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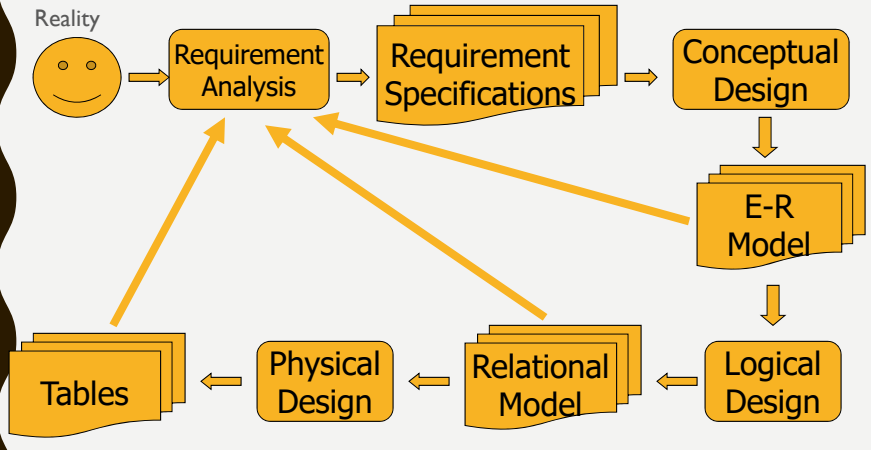
- The greatest obstacle to discovery is not ignorance - it is the illusion of knowledge.

Steve Jobs, 1998

That's been one of my mantras — focus and simplicity. Simple can be harder than complex: You have to work hard to get your thinking clean to make it simple.

But it's worth it in the end because once you get there, you can move mountains.

DATABASE DESIGN PROCESS



THE ENTITY RELATIONSHIP MODEL (ENTITY)

- Entity: a "thing" in the real world with an independent existence.
- Hints for entities:

  -Have a unique identity.

  -Have its own properties.
- Examples: STUDENT, COMPANY, COURSE, ITEM, DESK, etc.

THE E-R MODEL (ATTRIBUTES)

Attributes: the properties that describe an entity.

- Composite versus Simple Attributes:

  Composite attributes can be divided into smaller subparts

  e.g. name => (FirstName, Minitial, LastName)

  Attributes that are not divisible are called simple attributes.

  e.g. SSN, Level, Book title, City, Zip code, etc.

- Single-valued versus Multi-valued Attributes:

  Most attributes are single-valued.

  e.g. Grade, Course number, Price, etc.

  College degrees is an example of multi-valued attributes.

  e.g. {B.S. Math, M.S. Biology, Ph.D. Computer Science}

THE E-R MODEL (ATTRIBUTES)

- Stored versus Derived Attributes:

  e.g. DateOfBirth => Age

  ClassList => NumberOfStudents

- Null values: when the value of an attribute is irrelevant or unknown, we use a null value.

  e.g. The grade of a student in a course is not known in the beginning of the semester.

  Apartment number may be irrelevant for some addresses.

- Complex Attributes: A complex attribute is any combination of composite and multi-valued attributes.

  e.g. {AddressPhone({Phone(AreaCode, PhoneNumber)}, Address(StreetAddress(Number, Street, ApartmentNumber), city, State, Zip))}

THE E-R MODEL (ENTITY TYPE AND KEY)

- Entity Types: An Entity type defines a set of entities that have the same attributes. It is analog to class definitions that specify a template of objects in Object-Oriented programming.

  e.g. STUDENT(CWID, FirstName, Minitial, LastName, Sex, DateOfBirth, Level, Major, Telephone, Address)
- Key Attributes: A key attribute is an attribute whose values are distinct for each individual entity.

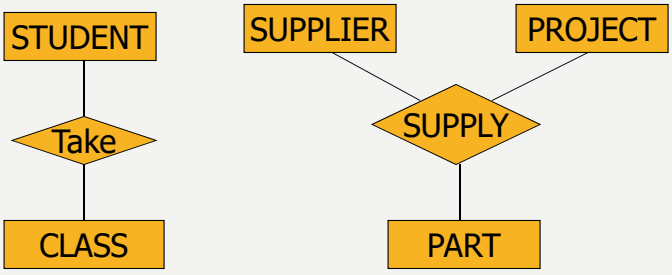
  e.g. CWID, Course number, VIN (vehicle identification number)
- Domains of Attributes: The domain of an attribute is the set of valid values that may be assigned to the attribute for each individual entity.

  e.g. The domain of grade could be {A, B, C, D, F, W}

THE E-R MODEL (RELATIONSHIP)

- Relationship type: A relationship type defines a set of associations among entities.
- The degree of a relationship type is the number of participating entities types.

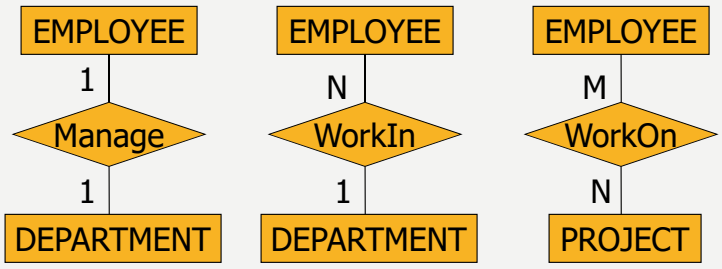
  e.g. degree 2 relationship degree 3 relationship



THE E-R MODEL (RELATIONSHIP)

- Cardinality Ratios for Binary Relationship: 1:1, 1:N, N:1, M:N.

