Data Modeling

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Domain

Model

Concept
Animal*

Instance of

Animal
age : int

Instance of

Sher Kahn : Animal
age : int = 17

* Image © Heritage Park Zoological Sanctuary. http://www.heritageparkzoo.com

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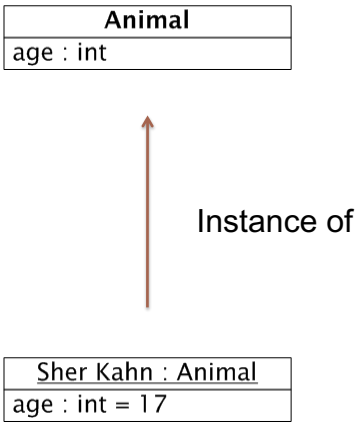
Data Modeling

- Entity Types
- Entities (instance)
- Relationship Types
- Relationships (instance)
- Attributes



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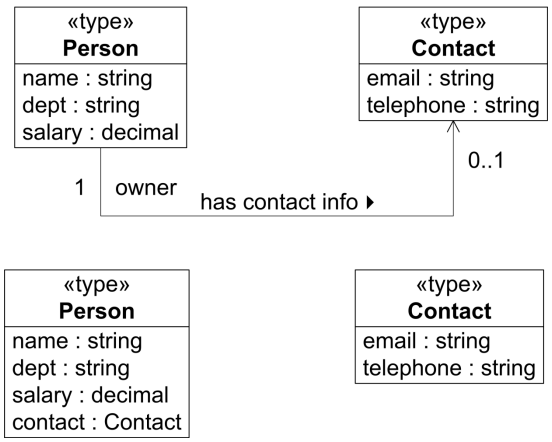
Relationships versus Attributes



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```
<Person>
   <Id>123456</Id>
   <Name>John Smith</Name>
   <Department>Finance</Department>
   <Salary>50</Salary>
   <Contact>
      <Email>js@email.com</Email>
      <Telephone>555-6789</Telephone>
   </Contact>
</Person>
<Person>
   <Id>654321</Id>
   <Name>Jane Doe</Name>
   <Department>Marketing</Department>
   <Salary>39</Salary>
   <Contact>
      <Email>jd@email.com</Email>
      <Telephone>555-1234</Telephone>
   </Contact>
</Person>
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5

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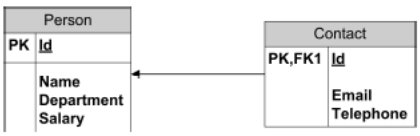

Person:

Id	Name	Department	Salary
123456	John Smith	Finance	50
654321	Jane Doe	Marketing	39

Contact:

Id	Email	Telephone
123456	js@email.com	555-6789
654321	jd@email.com	555-1234

(b) Representation in relational model

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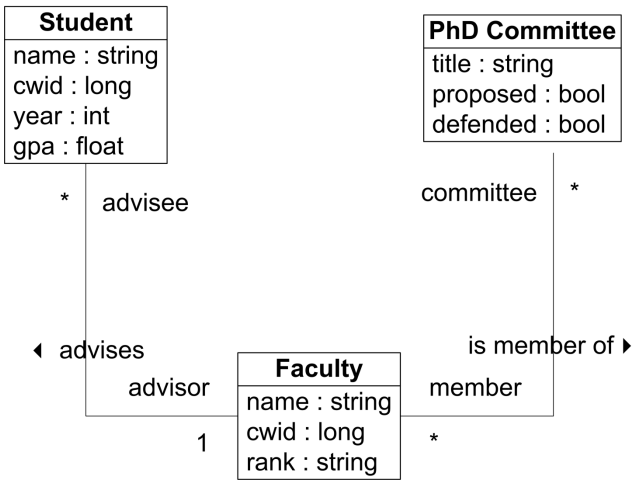
One-to-Many and Many-to-many relationships



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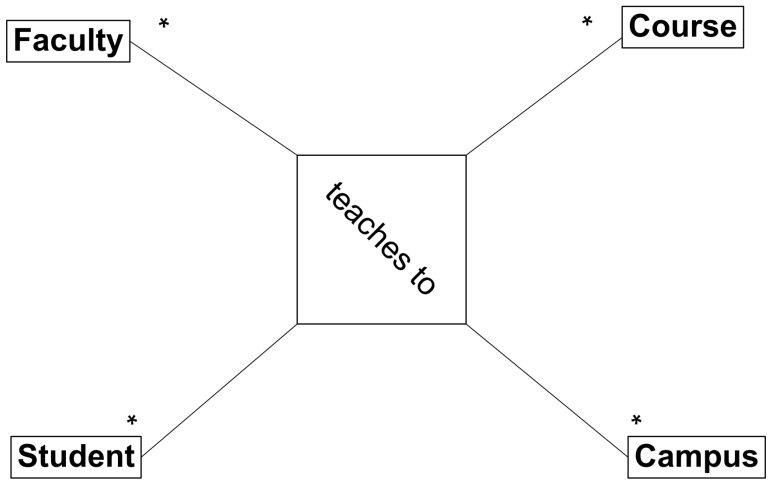
Elementary Relationships



