CIS 8040

Introduction to Conceptual Modeling Using the Entity-Relationship Model (Chen’s Model)

Important Concepts

The Nature of Data [Revisited]

- Data asset – know what this refers to
- Different types of useful data; lots of "non-useful" data

Conceptual modeling

- What is it?
- Where it fits in the entire database design and development process. [After requirements collection/analysis]

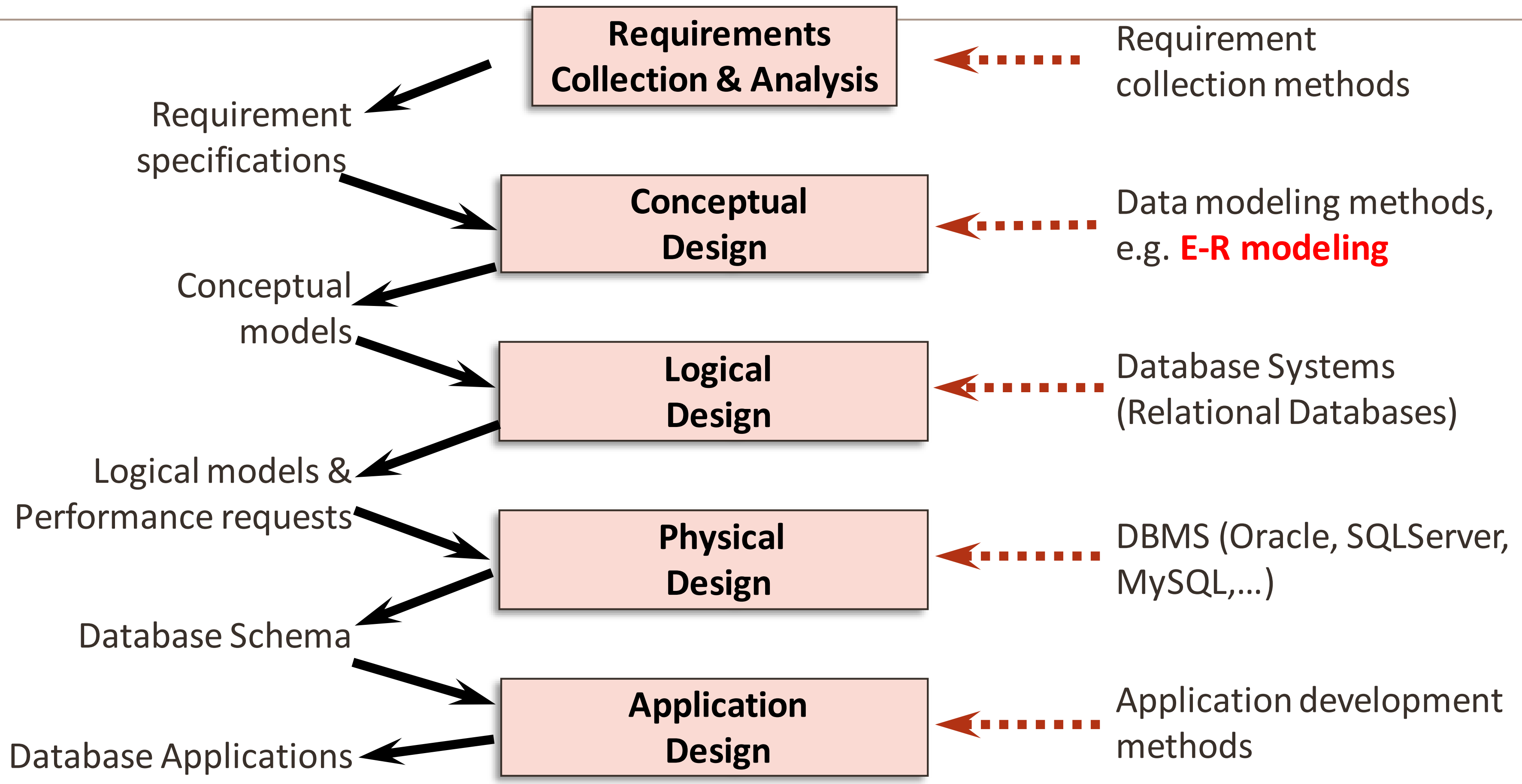
Relational databases [This is what we will implement in this course]

- Understand what they are (generally, set of tables, called relations)
- Where they fit in the entire database design and development process. [After conceptual modeling]

Terminology (Keep these handy. The list only grows …..)

