Database solutions

Chosen aspects
of the relational model

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Database design methodology

Database desing methodology is a structural approach in which procedures, techniques, tools, and documentation aids are used to support and facilitate the process of the development of a database project.

Conceptual database design

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Logical database design

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Physical database design
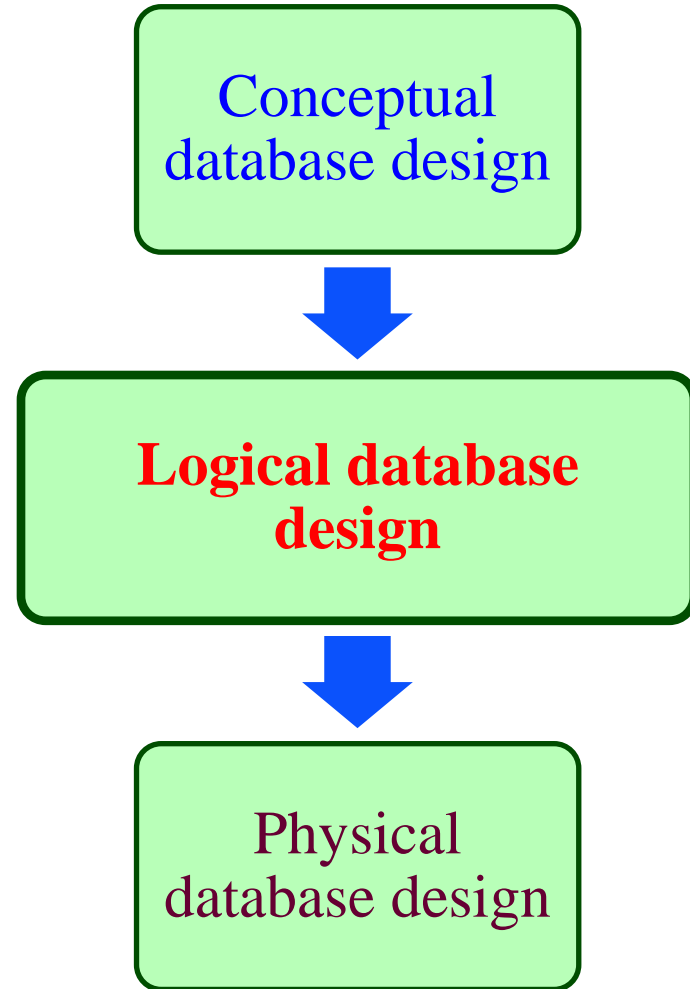
Database design

Conceptual database design is a global view of the database as seen by high-level managers and decision makers. It is independent of all physical considerations, including a database model.

Logical database design refers to a complete view of a logical data representation. This level describes <u>what </u>data are stored in the database:
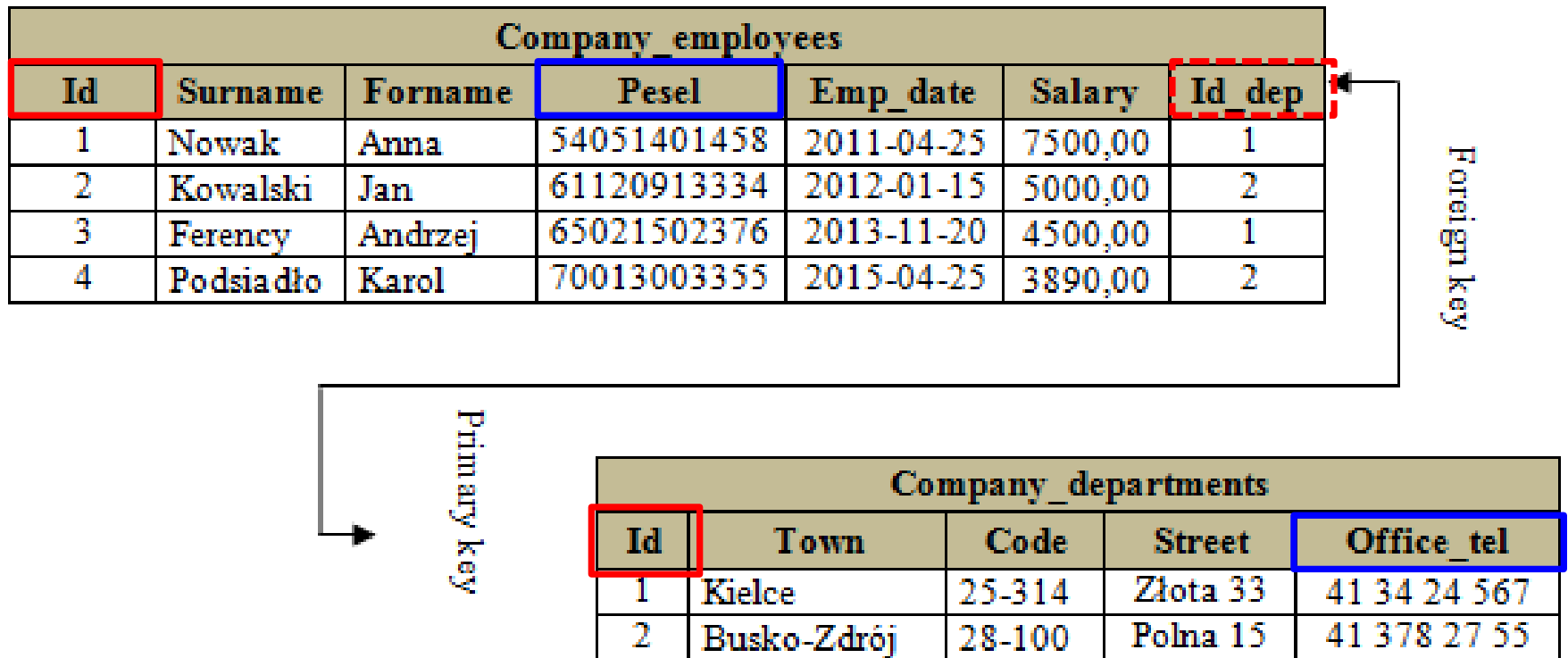- all entities, their attributes, and relationships,
- the constraints on the data,
- semantic information about the data,
- security and integrity information.

