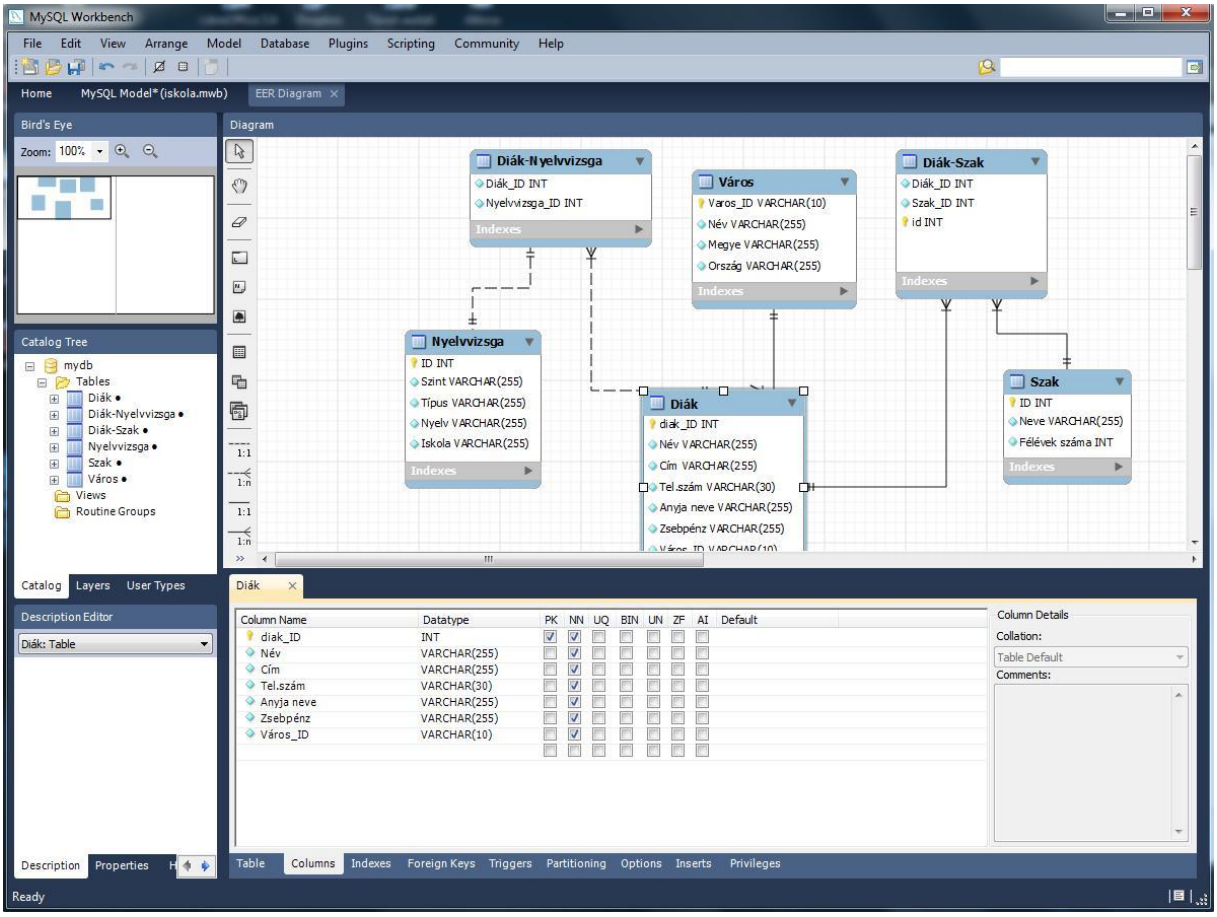
Here we can create a new model

When Create New EER Model clicked, a window appears:


Here we can create a new model
Model Overview
Add Diagram
Physical Schemata
mydb
MySQL Schema
Tables (0 items)
Add Table
Views (0 items)
Add View

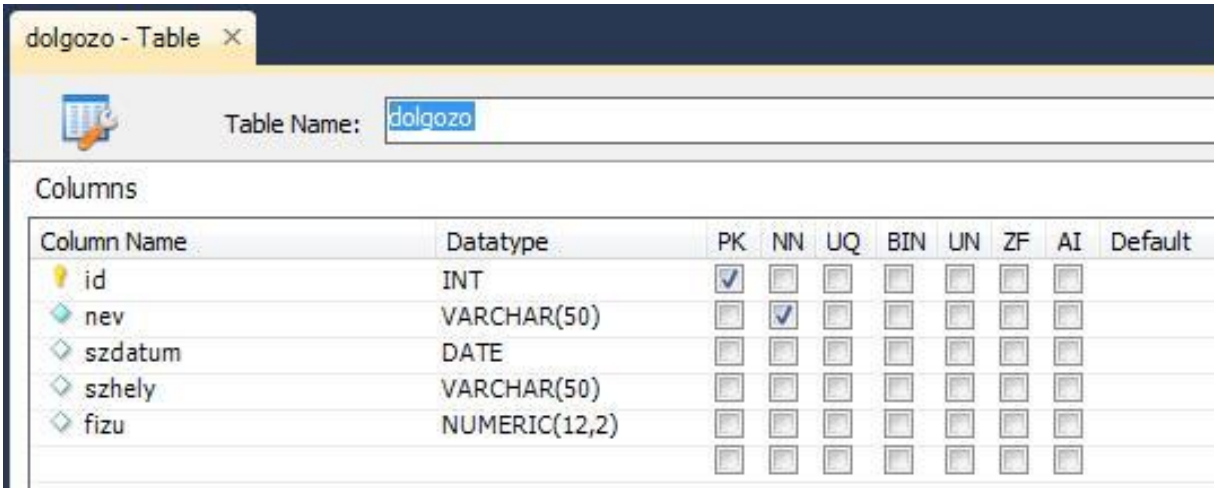

mouse tool: drag objects
we can drag desing view
delete tables and objects
create new table in model
1:1 Relationship (unidentified)
1:N Relationship (unidentified)
create new identified 1:1 relationship
create new identified 1:N relationship
create new N:M relationship
1:1
1:n
1:1
1:n
n:m
1:n

Designing fields:



Editing a table properties

We can define the types of the fields and its other detalis



The primary key of the ‘dolgozo’ table is the ‘id’ fileld with type of ‘int’.

After naming the fields we select their types.

A field properties could be the following:

PK – PrimaryKey

NN – NotNull – The field could not be empty

UQ

BIN

UN

ZF

AI

By ticking the corresponding checkboxes we can define the further properties of the field.

Creating relationships:

We select the kind of the relationship, and we connect the desired fields considered the relations ‘one’ side always linked for the primary key, the ‘many’ side for the foregin key.

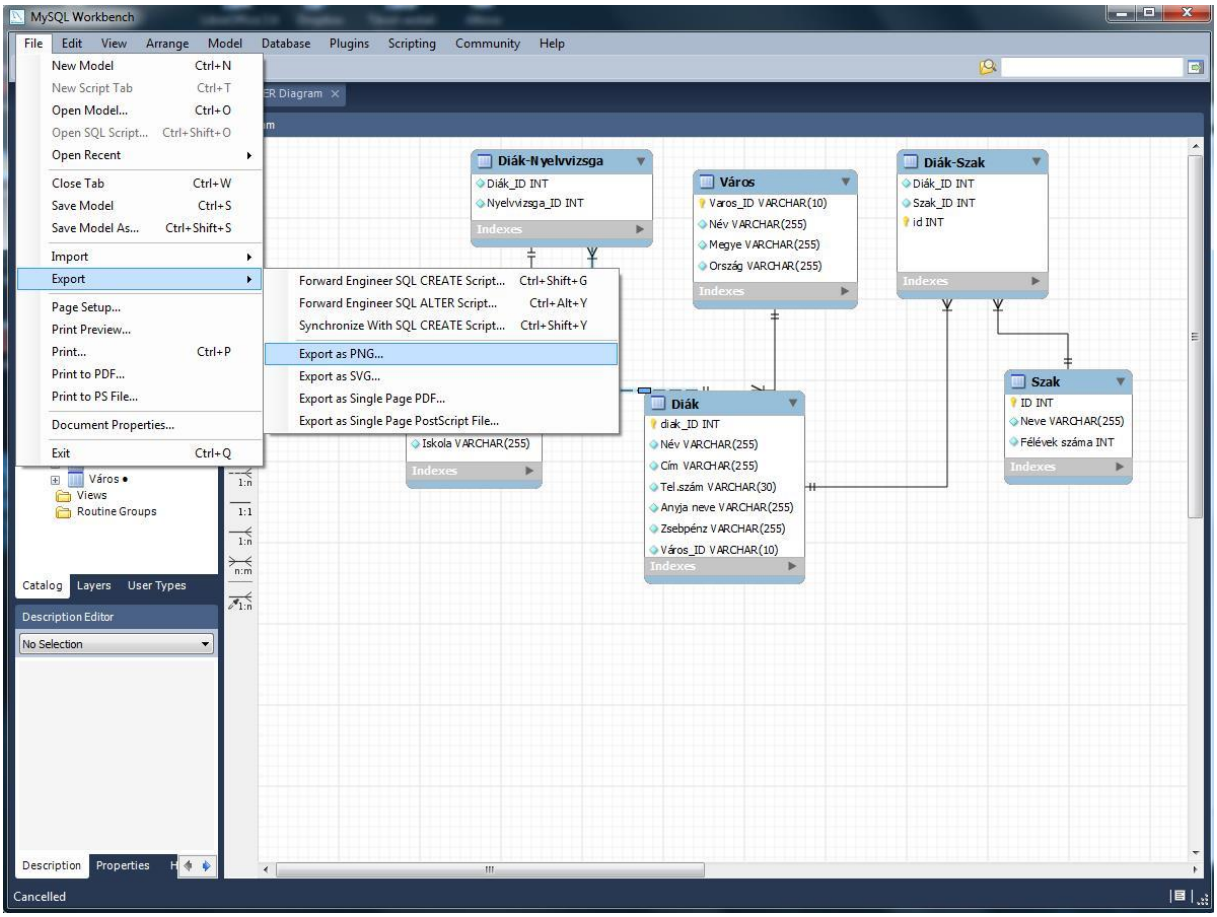
We should pay attention for the keyed fields types must be the same. Creating many-to-many relationship is done by switching tables. In the name of the table we name that it will be a switched table, then, we indicate the switched fields names. The rule, - keyed fileds types must be the same - applies here too.

Deleting relationships:

In this case the program asks, if the connected fields should be deleted too, or keep them.

When we hover the cursor above the line which indicates the relationship, we can see, what fields are involved in the relationship.

The well-developed database design could be exported in some picture formats in order to use in a presentation easily.



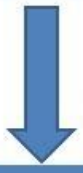
Operations of relational algebra

Connected with relations a whole branch developed in mathematics. Mathematicians defined operations for the relations and they applied set operations for the relations. In the following let's see these operations in brief.

Selection

In the operation of selection we just keep rows in the result relation satisfying a certain condition.

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza
7654	Ferenc Zoltán	Eger



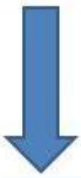
Selection, in the selected records only the Eger ones remain

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
7654	Ferenc Zoltán	Eger

Projection

During the operation of projection we just keep particular columns in the result relation

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza
7654	Ferenc Zoltán	Eger



Projection, the selected fields remain

ID	Name
1234	Kis Béla
1237	Nagy Lajos
2345	Nagy Piroska
4324	Ede Kázmér
7654	Ferenc Zoltán

Cartesian product

The Cartesian product puts two relations rows next to each other in every combination in the output relation.

Natural join

The operation of join connects two or more relations by comparing attribute values. The most common case when we examine the match of the attributes, that we call natural join.

This is a special product which could be described as the follows:

1. Take a row from the first relation
2. Examine the joining condition for the second tables all row. If it is true, add both relations rows to the result.
3. Continue with the 1st step until there is any row in the first relation.

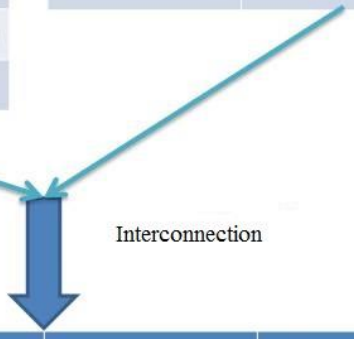
In the result relation appear those rows from the first relation where could be found a satisfying condition in the second relation. In many cases it is necessary that the first relation every row appear at least once in the result relation. This kind of outer join we call outer join.

Workers

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza
7654	Ferenc Zoltán	Eger

Payments

Date	Worker	amount
2013.01.03	1237	120 000
2013.02.05	1234	110 000
2013.02.05	1237	130 000



ID	Name	City	Date	Worker	amount
1237	Nagy Lajos	Eger	2013.01.03	1237	120 000
1234	Kis Béla	Eger	2013.02.05	1234	110 000
1237	Nagy Lajos	Eger	2013.02.05	1237	130 000

Set operations

The basic operations with sets – union, intersection, complement – we can interpret to the relations too. Every interpreted set operation is needed at least two operands, in the case of complement there could not be more. Set operations can executed only between relations with

the same structure. That means, the two relations must correspond in name and in type of stored data. For relations creating complement in general could not be evaluated.

Union

The operation of union could be executed between two or more relations with the same structure. The result relation contains those rows which are appear in relations in the operation at least once. If the same row should appear multiple times in the unioned relation, it will appear only once in the result relation....

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza
7654	Ferenc Zoltán	Eger

ID	Name	City
5555	Kis Géza	Budapest
6666	Nagy Zoltán	Budapest

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza
7654	Ferenc Zoltán	Eger
5555	Kis Géza	Budapest
6666	Nagy Zoltán	Budapest

Intersection

The operation of intersection could be executed between two or more relations with the same structure. The result relation contains only those rows which are appear every relations involved the operation.

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza
7654	Ferenc Zoltán	Eger

ID	Name	City
5555	Kis Géza	Budapest
6666	Nagy Zoltán	Budapest
1237	Nagy Lajos	Eger
7654	Ferenc Zoltán	Eger

section

ID	Name	City
1237	Nagy Lajos	Eger
7654	Ferenc Zoltán	Eger

Complement

The operation of complement could be executed between two or more relations with the same structure. The result relation contains only those rows which are appear only the first relation but not in the second one.

ID	Name	City
1234	Kis Béla	Eger
1237	Nagy Lajos	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza
7654	Ferenc Zoltán	Eger

ID	Name	City
5555	Kis Géza	Budapest
6666	Nagy Zoltán	Budapest
1237	Nagy Lajos	Eger
7654	Ferenc Zoltán	Eger

difference

ID	Name	City
1234	Kis Béla	Eger
2345	Nagy Piroska	Miskolc
4324	Ede Kázmér	Nyékládháza

Tasks

1. Work – Artist

We know about the work in which year was created, what is its kind (sculpture, painting, sketchbook, etc.) how much it worth in forints, we know its title, the artist, the year the artist born, and his/her nationality. One work always belongs to one kind, and the artist can have only one nationality. We should process the complete work of an artist. The task is to create the design of the database in drawing including table names, field names, field types.

2. The "Stupido-Gigantic GmbH Ltd Kft S.A." company deals mostly with commerce. Accordingly *orders* are coming in from *costumers,* which are delivered by *transporters*. One product is being delivered by only one transporter. We record the actual balance of the costumers. In one order there could be more *items*, the content of an item is the name of the product and the quantity. The transporters, products and the city names are identical, but the costumer names are only among the city identical. We suppose every city has only one zip code.

Stored data in bulk:

TransporterZipCode, CostumerZipCode, TransporterName, OrderNumber, OrderDate, CostumerCity, Balance, UnitPrice, ProductName, TransporterCity, CostumerName, ProductName.

Create the logical database model of the "Stupido-Gigantic GmbH Ltd Kft S.A." company until the third normal form.

3. Design a database where we can store the results of a problem-solving competition. We know the competitor name, his/her school name, the detailed address of the school, the class of the competitor, the points earned in the competition, what we get in *task number, earned points* form. It is no restriction how many competitors can come from a school.

4. An Arabic sheikh would like to maintain the data related to his crude oil commerce. would like to see the following data in the registry: Oil well (Name, Capacity) Refinery(Name, Address, Capacity), Costumers (Name, Address). The sheikh deals with selling both refined and crude oil. Therefore he wants to track every costumer purchase. Selling crude oil is done by the oil wells, the refined oil is being sold by the refineries. The sheikh would like to know

the quantity of each costumers order, and the deadline. Refineries are process the oil from the sheikh's oil wells. The sheikh would like to track the particular oil wells transfer oil to which refineries, the deadline of the transfer, and the quantity.

5. We examine the records of a video rental. The rental rents films only, about films there is a registry which contains the title of the film, the star, and the director. Each film has an identifying number, the title is not always identical. A film could be appear in more cassette, copies created by the rental. Cassettes also have an identical identifier, and its type is also recorded. From the rental the members may rent. The members name, address, and his identifier is recorded. Members rent film(s), we should track the rental dates, and the bring back dates accurately. The rental buys the films from a distributor, every order has a number and the order date is recorded in order to the easier tracking. In one particular order there could be more films. The documents at the video rental are contain the following data in different data sheets:
From those document we should create the logical database model.
Cassette number
Cassette type
Film title
Film number
Order number
Order date
Rental number
Member number
Member name
Member address
Rental date
Bring-back date
Film star
Film director

6. Create a database which contain the following details about school students: name, address, home telephone number, mothers name, pocket money, when started the school, what is his major, (PE, music, English, German) language certificates, (English, German, French,

Russian…). Pay attention to the details of the address, and the recurrence of the city. Design the most general case. To be submitted the database design in third normal form.

7. A hotel would like to track the expenses of its guests. The guests would stay in rooms for a particular period. The important detail about a room is its area, number of beds and its price per day. Guests can stay in many rooms, or one room, even at the same time. Important information about room usage by guests is the time of checking in and checking out. Of course there could be a room where haven't stayed any guest yet. Guests can book rooms in advance; important information about booking is the planned date of arrival and the leaving. Guest can resort different services in the hotel (internet, meal, sauna) related information to the service is its name, price, description. Guests can take up many services, and there could be such services which were never used.

