Introduction to Database Systems
Lecture 3

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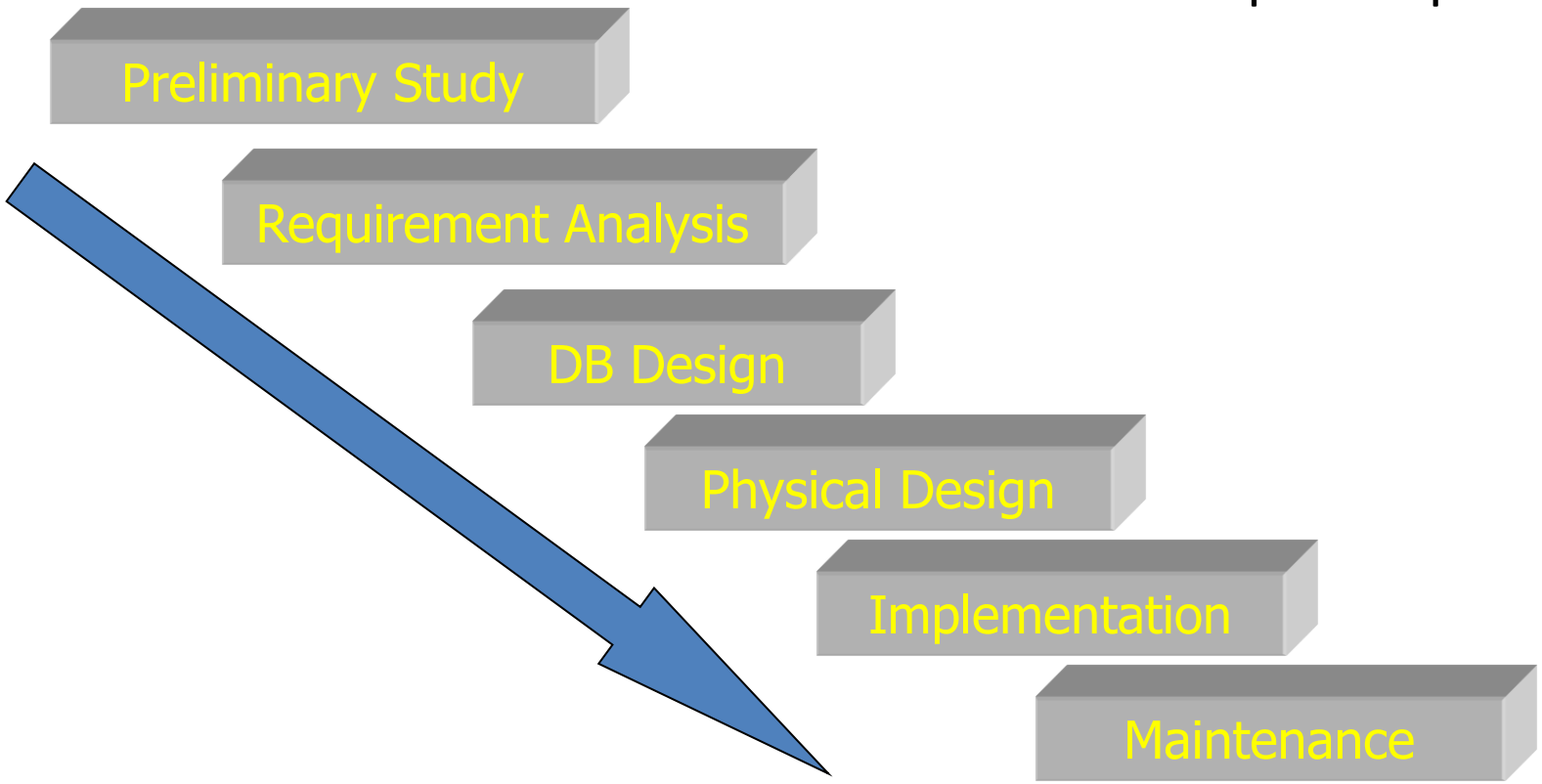
Database Development Process

- Similar to software development process.