- Data modeling, data models, entity, relationship, attribute, abstraction, instance, instantiation, occurrence, entity type, relationship type, association, mapping ratios, identifiers, key (primary, composite, candidate), mapping ratios, min/max cardinalities, application domain

Database design methodology



Requirements Collection & Analysis

Requirement collection methods

Requirement specifications

Conceptual Design

Data modeling methods, e.g. **E-R modeling**

Conceptual models

Logical Design

Database Systems (Relational Databases)

Logical models & Performance requests

Physical Design

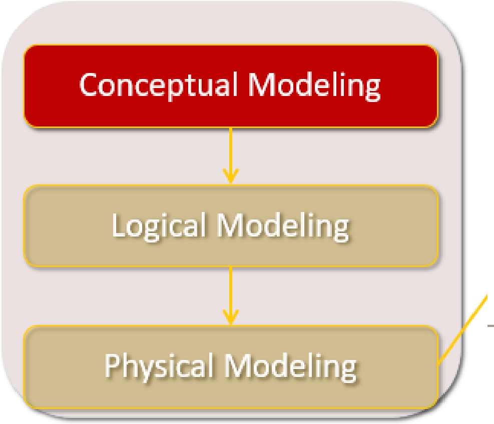
DBMS (Oracle, SQLServer, MySQL,…)

Database Schema

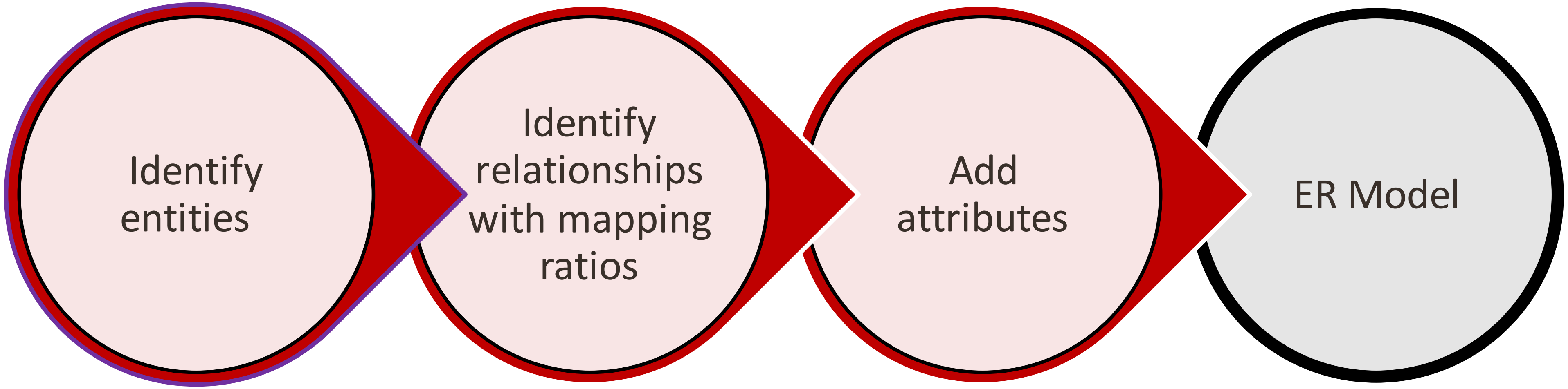
Application Design

Application development methods

Database Applications

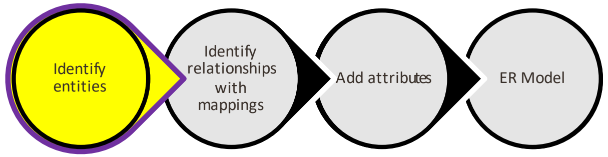


Conceptual Modeling: Creation of ER (Entity-Relationship) Model



Important terminology:

- Mapping ratios [For today]
- Min/max cardinalities [Coming – finer level of granularity]

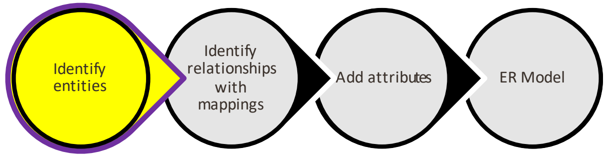


Entity: a “thing” of interest about which you want to record data in a database.