8. Design a database for storing a swimming tournament results. Swimmers competed in different tournaments. The database should contain:

- swimming association data
- swimmers data
- data of the tournament
- data of tournament places
- the records

Language Reference of SQL

Elements of DDL

Create schemes, the creat

Create the tables by CREATE TABLE command.We can use lot of data types (here),but practically we just need some of them.

NUMBER (h, t) - numeric data, length <= 38, h - number contains the length, the number of decimal places;

DATE - date and time types;

VARCHAR2*(size)* – character types, the length of variable (*max*length<=4000);

CHAR(*size*)- character types, fixed length (*max length*<=2000);

NCHAR(*size*) – same as the character types, but the max size depending on the character set,

LOB (*large objects*) – binary or text format. It may be an image, audio or large text file.

Include the LOB types:

LONG – text data, max length<=2 Gbyte;

LONG RAW – binary data, max length<=2 Gbyte;

The LONG and LONG RAW types used only simple data processing operations.

CLOB, NCLOB, BLOB – *internal LOB types*,because they are stored in the AB , *max* length<=4 Gbyte;

CLOB – the data stored in AB Character set;

NCLOB –stores the data in the national character set

The Oracle puts a Pseudocolumn, calls ROWID to every table automaticly, but it's rarely used by Programmers.

ROWID – pseudocolumn that contain the logically individual title of the line. The ROWID does not need to be changed,but you can search in the SELECT command:

SELECT rowid FROM tabel_1;

The *Sequential number of the Line* - a number that is assigned to the line when it is added to the table.This number is part of the ROWID.

Only the user can create tables, who has privileges to CREATE TABLE or CREATE ANY TABLE.

The applicationof the STORAGE parameters on CREATE TABLE command.

We can create a table without the **STORAGE** memory-parameters. In that case the table get the default value, but it is not always the good solution. The memory storage(segments), are stored in the table calls ***extent***. The first extent name's **INITIAL**, the rest of the extent are secondary extent

```
CREATE TABLE testtab
  (col1 VARCHAR2(10))
  STORAGE (INITIAL 100K
        NEXT 50K
        MINEXTENTS 1
        MAXEXTENTS 99
        PCINCREASE 20);
```

The first extent gets 100K memory, the second – 50K. By the **PCINCREASE 20** values of every extent grow with 20% compared to the previous. MINEXTENTS 1 MEANS, the table gets in first time 1extent, the MAXEXTENTS 99 – the table get 99 extent maximum.

The tables may be partitioned as like the index tables. The partitioning gives the possibility of the very large tables and index tables for the treatment of. During the partitioning of the large table, the system divides into that to smaller and it more manageable.

Partitioned table - This is a table where, the rows are smaller but identical construction with boards, partitions, they share. The partitions can be stored on different physical locations.

The benefits of partitioning:

- Better distribution of I/O-load
- Backup and restore is a simple.
- Minimize the possibility of data corruption.
- Help to the archiving process.

For example:

```
CREATE TABLE large_table
  (col1 VARCHAR2(10),
  (col2 VARCHAR2(10))
```

```
             )
  PARTITION BY RANGE (col1, col2)
        (PARTITION p1 VALUES LESS THEN (…)  TABLESPACE p1,
         PARTITION p2 VALUES LESS THEN (…)  TABLESPACE p2);
```

Changed the schema elements, the alter

The length of the column can be increase even if the table contains data. But the length of the column can only be reduced if the table is empty.

ALTER TABLE testtab ADD col2 VARCHAR2(100);

ALTER TABLE testtab MODIFY col2 VARCHAR2(150);

ALTER TABLE testtab STORAGE (NEXT 10K

MAXEXTENTS 50);

ALTER TABLE testtab DROP col1;

We can rename the tables:

RENAME testtab TP testtab1;

and we can delete it:

DROP TABLE testtab;

For example:

```
CREATE TABLE students(
idNUMBER(5) PRIMARY KEY,
    first_nameVARCHAR2(20),
    last_name        VARCHAR2(20),
majorVARCHAR2(30),               -- professional
current_credits   NUMBER(3));         -- cast the number of exams
```

The ORACLE-system contains a presentation scheme, that owner is *Scott:*

```
CREATE TABLE scott.dept
 (deptno  NUMBER(2) NOT NULL,
  dname  VARCHAR2(14),
  loc  VARCHAR2(13),
 CONSTRAINT pk_dept PRIMARY KEY (deptno));
```

```
CREATE TABLE scott.emp
(empno  NUMBER(4) NOT NULL,
  ename  VARCHAR2(10),
  job    VARCHAR2(9),
  mgr    NUMBER(4),
hiredate  DATE,
  sal       NUMBER(7,2),
  comm      NUMBER(7,2),
  sal       NUMBER(7,2),
  deptn     NUMBER(2),
 CONSTRAINT pk_emp PRIMARY KEY (empno));
```

When we refer to the table(or other Oracle-object),what we does not the owner, that time we must give the really owner name too. *owner.table_name*

.CONSTRAINT integrity constraint application

Referential integrity ensures that a specific column values to which appear in another column. Integrity can be imposed austerity.

Constraint – a rule or restriction, on a part of the data will be checked.

Integrity constraint – a rule, comprising one or more columns is limited by the possible range of values. The constraint when creating the table can be assigned to the columns.

You can use the CONSTRAINT clause of the CREATE TABLE or ALTER TABLE commands. Lots of constraints can be approved without the CONSTRAINT clause.

Exists:

table constraints

column constraints

Table constraints–that integrity constraints, what we apply for one or more column to the table.

Column constraints – one integrity constraints what we apply to one column of the table.

List of the table constains:

UNIQUE

PRIMARY KEY

FOREIGN KEY

REFERENCES

ON DELETE CASCADE

CHECK

ENABLE VALIDATE

DISABLE

The column contains:

NULL

NOT NULL

The other column constraints and the table constraints are the same.

The DISABLE options is the integrity constraints or we can use to turn off the trigger.(but not delete it) Most of the time applied it in the ALTER TABLE order.

```
ALTER TABLE tabla DISABLE UNIQUE oszlop, column,..
ALTER TABLE tabla DISABLE PRIMARY KEY
ALTER TABLE tabla DISABLE CONSTRAINT constraint_name
DISABLE ALL TRIGGERS
```

.Elements of the DML

- **INSERT** – insert a new line
- **UPDATE**update existing records of data
- **DELETE** – delete records
- **TRUNCATE**– fast delete of all records

.New data entries, insert the command

For the first time check the SQL * Plus structure of testtab table:

```
       DESCRIBE testtab;
```

```
       NAME          NULL?              TYPE
   ---------      ----------          --------
       COL1                            VARCHAR2(10)
        COL2                           NUMBER(38)

INSERT INTO testtab(col1, col2) VALUES('text', 123);
```

Although this result is obtained if the

```
       INSERT INTO testtab VALUES ('szöveg', 123);
```

we use the command.

The insert nulls

```
       INSERT INTO testtab (col1, col2) VALUES ('text', NULL);
```

or

```
       INSERT INTO testtab (col1) VALUES ('text');
```

It is also possible that the INSERT command insert one in time more rows to the table. (use for this purpose an embedded SELECT command)

```
       INSERT INTO testtab (col1, col2) SELECT e_name, emp_no FROM
emp;
```

. Create table based on another table

```
CREATE TABLE emp_copy AS
 SELECT * FROM emp;
```

```
CREATE TABLE emp_copy2 AS
 SELECT emp_no, e_name FROM emp
WHERE e_name LIKE '%a%';
```

.Change data,the update

The UPDATE command modifies all rows for which the WHERE condition is met. If the UPDATE command has WHERE condition, that time the modify executed every rows. It is very rare.

For example:.

```
UPDATE emp_copy2  SET e_name='Kovacs' WHERE emp_no=7499;

UPDATE emp_copy2  ec  SET (emp_no, e_name) =
       (SELECT emp_no, e_name FROM emp e WHERE e.emp_no=ec.emp_no)
WHERE e_name LIKE 'I%';
```

In the last command, the secondary names of the table ec and e. The last WHERE condition includes the entire command(to UPDATE) and enter the rows that you want to modify. The nested SELECT command edits the values that are entered in the table emp_copy2.The WHERE condition in the SELECT is linked to the appropriate rows of the two tables.

.Delete data, the delete

```
DELETE FROM emp_copy2 WHERE emp_no=7876;
```

```
DELETE FROM emp_copy2 WHERE emp_no IN
(SELECT emp_no FROM emp_copy);
```

We can use functions in every SQL commands.

For exampla:

```
UPDATE emp_copy  SET e_name=UPPER( SUBSTR(e_name, 1, 1))       ||
LOWER(SUBSTR(e_name, 2, LENGTH(e_name)-1));
```

We get the same results if we use the INITCUP function.

Deleting data quickly.

The table's all rows can delete quickly with the TRUNCATE command.

```
TRUNCATE TABLE emp_copy;
```

After the command executed, the table structure will remain, but it will not contain single rows.

.Rights and user management, the DCL

Privilege (entitlement) allows the user to be able to carry out certain actions in AB.

The privilege can be two types:

- system privilege;
- object privilege.

The system privileges allow data definition and data control commands from and to enter into the AB.The object privilege give privilege to operation with AB object. After the create the user has not privilege, and just later got it from AB admin. When the user gets a privilege, then the authorized work to enforce AB-listed objects.

In general case can attach more user to one AB. Every object have user attribute in Oracle. If the user not owner: he can not do operation just when he get the relevant privilege. There are more relevant privileges than 80.

```
ALTER
DELETE
EXECUTE
INDEX
INSERT
REFERENCES
SELECT
UPDATE
```

…

The next table contains some privileges and contact between the AB objects.

privileges	Table	View	Sequence	Procedure
ALTER	+		+	
DELETE	+	+		
EXECUTE				+

INDEX	+			
INSERT	+	+		
REFERENCES	+			
SELECT	+	+	+	
UPDATE	+	+		

We can deal the INSERT, UPDATE and REFERENCES privileges to the column of the table. If we want to know, which system privileges may to use, we must execute the next command:

```
SELECT UNIQUE privilege FROM dba_sys_priv;
```

.Privileges contribute

The AB admin to get the privilages with GRANT command for the users:

```
GRANT  privilages_list ON object_list TO user_list
[WITH GRANT OPTION];
```

```
GRANT  privilage_list ON object_list TO role_list
[WITH GRANT OPTION];
```

```
GRANT  privilage_list ON object_list TO PUBLIC
[WITH GRANT OPTION];
```

When we use the WITH FANT OPTION, the user can get move the privilages to the other usres.

For examples.

```
GRANT SELECT, UPDATE ON emp_copy TO test_user;
```

The *test_user* user can excuse the SELECT and the UPDATE command with the *emp_copy* command.In this table not enough to get the table name: *emp_copy* because we must get the name of the *owner* the table. For examples, if the *scott* user is the owner of the *emp_copy* table, the right reference:

```
SELECT * FROM scott.emp_copy;
```

In some, cases the requirement make some problem. For examples if the owner of the table changed between the creation and the execution time we have to be considered all of the table references. In such cases approve use the table's *synonim*:

```
CREATE SYNONIM test FOR  scott.emp_copy;
```

The *scott.emp_copy* table got the *test* synonim.If after that change the owner,we can reference the table with the synonim.

```
SELECT * FROM test;
```

When we use the PUBLIC options ,the privileges allow all of the users, so the objects are public. The Public object available, visible all of the users.

```
GRANT SELECT, UPDATE ON emp_copy TO PUBLIC;
```

If the privilages contains the ANY options, the AB allow all of the tables. Like that privileges:

```
DELETE ANY TABLE
UPDATE ANY TABLE
INSERT ANY TABLE,
```

the user can move all of the AB's table, even if the user not the owner of the table. This is the largest potential eligibility and the just the admin level's user get this.
In the SESSION_PRIVS view can find the actual privileges. For the ALL_TAB_PRIVS and ALL_COL_PRIVS view we can find the users which privileges has.

.Roles(ROLE)

Role –privileges ensemble, the chances of creating the users' group. The users can assigned one group, and in the group every users have the same privileges. For examples, we create the role:

```
CREATE ROLE common;
```

after we can get some privileges to the role.

```
GRANT INSERT ON table_a TO common;
GRANT INSERT ON table_b TO common;
GRANT INSERT, DELETE  ON table_c  TO common;
GRANT UPDATE ON table_d TO common;
GRANT DELETE ON  table_e TO common;
GRANT SELECT  ON table_f TO common;
```

If the *user_1* and the *user_2* users get the *common* role:

```
GRANT common  TO x;
GRANT common  TO y;
```

that time they has all of the *common* role's privilege

Undercover roles

There are some undercover roles in the Oracle too:

```
CONNECT-
ALTER SESSION
CREATE CLUSTER
CREATE DATABASE LINK
CREATE SEQUENCE
CREATE SESSION
CREATE SYNONIM
CREATE TABLE
CREATE VIEW
RESOURSE-
CREATE CLUSTER
CREATE PROCEDURE
CREATE  SEQUENCE
CREATE TABLE
```

.Privileges of the system's executions

Stored in AB.

Procedure

Package

Function

The objects are allowed when the user has EXECUTE privilage.

For example:

```
GRANT EXECUTE  ON my_package TO PUBLIC;
GRANT EXECUTE  ON my_func TO user_2;
GRANT EXECUTE  ON my_proc TO user_1;
```

Withdrawal of the privileges.

The AB admin can withdrawal the privileges of the users with REVOKE command:

```
REVOKE privilege ON object FROM user
[CASCADE CONSTRAINTS];
```

The CASCADE CONSTRAINTS deletes all the REFERENCES integrity limitations in case of withdrawal of the preferences privelege which were created by the user.

```
REVOKE UPDATE ON emp_copy FROM test_user;
```

After this command the *test_user* user can not modify the *emp_copy* table,but he can use the SELECT command.

```
REVOKE  SELECT ON classes FROM user_1;
REVOKE ALTER TABLE, EXECUTE ANY PROCEDURE FROM user_2;
REVOKE  common FROM user_1;
```

Queries and the QL

The most basic SQL command is used to query a whole table or a column of a table. Exactly it is the real algebraic method of projection.

The base of the *select* command

The main syntax of the command is the following:

```
SELECT [ALL|DISTINCT] * | <coulmnnamelist> FROM <tablename>
```

In the first part of the command the * mark means that the query refers to the whole table, and we would like to see all the columns and fields in the query.

In case we would not like to use all the columns, with the help of the <coulmnnamelist> we can give the name of the columns we would like to get as the result of the query.

We have the chance to make other modifications, e.g. we can rename or make new expressions from the items on the list. Its method is putting an AS keyword after the name of the field and then we give the alias name. This only exists for the time period of the query.

```
SELECT name as „NAME” …
```

We can use other functions, which's first parts are the aggregate functions, and their other parts are functions which are proved by the host language for the SQL environment.

In this command ALL and DISTINCT keywords have a special meaning. It can occur that after taking through the query the same record occurs more than one times.

If we used the ALL option, and according to the basic settings, all the same incidence will occur more times on the result table.

If we used the DISTINCT option, all the same incidences will occur only once on the result table.

Counted fields and aggregate functions

As long as we use an aggregate function during expressing the column, the occurring details of the table won't occur in the result table but their analogical aggregate will be formed. The function will be carried out on the set including the rows of the table.

The <columnexpression> may include the following aggregate functions:

- **COUNT**: Returns the number of the table's rows. In order to get an accurate result it is advisable to use * or the primary key field as a parameter.
- **SUM**: Returns the sum of the table's data in the parameter for all records. Only can be used for numeric attributes.
- **AVG**: Returns the average value of the table's data in the parameter for all records. Only can be used for numeric attributes.
- **MIN**: Returns the minimum of the table's data in the parameter for all records. Only can be used for numeric attributes.
- **MAX**: Returns the maximum of the table's data in the parameter for all records. Only can be used for numeric attributes.

Let us look through some examples of simple queries:

We will use the employee table, in which we store the names of the employees, date of their birth, the city they live in, and their monthly payment.

Employee				
ID	**Name**	**Dateofbirth**	**City**	**Payment**
12	Kiss Szilárd	05.01.1985	Eger	120000
13	Nagy József	06.05.1973	Eger	156000
15	Gipsz Jakab	01.11.1955	Miskolc	210000
17	Kovács Piroska	15.07.1996	Budapest	189000

Example 1

Querying the whole table can be done with the following command:

```
SELECT * FROM Employee
```

Example 2

Let us assume that we would like to query the name of the employees and their monthly payment. The correct command is the following:

```
SELECT Name, Payment FROM Employee
```

Our results are going to be the following:

Name	Payment
Kiss Szilárd	120000
Nagy József	156000
Gipsz Jakab	210000
Kovács Piroska	189000

Example 3

Let us make a result table which contains the name of the employees, their payment, and their new payment which is raised by 20%. Let's name the new column Raised Payment. We can solve the problem with the following command:

```
SELECT Name, Payment, 1.2*Payment AS „Raised Payment” FROM Employee
```

Our results are going to be the following:

Name	Payment	Raised Payment
Kiss Szilárd	120000	144000
Nagy József	156000	187200
Gipsz Jakab	210000	252000
Kovács Piroska	189000	226800

Example 4

Let us make a table of the city the employees live in avoiding to have two same values.

We can solve the task with the following command:

```
SELECT DISTINCT City FROM Employee
```

Our results are going to be the following:

City
Eger
Miskolc
Budapest

Example 5

Let us make a chart in which shows the number of the employees, the summation of the payments, the average, the smallest and the largest payments.

We can solve the problem with the following method:

```
SELECT COUNT(id) as „Number of employees”,
 SUM(payment) as „Summed payment”,
 AVG(payment) as „Average payment”,
MIN(payment) as „Smallest payment”,
 MAX(payment) as „Largest payment”
FROM Employee
```

Our results are going to be the following:

Number of Employees	Summed payment	Average payment	Smallest payment	Largest payment
4	675000	168750	120000	210000

Example 6

Let us make a chart which shows the name and date of birth of the employees. The new column which contains the date of birth might be named ‘Date of birth’

We can solve the problem with an Oracle function.

```
SELECT Name, TO_CHAR(Dateofbirth, ’yyyy’) as „Date of Birth” FROM
Employee
```

Here the TO_CHAR function transfers the date-type value stored in the Dateofbirth field into the given form, in this case, into a four-figure.