Database Development Process

- The first step shown is requirements analysis. During this step, the database designers interview prospective database users to understand and document their data requirements.
- The next step is conceptual Database Design.
- These are expressed using the concepts provided by the high-level data model.
- Because these concepts do not include implementation details, they are usually easier to understand and can be used to communicate with nontechnical users.

Database Development Process

- In the physical design phase, internal storage structures, file organizations, indexes, access paths, and physical design parameters for the database files are specified.
- In parallel with these activities, application programs are designed and implemented as database transactions corresponding to the high level transaction specifications.

Database Design

- A DB Design is a model of a particular real-world system.
- It provides a picture of reality.
- Should be simple and self- explanatory.
- Conceptual modeling is a very important phase in designing a successful database application.

E-R Data Model

- A semantic data model, used for the graphical representation of the conceptual database design.
- Major components of E-R model are:
  - Entities
  - Attributes
  - Relationships

E-R Data Model

- Entity:
  - The basic object that the ER model represents is an entity, which is a *thing* in the real world with an independent existence.
  - An entity may be an object with a physical existence (for example, a particular person, car, house, or employee) or
  - It may be an object with a conceptual existence (for instance, a company, a job, or a university course).

E-R Data Model

- Attributes:
  - Each entity has attributes—the particular properties that describe it.
  - For example, an EMPLOYEE entity may be described by the employee's name, age, address, salary, and job.
  - A particular entity will have a value for each of its attributes. The attribute values that describe each entity become a major part of the data stored in the database.

E-R Data Model

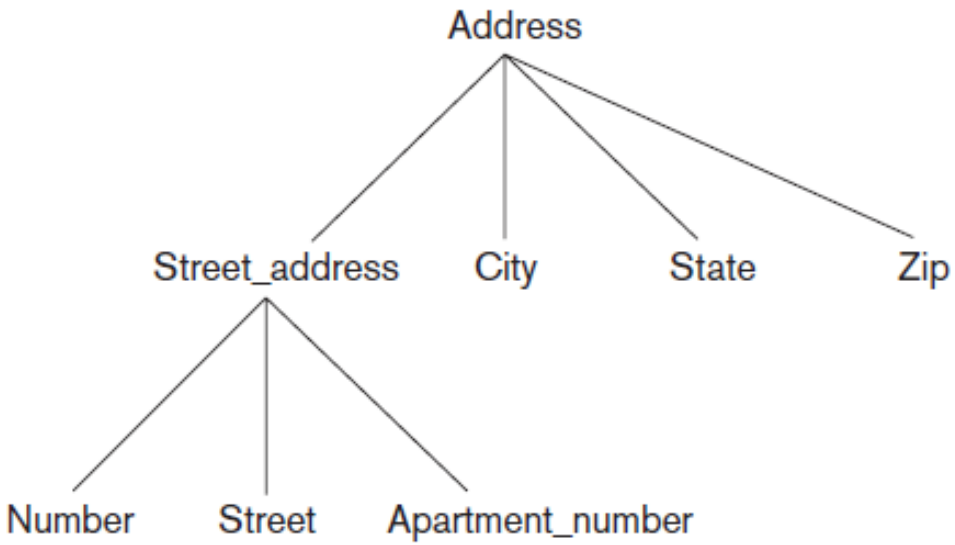
- Several types of attributes occur in the ER model:
  - *simple* versus *composite*,
  - *singlevalued* versus *multivalued*
  - *stored* versus *derived*.

E-R Data Model

- Simple(Atomic) versus Composite Attributes:
  - Composite attributes can be divided into smaller subparts, which represent more basic attributes with independent meanings.
  - For example, the Address attribute of the EMPLOYEE entity can be subdivided into Street_address, City, State, and Zip, with the values ‘2311 Kirby’, ‘Houston’, ‘Texas’, and ‘77001.’
  - Attributes that are not divisible are called simple or atomic attributes.

E-R Data Model

- The value of a composite attribute is the concatenation of the values of its component simple attributes.
- Composite attributes can form a hierarchy.