- Person – employee, student, patient, professor
- Place – store, university, warehouse
- Object – machine, vehicle
- Event – sale, registration
- Concept – course, account

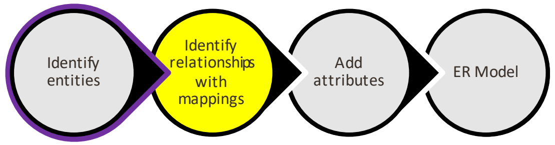
What do these have in common?
What are the implications for database design?
Note: Can be concrete or conceptual.

Source: Hoffer et al.



Entities

- Suppose you want to design a database for managing football recruiting and games at Georgia State University.
- Identify 2-3 reasonable entities to include in your database.


Identify entities

Identify relationships with mappings

Add attributes

ER Model

Relationship: association between [among] entities

Examples (of binary relationship):

STUDENT *takes* CLASS

PROFESSOR *teaches* CLASS

DEPARTMENT *employs* PROFESSOR

DIVISION *managed by* EMPLOYEE

AIRCRAFT *flown by* CREW

Questions: What do these have in common?

Why would you want to represent these in a database?

How would you represent these in a database? [Later …]

Relationship: operates in both directions

Concept of mappings (reflects real world situation).

Mapping ratios (M:N (or N:M), 1:N (or 1:M), 1:1)

Capture / represent some business rules.

STUDENT *takes* CLASS
M N
PROFESSOR *teaches* CLASS
1 N
DEPARTMENT *employs* PROFESSOR
1 N
DIVISION *managed by* EMPLOYEE
N 1
AIRCRAFT *flown by* CREW
N 1

Note: 1:N versus N:1
N:M versus M:N
1:1
Important to be correct
(influences organization of a database)

Relationships: Mappings

Customer buys Car

Chef prepares Menu-Items

Team has Player

Relationships: Mappings

QUESTION: WHAT ARE YOU MODELING?

Customer buys Car

N M

Chef prepares Menu-Items

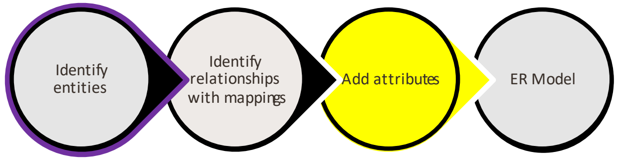
1 N

Chef prepares Menu-Items

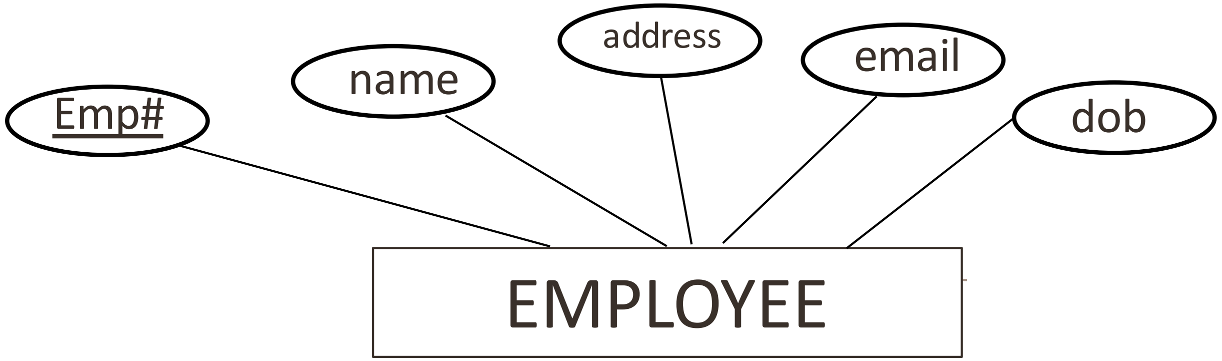
N M

Team has Player

1 N



Entity and its attributes



Employee: (Emp#, name, address, email, dob)

Attributes are characteristics of entities that are important to include in a database.

Attributes

Domain

- Important concept for attributes
- Implications for physical design (implementation) where you must specify data type (later)

Domain -- possible values for a given attribute

Domain for grade point average (GPA) [0,4.3]

Domain for answer – T or F (or some other equivalent code).

Attributes may share a domain.

E.g.: student address and professor address share the same
domain of all possible addresses.

NOTE: Also the concept of "application domain."

Entity Student

What are reasonable attributes?

Can you justify them?

Entity and its Attributes

Student: (StudentID, name, address, major, full-time, …)

Context: StudentID at GSU is a Panther#

What other data?

