Courses B0B36DBS, A7B36DBS: **Database Systems**

Practical Classes 01 and 02:

**Conceptual Modeling in ER and UML**

*Martin Svoboda*

21. and 28. 2. 2017

Faculty of Electrical Engineering, Czech Technical University in Prague
Conceptual Modeling

• Conceptual, logical, and physical layers
• ER
  ▪ Entity type (strong, weak)
  ▪ Relationship type (binary, n-ary, recursive, cardinalities)
  ▪ Attribute (ordinary, composite, multivalued)
  ▪ Identifier (full, partial)
  ▪ ISA hierarchy (covering, overlap constraints)
• UML
  ▪ Class, association, attribute, generalization
Exercise 1

• Create an ER conceptual schema for a simple student information system...
  ▪ Each person has a name, personal id number, address, and e-mail address
  ▪ Values of personal ids are unique among persons
Exercise 2

• Extend the previous schema...
  ▪ Each person may have several login names
  ▪ Together with each login name we also store hashed value of a corresponding password
Exercise 3

• Modify the previous schema...
  - We would like to split the unstructured address attribute of a person to separate values of a street, city, and post code
  - Each person may have at least one e-mail address from now on
Exercise 4

• Extend the previous schema...
  ▪ Two types of persons are now distinguished:
    – Student has at least one phone number
    – Teacher may have a website and is also identifiable using an employee number
Exercise 5

• Extend the previous schema...
  ▪ Course is identified by its code, it has a unique name, and also a number of credits
  ▪ Each course is guaranteed by exactly one teacher
Exercise 6

- Extend the previous schema...
  - Two courses may have a mutual dependency
    - Two types of such dependencies are distinguished: co-requisites and pre-requisites
Exercise 7

• Extend the previous schema...
  ▪ Students work on theses which are lead by teachers
  ▪ Each thesis has its type (bachelor, master, doctoral), unique name, and year of assignment
  ▪ Use an entity type for theses
  ▪ Determine all the relationship cardinalities correctly
Exercise 8

• Modify the previous schema...
  ▪ Can the relationship types of thesis assignment / leadership be modeled using two binary relationship types (instead of one ternary)?
Exercise 9

- Extend the previous schema...
  - Model a timetable using a relationship type
  - I.e. describe timetable events of teaching courses by teachers, always in a given day of a week, at a given time, and on a given place
  - Limit yourself to one active semester only
Exercise 10

• Extend the previous schema...
  ▪ Each thesis may also be associated with several teachers acting as consultants
Exercise 11

• Extend the previous schema...
  ▪ Departments consist of research groups
  ▪ Each department has its name and code, both allowing to be used as independent identifiers
  ▪ Research group can only be identified locally using an abbreviated name within a particular department to which it belongs to
Exercise 12

- Extend and modify the previous schema...
  - Timetable events must support different semesters
  - Students can enroll in courses (even repeatedly)
  - For each such enrollment we need to record the final achieved grade (if any)
Exercise 13

- Modify the previous schema...
  - Model timetable events using an entity type
Exercise 14

- Create a UML schema diagram for the entire student information system as described
  - I.e. model all the following classes and associations:
    - Person, student, teacher, login, course, thesis, timetable, event, time slot, room, semester, department, group