E-R Data Model

- Single-Valued versus Multivalued Attributes:
  - Most attributes have a single value for a particular entity; such attributes are called single-valued.
  - For example, Age is a single-valued attribute of a person.
  - In some cases an attribute can have a set of values for the same entity—for instance, a Colors attribute for a car(two-tone cars), or a College_degrees attribute for a person.
  - One person may not have a college degree, another person may have one, and a third person may have two or more degrees.

E-R Data Model

- Stored versus Derived Attributes:
  - In some cases, two (or more) attribute values are related—for example, the Age and Birth_date attributes of a person.
  - For a particular person entity, the value of Age can be determined from the current(today's) date and the value of that person's Birth_date.
  - The Age attribute is hence called a derived attribute and is said to be derivable from the Birth_date attribute, which is called a stored attribute.

E-R Data Model

- NULL Values:
  - In some cases, a particular entity may not have an applicable value for an attribute.
  - For example, the Apartment_number attribute of an address applies only to addresses that are in apartment buildings and not to other types of residences, such as single-family homes.
  - Similarly, a College_degrees attribute applies only to people with college degrees.

Symbols for Attributes

Simple

Composite

Multi-valued

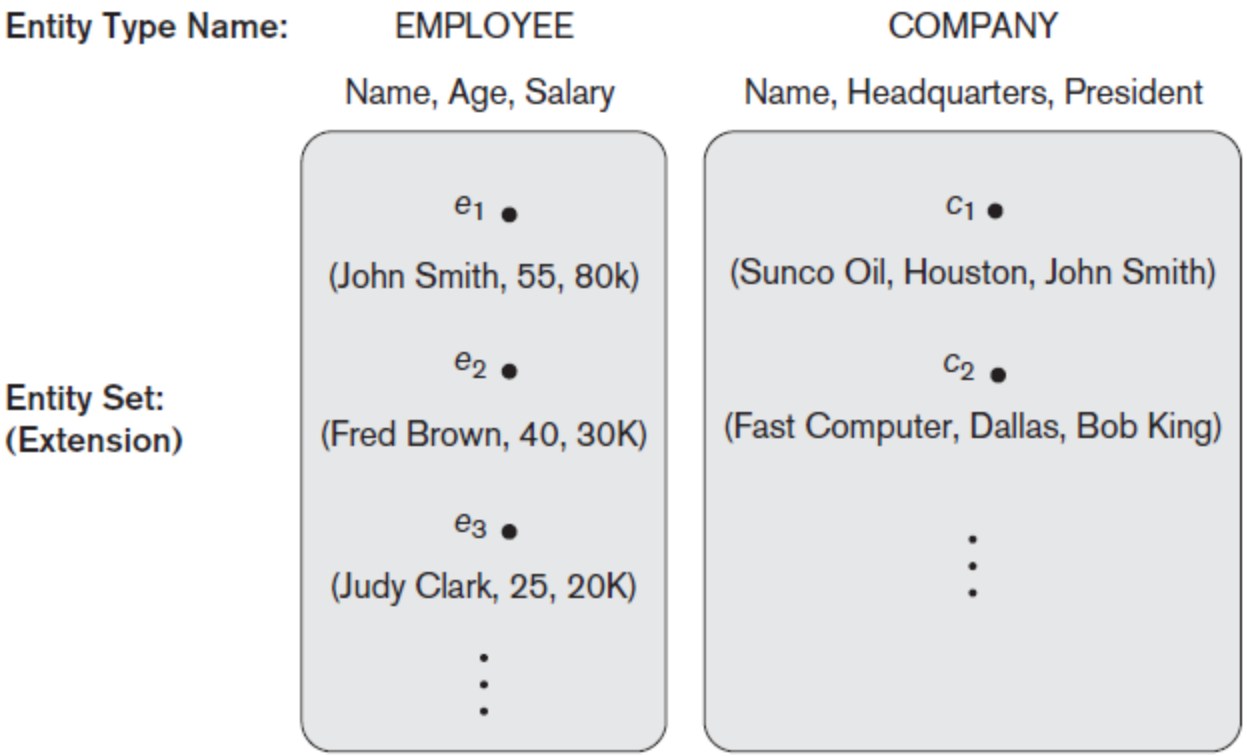
Derived

E-R Data Model

- Entity Types and Entity Sets:
  - A database usually contains groups of entities that are similar.
  - For example, a company employing hundreds of employees may want to store similar information concerning each of the employees.
  - These employee entities share the same attributes, but each entity has its *own value*(*s*) for each attribute.
  - An entity type defines a *collection* (or *set*) of entities that have the same attributes.
  - Each entity type in the database is described by its name and attributes.