Our results are going to be the following:

Name	Date of birth
Kiss Szilárd	1985
Nagy József	1973
Gipsz Jakab	1955
Kovács Piroska	1996

Filters and the *where* clause

In case of a command which takes through the selects, we can use the sub-command after the FROM command as you can see below:

```
[WHERE <assumption>]
```

In the assumption we can use operand uses and operators.

Operators are comparative (<,>,<=,>=,<>), arithmetical (+,-,*,/), and logical procedures (AND, OR, NOT), while operand uses can be constant, relation attributes viz. column names, and function references.

For these operations the usual precedence rules are valid. Of course they can be overwritten with brackets. We have to pay attention to make expressions serve logical values, as only the existences will get to the result table which are true for the expression.

There are some great predicate functions:

The first one is the **BETWEEN** predicate function, which is used on the following way:

```
[<columnexpression> BETWEEN <value1> AND <value2>]
```

<**value1**> and <**value2**> are constants, equal with some of the known basic types (numeric, date).

The <**columnexpression**> is an expression, formed from column names, having the same type as the ones mentioned below. Records, on which the value of the expression will be between the two constants, will fulfil the conditions. Thus, BETWEEN expresses a closed interval.

So the condition only makes a sense if the constant given in the <value1> parameter is smaller than the one given in the <value2>parameter.

The predicate can be definitely replaced with a logical expression containing comparative operators:

```
payment between 100000 and 200000
```

means the same as

```
(payment >= 100000) and (payment <= 200000)
```

The following **IN predicate** can be used this way:

```
[<columnexpression> [NOT] IN <valuelist>]
```

As an effect of this expression, the following examination will be taken through: whether the <columnexpression>'s value is on the given value list, or not. As far as the expression's value exists, it will be true. If we use the NOT keyword, the expression will be true so far as its value is not on the list. So in the <valuelist> parameter we have to list the values fitting the type of the expression.

The role of the predicate is highlighted in the embedded queries.

The third type of the predicates goes with the character chain type expressions. Its average form is the following:

```
[<columnexpression> LIKE <characterchain>]
```

In the <characterchain> constant we can give the chain of characters between quotation marks. Two characters have special meanings: these are the % and the _ marks. Characteristic value has to be served to the <columnexpression> parameter which will be compared to the constant. As long as they are equal, the condition will be true. If we use the % mark in the constant, the two chains of characters have to match till the mark. So the % can replace an arbitrary number of characters. The _ mark replaces only one character.

Example 7

Let's make a chart which gives the name and the payment of the employees who earn more than 150000 Ft.

We can solve the problem with the following order:

```
SELECT Name, Payment FROM Employee
WHERE Payment >= 150000
```

The results will look like the following one:

Name	**Payment**
Nagy József	156000
Gipsz Jakab	210000
Kovács Piroska	189000

Example 8

Let's make a chart which shows the name and the payment of the employees who live in Eger and their payment is more than 150 000 Ft.

We can solve the problem with the following order:

```
SELECT Name, Payment FROM Employee
WHERE (City = 'Eger') AND (Payment >= 150000)
```

The results will be the following:

Name	**Payment**
Nagy József	156000

Example 9

Let's make a chart which shows the name and payment of the employees who earn between 150 000Ft and 200 000 Ft.

We can solve the problem on the following way:

```
SELECT Name, Payment FROM Employee
  WHERE Payment BETWEEN 150000 AND 200000
```

However we can solve the problem on this way as well:

```
SELECT Name, Payment FROM Employee
  WHERE (Payment >= 150000) and (Payment <= 200000)
```

The results will be the following:

Name	Payment
Nagy József	156000
Kovács Piroska	189000

Example 10

Let's make a chart which shows the name and city of the employees who live in Eger, Szeged, or Debrecen.

We can solve the problem on the following way:

```
SELECT Name, City FROM Employee
WHERE City IN („Eger”,”Szeged”,”Debrecen”)
```

The results will be like this:

Name	City
Kiss Szilárd	Eger
Nagy József	Eger

Example 11

Let's make a chart which shows the details of the employee named Kovács.

We can solve the problem this way:

```
SELECT * FROM Employee WHERE Name LIKE "Kovács%"
```

The results will be the following:

ID	Name	DateofBirth	City	Payment
17	Kovács Piroska	1996.07.15	Budapest	189000

Aggregation queries, the usage of *group by* and *having*, and arrangement

Aggregation means that we group records according to the values of one or more fields. After that we can do different operations with the records in the groups, or we can use the aggregation functions we have discussed before. We also may use selecting operations for the groups.

We can group with this command:

```
GROUP BY <columnname>,[<columnname>]…
```

Grouping will go according to the equal values of the column names. As far as we give more columns, it will make groups within the first column according to the second column's equal values, and according to the third column's, etc. The system puts the values belong to the single fields in the sequence given below. It makes group according to the scheme we get this way.

After taking through the operation there will be one row for every group in the result table. As it is a special command, during its usage we'll have to make restrictions for other parts of the SELECT command.

This way we'll have to use an aggregation operator for the data of the column. Otherwise the column has to be among the columns in the grouping, so after the GROUP BY command.

The SQL language proves us the possibility to make conditions for the data incurred by the aggregation. In this case we have to use the HAVING command.

The form of the subcommand is the following:

```
HAVING <groupcondition>
```

In the <groupcondition> condition we can give conditions on the traditional way, except that the column names in the conditions must include an aggregation operator, and this also have to be after the SELECT command.

The SQL language proves us a possibility to visualise the results of our queries on a trimmed way. We can use the ORDER BY subcommand:

```
ORDER BY <columnname|columnnumber> [ASC|DESC], <columnname|
columnnumber> [ASC|DESC]]…
```

Ordering goes according to the columns given before. First aspect will be the first column, and the following aspect will be the following given columns. Columns can be defined on two ways.

Firstly, with their original name, and secondly, with a number which is the line number of the column in the chart. Numbering starts at 1 according to the sequence determined in the header of the chart. It is important to have the column which represents the ordering aspect after the SELECT command. The meaning of the ASC and the DESC keywords are also essential.
ASC is the default what means that ordering goes by an ascending order. As far as we use the DESC keyword the ordering will go by a descending order.
Let's look through some examples for the usage of grouping and ordering SQL commands.

Example 12

Let's make a list which gives that how many employees live in each city.

We will use the following command:

```
SELECT City, COUNT(id) as „Piece”  FROM Employee
GROUP BY City
```

The results are going to be like this:

City	Piece
Eger	2
Miskolc	1
Budapest	1

Example 13

Let's make a list which gives the sum and the average of the employee's payment in each city.

We will use the following command:

```
SELECT City, sum(Payment) as „Summed”, avg(Payment) as „Average”
FROM Employee
GROUP BY City
```

The results are going to be the following:

City	Summed	Average
Eger	276000	138000
Miskolc	210000	210000
Budapest	189000	189000

Example 14

Let's make a list which gives the cities which are true for the condition that the employees living there have a maximum of 150 000Ft payment.

We will use the following command:

```
SELECT City, avg(payment) as „Average”
FROM Employee
GROUP BY City
HAVING avg(Average) <= 150000
```

As a result we will get this table:

City	Average
Eger	138000

Example 15

Let’s make a list which gives the name and payment of the employees by their payment in descending order. In case there are same payments let’s order by name in an alphabetic sequence.

We might use the following command:

```
SELECT Name, Payment FROM Employee
ORDER BY Payment DESC, Name
```

The results are going to be the following:

Name	Payment
Gipsz Jakab	210000
Kovács Piroska	189000
Nagy József	156000
Kiss Szilárd	120000

Connecting Tables

In most of the cases the database is designed the way that details we need are stored in more tables. It is especially true if we use normalized relations, as we all know that the base of normalization is separating into more relations. So in this case we need all the tables, thus queries have to be extended into multiple table queries. The SQL language provides us to take the real algebraic operation of connection through directly. It means that there are previously made special commands which give the different types of connections.

The first command from this group creates the Descartes product itself. During making the command we only define the part which comes after the FROM keyword.

```
<tablename> CROSS JOIN <tablename>
```

As the effect of the command the system creates the Descartes product of the two tables. As we all know, the connection based on conditions are far more natural.
Its form is the following:

```
<tablename> INNER JOIN <tablename> ON <condition>
```

As a condition we can give any of the conditions which can be used after the WHERE command. In most of the cases one of the two connected tables' (named master) primary key field equals with the other table's (named detail) unknown key field. As relational database management systems don't treat directly the more-to-more connections, this compliance is clear.
This connection is called close inner connection, too.
Let's examine the following Disbursal table which contains the paying-outs for the employees. It has a one-to-many relationship with the (previously mentioned) Employee table.

Employee

ID	Name	DateofBirth	City	Payment
12	Kiss Szilárd	1985.01.05	Eger	120000
13	Nagy József	1973.05.06	Eger	156000
15	Gipsz Jakab	1955.11.01	Miskolc	210000
17	Kovács Piroska	1996.07.15	Budapest	189000

Disbursal

ID	Date	Money	Employee
101	2012.01.05	120000	12
102	2012.01.05	160000	13
103	2012.01.05	200000	15
104	2012.02.05	123000	12
105	2012.02.05	240000	15

The Employee table's ID primary key and the Disbursal table's unknown key field form the relationship between the two tables.
Example 16
Let's make a list which contains the name of the employees and the amount of money they had been paid. The date of the disbursal should be given in alphabetic order according to the names.

We have to use the following command:

```
SELECT Employee.name as „Name”,
  Disbursal.money as „Money”,
  Disbursal.date as „Date”
FROM Employee INNER JOIN Disbursal ON employee.id = disbursal.employee
ORDER BY 1
```

The results are going to be the following:

Name	Money	Date
Gipsz Jakab	200000	2012.01.05
Gipsz Jakab	240000	2012.02.05
Kiss Szilárd	120000	2012.01.05
Kiss Szilárd	123000	2012.02.05
Nagy József	160000	2012.01.05

As you can see Kovács Piroska hasn't got her salary yet, so she wasn't returned. As far as we would like to add records which aren't connected to any record, we have to use outer joins.

They are used to treat the problem which occurs when there is a row from the two tables which isn't connected to any items of the other table. In this case, according to the definition of the connection, this row can't get into the result table. In practice we might need these occurrences in the connected relation. An outer join differs from the standard in that every row gets into the result even the ones which aren't connected to any other rows of the other table. An outer join can be taken through on three ways. The first way is when all the non-matching rows of both tables can get into the result. On the two other ways only the left or the right sided table's non-matching rows can.

Owing to this the following cases can exist:

```
<táblanév> FULL OUTER JOIN <táblanév> ON <feltétel>
```

In this case both table's non-matching rows are returned.

```
<táblanév> LEFT OUTER JOIN <táblanév> ON <feltétel>
```

In this case only the non-matching rows of the table given in the first <tablename> parameter are returned.

```
<táblanév> RIGHT OUTER JOIN <táblanév> ON <feltétel>
```

In this case only the non-matching rows of the table given in the second <tablename> parameter are returned.

Example 17

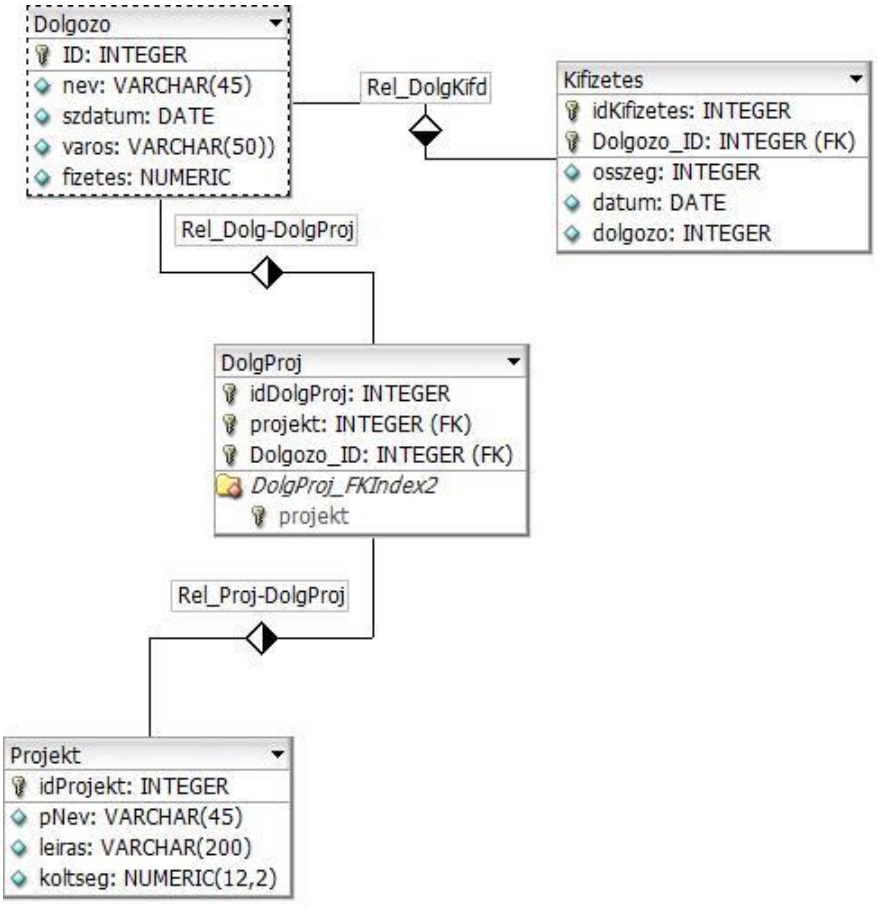
Let's make a list which solves the task, we were dealing in the previous example with, returning the employees who didn't get their salary, too.

The solution is the following:

```
SELECT employee.name as „Name”,
  disbursal.money as „Money”,
  disbursal.date as „Date”
FROM employee LEFT OUTER JOIN disbursal
  ON employee.id = disbursal.employee
ORDER BY 1
```

It can occur that we have to connect more tables. In this case our method will be the same. Every connection is a JOIN command. Like if we wanted to connect five tables we would have four JOINs in our query.

Let’s have a look on the attendance of the employees in the corporate projects. It’s a more-to-more relationship so we will need a connection table. In this case our database will look like this:



Example 18

Let's order the names of the employees taking part in the projects.

The solution is the following:

```
SELECT p.pName, e.Name
FROM employee e
INNER JOIN EmpProj ep ON e.id = dp.employee
 INNER JOIN project p ON ep.project = p.idProject
ORDER BY p.pName, e.name
```

As you can see I have used the shorter form of the table names. The employee table was put in as 'e'. It is to use a shorter way of writing within the query. The rule is if we shorten the name of a table we have to use the shorter form in the whole query.

Embedded queries

The SQL language provides us the facility of using the SQL query command in the condition of the select queries. In this case we separate inner and outer SELECT command, and name these queries embedded queries.

The syntax of the SELECT commands equals with the forms we have already discussed, we only have to pay attention to make some requirements fulfilled in connection with the inner queries. We separate more cases in accordance with the type of the inner query.

They are the following:

1. The inner query serves only one value. This is the simpler case as at this time everything happens on the standard way except that the system serves the value given in the expression as a condition.
2. The inner query serves a one column relation. This time we can give conditions which use the data of the column served by the inner query. In this case we might use different predicates:

The following predicate do exists:

```
<columnexpression> [NOT] IN <inner query>
```

Dealing with this type the system will decide if it is in the generated column's data examining the value of the expression given in the <columnexpression> parameter. If the condition's value is yes, it'll be true; if it is not, it'll be false. If we use the NOT keyword we have to read the condition reversed.

The form of the forthcoming predicates is the following:

```
[NOT] <columnexpression> <relation> ALL|ANY <inner query>
```

At this type the system will examine whether the relation is fulfilled with the data of the column created by the inner query, referring to the value of the expression given in the

<columnexpression> parameter. If we use the ALL keyword the condition will be true in the only case when the relation is fulfilled for every elements of the column. Whereas, using the ANY keyword, it is enough to fulfil the relation for one element. The NOT keyword also means the controversial.

The most average case is when the inner query serves an average relation. This time we can examine only two cases. The first is to examine is whether the created relation is empty or not. To go through with this examination we have to use the EXIST keyword which, of course, can be modified with the NOT.

The form of the command is the following:

```
[NOT] EXISTS <inner query>
```

The second case is similar to the things we have discussed in the first part of the second point, with the only difference, that we can give more column expressions in the condition, which's equality will be separately examined for the elements of the table given by the inner query. The number of the rows in the list given below and in the results must equal. The correct syntax is the following:

```
(<columnexpression> [,<columnexpression>]…) [NOT] IN <inner query>
```

Example 19

Let's make a list which lists the name and the payment of the employees from table Employee who earn less than the average.

```
SELECT Name, Payment FROM Employee
WHERE Payment <
(SELECT AVG(Payment) FROM Employee)
```

The results are going to be the following:

Name	Payment
Kiss Szilárd	120000
Nagy József	156000

Example 20

Let's make a list which lists the name and the payment of the employees from table Employee, whose payment differs from the largest salary with maximum 50 000 Ft. We have to use the following command:

```
SELECT Name, Payment FROM Employee
WHERE Payment+50000 >
(SELECT MAX(Payment) FROM Employee)
```

The results are going to be the following:

Name	Payment
Kiss Szilárd	120000
Nagy József	156000
Gipsz Jakab	210000
Kovács Piroska	189000

Example 21

Let's make a list with the help of the Disbursal table we dealt with below which lists the name and the number who haven't got their salary yet.

We will have to use the following command:

```
SELECT Name, ID FROM Employee
WHERE ID NOT IN
(SELECT ID FROM Disbursal)
```

Another solution might be the following:

```
SELECT Name, ID FROM Employee
WHERE NOT EXISTS
(SELECT ID FROM Disbursal
WHERE Disbursal.employee = Employee.ID)
```

You might recognise that the second way of solving the problem includes a special case when we use a field of the table of the outer query in the inner query.

The results are the following:

Name	ID
Kovács Piroska	17

Example 22

Let's make a list which lists the details of the employees who earn more than all the employees living in Eger or Szeged.

We will use the following command:

```
SELECT * FROM Employee
WHERE Payment > ALL
(SELECT Payment FROM Employee
WHERE City = "Eger" OR City = "Szeged")
```

ID	Name	DateofBirth	City	Payment
15	Gipsz Jakab	1955.11.01	Miskolc	210000
17	Kovács	1996.07.15	Budapest	189000

	Piroska			

Tasks

Task 1.