Functional Dependency: Course, Campus → Faculty

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Elementary Relationships

- Non-elementary

```
Prof Duggan teaches CS548 to BetteDavis in Hoboken
Prof Duggan teaches CS548 to CaryGrant in Hoboken
Prof Duggan teaches CS548 to JeanArthur in WebCampus
```

- Elementary

```
Prof Duggan teaches CS548 in Hoboken
Prof Duggan teaches CS548 in WebCampus
BetteDavis enrolled in CS548 in Hoboken
CaryGrant enrolled in CS548 in Hoboken
JeanArthur enrolled in CS548 in WebCampus
```

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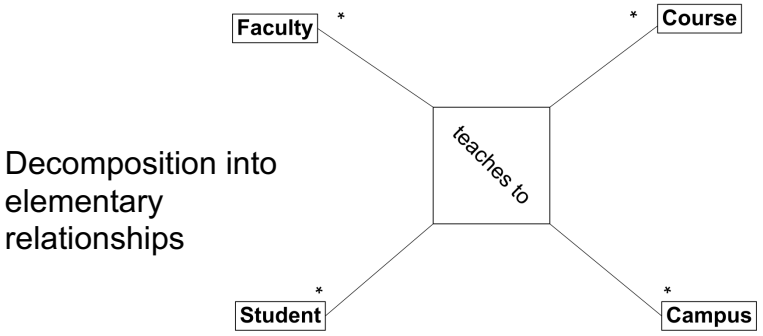
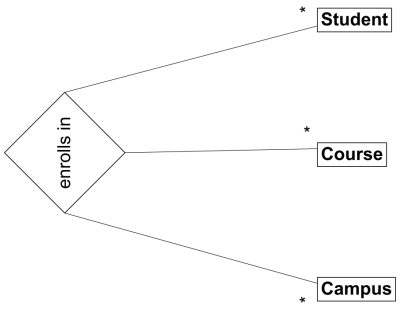
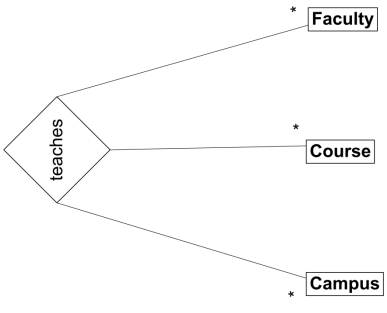
Decomposition into elementary relationships







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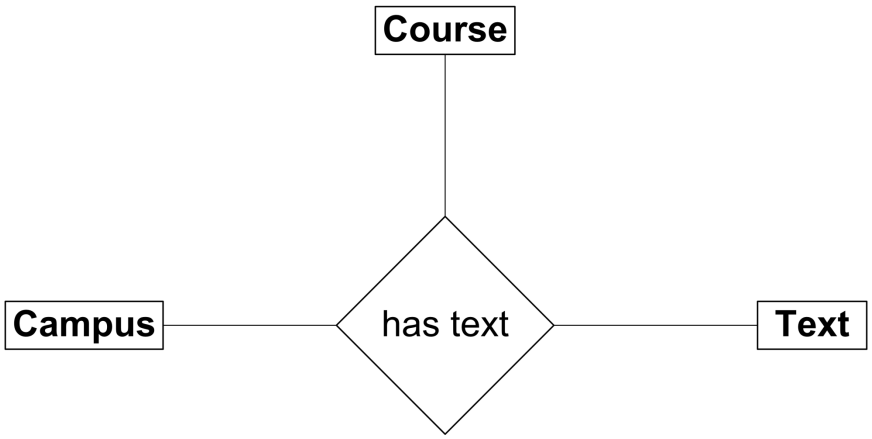
Elementary Relationships



Multi-valued dependency: Course →> Text | Campus

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Elementary Relationships

- Non-elementary

  CS548 has text “Enterprise Soft Arch” in Hoboken

  CS548 has text “Enterprise Soft Arch” in WebCampus

- Elementary

  CS548 has text “Enterprise Soft Arch”

