

B

# Data Modeling and Database Design

## Advanced Modeling

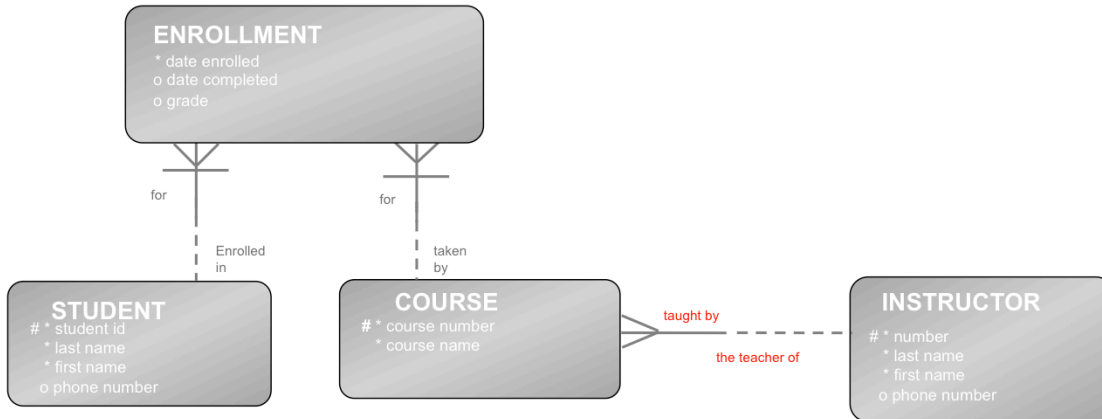
ORACLE

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## Model Roles With Relationships

Beware of entities that represent roles.

In the E-R Model for the Training Company, we defined an INSTRUCTOR entity and a STUDENT entity. This model works fine if an INSTRUCTOR is never a STUDENT and a STUDENT is never an INSTRUCTOR. But what if an INSTRUCTOR is also a STUDENT.

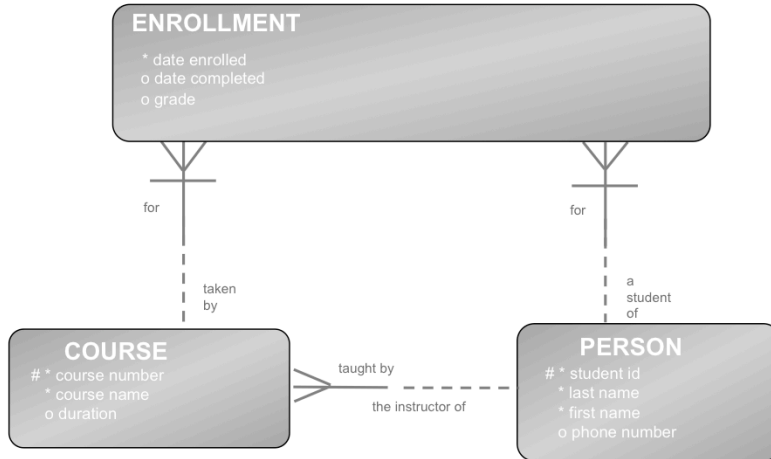


**Entities which represent roles may share overlapping instances**

## Model Roles with Relationships (cont.)

Use relationships to model roles. Relationships allow a single entity instance to assume multiple roles.

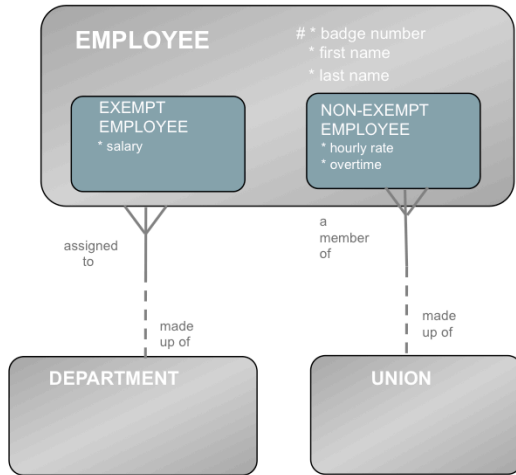
Example - For the Training Company, define a PERSON entity which may take on the roles of instructor and/or student.



# Model Subtypes

Use subtypes to model exclusive entity types which have common attributes and common relationships

A supertype is an entity that has subtypes. A supertype may be split into two or more mutually exclusive subtypes.



Example - An EMPLOYEE is either an EXEMPT EMPLOYEE or a NON-EXEMPT EMPLOYEE, but not both.