Artwork- Artificer

We know several things about a piece of artwork like the year of the creation, its genre (sculpture, painting, art book, etc.) its value in HUF, its title, and the name, date of birth, and nationality of the artist. One piece of artwork always belongs to one type of genre, and the artists belong to one nationality as well. We are able to process the whole life and work of the artist.

The drawn plan of the database including the names of the tables, names of the fields, types of the fields, and relationships should be delivered.

The DDL commands which are creating the table.

The DML commands doing the data upload.

The QL, DDL, and DML commands which are giving answers.

1. Design a database at least in 3NF to solve the problem mentioned above.
2. Add at least 5 artificers and 10 artworks. Create at least 3 kinds of genres and nationalities. Upload the created data tables in the given sequence.
3. Answer the following questions with SQL queries.
   a. List the name of the artworks made in the 20th century and order them by the name of their creator in cumulative sequence.
   b. List all the details of the sculptures.
   c. List the details of the Hungarian artists in an alphabetical order in decreasing sequence
   d. Figure out the summed value of all the artworks for each nationality.
   e. List the Italian artworks and the name of their creator which worth more than the average.
   f. List the name of the genres but pay attention to have every genre only once in the result.
   g. List the number of the artworks in each nation with the name of the nations but visualise only the nations which have more than 3 pieces of artwork.
   h. Add a new field to the appropriate table which contains the number of the artificer's international awards.

Solutions for the SQL queries:

A.

```
select ar.title, sz.name
```

```
from artwork ar
 inner join K1 on ar.ar_id = K1.ar_id
 inner join artificer sz on k1.a_id = sz.a_id
where  ar.ar_year between 1901 and 2000
order by sz.name;
```

A/2

```
select ar.title, sz.name
from artwork ar, K1, artificer sz
where
(ar.ar_id = K1.ar_id) and
(k1.a_id = sz.a_id) and
(ar.ar_year between 1901 and 2000)
order by sz.name;
```

B.

```
select sz.name, aa.*, n.n_name
from artwork ar
 inner join K1 on ar.ar_id = K1.ar_id
 inner join artificer sz on k1.a_id = sz.a_id
 inner join nation n on n.n_id = sz.n_id
 inner join genre g on g.g_id = ar.g_id
where g.g_name = "sculpture"
order by ar.ar_name
```

C.

```
select sz.*
from artificer sz
 inner join nation n on n.n_id = sz.n_id
where n.n_name = "Hungarian"
order by sz.a_name desc;
```

D.

```
select n.n_name as nation, sum(ar.ar_value) as summed
from artwork ar
 inner join K1 on ar.ar_id = K1.ar_id
 inner join artificer sz on k1.a_id = sz.a_id
 inner join nation n on n.n_id = sz.n_id
group by n.n_name;
```

E.

```
select ar.ar_name, sz.a_name
from artwork ar
 inner join K1 on ar.ar_id = K1.ar_id
 inner join artificer sz on k1.a_id = sz.a_id
where
ar.ar_value >
 (
 select avg(ar.ar_value)
```

```
 from artwork ar
 inner join K1 on ar.ar_id = K1.ar_id
 inner join artificer sz on k1.a_id = sz.a_id
 inner join nation n on n.n_id = sz.n_id
 where n.n_name = "Italian"
 )
order by sz.a_name;
```

F.

```
select g.g_name
from genre g
where g.g_id not in
(
 select distinct g.g_id
 from genre g
       inner join artwork ar on g.g_id = ar.g_id
)
order by g.g_name;
```

G.

```
select n.n_name as nation, count(ar.ar_id) as number
from artwork ar
 inner join K1 on ar.ar_id = K1.ar_id
 inner join artificer sz on k1.a_id = sz.a_id
 inner join nation n on n.n_id = sz.n_id
group by n.n_name
having count(ar.ar_id) > 3
```

Task 2.

Basic tables

man [id integer primary key, name varchar(40) not null, city varchar(40)]

car [rsz char(7) primary key, owner int, type varchar(20), color varchar(20), price numeric(7,0)]

1. Query the price of the red coloured cars.
2. Increase the price of the cars cost between 500 000 and 1 000 000 Ft with 20%.
3. Query the name of the owners and the type of their cars whose name starts with “K”.
4. Query the name of the owners and the price of their car who live in Eger or Miskolc, in alphabetical order according to the name of the owners.
5. Query the name of the owners who has cheaper car than 1 000 000 Ft.
6. Query the name and address of the owners who has a car.
7. Query the registration number of the cars which’s owner lives in Miskolc.
8. Query the cars which’s price is larger than all the red cars’.
9. Query the average price of the cars in Miskolc.

10. Query that how much cars are in each cities.
11. Query the registration number and the name of the owners of the cars which are more expensive than the average.
12. Query the owners who have only one car grouped and ordered by the city they live in.

Solutions for the SQL queries:

1. Query the price of the red coloured cars.

```
SELECT price FROM car WHERE color = 'red';
```

2. Increase the price of the cars cost between 500 000 and 1 000 000 Ft with 20%

```
UPDATE car SET price=price*1.2 WHERE price BETWEEN 500000 AND 1000000
```

3. Query the name of the owners and the type of their cars whose name starts with "K".

```
SELECT m.name, c.type
FROM man m inner join
       car c on m.id = c.owmner
WHERE m.name LIKE 'K%';
```

4. Query the name of the owners and the price of their car that lives in Eger or Miskolc, in alphabetical order according to the name of the owners.

```
SELECT man.name, car.price
FROM man m inner join
       car c on m.id = c.owner
WHERE  city IN ('Miskolc', 'Eger')
ORDER BY man.name;
```

5. Query the name of the owners who has cheaper car than 1 000 000 Ft.

```
SELECT man.name
FROM man m inner join
       car c on m.id = c.owner
WHERE  car.price < 1000000;
```

6. Query the name and address of the owners who has a car.

```
SELECT name, city
FROM man
WHERE id IN (SELECT owner FROM car);
```

7. Query the registration number of the cars which's owner lives in Miskolc.

```
SELECT c.rn
FROM man m inner join
       car c on m.id = c.owner
WHERE m.city LIKE 'Misk%';
```

8. Query the cars which's price is larger than all the red cars'.

```
SELECT *
FROM car
WHERE price >
 (SELECT max(price) FROM car WHERE color LIKE 'red');
```

9. Query the average price of the cars in Miskolc.

```
SELECT AVG(price)
FROM man m inner join
       car c on m.id = c.owner
WHERE city LIKE 'Mi%';
```

10. Query that how much cars are in each cities.

```
SELECT city, COUNT(*)
FROM man m inner join
       car c on m.id = c.owner
GROUP BY city;
```

11. Query the registration number and the name of the owners of the cars which are more expensive than the average.

```
SELECT car.rn, man.name
FROM man m inner join
       car c on m.id = c.owner
WHERE  price > (SELECT AVG(price) FROM car);
```

12. Query the owners who have only one car grouped and ordered by the city they live in.

```
SELECT city, COUNT(*)
FROM man
WHERE name IN (SELECT name
FROM man m inner join
       car c on m.id = c.owner
 GROUP BY name
 HAVING COUNT(*)=1)
GROUP BY city
ORDER BY city;
```

Task 3.

Video rental store

We are examining a video rental store's registration. The lender rents only videos, and all the videos are registered including the title of the film, the main character, and the director. Every film has a unique identity number but we can't be sure if its title is unique or not. One film can be stored on more cassettes as the video rental store can make copies. Every cassette has its unique identity number and their type is registered. Only the members of the video rental store are allowed to rent a video. The members' name, address, and identity number are also registered. Members are allowed to lend films, so the date of the lending and the date of the return are registered as well. The video rental store purchases videos from a wholesaler. Every order has an identity number and to make orders easy to follow, they register the date of the order. One order may include more films. Documents at the video rental store are the following, stored on different pages. These items have to be used during designing the logical database model:

Number of the Cassette
Type of the Cassette
Title of the Film
Number of the Film
Number of the Order
Date of the Order
Number of the Lending
Identity number of the Member
Name of the Member
Address of the Member
Date of the Lending
Date of the Return
Main Character of the Film
Director of the Film

Queries

1. List the details of the members who haven't borrowed anything but own a membership.
2. List all the main characters of the films available.

3. List the title and the director of all the films available.
4. Visualize the number of the cassettes and the name of the films which haven't been borrowed ever.
5. List the name of the members borrowed something today.
6. List the films have to be returned today.
7. List the films which should have been returned till today.

Solutions for the SQL queries:

1.

```
select * from tag
where tag_snumber not in
 (select tag_snumber from borrow)
order by name
```

2.

```
select e.name from employee e
 inner join film_emp fe on e.em_id = fe.em_id
 inner join emp_type et on et.et_id = fe.et_id
where et.description = "main character"
order by e.name
```

3.

```
select f.filmtitle, e.name from employee e
 inner join film_emp fe on e.em_id = fe.em_id
 inner join dolg_tipus dt on dt.dt_id = fd.dt_id
 inner join film f on f.filmnumber = fe.filmnumber
where et.description = "director"
order by e.name
```

4.

```
select f.filmtitle, c.cassettenumber
from film f
 inner join cassette c on f.filmnumber = c.filmnumber
where c.cassettenumber not in
(select disctinct c2.cassettenumber from cassette c2
 inner join borrow bo
 on c2.cassettenumber = bo.cassettenumber)
```

5.

```
select t.name from tag t inner join borrow b
 on b.tag_snumber = t.tag_snumber
where borrow_date = '2005.11.21'
```

6.

```
select f.filmtitle, c.cassettenumber
from film f
 inner join cassette c on f.filmnumber = c.filmnumber
```

```
 inner join borrow bo
       on c.cassettenumber = bo.cassettenumber
where bo.return_date = '2005.11.21'
order by f.filmtitle
```

7.

```
select f.filmtitle, c.cassettenumber
from film f
 inner join cassette c on f.filmnumber = c.filmnumber
 inner join borrow bo
       on c.cassettenumber = bo.cassettenumber
where bo.return_date < '2005.11.21'
order by f.filmtitle
```

8.

```
select filmtitle from film order by filmtitle
```

Task 4.

Kings

We would like to store and work with the period of their reign. We know the name of the kings, the starting and ending date of their reign.

Table:

KING (THE, Name, Begin, End)

THE The ID of the king (counter) this is the key

Name The name of the king (text)

Begin The first year of his reign (number)

End The last year of his reign (number)

1. List the kings in alphabetical order. (nominal roll)
2. List the name and the period of their reign of the kings named László. Don't add the kings named Ulászló. (László)
3. List the name of the kings ordered according to the length of their reign in descending sequence. (LengthOrder)
4. Query the number of the kings named István. (Number of Istváns)
5. In 1347 the court of the king temporarily moved from Visegrád to Buda. Who was the king at that time? (Buda court)
6. List the name of the kings who owned the throne for more than 10 years in alphabetical order. (10 years)
7. How many kings reigned from 1300 till 1399 in Hungary? Don't forget that only a part of the reign of a king might belong to this period. (Number of kings)
8. Identify that how many kings reigned before Mátyás with the help of a subquery. (before Mátyás)
9. Who owned the throne for the longest period of time? (MaxKing)

Task 5.

Borrowing water sports equipment

During our holiday nearby the cost we can borrow sport equipment for more hours a day several times. Let's make a database for the rental service.

The database stores the tools which can be lent, their type (like paddle boat, kayak, surf, ect.) and how much the rent costs for an hour. Borrowers have to pay for every hour as it begins. The clients (borrowers) must be stored and the details that which client borrowed the tool and when. The head of the rental service trusts the clients so the clients have to pay at the end of the day in sum.

To solve this you should create four tables, which have to contain the following attributes and relationships (we mark the primary keys with a *)

Tooltype *Type (text), Price_hour (number)

Tool *Tidentifyer (number), Type (text), Brand (text)

Client *Cidentifyer (number), Name (text), Address (text), Pay (number)

Borrow Cidentifyer (number), Tidentifyer (number), Period (number) Start (time) End (time

1. Create the data tables based on the information given above. Choose the optimal field size during defining the fields. Set the unknown keys (the relationships) to make the database management system keep integrity.
2. Invert to the tables the details given in the borrow.xls worksheet.
3. Make a query which returns the contains of the Borrow table in the way that the Identifier is replaced with the name of the client and the Identifier is replaced with the type and the brand of the tool.
4. List the type of all the tools which were borrowed at 12 am.
5. Query all the tool types (once) which were borrowed once at least for 2 hours.
6. List all the details of the tools which haven't been borrowed yet.
7. Make a query what counts how much a client will have to pay at the end of the day, based on the number of the daily borrows, their period of time, and the price of the borrowed tools.

Task 6.

Competition

Create a database for registering the result of a problem-solving competition answering the following data structure. (We mark the primary keys with a *)

Tables:

COMPETITOR (CompetitorAZ, Name, SchoolAZ, Class)

*CompetitorAZ ID of the competitor (text)

Name	Name of the competitor (text)
SchoolAZ	The ID of the competitor's school (text)
Class	Class of the competitor (number)

RESULT (CompetitorAZ, TaskNumber, Points)

*R_id (number)	
CompetitorAZ	ID of the competitor (text)
TaskNumber	The number of the task (text)
Points	The points the competitor achieved in that task (number)

SCHOOL (SchoolAZ, SchoolName, PostCode, City, Street, Number)

*SchoolAZ	The ID of the school
SchoolName	The name of the school
PostCode	The post code of the school (number)
City	The city the school is situated in (text)
Street	The street of the school (text)
Number	The number of the school (text)

Relationships between the tables:

SCHOOL-COMPETITOR : one-to-many type

COMPETITOR-RESULT : one-to-many type

Tasks

1. Crate a COMPETITON database matching the table structures discussed above.
2. Fulfil the tables according to this scheme:

Name	CompetitorID	SchoolID	class
Sziroczák Richárd	1	1	9
Hamvas Mihály	10	1	9
Tassy Gergely	11	1	9
Holicska Ábel	12	2	10
Benkő Zsolt	2	2	9
Bogner Orsolya	3	2	10
Réti Kornél	4	3	10
Susuk Márton	5	4	10
Sipos András	6	5	9
Sipos András	7	3	9
Siska Attila	8	2	9
Bein Ákos	9	4	10

Competitor ID	No listing	Score
1	I	12
1	II	8
1	III	11
1	IV	3
10	I	2
10	II	5
10	III	0
10	IV	6
11	I	4
11	II	9
11	III	13
11	IV	2
And so on		

CompetitorAZ	TaskNumber	Points
1	I	12
1	II	8
1	III	11
1	IV	3
10	I	2
10	II	5
10	III	0
10	IV	6
11	I	4
11	II	9
11	III	13
11	IV	2
And so on		

All the competitors have to solve four tasks. The tasks are marked with roman numbers.

School					
School ID	Name of school	Zip code	City	Street	Number
1	Berzsenyi Dániel Gimnázium	1133	Budapest	Kárpát u.	49-53
2	Könyves Kálmán Gimnázium	1043	Budapest	Tanoda tér	1
3	Eötvös József Gimnázium	1053	Budapest	Reáltanoda	7
4	Árpád Vezér Gimnázium	3950	Sárospatak	Arany János út	3
5	Táncsics Mihály Gimnázium	5900	Orosháza	Táncsics Mihály u.	2

Make a query to answer the following questions! Mark the name of the solutions with the letters in brackets.

3. Query the name and the points of the competitors in increasing sequence. (A)
4. Identify the largest point for each task. (B)
5. How many students entered the competition from each school (school's name and city)? (C)
6. Order the name of the competitors in alphabetical order that got 0 points for any task. One name can be there only once. (D)
7. Query the name, school's name and address of the students who got more than 10 points for a task.
8. Who got the maximum points for the first task from the students living in the country? Query his name and his school's name. (F)

Task 7.

Products

Make the structure of Products table according to this scheme:

Products (ProductCode, ProductName, CategoryCode, Size, Color, Price, InStock)

ProductCode (Counter)

ProductName (text)

CategoryCode (number)

Size (text)

Color (text)

Price (number)

InStock (number)

Set the key of the tables.

Change the form of the Price field of the Products table to make the prices appear as full currencies.

During solving the tasks pay attention for the relationships between the tables.

Tasks:

Solve the following tasks. Save the solutions as the name given in brackets.

1. Which are the products and in which colors are they on sale which are sized L and there are at least 5 ones in stock? Order the list to make the product with the largest price to be at the first place. (A)
2. What's the average price of the products in each category? (B)
3. What is the actual stock value of the cotton and canvas trousers? The name, color, category, and the stock value of the products should be listed in alphabetical order. (C)
4. List the black tops which are in stock? In which size and price are they for sale? (D)
5. Sum the number of the pullovers which are in stock. (E)
6. List the products and the number of them which are in stock which's price is between 5000 and 10 000 HUF. Order the list in increasing sequence according to the stock. In case of a same stock, list them in alphabetical order.

Task 8.

Epee

Examine the details of the ones who won a medal in men's individual epee at the modern Olympic Games with the help of a database management system. These pieces of information are stored in a data table. Create a new database named duel.

The structure of the table:

INDIVIDUAL (ID, Year, Location, Name, Country)

ID	The ID of the athlete (counter). This is the key.
Year	Date of the Olympics (number)

Location	The city where the Olympics took place (text)
Place	The place the athlete achieved (number)
Name	The name of the athlete (text)
Country	The shorter form of the country the athlete represents (text)

Tasks

Solve the following problems.

1. List the name of the athletes who earned a gold medal, the date, and the location of the Games. Order them by date in increasing sequence. (A)
2. In which Olympics and what place did Kulcsár Győző achieved? (B)
3. List the name and place of the athletes who won a medal in the Olympics in Atlanta. (C)
4. How many medals have the Hungarians earned? (D)
5. Who were the ones who won a medal representing Hungary? Every athlete should be on the list only once. (E)
6. Who won the most gold medals? (F)
7. Sum the number of the gold medals earned by each country. (G)
8. In which city was the Olympic Games organised the most times? (H)

Task 9.