Physical database design refers to a complete definition of physical data representation. This level describes <u>how</u> data are stored in a database.

Concept of a key

- **Superkey**. An attribute or a set of attributes that uniquely identifies each entity occurrence.

- **Candidate key**. A superkey that contains only the minimum number of attributes necessary for the unique identification.

- **Simple key**. A key that consists of one attribute.

- **Composite key**. A key that consists of more than one attribute.

- **Primary key**. A candidate key that is selected to identify each entity occurrence / to identify records uniquely within the table.

- **Alternate key**. The candidate key that are not selected to be a primary key.

- **Foreign key**. An attribute or a set of attributes within one table that matches the primary key in a related table.

Concept of a key - illustration

Company_employees						
Id	**Surname**	**Forname**	**Pesel**	**Emp_date**	**Salary**	**Id_dep**
1	Nowak	Anna	54051401458	2011-04-25	7500,00	1
2	Kowalski	Jan	61120913334	2012-01-15	5000,00	2
3	Ferency	Andrzej	65021502376	2013-11-20	4500,00	1
4	Podsiadło	Karol	70013003355	2015-04-25	3890,00	2

Foreign key

Primary key

Company_departments				
Id	**Town**	**Code**	**Street**	**Office_tel**
1	Kielce	25-314	Złota 33	41 34 24 567
2	Busko-Zdrój	28-100	Polna 15	41 378 27 55

Database relational integrity

Database integrity refers to the correctness and consistency of stored data.

The relational integrity rules:

- entity integrity,
- referential integrity,
- domain constraints,
- business rules.

Null *represents an absence of a value. It can appear in any cell of any column in a table. Null value is used when there is no value for a field in a record or the value is unknown or missing.*

Integrity rules

Entity integrity is the rule according to which no attribute that is a part of a primary key may accept null value. The rule guarantees that one record can be distinguish from another, which means that all values of the primary key within a table are unique.

Referential integrity is the rule according to which if a foreign key exists in a table, either the foreign key value must match the value of the primary key for some row of the home table or must be null.

Domain constraints is the form of restrictions on the set of values allowed for the columns of tables (semantic integrity).

Business rules cover all remaining (additional) constraints that the database must satisfy.

Anomalies in a table design

Anomalies in a table design are abnormalities (irregulaties, inadequacies, deficiencies) that cause problems in the database management. The problems are connected mainly with data redundancy.

Data redundancy is a multiple appearance of the same data in a table or the appearance of duplicated data stored in more than one table. Tables that have redundant data suffer from **update anomalies**, which are classified into the categories:

- insertion anomalies,
- deletion anomalies,
- modification anomalies.

Categories of anomalies

Insertion anomaly is a design irregularity when a new record is inserted into a table and at least one of the following actions are undertaken:

- some values already existing in the table are to be duplicated, thus causing potential data inconsistency,

- nulls are to be entered for some attributes in certain rows, which can violate the entity integrity if one of the attribute defines the primary key.

Deletion anomaly is a design irregularity that occurs when the deletion of a record from a table causes that some important details are lost unintentionally (unwillingly).

Modification anomaly is a design irregularity that occurs when the change of an attribute value for a record requires changing relative values in other records – if the change is not done, the database will become inconsistent.

Illustration of anomalies

Education_projects						
Id	Name	Coordinator	Office_tel	Id_part	Participant	Contact
P1	Baroque	MSc. Anna Jamrożuy	697 675 876	U1	Grammar School No 11, Kielce, Jasna St. 5	123 987 567
P1	Baroque	MSc. Anna Jamrożuy	697 675 876	U2	National Museum of Kielce, Rynek St.1	654 678 444
P2	Old Kielce	MSc. Jan Kołek	611 209 133	U3	PPTA, Kielce Department, Młoda St. 5	967 111 345
P3	Facing the Nature	Dr. Andrzej Wojton	650 215 023	U1	Grammar School No 11, Kielce, Jasna St. 5	123 987 567
P3	Facing the Nature	Dr. Andrzej Wojton	650 215 023	U3	PPTA, Kielce Department, Młoda St. 5	967 111 345
P3	Facing the Nature	Dr. Andrzej Wojton	650 215 023	U4	Forest High School, Zagnańsk, Wonna St. 6	666 888 333

Insertion anomaly: participant of a new project (duplication), new prepared project (null value in an attribute key),

Deletion anomaly: deletion the U3 participant $\Rightarrow$ deletion the P2 project

Modification anomaly: changing the phone number of the P3 project office (possible inconsistency).