Entity Relationship Diagrams

SEEM 3430 Tutorial

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What we cover today?

• What is ERD?
  • Definition
  • Building blocks
• How to draw ERDs
  • An exercise
Definition

• An approach for data modeling

• A database is divided into two logical parts:
  • Entities
  • Relationships

• Diagrams created to design entities and relationships are called entity-relationship diagrams
They look like this
They look like this

*Chen Notation*

A One-to-Many (1:M) Relationship: a PAINTER can paint many PAINTINGs; each PAINTING is painted by one PAINTER.

![Chen Notation Diagram](image)

A Many-to-Many (M:N) Relationship: an EMPLOYEE can learn many SKILLS; each SKILL can be learned by many EMPLOYEES.

![Chen Notation Diagram](image)

A One-to-One (1:1) Relationship: an EMPLOYEE manages one STORE; each STORE is managed by one EMPLOYEE.

![Chen Notation Diagram](image)

*Crow’s Foot Notation*

![Crow’s Foot Notation Diagram](image)
Building Blocks

- Entities
  - Real-world objects, e.g., student, book
  - Entity instance: a particular entity, e.g., Harry Potter
  - Represented by a named rectangle
  - Attributes and identifiers
- Relationships
Example of Entities
Attributes of Entities

• Entity characteristics

• Listed in the rectangles in Crow’s

• Derived attributes: can be reasoned/calculated from other attributes
  • Should they be put into the ERD?
Example of Entities
Identifiers

• Primary keys (PK):
  • Unique attributes
  • Distinguish characteristic of entities
  • Can be based on single or multiple attributes

• Foreign keys (FK):
  • Attributes that are primary keys of other entities
Example of Entities

Employee Table:
- EMP_NUM
- EMP_LNAME
- EMP_FNAME
- EMP_INITIAL
- EMP_DOB
- EMP_AGE

Instructor Table:
- PK: instructor_number
- instructor_name
- instructor_faculty
Building Blocks

• Entities

• Relationships
  • An association among entities
  • Drawn as lines connecting entities
  • Example: an “owns” relationship between a company and a computer
  • Can you give more examples?
Examples of Relationships
Strong and Weak Relationships

• Strong Relationships: the FK of the related table is also involved in its PK, along with being the PK of another table

  • Drawn as solid lines in Crow’s

• Weak Relationships: the relationship is not strong

  • Sales had the Agent's ID (the Agent PK) as a FK, which is not its PK

  • Drawn as a dashed line in a Crow's Foot ERD
Examples of Relationships

Weak Relationship

Strong Relationships
Cardinalities of Relationships

- Cardinality specifies how many instances of an entity relate to one instance of another entity.
  - 1:1 relationship: one instance of the parent entity is associated with one instance of the child entity.
  - 1:M relationship: a single instance of a parent entity is associated with many instances of a child entity.
  - M:N relationship: many instances of a parent entity can relate to many instances of a child entity.
Cardinalities of Relationships

• Optional: When the 'parent' does not require a 'child' to be present
  • In Crow's Foot a circle is added to the related entity's end
  • It allows some entities not to involve in the relationship
• Mandatory: There is an entity required on each end for the relationship to make sense
  • In Crow's Foot no circle is assumed mandatory
  • All entities are required to involve in the relationship
How to draw?

<table>
<thead>
<tr>
<th>CROW'S FOOT SYMBOL</th>
<th>CARDINALITY</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Symbol A]</td>
<td>(0,N)</td>
<td>Zero or many. Many side is optional.</td>
</tr>
<tr>
<td>![Symbol B]</td>
<td>(1,N)</td>
<td>One or many. Many side is mandatory.</td>
</tr>
<tr>
<td>![Symbol C]</td>
<td>(1,1)</td>
<td>One and only one. 1 side is mandatory.</td>
</tr>
<tr>
<td>![Symbol D]</td>
<td>(0,1)</td>
<td>Zero or one. 1 side is optional.</td>
</tr>
</tbody>
</table>

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Example of Relationship Cardinalities

• One course can have multiple classes.

• Some courses may not have classes.
Example of Relationship Cardinalities

- One course can have multiple classes.
- Each course must have at least one class.
Prof. McGonagall found that the modern student information management system convenient

She would like to build up one for students in Hogwarts too. But she has been in the magic world for too long. Can you help her draw the ERD?

Basic entities:

- Students (SID, SNAME, HOUSE, COURSE, GRADE)
- Courses (CID, CNAME, TEACHER)
- Houses (HNAME, HEAD)
Solution

Student
- **PK**: SID
- **FK**: SNAME, HNAME

Enrollment
- **PK, FK**: SID
- **PK, FK**: CID
- **PK, FK**: GRADE

Course
- **PK**: CID
- **CID**: CNAME
- **CID**: TEACHER

House
- **PK**: HNAME
- **PK**: HEAD