Course

Name of the data table: EMPLOYEE

Employee code	Employee name	Date of birth	Post code
2000	Kos Miklós	1966.12.12.	1095
2001	Kiss Emese	1970.10.12.	3515
2002	Zili Zoltán	1980.11.25.	4000
2003	Cserepes Virág	1971.02.18.	2840

Post code	City
1095	Budapest
3515	Miskolc
4000	Debrecen
2840	Oroszlány

Name of the data table: COURSE

Course code	Start	Course name	Fee
1	1998.05.01	Informatics	3000
2	1998.05.01	English	6000
3	1998.05.01	German	6000
4	1998.06.02	Economy	7000
5	1998.07.02	Business studies	8000

Name of the data table: ATTENDANCE

Employee code	Course code
2000	1
2000	5
2001	1
2002	4
2003	1
2003	4

The employees of a company take part in different courses. One employee might attend more courses.

1. Create the data tables you've seen above, and define the field types.
2. Create logically the primary keys and acceptable relationships between the tables.
3. Query the employees who attend the informatics course.
4. How many employees attend the informatics course?
5. Query the courses which cost between 4500 HUF and 6500 HUF.
6. Lower all the fees by 50%.
7. Query all the fees the attendees have paid ever.

Task 10.

Statistics

One of the local schools in Budapest from distinct VII makes a database for its statistical registries.

1. Design a database named statistics.
2. Create a table named student on the way to be able to answer the following questions after the uploading.
   - What is the number of the boys, the girls, and the private students in the class?
   - What is the number of the students who are aged 14, 15, 16, 17, and 18?

- Who has two or more siblings?
- How many students live in another distinct or city, and what is the number of the local students?
- How many students live in a college?
- What is the number of the students who have a resort to the school canteen or to the prep room?
- What is the number of the families where monthly income per capita is less than 30 000 HUF?

3. Give a key field in the data table.
4. Load up the data table fulfilled with 5 records with details of fictitious people. Answer the following questions due to these details. Save your answers with the name in brackets at the end of the question.
5. Who has two or more siblings? Order the name of the students, the number of their siblings, and the monthly income per capita in increasing sequence according to their income. (sibling)
6. Who are the ones who live in another distinct or city than the seat of the school? (other place)

Task 11.

Nobel Prize

Process the details of the ones who earned a Nobel Prize with the help of a database management system.

Create a new database named nobel.

The structure of the table should be the following:

year	The year of the remuneration (number)
name	The name of the one who got the prize (text)
country	The country the one who got the prize lived in (text)
prize	The type of the prize (text)

1. Kertész Imre's Nobel Prize in Literature which he got in 2002 is missed out of the database. Fulfil the database.
2. Make the list of the Hungarian Nobel Prizes. (Hungarian)
3. What kind of prize did Bárány Róbert get? Which country did he represent? (Bárány)
4. What kind of prize did Wigner Jenő get? Which country did he represent? (Wigner)
5. Who were the Dutch Nobel Prize winners (its mark: NL)? (NL)
6. Which prize was given the most of the times? Whom was the prizes given to?(prizes)
7. In which year what kind of prizes weren't given to anyone? (miss)
8. Which countries' reps got only one Nobel Prize? (once)
9. List the number of the Nobel Prizes in each country. Only real countries can be on the list. They have to be listed hierarchically. (hierarchy)
10. List the prizes, winners, and their country that got a Nobel Prize between 1901 and 1939. (1939)

12.

1. The Stupido-Gigantic GmbH Ltd Kft S.A. is mainly dealing with commercialism. According to this they get orders from their customers who are served by the deliverers. One product is delivered by one deliverer and one deliverer delivers only one product. We register the customer's momentary remainder. One order may include more items – an item consists of the name of the product and the amount of the ordered item(s). The name of the deliverers, products, and cities are unique but the names of the customers are only unique within a city. We can assume that every city has only one post code.

The stored datas:

DeliverерPostCode, CustomerPostCode, DelivererName, OrderNumber, Quantity, OrderDate, CustomerCityName, Remainder, OnePrice, ProductName, DelivererCityName, CustomerName, ProductName.

Tasks:

1. Create the logical database model of the Stupido-Gigantic GmbH Ltd Kft S.A. company's trade. (Till the 3NF form)
2. Put the model into practical.
3. Make the following queries:
    - the post code of the deliverer who delivers the "gummy bear" item
    - the names of the customers in the year 1998
    - the remainder of the customers living in Ajka
    - the name and location of the customer having the largest remainder
    - from which deliverer have the most loyal customer ordered the most of the times?

Task 13.

Basic tables

man [id integer primary key, name varchar(40) not null, city varchar(40)]

car [rsz char(7) primary key, owner int, type varchar(20), color varchar(20), price numeric(7,0)]

1. Query the price of the red coloured cars.
2. Increase the price of the cars cost between 500 000 and 1 000 000 Ft by 20%.
3. Query the name of the owners and the type of their cars whose name starts with "K".
4. Query the name of the owners and the price of their cars that live in Eger or Miskolc, in alphabetical order according to the name of the owners.
5. Query the name of the owners who has cheaper car than 1 000 000 Ft.
6. Query the name and address of the owners who has a car.
7. Query the registration number of the cars which's owner lives in Miskolc.
8. Query the cars which's price is larger than all the red cars'.
9. Query the average price of the cars in Miskolc.

10. Query that how much cars are in each cities.
11. Query the registration number and the name of the owners of the cars which are more expensive than the average.
12. Query the owners who have only one car grouped and ordered by the city they live in.
13. Query the registration number of the cars which are more expensive than the cheapest car in Miskolc.

Views and Indexes

View

Some groups of the users don't see the whole database, or they might see some parts differently from they are built up in the conceptual model.

For example, this case obtains when a group can't see the Payment field of the record of the Personal Details table, while another group can't see the Date of Birth field. So planning the views is one of our duties during designing a database. We can sort the data model into three levels:

- User level: describes the way the users see the database
- Logical level: illustrates the whole conceptual structure of the database
- Physical level: Writes down the physical position and the access path of the datas

Due to the strong severance of the logical and the physical level, data independence became the most important requirement of database designing. We distinguish logical and physical data independence:

Metadata provide us the logical data independence, viz. not only data but the features of the data and descriptions of the connections between data groups are stored as well.

Database management systems (DBMS) provide logical data independence basically. A change in the data structure doesn't mean that we have to rewrite the user program as it means a change just among the metadata. We are able to make changes on the logical level without making a change on the user level.

DBMS provides physical data independence as well. A change in the structure of data storage or the way of access – in one word: the physical database – doesn't mean a change in the logical scheme or in the user level. For example the only thing a user recognises from indexing is that they can reach some data faster than before.

The aim in every well-designed system built up according to the layering conception is that layers have to be changeable without reference to each other, providing that the interfaces between the layers remain the same.

Two types of data independence are distinguished:

Physical data independence, which is meant between the physical and the logical database

Logical data independence, which is meant between the logical database and the views

When we talk about physical data independence, we think of a requirement that the changes taken through the physical database shouldn't affect the logical database. If it is realized (in most of the cases) then the physical data medium can be exchanged to another with different parameters (in case of a breakdown or a technical improvement) without experiencing any changes in the logical database.

We talk about logical data independence when a change in the logical database doesn't go with a change in the views which belong to the users. This requirement isn't fulfilled in all cases.

We can create a view with the following order:

CREATE VIEW <view_name> [(<column_name1>, …)] AS <query>

There is only one restriction for queries: they mustn't contain orderings. If we don't name the columns, the columns of the view equals with the names of the columns listed after SELECT. However, if the SELECT creates counted values, we'll have to name the columns.

For example:

CREATE VIEW dept_sal (deptno, avg salary) AS SELECT deptno, AVG (sal) FROM emp GPOUP BY deptno

Modifiable view tables

- During modifying a view table we also modify the content of the data tables behind them
- Basically not all the view tables are modifiable
- Modifiability can be gained on two ways:
  - The view table has an originally a more simple structure
  - We make an INSTEAD OF type trigger

Structural terms of modifiability:

- The definition of the view table mustn't contain:
  - set procedures
  - DISTINCT, GROUP BY, ORDER BY keywords
  - cumulative functions
  - sub-queries
- Columns, which's value come from a monomial, can't be modified
- In case of views referring to more tables
  - Modifying can affect only one table
  - In case of INSERT or UPDATE the keys and unique values of the modified table have to be unique in the view as well

For modifying the structure of the view table we use CREATE OR REPLACE VIEW.

Deleting a view table

- Form:
  DROP VIEW view_name
- Example:
  DROP VIEW customers_budapest_vw
- Data aren't deleted! They are in the tables!

Consequently, let's look through the advantages of view tables:

- First of all safety: they allow access to the chosen data
  - e.g. every employer can see only their employees
  - In the data dictionary we only see the view tables (e.g. USER_TABLES or ALL_USERS). It is advantageous as the user can see what they are allowed to see but nothing else.
- They simplify the orders the users have to give out
  - e.g. users don't have to connect tables
- They make applications independent from the structure of the tables
  - e.g. new columns can be added to the data tables and their names can be modified as well
- They increase safety
  - e.g. complicated queries which are used frequently can be saved as a view table
- Data can be "served" due to the different user's demands.
  - e.g. users can see data which are useful for them

Indexes

Pointers in index records can identify the record on two ways:

- Clustered indexing, when we put indexes on every single data record
- Sparse indexing, when we put indexes on groups of data stored in blocks

Sparse indexes

Index records locate the block the records of the data file are stored in. Within a block, data records can be treated as free records. In case of a sparse index the data file has to be stored on a trimmed way; viz. all the records having their keys in one interval have to be stored in one block.

Searching

Let's put the case that we are searching a k1 type key. Within the index file we look up the record whiches k2 type key is the largest out of the ones which are smaller than k1. The pointer of the k2 key of the index record will name the block in which you'll find the k1 key.

Insertion

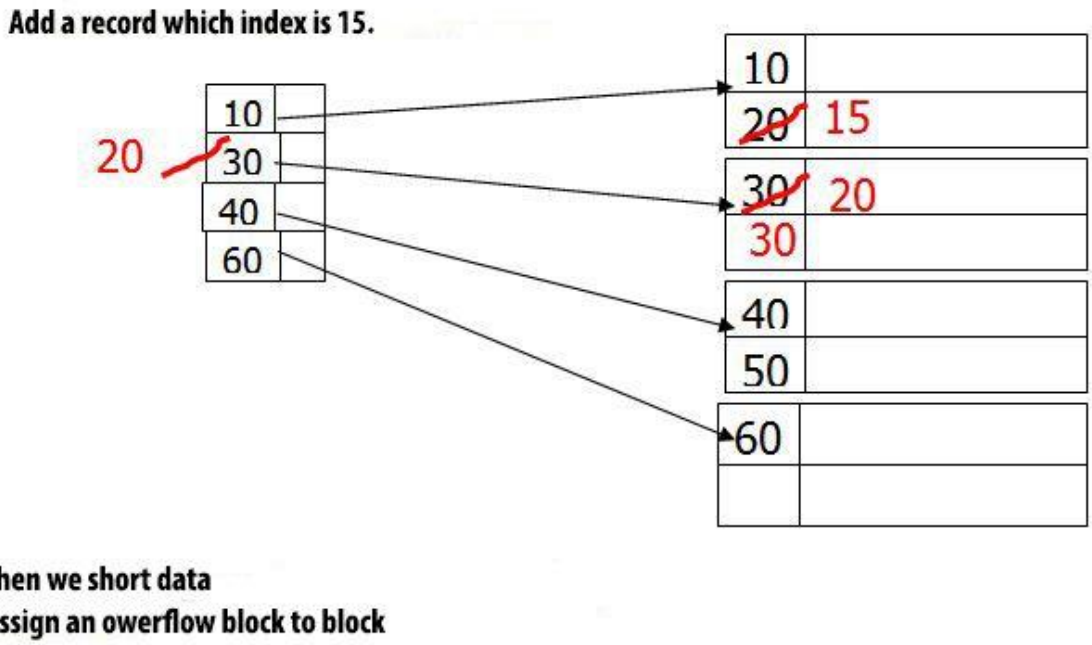
Let's put the case that we would like to store the record having the k1 type key. Firstly we have to find the block in which the record must be stored. If it were in the data file, let's name it Bi block.

After that two cases can exist.

It depends on whether there is enough space for the k1 key in the Bi block or not.

If there is, we don't have much to do only to write it into the Bi block as a record.

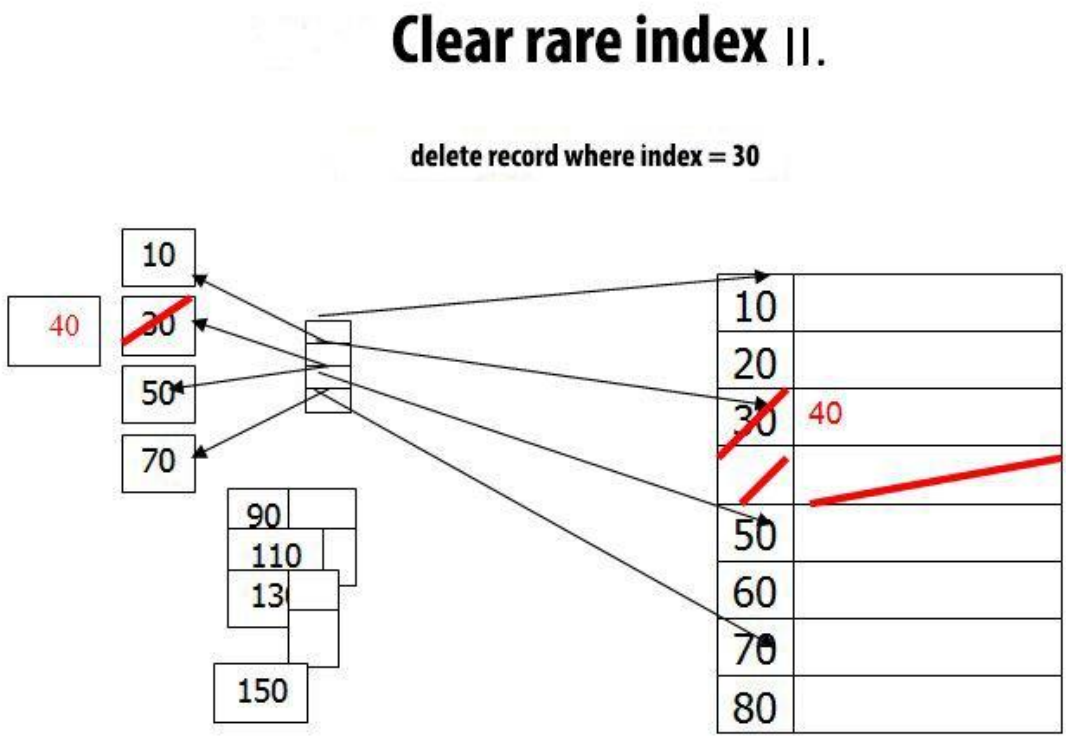
If there is no space, we'll have to make. We have to make a new empty block.



Deleting

Let us assume that we wish to delete the record with the k1 key. First of all, we have to look up the block the record is stored in. Here it is called Bi. If the k1 key is not the smallest key in

the block we can delete it smoothly, and abolish the empty space in the place of the deleted key with moving the records inside the block.



Modifying:

In case of modifying two cases can exist. It can be simple, if the modifiction didn't affect the key of the record. In this case we just look up the record, take through the modifiction, and rewrite it to the storage device.
Alhtough it can be complicated, if the modifiction affects a key field. In this case deleting can be taken through with deleting and inserting followed by each other.

B*-trees as multilevel sparse indexes

With indexed searching searching time commensurate with log2N can be reached, which is less than the heap organising's but more, than the hash organizing's. In exchange, the amount of the usage of the storage device can be handled in case of a database with a changing size.
A k-ponter imaged in an intersection can be stored with only a k-1 key as the meaning of this key is the smallest key value in the given part of the tree. This way the first key value of the index blocks wouldn't contain any information. This indexing is called B*-tree indexing.

Searching:

The procedure is similar to those studied on rare indexes, only the index file searching is carried out in several steps.
Suppose that v1 key records are required. Find the record, in the top block of indexes, which has the highest v2 key but lower v1 keys. This record's pointer directs to the lower level block, in which the search should be continued for a record that has the largest v3 key of those with smaller v1 keys. This process continues until the last indicator identifies a block of the database in which the key must be a record.

Insertion:

The main deviation from inserting rare indexes is the added requirement of managing
the original tree-system and it's equilibrium.

Delete:

Find and delete the appropriate entry. Data blocks should be merged if possible. When merging, or when a record's last data block is deleted, the block's keys are to be removed from the concerned index.

Modification:

Same as mentioned during rare indexes.

Dense indexes:

The disadvantage of rare indexing is that the data files have to be stored orderly. Therefore, there is no way to insert a new record for any available position, thus storage utilization is reduced.

One solution could be if all data records have index record. The index records continue to only identify the block containing the record. This way, the search time within the block can be reduced.
Dense indexing primarily helps the use of the main database and makes searching by multiple keys possible.

Disadvantages:

- More space required
- Requires an extra data access to read records
- Extra administration to maintenance

Advantages:

- No need for organized storage,thus space savings
- Faster access to the record
- Multiple key search
- Database records can be freed if all other records of the calls are made through a dense indexes.

Search:

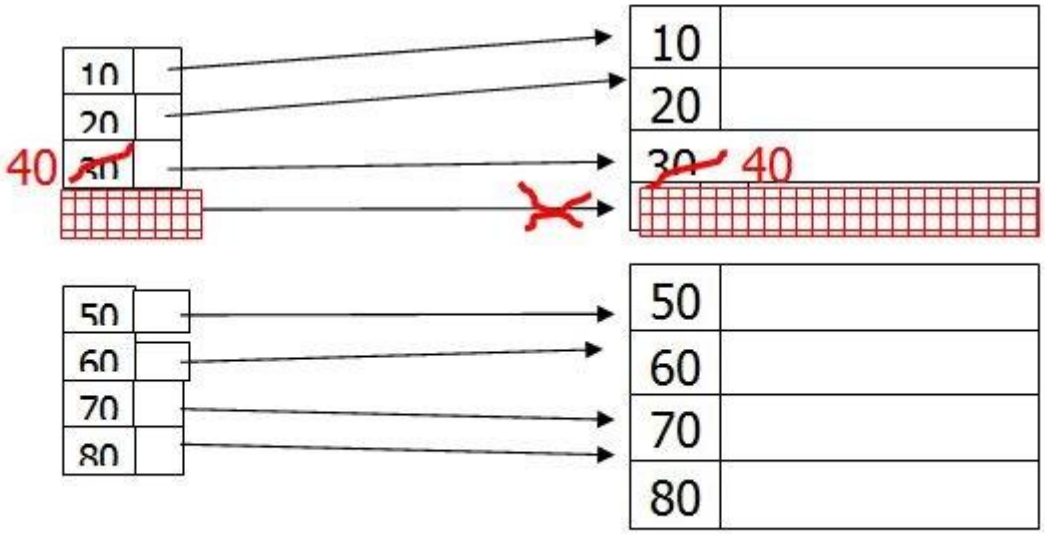
Find the key in the index database, access the record using the connected pointer.