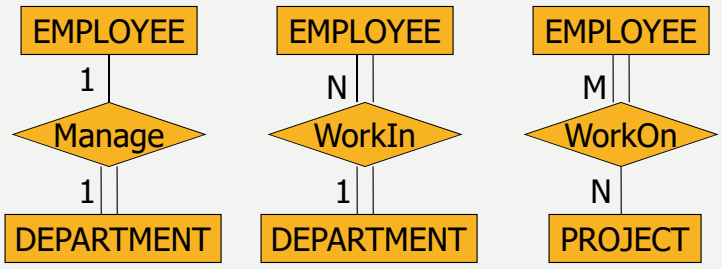
  e.g.



THE E-R MODEL (RELATIONSHIP)

- Participation Constraints: partial vs. total participation

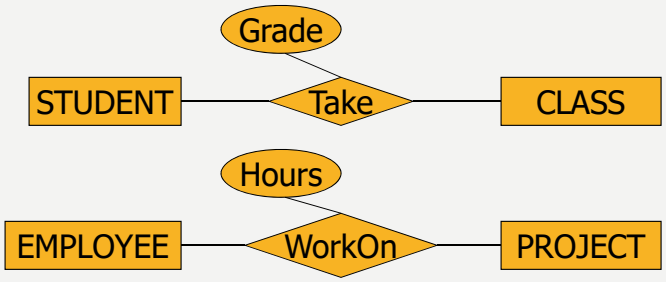
  e.g.



THE E-R MODEL (RELATIONSHIP)

- Attributes of a relationship type: Some attributes can not be moved to any single entity type. They are attributes of a relationship type.

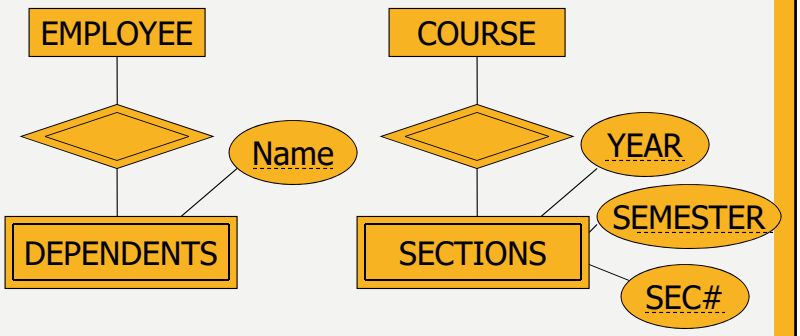
e.g.



THE E-R MODEL (WEAK ENTITY TYPE)

- A weak entity type only exists when it is related to an owner entity type. A partial key uniquely identifies a weak entity that is related to the same owner entity.

e.g.



SYMBOLS IN AN E-R DIAGRAM

Entity

RELATIONSHIP

Weak Entity

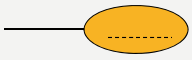
IDENTIFYING RELATIONSHIP

SYMBOLS IN AN E-R DIAGRAM

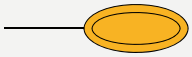
ATTRBUTE

KEY ATTRBUTE

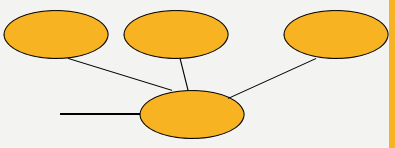
PARTIAL KEY ATTRBUTE



MULTIVALUED ATTRBUTE



COMPOSITE ATTRBUTE



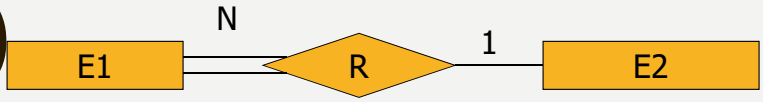
DERIVED ATTRBUTE

SYMBOLS IN AN E-R DIAGRAM

E1:TOTAL PARTICIPATION

E2: PARTIAL PARTITICIPATION

CARDINALITY RATIO N:1 FOR E1:E2 IN R



E-R MODELING - A ZOOM-IN/ZOOM-OUT APPROACH

- Identify Entities, that is those "things" that can exist alone without being related to something else; Decide the Key attributes, pay attention to those words like "unique", "uniquely", "identifier", "distinct", etc.; Identify weak entities, whose existence depends on the owner entity, decide partial keys.
- Identify attributes for each entity.
- Identify relationships, pay attention to those sentences that related two or more entities together usually by a verb.
- Identify attributes for each relationship. Try to move the attributes to an entity and understand what is the semantic meaning (implication). Does it make sense? If yes, move!
- Specify the structural constraints of the binary relationship, i.e. total vs. partial participation, 1:1, 1:N, M:N, etc.

E-R MODELING-A COMPANY DATABASE

- The company is organized into departments. Each department has a unique name, a unique number, and a particular employee who manages the department. We keep track of the start date when that employee began managing the department. A department may have several locations.
- A department controls a number of projects, each of which has a unique name, a unique number, and a single location.
- We store each employee's name, social security number, address, salary, sex, and birth date. An employee is assigned to one department but may work on several projects, which are not necessarily controlled by the same department. We keep track of the number of hours per week that an employee works on each project. We also keep track of the direct supervisor of each employee.
- We want to keep track of the dependents of each employee for insurance purposes. We keep each dependent's first name, sex, birth date, and relationship to the employee.