Database design

- The learning objectives for this week are:
  - Knowing what database development lifecycle is and from which phases it consists of
  - Knowing what conceptual database design is?
  - Knowing what is entity-relationship modeling
  - Knowing how to implement entity-relationship diagrams

Database development lifecycle

- So far we have explored and written SQL queries for existing databases, such as the Takkula database
- We have been able to successfully retrieve all kinds of relevant information from the database
- What we might not have thought is that *why* the Takkula database structured as it is
  - Why does it have these specific tables and columns?
  - Why does it have these relationships between tables?
- The end result is an output of the *database development lifecycle*

Database development lifecycle

- The *database development lifecycle* is a step-by-step process of implementing a database for certain set of requirements
- It consists of the following phases:
    i. Database planning
    ii. System definition
    iii. Requirements collection and analysis
    iv. Database design
    v. Database implementation
    vi. Data conversion and loading
    vii. Testing
    viii. Operational maintenance

Database design

- Once the users' requirements are identified after the *requirements collection and analysis phase*, the *database design* phase can start
- *Database design* is a the process of creating a design that will meet the *data requirements* of the enterprise and support the enterprise's operations
- For example, this is could be one data requirement in the Takkula database:
  - "University has courses. Each course has multiple course instances which are taught during a certain time period. Each course instance has a teacher"

Database design

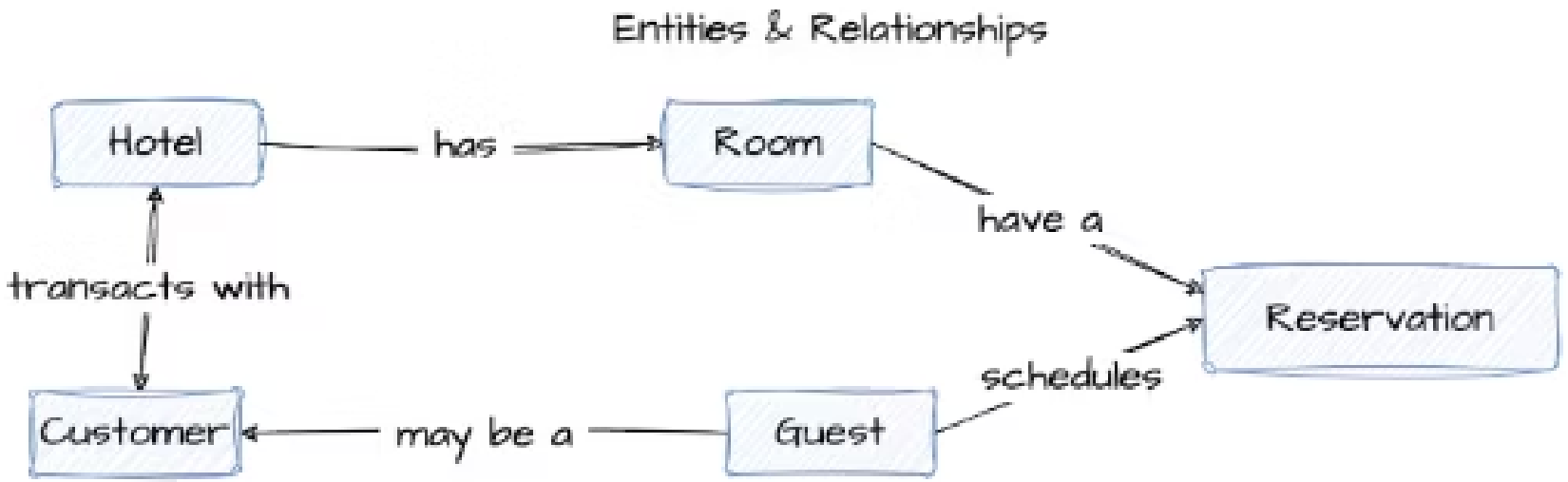
- A common approach in database design, is the *top-down* approach
- We start from the "top", with the development of high-level conceptual data model with few high-level entity types (for example "Course", "Course instance" and "Teacher")
- Then we move down to the "bottom" by adding details step-by-step until we have developed the physical data model with all the tables, columns and other details about the database schema
- The typical main phases in a systematic top-down database design process are:
    i. Conceptual database design
    ii. Logical database design
    iii. Physical database design

Conceptual database design

- During the *conceptual database design* phase, a high-level conceptual model of the data requirements of the enterprise is constructed
- The model represents the entities and their relationships
- The model is *independent of all physical considerations*, for example how the data is actually organized into database tables
- The end result is a *conceptual database schema*