Delete:

We find the record, set the signal to unused, the key is removed from the index file and compact the index stocks.

Deletion from a thick index

Let us delete the record of thirty!



Insertion:

Look for an empty space for the record, if it's not found, add it to the end of the file.
Set the signal, and enter the data.

Modification:

We find the data block containing the record, then re-enter the amended record to the database. If a key field has been modified rearrange the indexes.

Constraints, integrity rules, triggers

The constraints are such regulations we can provide our expectations related to the content of the database. When we make these statements for the database system in one place once, it will make sure to force them. If we happen to design them in the user-interface, we would modify and declare them in many places.
Constraints are checked after every action which would change the content of the database in a way that the content would not satisfy the constraints. Constraints are valid since we declare them. They do not have a retrospective effect. Execute a delayed check by the keyword DEFFERRED.

Keys

Used for identify the individual clearly. As a constraint it means to check that in the relation should not occur two rows, where the value of the key attributes would be the same for a pair. In one relation there might be more keys. It is a custom to declare one primary key form them. At the CREATE TABLE statement it could be defined. When the key has one attribute, we can declare it by the PRIMARY KEY or the UNIQUE keywords, or at the end of the statement after the above keywords in brackets as an enumeration. If it has more attributes, at the end of the table only.

In the following example we create tables with the same constraints, illustrating how to define constraints in two possible ways.

```
CREATE TABLE hallgatok(
neptun_kod CHAR(6) PRIMARY KEY,
nev VARCHAR2(30) NOT NULL,
szul_ev NUMBER(4) CHECK (szul_ev > 1900),
telefonszam NUMBER(10) UNIQUE);
CREATE TABLE atlagok(
neptun_kod CHAR(6) REFERENCES hallgatok(neptun_kod),
atlag NUMBER(3,2));
```

```
CREATE TABLE hallgatok2(
neptun_kod CHAR(6),
nev VARCHAR2(30) NOT NULL,
szul_ev NUMBER(4),
```

```
telefonszam NUMBER(10),
PRIMARY KEY (neptun_kod),
CHECK (szul_ev > 1900),
UNIQUE (telefonszam)
);
```

```
CREATE TABLE atlagok2(
neptun_kod CHAR(6),
atlag NUMBER(3,2),
FOREIGN KEY (neptun_kod) REFERENCES hallgatok2(neptun_kod)
)
```

Above attributes have the following constraints.

• in tables ‘hallgatok’ and ‘hallgatok2’ the a ‘neptun_kod’ is the primary key, so in every row must have different values, and none of them could be null.

• the ‘név’ field could not contain null value;

• ‘szul_ev’ must be greater than 1900;

• there could not be two same telephone numbers, but it could happen that we do not know somebody’s telephone number;

• to the tables ‘átlagok’ and ‘átlagok2’ could go only such record where the value of ‘neptun_kod’ field is appearing in the ‘hallgatok’ table’s ‘neptun_kod’ attribute values.

Let’s see an example, how else to define an attribute set as a primary key. (UNIQUE and FOREIGN KEY could be defined similarly for an attribute set.

```
CREATE TABLE hallgatok(
nev VARCHAR2(30),
szul_datum DATE,
anyja_neve VARCHAR2(30),
lakcim VARCHAR2(100),
PRIMARY KEY(nev, szul_datum, anyja_neve));
```

In this table the ‘nev’, ‘szul_datum’ and ‘anyja_neve’ attributes could take same value in two records one by one, but there is a slight chance to all three attributes would be the same, so in practice they are used as primary key often.

Referential integrity constraint

~ that means that certain attributes in a relation could be just such values which are in a given table occurring primary key values. (foreign keys) Definig the referential integrity constraint there are two ways. When the foreign key is one-attributed then during the definition: REFERENCES table (attribute) or in the end of the statement CREATE TABLE in this way: FOREGIN KEY attributes REFERENCES table (attributes). If the foreign key has multiple attributes we have just the second way.

The referential integrity could be harmed in the following way: the referring table get a such value during modification or inserting which does not appear in the referred table at the named attributes. Or we do modifications or deleting from the referred table, or delete rows which were pairs of earlier right references.

When the referential integrity harmed, database systems not only could deny these actions but they offer two ways of reaction:

Denying modifications

- Cascading procedure
  When in the referred place we modify the two references then in the referring places the referring values will be modified also by the database system recovering the reference.
- SET NULL procedure
  When the reference would be harmed due to a change in the referred place, then in the referring place the referring value will be set to NULL.NULL értékre állítás módszere, (SET NULL).

In case of harming the referential integration the reaction of the database system could be set at the CREATE TABLE statement setting the reference which creates the referring table. ON DELETE SET NULL: harm due to delete the referring value will be set to NULL. ON UPDATE CASCADE in the event of modification in the referring place should happen the change of the values in order to keep the reference valid.

Referential Integrity Constraints: We can define that one or an attribute-set values must occur an another relation's any row's primary key attribute(s). This could be set defining the relation scheme by the REFERENCES or the FOREIGN KEY keyword.

- When the foreign key is the only attribute:

```
REFERENCES <table> (<attribute>)
```

- When the foreign key is set of multiple attributes:

```
FOREIGN KEY <attributes> REFERENCES <table>  (<attributes>)
```

Foreign key could be declared in two ways as we did in the case of foreign keys.

Constraints for attribute values

The possible values of the attributes are slightly restricted by setting their types. However the chance of input invalid data or modify to invalid is decreased.

NOT NULL condition - By setting it we can define that the given attribute must always have a valid value; its value could never be NULL. It should be setting in the CREATE TABLE statement defining the particular attribute.

CHECK condition – By setting it we can prescribe such restrictions like after WHERE. Arithmetical expressions, values are allowed. It should be setting in the CREATE TABLE statement defining the particular attribute.

By the CHECK condition we could not only make clauses for attribute values but constraints for them. Doing so we do not connect the CHECK condition but we declare it in the end of the table defining statement.

When defining a table beyond its name and its attributes we can give other information too. These are the keys and constraints regarding to attribute values. At first we describe the method of declaring keys and attributes having unique values.
In the SQL basically we have a chance to define the *primary key* as the most database system requires it. If we want define the primary key, then we could extend the table creating with the corresponding clauses. This looks like the following.

```
CREATE TABLE <tablename> {
<attributedefinition> [UNIQUE]  [,<attributedefinition > [UNIQUE]]…
[,PRIMARY KEY (<keyattribute> [,<keyattribute
>]…)|UNIQUE(<keyattribute >) ]}
```

By the **UNIQUE** keyword at every attribute we can set that the given one could have unique value only. In the <keyattribute> parameter should give the attributes name which creates the key, or is part of the key. If only one attribute belongs to the key, then we could use either the PRIMARY KEY or the UNIQUE commands. Keys consisting of multiple attributes could be defined by the PRIMARY KEY only.

Standalone assertions

SQL2 offers constraints which make possible check any condition. General form: CREATE ASSERTION assertion name CHECK condition;

Contingencies of standalone assertions are expanded in SQL3. Checkings are triggered by the events given by the programmer, furthermore the assertion could be applied for particular rows of a table or tables not just for a whole table.

Modifying constraints

In order to modify or delete an assertion we have to name it at the creation. Giving a name could be done at the time of definition after the CONSTRAINT keyword. For example: CONSTRAINT title CHECK (parameters).
If we want to delete the named constraint we could do that by the *ALTER TABLE tablename DROP CONSTRAINT constraintname* statement.
New constraint: ALTER TABLE table name ADD CONSTRAINT constraint name define constraint;

Table-level constraint:

```
ALTER TABLE <tablename> ADD CONSTRAINT <name> <type> <column>;
```

Example:

Let's add an constraint to the tTeacher table, causing we cannot store two teachers by the same name.

```
ALTER TABLE tTeacher ADD CONSTRAINT uq_tTeacher UNIQUE  (Name);
```

Checking:

```
INSERT INTO tTeacher  VALUES (1, ' Example John');
```

Deleting a constraint:

```
ALTER TABLE <tablename> DROP CONSTRAINT <constraintname>;
```

Example:
Let's drop the above constraint:

```
ALTER TABLE tTeacher DROP CONSTRAINT  uq_tTeacher;
```

Checking:

```
INSERT INTO tTeacher VALUES  (1, ’ Example John’);
```

Keeping the consistence of the database

Consistence sequences

Triggers: (Oracle 10g)

The trigger defines an activity which executed automatically when a table or a view is being modified or other user- or system events should occur. So, any change in the database starts a trigger. The trigger is a database object.
Triggers are working transparent from the angle of the user.

Triggers could triggered by:

- An INSERT, DELETE or an UPDATE statement executed on a table or a view
- Some DLL statements
- Server errors
- User logon or logoff
- Starting or stopping a database

We use them in the following cases:

- generating inherited column value
- prevent an invalid transaction
- protection
- defining r**eferential integrity constraints**
- handling complex business rules
- event logging
- trace
- collect table statistics
- multiplying data

Triggers could be sorted by different angles. At a trigger we should declare that when and how many times should it being executed regarding to the event. According to the above, we could talk about the following triggers.

- row- and statement level trigger
- Before and After trigger
- Instead Of trigger
- System triggers

Row-level trigger:

Briefly it is being executed everytime when the table data is being modified. For example after a Delete statement every deleted row activates the trigger. But when none of the rows modify the trigger will not executed neither.

The trigger counts the new employees having less salary than 100 000.

```
CREATE TRIGGER empl_count
AFTER INSERT ON employee
FOR EACH ROW
WHEN (NEW.salary < 100000)
BEGIN
UPDATE counter SET value=value+1;
END;
```

Statement-level trigger

This trigger opposite its row-level peer just executed only once, and it is being executed even the database has not been changed.

One element support table:

```
CREATE TABLE counter (value NUMBER);
INSERT INTO counter VALUES (-1);
```

We define two triggers to enroll multiple new employees. The first resets the counter to zero:

```
CREATE TRIGGER dolg_kezdo
BEFORE INSERT ON dolgozo
BEGIN
UPDATE szamlalo SET ertek=0;
END;
```

Before and After triggers:

They could be equally at row- and statement levels. They can be attached for a table only not for a view, however a trigger connected to a base table executes on a view in a case of an executed DLM statement.

The Before trigger executes before the linked statement, and the After trigger executes after the statement as we can see it from its name.

Before:

```
CREATE OR REPLACE TRIGGER emp_alert_trig
BEFORE INSERT ON emp
BEGIN
DBMS_OUTPUT.PUT_LINE('New employees are about to be
added');
END;
```

Let's insert a row!

```
INSERT INTO emp(empno, ename, deptno) VALUES(8000, 'valaki',
40);
```

After:

Let's create the new table where we will store the modifications!

```
CREATE TABLE empauditlog (
audit_date DATE,
audit_user VARCHAR2(20),
audit_desc VARCHAR2(20)
);
```

Let's create the trigger!

```
CREATE OR REPLACE TRIGGER emp_audit_trig
AFTER INSERT OR UPDATE OR DELETE ON emp
DECLARE
v_action VARCHAR2(20);
BEGIN
IF INSERTING THEN
v_action := 'Added employee(s)';
ELSIF UPDATING THEN
v_action := 'Updated employee(s)';
ELSIF DELETING THEN
v_action := 'Deleted employee(s)';
END IF;
INSERT INTO empauditlog VALUES (SYSDATE, USER, v_action);
END;
```

Instead of trigger

This trigger executes instead of its linked statement. It can be defined views, and it could be row-level only. When we want to modify a view, but we cannot do that directly by DML statements, the we use the Instead Of trigger.

System triggers

Their aim is inform the subscribers about the database events.

Now we know what are the triggers, when they are executed, and what kinds of do we have. However we do not know yet how to create them. The next section this is about.

Creating Triggers

In own schema ----- CREATE TRIGGER
In other user's schema ----- CREATE ANY TRIGGER
Creating in a database ----- ADMINISTER DATABASE TRIGGER
Rights are needed.

Creating statement:

```
CREATE [OR REPLACE] TRIGGER [schema. ] triggername
{ BEFORE | AFTER | INSTEAD OF }
{dml_trigger | { ddl_event  [OR ddl_ event] …|
Ab_esemény [OR  db_e event]…}
ON {DATABASE | [schema. ] SCHEMA}
[WHEN (condition) ]   {plsql_block | procedurecall}
```

Where

Dml_trigger::=

```
{INSERT | DELETE | UPDATE  [OF column [ , column]…}
[OR {INSERT | DELETE | UPDATE  [OF column [ , column]…} ]….
```

```
ON { [ schema. ] tábla |
[ NESTED TABLE  bát_column OF ]  [schema. ] nézet}
[REFERENCING {OLD  [AS] old | NEW [AS] new | PARENT [AS] parent}
[ { OLD [AS]  old | NEW [AS] new | PARENT [AS] parent} ]…
[FOR EACH ROW]
```

Let's summarize the above:

The OR REPLACE is a redefinition of an existing trigger, without its previous abolishment.
The schema trigger containing schema's name. If it is missing, then the trigger is being created in the user's schema who executed the command, therefore not the place we want it.
The trigger name is the trigger's name what is being created.
The BEFORE, AFTER, INSTEAD OF sets the type of the trigger.
The INSERT, DELETE, UPDATE defines that SQL statement causing the trigger executed.
The ON statement part gives the database object, the trigger will be created on.
A REFERENCING statement part determines correlating names (old, new, parent)
A NEW gives the names after the modification.
A FOR EACH ROW creates row-level triggers.

The dll_event determines a DLL statemet, the db_event a determines a database event, what activates the trigger.

There is only one question left related to triggers. How do they work?

How triggers work:

A trigger can have two statuses: enabled and disabled. Disabled trigger does not start even if the related event happens. In case of enabled trigger the Oracle executes the following events automatically.

- Executes the trigger, if more similar trigger is defined for the same statement, then their order is not determined.
- Checks the constraints and supervises the triggers not to harm them.
- Provides reading consistency for queries.
- Handles the depedicities between scheme objects and triggers.

- In case of divided database, when the trigger has modified a remote table, applies two-phased finalization.

The CREATE statement enables the trigger automatically.

We can disable and enable a trigger by the ALTER TRIGGER and ALTER TABLE statements.

We know already, when on the same statement there are same triggers there is no specific order. But what is the case, when they are not similar?

Oracle follows one execution order:

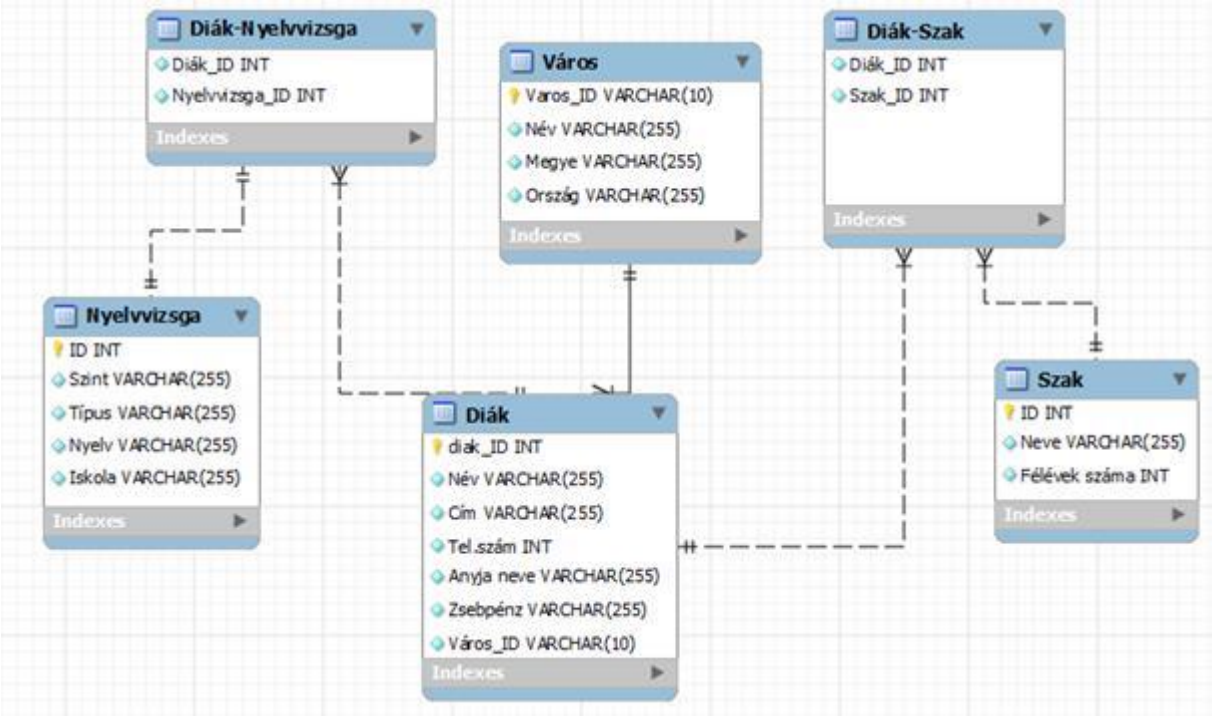
- Executes all statement-level BEFORE triggers
- Involved by the DML statement cyclically for every row:
  a, executes the row-level triggers
  b, locks and changes the row and checks the integrity constraints.
  the lock opens only in the end of the transaction,
  c, executes row-level AFTER triggers.
- Checks delayed integrity constraints.
- Executes the statement-level AFTER triggers.

The execution model is recursive. During execution a trigger could be another triggers start.