How much do we collect and store? Why?

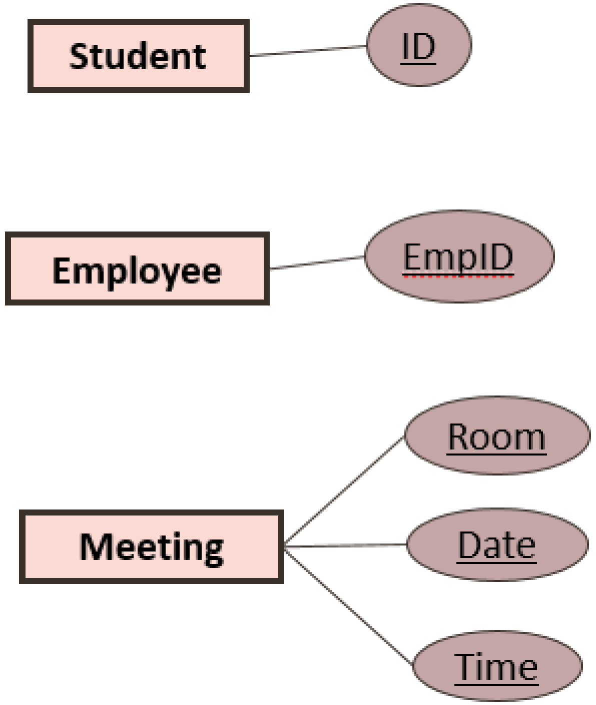
Each entity type must have unique identifier (key)

An entity type may have several qualified keys

- Candidate keys
- Single key or composite key

Primary key – One of the candidate keys

Primary key attribute(s) is(are) underlined in an entity-relationship diagram



Definition:
Identifier -- one or more attributes that uniquely identify each entity instance

Attribute: single valued, multi-valued, derived

Single-valued attribute (best)

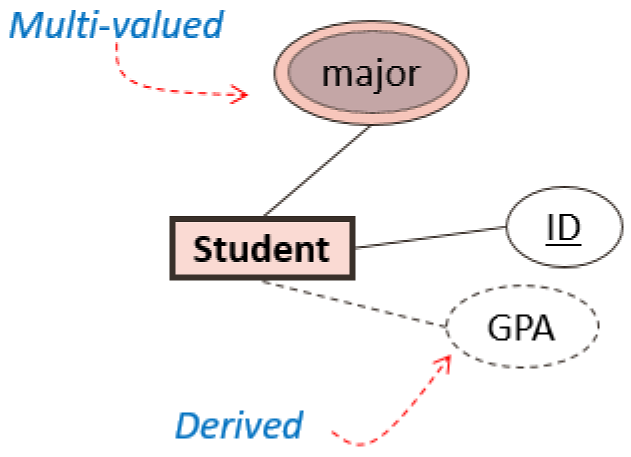
- Has exactly one value per entity
- Represented as a single lined oval

Multi-valued attribute (best not to use)

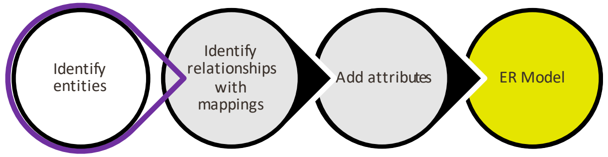
- Contains repeating values per entity
- Represented as a double lined oval

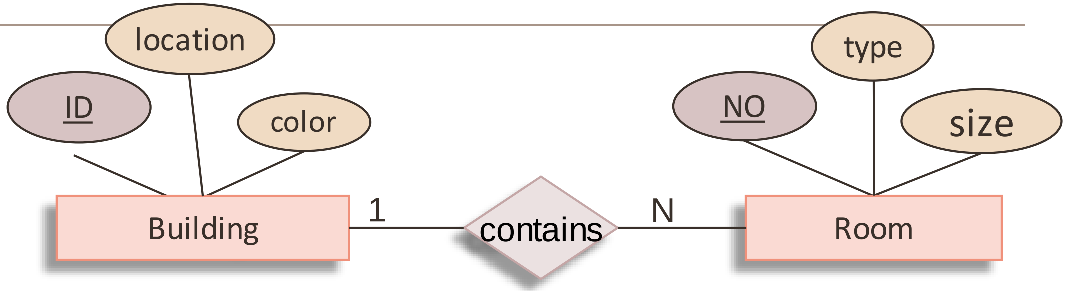
Derived attribute (best in application)

- Calculated based on other attributes
- Represented as a dotted line and a dotted line oval



Note: terminology / representation can differ depending on modeling approach used.
This is an entity-relationship model representation.
Multi-values attributes – need to be modeled separate entities. Do not include in your final model.
Derived – obtained in application. Why? Do not include on your final model.