A supertype must have the attributes and relationships shared by its subtypes.

Example - All EMPLOYEEs must have the attributes badge number, first name, and last name. All EMPLOYEEs must be assigned to one and only one DEPARTMENT.

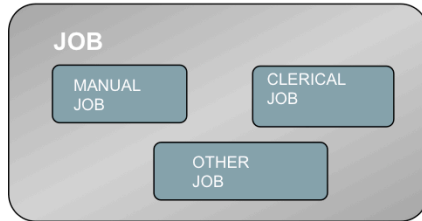
Each subtype may have its own attributes and relationships.

Example - The EXEMPT EMPLOYEE subtype has an attribute of salary.. The NON-EXEMPT EMPLOYEE subtype has attributes of hourly rate and overtime rate, and a relationship with the entity UNION.

## Model Subtypes (cont.)

All instances of the supertype entity must belong to one and only one of the subtype entities. Subtypes must form a complete set with no overlaps.

Example - In general, a job is either a MANUAL JOB or a CLERICAL JOB, but there might be a few exceptions.



### Super Reading Rules

"Each *supertype entity* must be either a *subtype1* or a *subtype2*"

Example - "Each JOB must be either a MANUAL JOB, a CLERICAL JOB, or OTHER JOB."

### Subtype Reading Rules

"...CLERICAL JOB, which is a type of JOB,..."

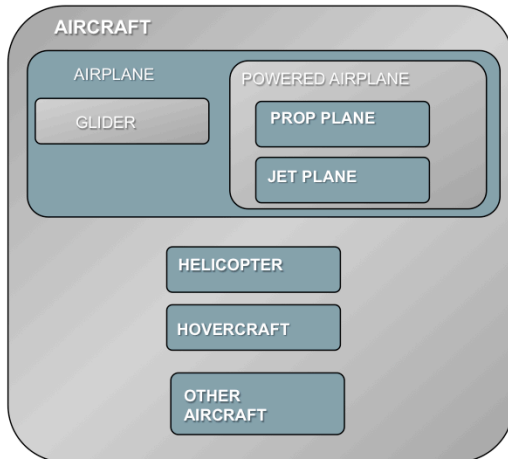
Example - "...CLERICAL JOB, which is a type of JOB,..."

Always use the subtype OTHER when unsure about the set's completeness.

## Model Subtypes (cont.)

Subtypes can be further subtyped. Normally two or three levels of nesting are adequate.

Example - Define further subtypes for the subtype entity AIRPLANE.



**AIRPLANE is a subtype of AIRCRAFT and a supertype of POWERED AIRPLANE and GLIDER.**

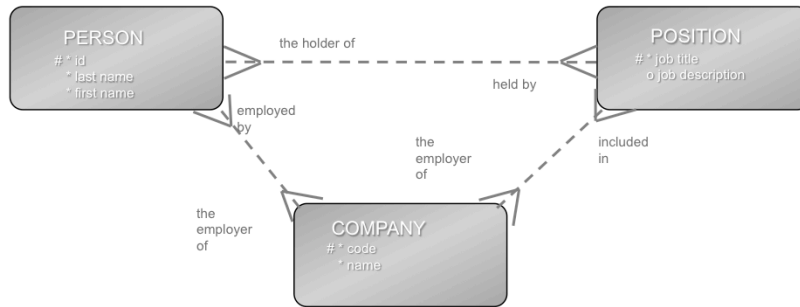
**JET PLANE inherits the attributes and relationships of POWERED AIRPLANE, AIRPLANE and AIRCRAFT.**