Tasks

Task 1

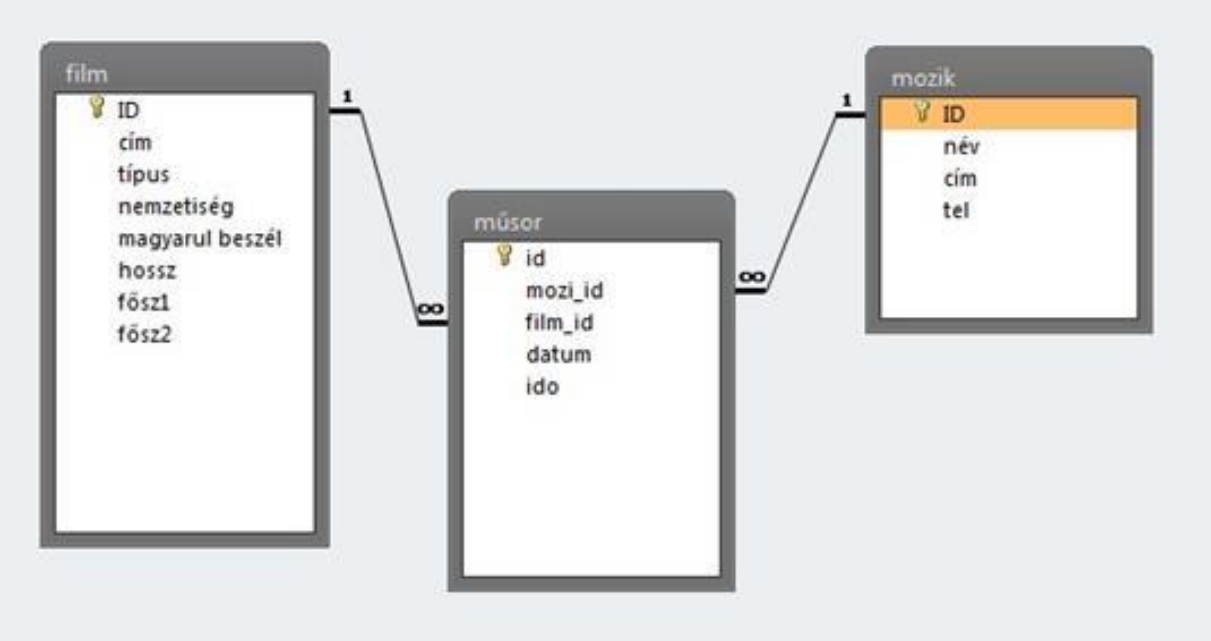
There is a database with the following structure.



1. Create the database tables in your own database.
2. Fill to the tables 5-5 corresponding records.
3. List the students names, pocket money ordered by name in reversed alphabetic order.
4. List the name of the majors, with the student's names. Order by name of the major, within student name.
5. Count how many student studies in the school by counties.
6. Who are those students who have less pocket money than the average? List their names, descending order by pocket money.
7. Write an own stored procedure, which determines the most difference between pocket moneys, and decreases the greatest pocket money value by this value.
8. Write a stored procedure, which increases the students pocket money living in Eger, by 10% if it is greater than the average, and by 15% when it is smaller.

2. feladat

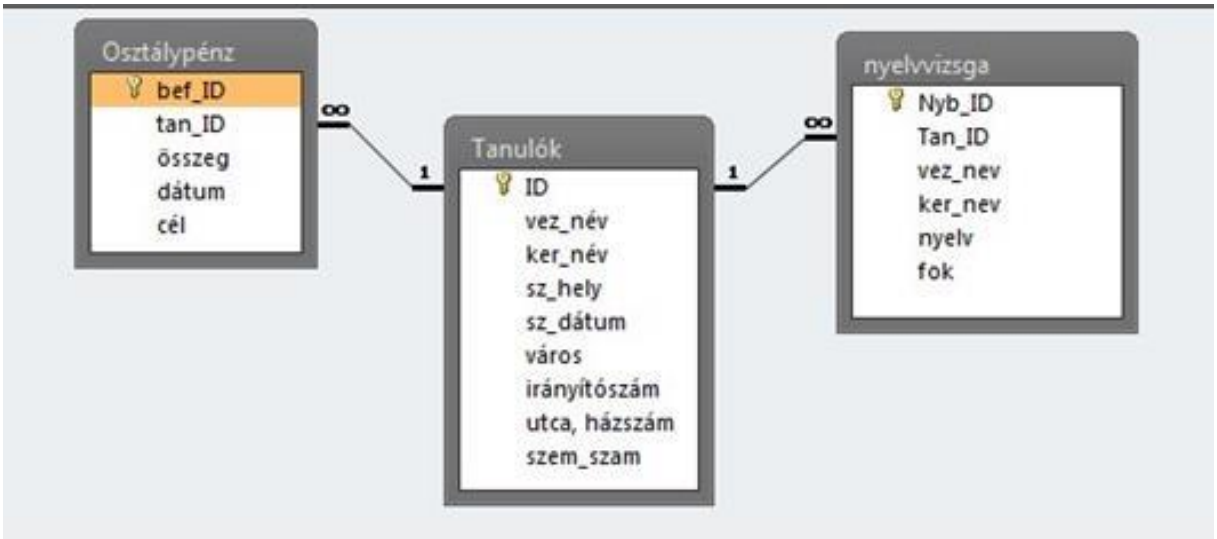
There is a database with the following structure.



1. Write the statement creating the cinemas table.
2. Add a new cinema to the table. Its data: name: Csillag, Address, Eger, Leányka út 4, 3300, the phone number we do not know. The primary key is identity type.
3. Modify the movie Blade genre to romantic and the length to 135 minutes.
4. Cancel all Sunday (22 April) shows due to blackout.
5. Create a show-list from April movies.
6. How many shows were in March in the Uránia cinema?
7. List all the films which are shorter than the average movie length.
8. Which cinema shows the most movies?
9. How many movies can be found by nationality? Show them descending order.
10. In 2012 Harry Potter 7 part two in how many cinemas is being showed?
11. Write a stored procedure which sums up all longer movies than 120 minutes length in minutes.

Task 3

There is a database with the following structure.



1. Write the statement creating the table Students.
2. There is a new student in class. His data should stored in the database. (class.mdb) The data is the following: name: Kovács Péter, place of birth: Budapest, date of birth, 1992. jun 12, address: 2120 Dunakeszi, Munkácsy u. 12. (the identifier consist of the initial letter of surname and forname, and a number, which indicates the order of the student with the same initials.)
3. Vágó László (VL1) place of birth was recorded wrong by the headteacher, he was born in Pécs instead of Bécs. Correct the place of birth in the class's database table.
4. Kovács Péter (KP1) parents decided that they will take him to another school so Kovács Péter should be removed from the class.
5. Filter from the students table those, who born in a place beginning with B or V and order them ascending by birth date.
6. Count each language how many students does have a certificate.
7. Create the list containing all of the incomes by student. Order it alphabetically, then descending by the income.
8. How many students income is above the average income?
9. The most students which city came from?
10. Which students did not make any income?
11. Write a stored procedure that selects the students with English and German certificate, and compares their average income.

Basics of PL/SQL

Basic elements of PL/SQL

Character set

A PL/SQL program's source code –like every source code – the smallest elements are the characters. The A PL/SQL language's character set elements are the following:

• letters, the English small- and capital letters: A—Z and a—z;
numbers: 0—9;
• other characters: ()+-/<>=!~^;:.@%,#$&{}?[]
• space, tabulator, carriage return
The PL/SQL is not case sensitive except inside string literals.

Lexical units

In the text of a PL/SQL program the following lexical units may be used:

- delimiters,
- symbolic names,
- comments,
- literals.

These will detailed in the following section.

Delimiters

symbol	meaning
+	operator of addition
%	beginning symbol of an attribute
'	string literal delimiter
.	component selector
/	operator of division
(	beginning of a part expression or a list
)	end of a part expression or a list
:	beginning symbol of a parent variable
,	dividing symbol of an enumeration
*	operator of multiplication
"	quotation marked identifier separator
=	comparing operator
<	comparing operator
>	comparing operator
@	symbol of a remote reference
;	end symbol of a statement
-	operator of subtraction and negative portent

Symbolic names

Identifiers: begins with a letter and followed by numbers or $ _ # characters.

These are non-case sensitive.

hallgato, HALGGATO, Hallgato

means the same

Further symbols:

symbol	meaning
:=	operator of giving a value
=>	operator of assignment
||	operator of concatenation
**	operator of power
<<	beginning of a label
>>	end of a label
/*	beginning of a comment
*/	end of a comment
..	operator of interval
<>	comparing operator
!=	comparing operator
~=	comparing operator
^=	comparing operator
<=	comparing operator
>=	comparing operator
--	beginning of a single-line comment

Reserved words

(mod, or and, declare, …)

Identifiers with quotation marks:

„Yes/No”

„mod”

„That is an identifier too”

The identifiers with quotation marks are case sensitive!

Literals

5, 33, 6.666, -1.0, 2.0f (BINARY_FLOAT),

2.1d (BINARY_DOUBLE)

’appletree’, ’said’

Label

<< label >>

Could occur in any row. Identifier!

Nominated constants

```
name CONSTANT type [NOT NULL] {:=|DEFAULT} expression;
```

Variable

```
name type [NOT NULL] {:=|DEFAULT} expression;
```

Example:

```
DECLARE
  -- NOT NULL at a declaration giving a value is compulsory
  v_Szam1 NUMBER NOT NULL := 10;

  -- v_Szam2 initial value will be NULL
  v_Szam2 NUMBER;

BEGIN
  v_Szam1 := v_Szam2; -- causes VALUE_ERROR exception
END;
```

```
-- declaration of nominated constant, the value-giving expression is a
function call
  c_Now       CONSTANT DATE := SYSDATE;
  -- declaration a variable without giving initial value
  v_Egeszszam  PLS_INTEGER;
  v_Logikai    BOOLEAN;
  -- declaration a variable with giving an initial value
  v_Pozitiv    POSITIVEN DEFAULT 1;
  v_Idopecset  TIMESTAMP := CURRENT_TIMESTAMP;
  -- giving initial value for a record type field
  TYPE t_Kiserlet IS RECORD (
     leiras       VARCHAR2(20),
     probalkozas  NUMBER := 0,
     sikeres      NUMBER := 0    );
  -- record fields can get initial value only in type declaration
  v_Kiserlet   t_Kiserlet;
```

Simple and complex types

Literals, nominated constants, variables all have a data-type component which determines for them not only the values, but the operators, and how the values represented in the memory. The data types could be system-defined or user types.

Scalar types:

SCALAR TYPES		
Numeric family	Character family	Date/interval family
BINARY_DOUBLE	CHAR	DATE
BINARY_FLOAT	CHARACTER	INTERVAL DAY TO SECOND
BINARY_INTEGER	LONG	INTERVAL YEAR TO MONTH
DEC	LONG RAW	TIMESTAMP
DECIMAL	NCHAR	TIMESTAMP WITH TIME
DOUBLE PRECISION	NVARCHAR2	ZONE
FLOAT	RAW	TIMESTAMP WITH LOCAL
INT	ROWID	TIME ZONE
INTEGER	STRING	
NATURAL	UROWID	
NATURALN	VARCHAR	
NUMBER	VARCHAR2	
NUMERIC		
PLS_INTEGER		
POSITIVE		
POSITIVEN	Logikacal family	
REAL	BOOLEAN	
SIGNTYPE		

SMALLINT		
Complex Types	LOB Types	Reference types
RECORD	BFILE REF	CURSOR
TABLE	BLOB	SYS_REFCURSOR
VARRAY	CLOB	REF objektumtípus
NCLOB		

NUMBER type

This type can handle integer and real numbers. It is similar with the NUMBER database type. Range: 1E–130..10E125. Inside representation is fixed or float. The syntax is the following:

```
NUMBER [(p[,s])]
```

P is the accuracy, s is the scale. Their value could be only a whole literal. The accuracy sets all of the digits, scale sets the number of decimals.

Type	Value to handle	Stored value
NUMBER	123.456	123.456
NUMBER(3)	321	321
NUMBER(3)	3210	Overflow
NUMBER(4,3)	11.2222	Overflow
NUMBER(4,3)	3.17892	3.1799
NUMBER(3,–3)	1234	1000
NUMBER(3,–1)	1234	1230

The inside representation of the NUMBER type provides an effective storage method, however the arithmetical operations could not be done on it directly.
If we do not want to store an integer value, just make operations on them we should use the BINARY_INTEGER type. This type handles integer values in a range of

–2147483647..2147483647. These values are stored with fixed decimal point, so operations are faster.

The restricted basic types of BINARY_INTEGER are the followings:

NATURAL	0..2147483647
NATURALN	0..2147483647 and NOT NULL
POSITIVE	1..2147483647
POSITIVEN	1..2147483647 and NOT NULL
SIGNTYPE	–1,0,1

Character family

The elements of character types are arbitrary character sequences. Their representation CHAR TYPE

It can handle fixed-length strings.

Syntax:

```
CHAR [(h [CHAR|BYTE])]
```

where h is a whole literal from the range 1..32767 by default 1. Value of h understood in bytes (BYTE), or characters(CHATR). The default is character. For the strings always that amount of byte will be reserved. When the string to be stored is shorter, then it will be filled with spaces from the right.

VARCHAR2 Type

It handles strings with variable width. Syntax is the following:

```
VARCHAR2(h [CHAR|BYTE])
```

where h is a whole literal from the range 1..32767 and it sets the maximum length. Its value is in characters when CHAR was given, in bytes when BYTE was given, or in case of nothing was given, it is in characters. The maximum length is 32767 byte.

Within the maximum length the strings to be threated just take up the necessary bytes.

ROWID, UROWID Types

Every database table has a pseudo column named ROWID which stores a binary value the row identifier. Every row identifier based on its storage address. The physical row identifier identifies "normal table" the logical row identifier an associative arrays. The ROWID datatype's domain there are physical identifiers. On the other hand the UROWID data type can handle physical, logical, and foreign (non-Oracle) row identifiers.

Date/interval types

In this family there are three basic types: DATE, TIMESTAMP és INTERVAL.

DATE TYPE

This type makes possible to handle the date and time information. Every value is stored on 7 bytes, which are in order the century, year, month, day, hour, minute, second.

The range is between 4712 BC 1st January and AD 9999 31st December. Applying the Julian calendar the date contains the number of the days past from 4712 BC 1st January.

The actual date and time can be requested by the return value of the SYSDATE function.

TIMESTAMP TYPE

This type's range contains the year, month, day, hour, second and fragment of second. It can handle timestamp. Syntax:

```
TIMESTAMP[(p)] [WITH [LOCAL] TIME ZONE]
```

where p is the number of digits of the second fragment. By default it is 6. Giving the WITH TIME ZONE the values contains the user's timezone data. Giving LOCAL the database's timezone will be used instead of the user's.

INTERVAL TYPE

With the INTERVAL type we can handle the difference between two timestamps.

Syntax:

```
INTERVAL {YEAR[(p)] TO MONTH|DAY[(np)] TO SECOND[(mp)]}
```

The YEAR[(p)] TO MONTH the interval giving in years and months. The p is the number of digits in year. By default it is 2.

The DAY[(np)] TO SECOND [(mp)] gives the interval in days and seconds. np is the days, mp is the number of the seconds digits. np is by default 2, second is 6.

Logical type

Only one type belongs here, the BOOLEAN, which range consists of logical true, false, and NULL. There is not logical type literal, but in the Oracle interprets three Logical types. TRUE is the logical true, FALSE is the logical false, and the NULL is NULL.

Record type

The record is a group of logically together-belonging data where every data is stored in a field. The field has its own name and type. The record type provides us the feature, the different data could be handled together as a single logical unit. By the record data type we could declare such program tools which can handle database rows directly. The record type declaration is the follows:

```
TYPE name IS RECORD(
fieldname type [[NOT NULL] {:=|DEFAULT} expression]
[,mezőnév típus [[NOT NULL] {:=|DEFAULT} expression]]…);
```

The name is the created record type in the further declaration we use it for set the record type. The field name is name of the record fields, elements. The type could be any PL/SQL type except the REF CURSOR. Setting NOT NULL the given field cannot have the NULL value. During runtime should occur such assignment the VALUE_ERROR exception will be raised. When setting NOT NULL the initiation is compulsory
A :=|DEFAULT statement part is used for initiation the field. The expression determines the field initial value. Form of a record declaration:

record type recordtype_name;

```
DECLARE
TYPE cikk IS RECORD (
cikkkod NUMBER NOT NULL := 0,
cikknev VARCHAR2(20),
afa_kulcs NUMBER := 0.27
);
```

Between data types we use converting functions to convert. They are summarized in the table below:

Function	**Desciption**	**Convertible families**
TO_CHAR	Converts the given parameter to VARCHAR2, the format could be set optionally.	Numeric, date
TO_DATE	Converts the given parameter to DATE, the format could be set optionally.	Character
TO_TIMESTAMP	Converts the given parameter to TIMESTAMP, the format could be set optionally.	Character
TO_TIMESTAMP_TZ	Converts the given parameter to TIMESTAMP WITH TIMEZONE, the format could be set optionally.	Character
TO_DSINTERVAL		Character
TO_YMINTERVAL	Converts the given parameter to INTERVAL YEAR TO MONTH, the format could be set optionally.	Character
TO_NUMBER	Converts the given parameter to NUMBER, the format could be set optionally.	Character, Numeric
TO_BINARY_DOUBLE	Converts the given parameter to BINARY_DOUBLE, the format could be set optionally.	Character, Numeric

TO_BINARY_FLOAT	Converts the given parameter to BINARY_FLOAT, the format could be set optionally.	Character, Numeric
RAWTOHEX	Returns the hexadecimal representation of the given value.	Raw
HEXTORAW	Returns the given hexadecimal-represented value in binary format.	Character (should contain a hexadecimal representation).
CHARTOROWID	Returns the inside-binary format of the ROWID represented by characters.	Character (should contain a 18-character rowid format).
ROWIDTOCHAR		Rowid

Programming structures

Selection

Selection selects one from conversely excluded logical conditions, then based on this executes one or more statements.

Form:

```
IF condition THEN statement [statement]…
[ELSIF condition THEN statement [statement]…]…
[ELSE statement [statement]…]
END IF;
```

Selection has three forms:

IF-THEN

IF-THEN-ELSE

IF-THEN-ELSIF

At the simplest form we close the activity by a statement sequence between the THEN and END IF reserved words. These are executed when the condition value is true. At false and NULL conditions the IF statement does not do anything.
At the IF-THEN-ELSE form one activity given by between the THEN and ELSE, the other between the ELSE and END IF statement sequence. When the condition is true, then the statement sequence will be executed after the THEN, if the condition is false or NULL, then the statement sequence will be executed after the ELSE. The third form contains a condition sequence. This condition sequence will be evaluated in the written order. If one of them is true, then the statement sequence will be executed after the next THEN.
If all condition are false, or NULL, then the execution will be continued by the statement sequence after the next ELSE reserved word, if there is not ELSE part, then this is an empty statement. In case of the IF statement after execution any activity (if there was not GOTO) the program continues on the statement after the IF.