Simple Conceptual Model for Buildings

Interpretation: A building has 1 to many rooms.

Note: key and non-key attributes.

Example: Symphony Orchestra

You want to develop a database for a symphony orchestra. A concert is conducted by one conductor and includes the performance of one or more compositions.

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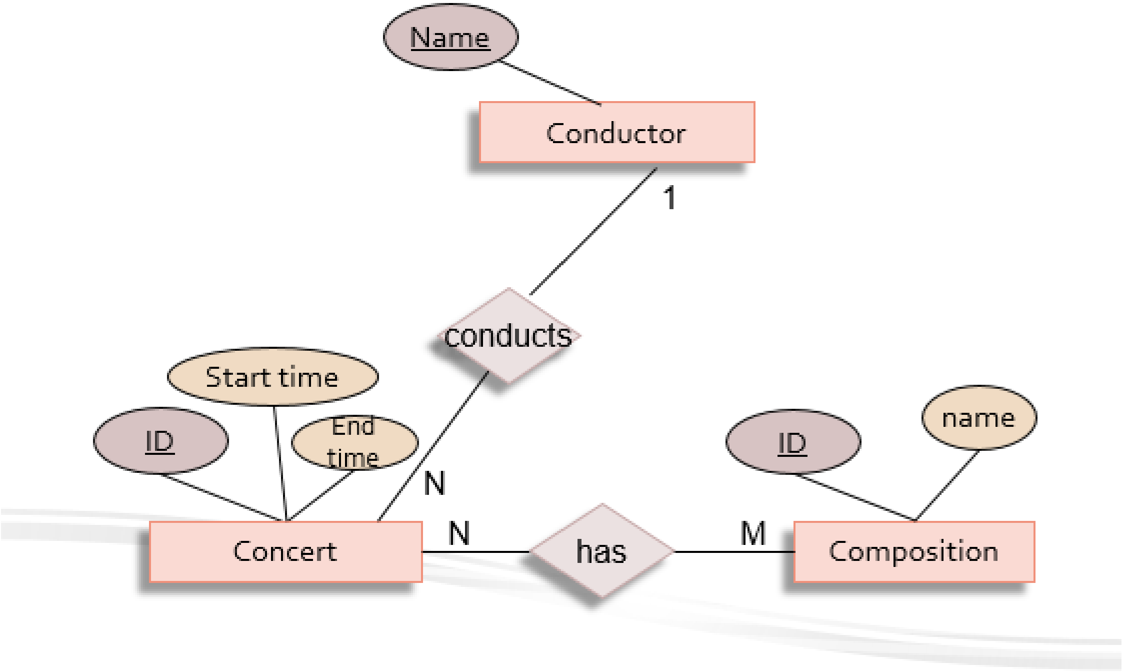
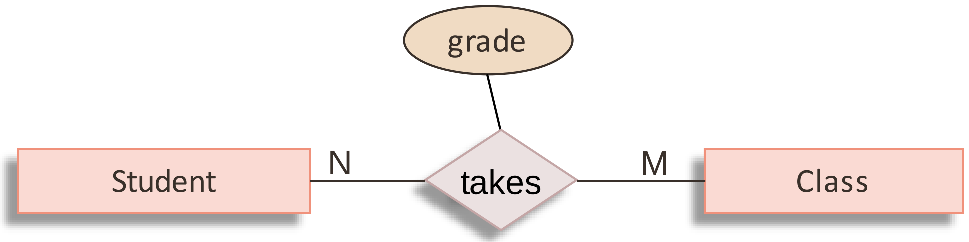


Relationship attributes



Interpretation?

Note: Only many-to-many relationships can have relationship attributes.

Some exceptions (but not for this course).