Example of conceptual database schema

Here's an example of the conceptual database schema for a hotel booking database:



Conceptual database design

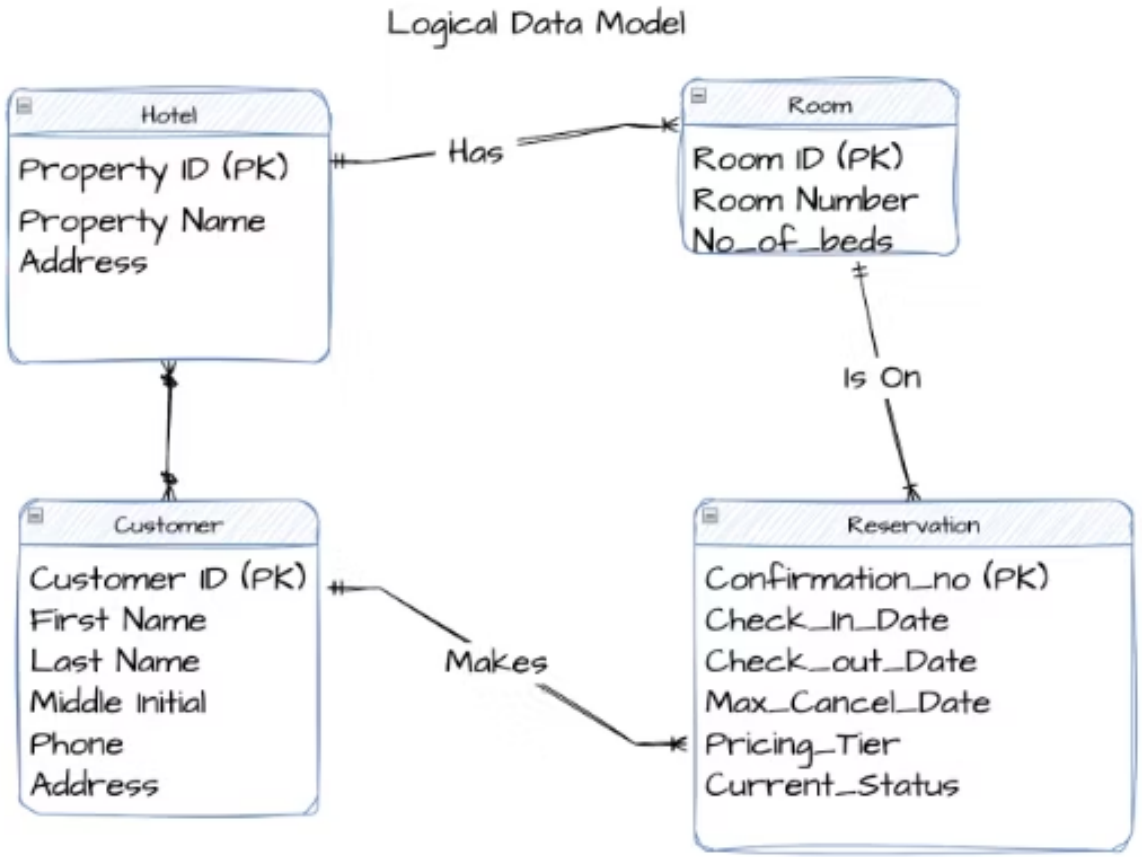
- The objective of conceptual database design is:
  - To assist in understanding the meaning (semantics) of the data
  - To facilitate communication about the data requirements
  - To understand the requirements (*what* should be done), well enough before moving to any technical considerations (*how* to do it)

Logical database design

- During the *logical database design* phase, the conceptual schema is translated into a logical database structure based on a specific data model (for example the Relational Model)
- The model represents details about the entities, such as relations, attributes, primary and foreign key contraints and other type of constraints
- The model is *independent of a particular DBMS product* and other physical considerations
- The end result is a *logical database schema*

Example of logical database schema

Here's an example of the logical database schema for a hotel booking database:

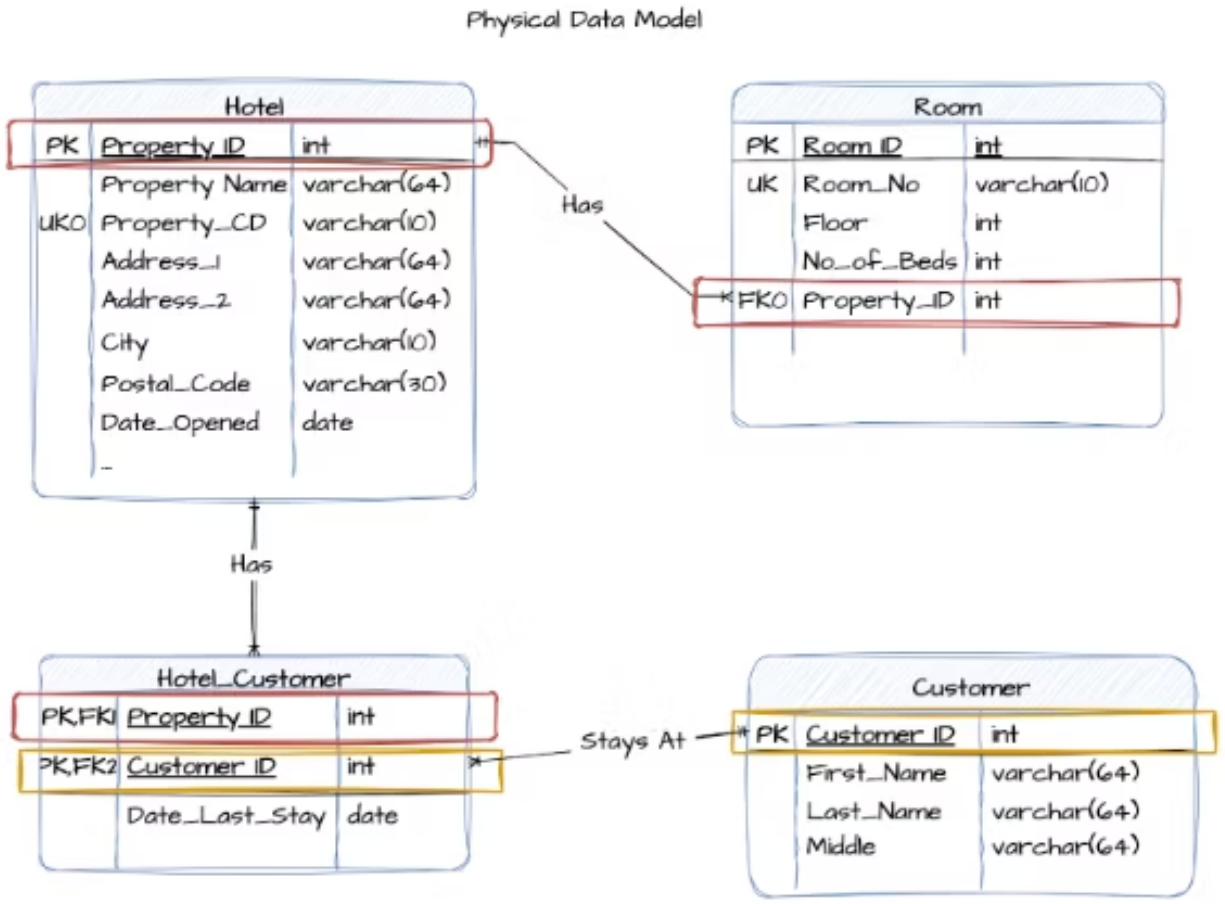


Physical database design

- During the *physical database design* phase, a description of the physical implementation of the database is produced
- The model describes the implemention using a particular DBMS product
- The model includes tables, columns, column types and all other DBMS specific details
- The end result is a *physical database schema*

Example of physical database schema

Here's an example of the physical database schema for a hotel booking database:



User views

- Different database users have a different requirements for the database
- A *user view* defines what is required of a database system from the perspective of a particular job role (such as manager or supervisor) or enterprise application area (such as marketing or human resources)
- Each user view defines from its own perspective *what data is held in the database* and *what the user will do with the data* (user transactions)
- We need to able to manage *multiple user views* during the design process
- There is three main approaches to solve this problem: the *centralised*, the *user view integration* and the *combined approach*

Managing multiple user views

- With the *centralised approach*, we first merge requirements for all user views into a *single set of requirements* and then create a *single data model* that represents all user views
- With the *user view integration approach*, we first create *a separate data model* for each user view and then merge these data models into a *single data model*
- With the *combined approach*, we first, merge *some user views* and then continue with *user view integration approach*
- Out of these three approaches, the user view integration approach is preferred when the system is more complex and there are significant differences between user views