E-R Data Model

- Figure shows two entity types:
- EMPLOYEE and COMPANY.



E-R Data Model

- Types of Entity Types:
- Entity types can be classified into
  - Regular/strong/independent ETs or
  - Weak/dependent ETs

E-R Data Model

- Weak Entity Type:
  - An entity type whose instances cannot exist without being linked with instances of some other entity type, i.e., they cannot exist independently.
- Strong Entity Type:
  - A strong/regular entity type is the one whose instances can exist independently, i.e., without being linked to other instances
  - Strong ETs have their own identity.

E-R Data Model

Regular Entity Type

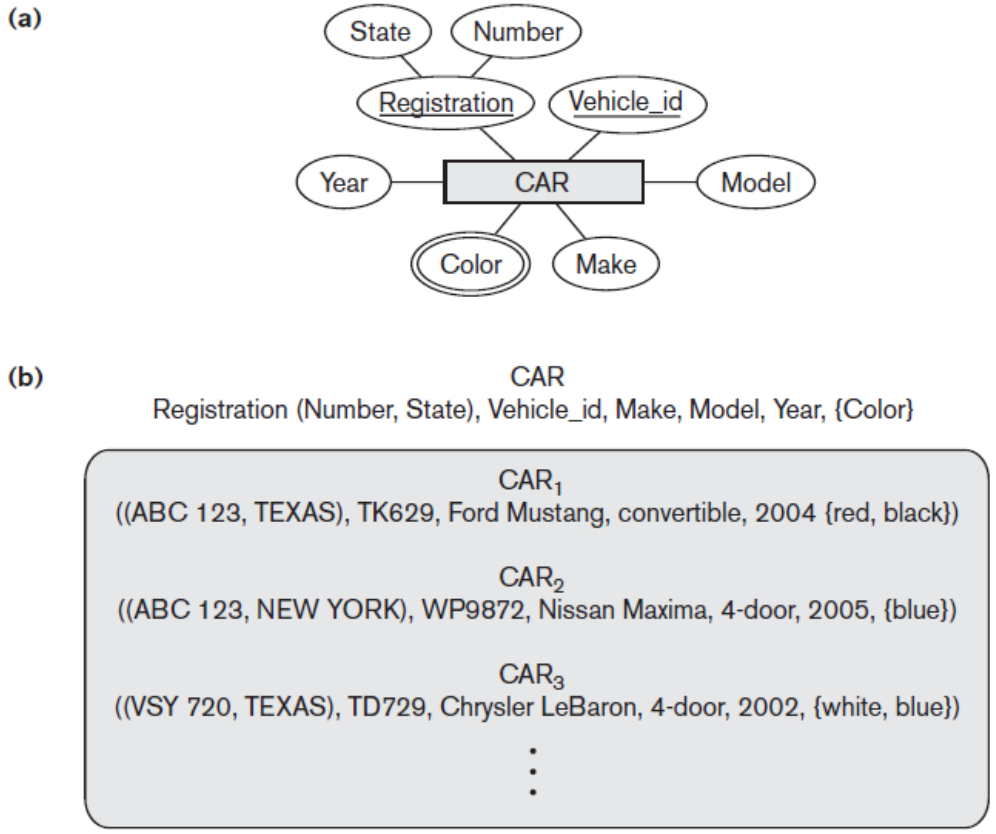
Weak Entity Type

E-R Data Model

- The collection of all entities of a particular entity type in the database at any point in time is called an entity set.
- The entity set is usually referred to using the same name as the entity type.
- For example, EMPLOYEE refers to both a *type of entity* as well as the current set *of all employee entities* in the database.

E-R Data Model

- An entity type is represented in ER diagrams as a rectangular box enclosing the entity type name.
- Figure shows a CAR entity type in this notation.



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