Between the THEN and ELSE reserved words could be a newer IF statement. The depth of the encapsulation is arbitrary.

```
declare
x number;
y number;
greater number;
if y > x then greater = y else greater = x;
```

The CASE statement

CASE is a kind of selection-statement, where the program can choose only one form conversely excluded activities depending on the values of an expression or cases of conditions. Its form:

```
CASE [selector_expression]
WHEN {expression | condition} THEN statement [statement]…
[WHEN { expression | condition } THEN statement [statement]…]…
[ELSE statement [statement]…]
END CASE;
```

If a CASE statement is labeled, then the given label is can be shown after the END CASE.

So a CASE statement consists of any number of WHEN branches, and an optional ELSE branch. If there is a selector_expression then there is an expression in the WHEN branches, if not then there is a condition.

It works as follows:

If there is a selector_expression, then it will be evaluated, after in the written order it will be compared with the WHEN branches expressions values. If it is similar with one of them, the statement sequence will be executed after the THEN, if there is not GOTO, the execution will continued on the statement after the CASE. If there is no match with the selector_expression, and there is a ELSE branch, then those statements will be executed, and if there is no GOTO, the execution will be continued the statement after the CASE. However if there is no ELSE branch, the CASE_NOT_FOUND exception will be risen. If there is no selector_expression after the reserved word CASE, then the conditions will be evaluated and which takes up a true value, those WHEN branch will be selected. The further semantics are the same as the above.

```
DECLARE
v_Allat VARCHAR2(10);
BEGIN
v_Allat := 'hal';
CASE v_Allat || 'maz'
WHEN 'halló' THEN
DBMS_OUTPUT.PUT_LINE('A halló nem is állat.');
WHEN SUBSTR('halmazelmélet(set-theory)', 1, 6) THEN
DBMS_OUTPUT.PUT_LINE('A halmaz sem állat.');
WHEN 'halmaz' THEN
DBMS_OUTPUT.PUT_LINE('Ez már nem fut le.(this will be not executed)');
ELSE
DBMS_OUTPUT.PUT_LINE('Most ez sem fut le.(this will be not executed
too)');
END CASE;
END;

* remarks from the translator: This is a really weird Hungarian
grammatical joke, it can’t be translated to English fluently.
hal = fish
set = halmaz
ló = horse
halló = hello / hal-ló = fish-horse
állat = animal
sem = neither
```

Loops

Loops are such programming tools which make possible repeat a particular activity as much as we want. It is possible to execute zero times if it is needed. The repetitive activity is closed by an executable statement sequence, this is called the core of the loop.
PL/SQL knows four kind of loops

- base loop (or infinite loop)
- WHILE loop (or pre-test loop)
- FOR loop (or explicit number of steps loop);
- cursor FOR loop.

Related information (if there is any) to repeating the loop core we should give before the core, in the head of the loop. This information is identical for the particular kind of loop. A loop can begin its work with the execution the first statement of the core. A loop could end, if

- the information related with the repeating forces the end;
- we exit from the core by the statement GOTO;
- we finish the loop by the statement EXIT;
- an exception should raise.

Base loop

Form of the base loop is the following:

```
[label] LOOP statement [statement]…
END LOOP [label];
```

In the base loop we not provide information related to repetition so if in the core we not force to exit the loop by one of the three statements, it will be repeat infinite times.

For example here is a seemingly infinite loop. However it will end due to an exception since the value of factor will be greaters than 5 digits.

```
DECLARE
v_Fact NUMBER(5);
i PLS_INTEGER;
```

```
BEGIN
i := 1;
v_ Fact := 1;
LOOP
v_ Fact := v_ Fact * i;
i := i + 1;
END LOOP;
EXCEPTION
WHEN VALUE_ERROR THEN
DBMS_OUTPUT.PUT_LINE(v_ Fact
|| ' is the greatest maximum 5-digited factorial');
END;
/
```

While loop

Form of a while loop is the following

```
[label] WHILE condition
LOOP statement [statement]…
END LOOP [label];
```

In this kind of loop the repetition is controlled by a condition. The loop starts with the evaluation of the expression. If the value of the condition is false or NULL the execution ends, and the program continues on the next statement after the loop.
Operation of the WHILE loop has two extreme cases. If the condition in the first case is false or NULL, the core of the loop will never execute (empty loop). If the condition is true in the first case, and in the core does not happen anything what would change this value, the repetition will not stop. (infinite loop).

The above example could be solved without handling exceptions.

```
DECLARE
v_Fact NUMBER(5);
i PLS_INTEGER;
BEGIN
i := 1;
v_ Fact := 1;
WHILE v_ Fact * i < 10**5 LOOP
v_Faktorialis := v_ Fact * i;
i := i + 1;
```

```
END LOOP;
DBMS_OUTPUT.PUT_LINE(v_ Fact
|| ' is the greatest, maximum 5 digit factorial');
END;
/
```

FOR loop

This kind of loop execute once for every value of an integer range. Its form:

```
[címke] FOR loopvariable IN [REVERSE] under_boundary..upper_boundary
LOOP statement [statement]...
END LOOP [label];
```

The loop variable (loop index, loop counter) implicitly is a PLS_INTEGER type variable, its scope the loop core. This variable takes up in order every value from under_boundary to upper_boundary and the core will execute for every value. The upper_boundary and the under_boundary have to be an integer-value expression. The expressions evaluated once, before the loop starts to operate.
Giving the REVERSE keyword, the loop variable takes up the values of the range descending, without it ascending. Note that in case of REVERSE we should determine the under boundary of the range.

```
FOR i IN REVERSE 1..10 LOOP …
```

In the loop core the loop variable could not be assigned with a new value. We can just use its actual value in an expression. If the under_boundary is greater than the upper_boundary, the loop will be never executed (empty loop). A FOR loop cannot be an empty loop.

```
DECLARE
v_Sum PLS_INTEGER;
BEGIN
v_ Sum := 0;
FOR i IN 1..100 LOOP
v_ Sum := v_ Sum + i;
END LOOP;
```

```
DBMS_OUTPUT.PUT_LINE(' 1 + 2 + ... + 100 = ' || v_ Sum || '.');
END;
/
```

The EXIT statement

The EXIT statement could be in any loops core, but outside the core it cannot be used. Due to its effect the loop finishes its work. Its form:

```
EXIT [label] [WHEN condition];
```

On EXIT the loop breaks, the program will continue on the next statement.

Mixed Tasks

There is the following data table:
DOLGOZO(**id** integer not null primary key, **nev** varchar (50), **szdatum** date, **fizu** numeric(12,2), **sz_hely** varchar (30), **belep_ev** int, **neme** char(1));

id: identifier, nev: name of the employee, szdatum: birth date, fizu: salary of the employee, sz_hely: city where he born, belep_ev: admission to the company, neme: F- male, N-female.

Select the right SQL sentences, which provide the answer to the questions! At least one answer should be chosen for each question.

1. All data of Kovács:

A. SELECT * FROM dolgozo WHERE nev LIKE „Kovács%”;
B. SELECT * FROM dolgozo WHERE nev = „Kovács%”;
C. SELECT * FROM dolgozo WHERE nev = Kovács ;
D. SELECT * FROM dolgozo WHERE nev LIKE Kovács%;

2. Salaries between 100 000 and 120 000 Ft salaries:

A. SELECT nev, fizu FROM dolgozo WHERE fizu BETWEEN 100000 AND 120000;
B. SELECT nev, fizu FROM dolgozo WHERE fizu BETWEEN „100000 Ft” AND „120000 Ft”;
C. SELECT nev, fizu FROM dolgozo WHERE (fizu >= 100000) AND (fizu <= 120000);
D. SELECT nev, fizu FROM dolgozo WHERE (fizu >= 100000) OR (fizu <= 120000);

3. Employee names and salaries greater than 100000 Ft and born after 1970.01.01.

A. SELECT nev, fizu FROM dolgozo WHERE (sz_datum > ’1970.01.01’) OR (fizu > 100000);
B. SELECT nev, fizu FROM dolgozo WHERE sz_datum > ’1970.01.01’ AND fizu > 100000;
C. SELECT nev, fizu FROM dolgozo WHERE sz_datum IN ’1970.01.01’ AND fizu < 100000;
D. SELECT DISTINCT nev, fizu FROM dolgozo WHERE sz_datum > ’1970.01.01’ AND fizu < 100000;

4. The number of the employee ordered by city.

A. SELECT sz_hely AS Hely, COUNT(id) as Törzsszám FROM dolgozo ORDER BY sz_hely;
B. SELECT sz_hely AS Hely, COUNT(id) as Törzsszám FROM dolgozo Where sz_hely in dolgozo;
C. SELECT sz_hely AS Hely, COUNT(id) as Törzsszám FROM dolgozo GROUP BY sz_hely;
D. SELECT sz_hely AS Hely, SUM(id) as Törzsszám FROM dolgozo GROUP BY sz_hely;

5. Which are the cities, where the average salary is less than 120000Ft?

A. SELECT sz_hely AS Hely, AVG(fizu) as átlag FROM dolgozo GROUP BY sz_hely HAVING fizu < 120 000;
B. SELECT sz_hely AS Hely, AVG(fizu) as átlag FROM dolgozo Where fizu < 120 000 GROUP BY sz_hely ;
C. SELECT sz_hely AS Hely, AVG(fizu) as átlag FROM dolgozo GROUP BY sz_hely HAVING AVG(fizu) < 120 000;
D. SELECT nev AS Hely, AVG(fizu) as átlag FROM dolgozo GROUP BY sz_hely HAVING AVG(fizu) < 120 000;

6. List the woman joined to the company last year descending order!

.....
.....
.....
.....

7. Who earns more than the average from the men working here at least 5 years?

.....
.....
.....
.....

8. How many men and women born in Eger?

.....
.....
.....
.....

9. We can list the raised by 10% salary near the actual salary with the name of the employee, because the query can select data from more tables.

A. True-True-There is correlation B. True-True-No correlation

C. True-False-No correlation D. False-True-No correlation

E. False-False-No correlation

10. The having clause filters the grouped records, because it has greater priority then the where.

A. True-True-There is correlation B. True-True-No correlation

C. True-False-No correlation D. False-True-No correlation

E. False-False-No correlation

11. The property occurrence is a … of the data table

A. Record C. Field

B. Field value D. Field type

12. The modification anomaly is:

A. When modifying a record, modification of another record will be necessary.

B. When modifying a record, the modification will be unsuccessful.

C. When inserting a record, insertion of other will be necessary.

D. When inserting a record, the insertion will be unsuccessful.

13. Which are the types containing integer numbers?

A. SmallInt B. Integer

C. BigInt D. Char

14. Which are the types containing real numbers?

A. VarChar B. Real

C. Boolean D. Float

15. Raising the salary in the fizetes table by 10% for every employee is like this:

A. insert fizetes set fiz = 1.1*fiz;

B. Update fizetes set fiz = 1.1*fiz;

C. Update fizetes from fiz = 1.1*fiz;

D. Update fizetes set fiz = 10% * fiz;

16. Let's change the city of the employees named Kis to Eger:

A. Update dolgozo set varos = 'Eger' having nev like 'Kis';

B. Update dolgozo from varos = 'Eger' where nev like 'Kis';

C. Update dolgozo set varos = 'Eger' where nev like 'Kis';

17. By which clause can we order?

A. Where B. Broup by

C. Order by D. Having

18. The system fills the empty spaces in case of fix-length text by what?

A. Nothing B. Space

C. Underscores D. the character #9

19. How do we create the *tanulo* data table

A. create new table tanulo (id int primary key, nev char(30));

B. alter table tanulo add nev char (30);

C. create table tanulo (id int primary key, nev char(30));

D. alter table tanulo tanulo (id int primary key, nev char(30));

20. Write the definition of the 3rd normal form. Define the necessary concepts too.

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21. Write the following steps by SQL statements:

a. Create the STUDENT table, where there is a integer type field ID, as primary key, the name of the student, birth date.

b. Insert as a new record the new student named Kiss Ferenc with the ID 17, born in 19th of March, 1983.

c. Correct the ID 17 student to Kiss Mátyás.

d. Expand the table with the CITY field, where you will store the place of birth.

22. Answer the following questions by one query:

a) Create a list ordered by name, from the students living in Budapest, and one of the forenames is Zsolt.

b) Calculate the average canteen money for every place of birth, and list it ordered by place of birth descending.

c) List the names and birth dates and canteen money, who pay more than the average canteen money ascending.

d) Let's suppose there is the following table near the STUDENT table.

BEFIZ(nr int PK, sum int, student int, date date)

List all of the payed sums, ascending by name.

e) Create a list from the payments of students from Budapest, which made in the last month of 2009.

23. Base tables.

ember [id integer primary key, nev varchar(40) not null, varos varchar(40)]

auto [rsz char(7) primary key, tulaj integer, tipus varchar(20), szin varchar(20), ar numeric(7,0)]

Create the two data tables.

Tasks:

1. Query the price of the red colored cars.
2. Increase the car prices valued between 500000 and 1000000 Ft by 20%.
3. Query the owner names beginning with K, and their car types.
4. Query the owners names, and car prices from the city Eger and Miskolc, ordered by the owner names.
5. Query those names who has cheaper car than 1 million Ft.

6. Query those car owners name and address, who own a car.
7. Query those number plates, which owner is from Miskolc.
8. Query those cars, which price is greater than any other red cars.
9. Query what types of the cars occur in the car tables without repetition.
10. Query the average price of the cars from Miskolc.
11. Query how many cars in each city.
12. Query the number plate of the cars more expensive than the average and their owner names.
13. Query the number plates of the more expensive car from the cheapest car from Miskolc.

24. Create the DOLGOZOK table with the following structure:

KOD VARCHAR2(4) NOT NULL
NEV VARCHAR2(30) NOT NULL
FIZETES NUMBER
SZUL DAT DATE

25. Extend the DOLGOZOK table with the COM column, which type is VARCHAR2(30). Modify the length of the NEV to 40.

26. Create the table UJ_RESZL1 which structure is the same of the table RESZLEG.

27. Create the table which has the same structure and content with the RESZLEG.

28. Rename the table UJ_RESZL2 to RESZLEG2.

29. Create the table NEZET which contains only those employees name and address whose post is ‘ELADO’ from the tables ALKALMAZOTT and RESZLEG.

30. Create those viewtable named VIDEK which contains all the division data except from Budapest.

31. Create the ATLAG viewtable, which contains the code of the divisions and the employee average salary. Create a list by the created viewtable, where there is the emplolyee name, salary, division code, and the average salary of the division.

32. Using the ATLAG viewtable created in the previous task, list the name, salary, the address and nema of the division, and the average salary of the division.

33. Create the UJ_RENDELES viewtable based on the RENDELES and AUTOK, which columns are costumer number, car group, type of the rented car, order date, costumer name, rental date and duration, and method of payment. List the content of the table!

34. Modify the structure of the viewtable created in the last task in a way one column shows the ran kilometers during the rental time.

35. Create the UJ_UGYFEL viewtable, based on UGYFELEK, TIPUSOK, AUTO_CSOP and RENDELES tables which contains the following columns: costumer number, name, contact person name, rented car name, type, number plate, ran kilometers during rental, rental price for kilometers, and days.

36. Create the KOLCSON_SZAM viewtable, based on the RENDELES table, which contains the rentals for every number plate. List using the content of the viewtable the number plates, type, count of rentals from the AUTOK table. The number of the rentals should be 0 at the non-rented cars.

37. Create the table, which contains the number plate, the actual mileage, the mileage at the last service, and the service period. The table name should be KARBANTART!

38. Create the ELADO_AUTOK table based on the AUTOK table, which contains the following columns: numberplate, type, purchased date, mileage. (with new column names)

39. In the table KARBANTART increase the mileage column length to 8.

40. Broaden the table KARBANTART with the service period column. Its length is 8, type numeric.

41. Create an index to the table AUTOK for the number plate.

42. Create an index to the table RENDELES for the costumer number and car type name.

43. Enter the data of the code 80 division to the RESZLEG2 table. Division name: AUTOKOLCSONZO, address: SZEGED.

44. Enter the data of the rental offices to the table RESZLEG2 from the table.

45. Enter the code 99 division to the table VIDEK with the name FORD --- AUTO, address DEBRECEN then check if the row is in the table RESZLEG and to the viewtable.

46. Modify in the table RESZLEG2 the 'KOZPONT' division name to 'IRODAK'.

47. Increse the salary of the employees in the code 10 division by 15%.

48. Increase the premium of the 'ELADO' post employees by 10000 Ft.

49. Delete the Debrecen divisions from the RESZLEG2 table.

50. Enter the newly purchased car data to the table AUTOK

Number plate: CAR-342

Type: RENAULT ESPACE

Group: LUXUS

Purchase date: 1994. június 23.

Price: 1.400.000 Ft

Mileage: 100

Last service: at 0 km

Condtion: rentable (A)

Division20

51. Enter to the ELADO_AUTOK table those cars which mileage is greater than

52. Increase in the table AUTO_CSOP the rental price by 10%.

53. Modify the service period to 12000 km in the NORMAL car group.

54. Delete the cars from the AUTOK table which you have been entered to the ELADO_AUTOK (task 175)

55. Delete from the table AUTOK the car with the number plate ABC-022.

56. Write an INSERT statement which inserts all data from the car group EXTRA to the newly created, but empty EX AUTOK table.

57. Write an UPDATE statement, which modifies in the table EX_AUTOK all 'OPEL ASTRA' type car division code to '99'.

58. Delete the content of EX AUTOK table except the cars with the code '99'.

59. Move the data from the AUTOK table to the ELADO_AUTOK table those cars which ran more than 50% of their car group.

60. You have to enter a new costumer to the table UGYFELEK

(Create a sequence with the initial value 351)

Costumer number: the next value in the table.

Name: Karát KFT.

Address: 4025 Debrecen, Nyugati utca 7.