*Where would you place the attribute **Engine Size**?*

## Model Complex Relationships

### Beware of a ring of M:M relationships

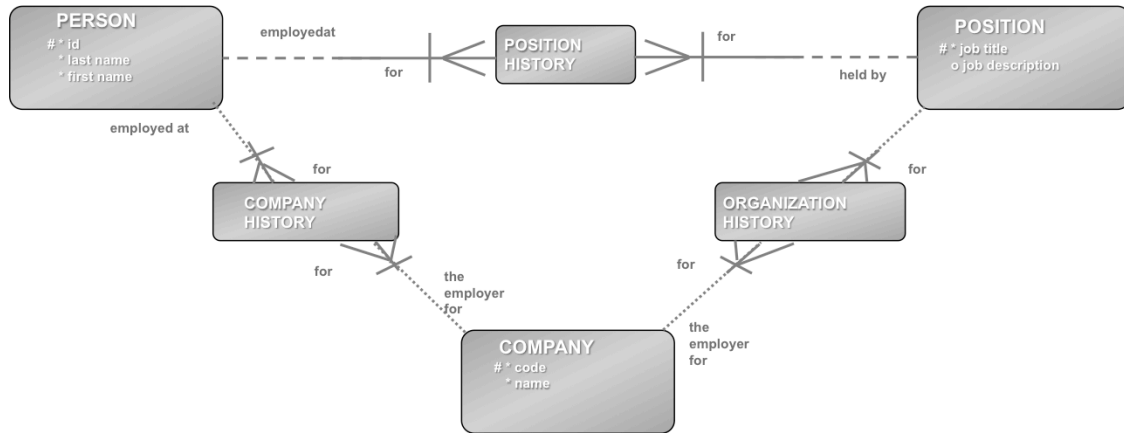
Example - Develop an E-R model for employment history. For each person, track the position held, the company worked for, and the dates the position was held. A person may hold a specific position within the same company multiple times during their career. Initially the following E-R Model was defined.



The dates of the position seem to be an attribute of a relationship, so resolve each of the M:M relationships.

## Model Complex Relationships (cont.)

The dates of the position seem to be an attribute of a relationship, so resolve each of the M:M relationships.



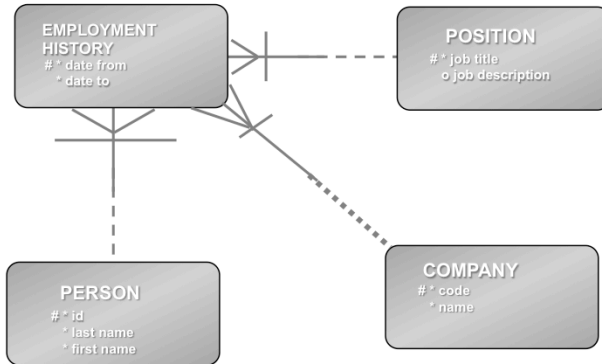
Which intersection entity are the dates of the position attributes of? All of them? None of them?



## Model Complex Relationships (cont.)

Model a relationship between three or more entities as in Intersection Entity with mandatory relationships with those entities.

Example - A person's employment history is really a 3-way relationship between the PERSON, COMPANY and POSITION entities. Use a single intersection entity called EMPLOYMENT HISTORY to model this relationship.



A **complex relationship** is a relationship between three or more entities.

**An intersection entity for a complex relationship always has mandatory relationships back to the entities to which it relates.**

**For an intersection entity representing a complex relationship, follow the rules of basic E-R Modeling to name the entity and to analyze and model its relationships, its attributes and its UID. Consider its mandatory relationships as candidates for inclusion in its UID.**

## Exercise

Develop an E-R Model for the following business.

"I am the senior partner in a large, diversified law firm. My firm, Bailey and Associates, handles a wide variety of cases including traffic violations, domestic disputes, civil suits and homicide cases.

We have retained a database administrator to organize and track various data because the firm grew faster than we had imagined and now there are "cases lying all over the place."

Our firm is made up of departments such as litigation, homicide, etceteras and each case is assigned to a particular department for administrative purposes. Attorneys are also assigned to a particular department, but this is only for billing/payroll purposes since an attorney can work on cases in other departments.

We need a list of events for a given case (essentially a history of the case) that includes a log of events and the date the event became effective. Cases have to be identifiable by a unique number which appears on a list with every event date and event description. Events have special codes like O for Open, T for Trial, L for Lost and there must always be an event status for every case.

We want to keep track of important information associated with a case including the department to which it is assigned and a brief description (such as Jones vs. Jones). After a case has been closed it may be reopened at some future date. We assign reopened cases new case numbers, but we need to tie the new case number to the previous case number.

## Exercise (cont.)

Attorneys can be party to multiple cases the same way a number of people can be party to multiple cases. For example, Jones may be a judge on one case and an eyewitness on another. We are only interested in keeping track of parties and the roles that they play in the context of a particular case. Parties should be identified by their name and date of birth, and some kind of unique numbering system. The kinds of people that may be involved in cases include judges(JG), eyewitnesses(EW), defendants (DE), and of course attorneys(AT). For example, we have a murder case, and we're working for the defendant. One attorney is assigned to he case, and there is, of course, a judge presiding over the case. There is also an eyewitness. Thus, there are four people who are parties to his case, and we'd like to know about all four. In this context, we are not tracking the attorney in terms of billing, but simply as party to a case.

To elaborate on the varying roles that people can play, assume that a given party can serve in different roles in different cases, but a party can only serve in one role on a given case.”

## Exercise (cont.)