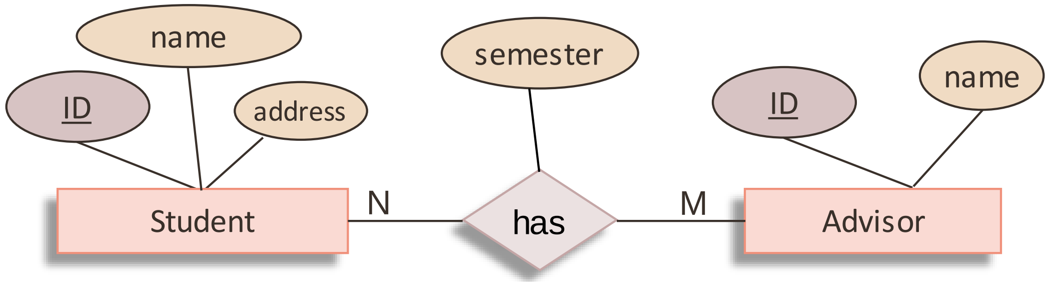
Example: Student-Advisor

Each semester, every student is assigned an advisor who helps the student understand degree requirements and register for classes. The advisor can change depending upon the semester. A database is needed to keep track of the students and their advisors for each semester.

Draw the conceptual model (entity-relationship model) for this application.

Identify the entities, relationship, mappings (mapping ratios), attributes

Example: Student-Advisor



What are the inherent assumptions in modeling the application in this way?

Example: Roger’s Catering Service

Each dinner is based on a single entree, but each entree can be served at many dinners. A guest can attend many dinners. Each dinner can be attended by many guests. Each dinner invitation can be mailed to many guests, and each guest can receive many invitations.

Develop a conceptual model for this application.

- Identify entities
- Identify relationships
- Identify attributes (based on your own knowledge)

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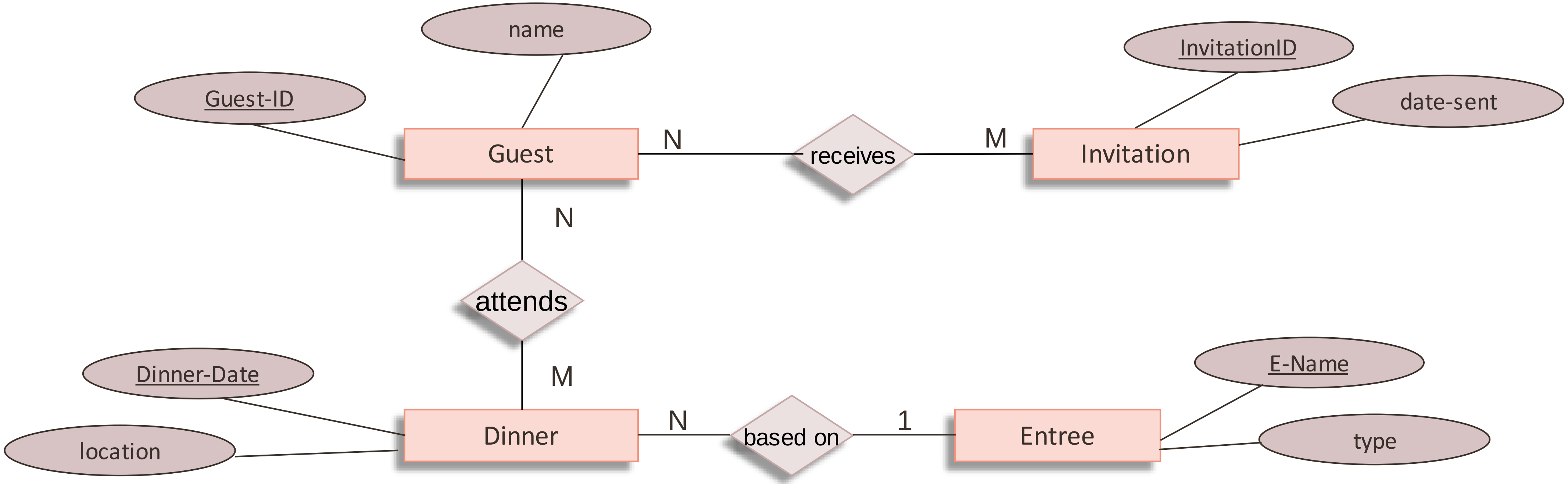

Conclusion

Conceptual modeling – important phase of database design

Entity-relationship model

- Entities
- Attributes
- Relationships

Important notion of keys

- Entities have keys. Must have primary keys (may be composite).
- Relationships are associations among entities but do not, by themselves, have keys.

Examples

- Capture essence of what is important in the real world
  - (e.g., attributes to include in a student database)
- Important to identify correct mapping ratio. Why?