  CS548 is taught in Hoboken

  CS548 is taught in WebCampus

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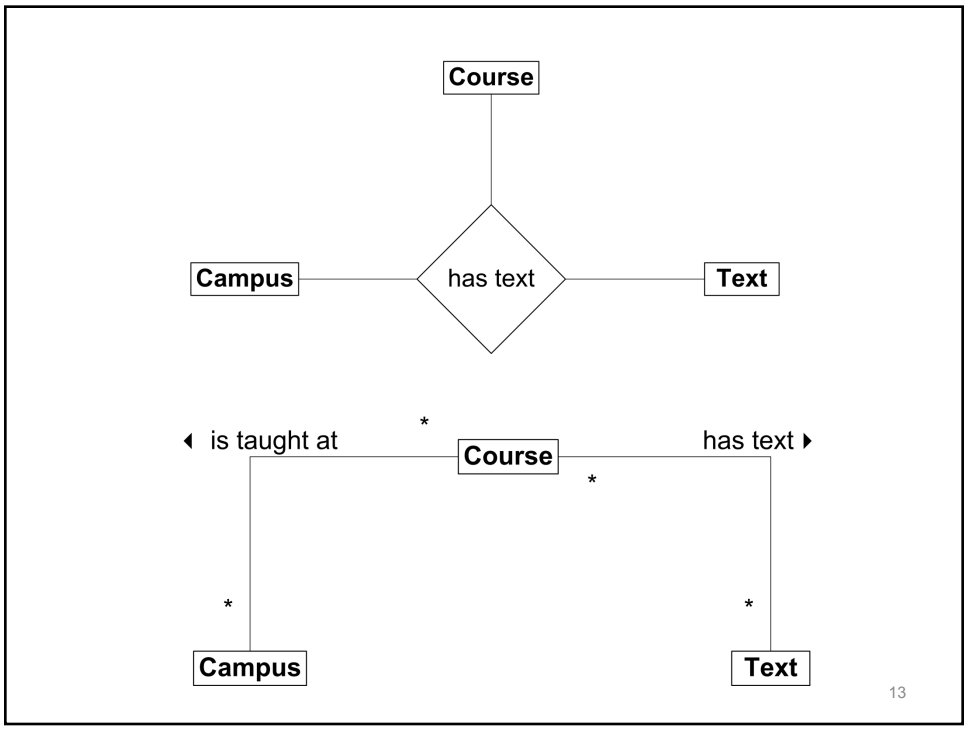

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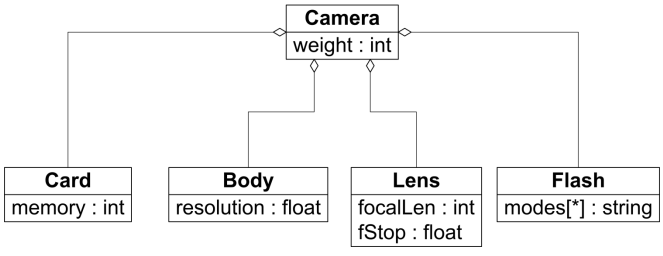
Aggregation



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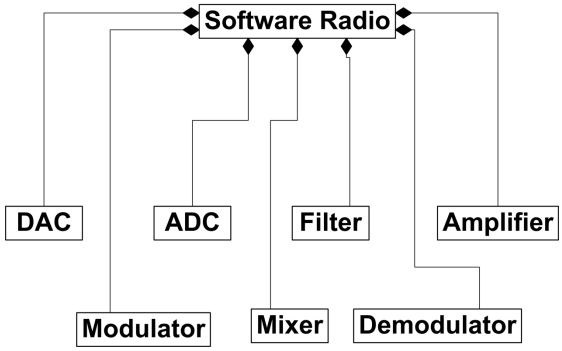
Composition



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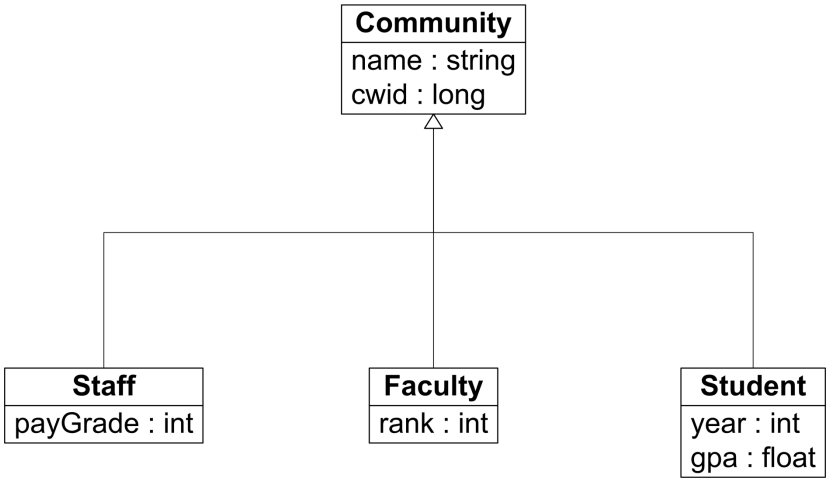
Generalization



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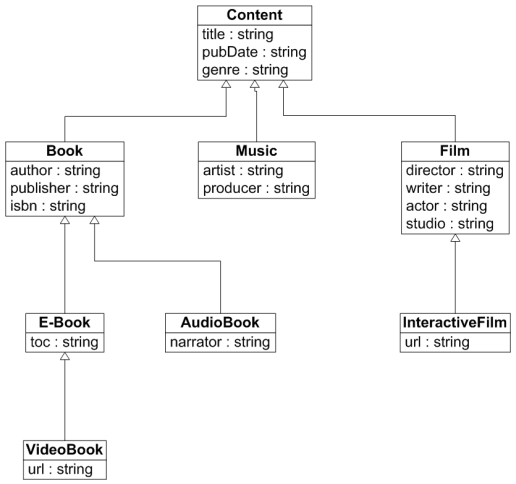
Specialization



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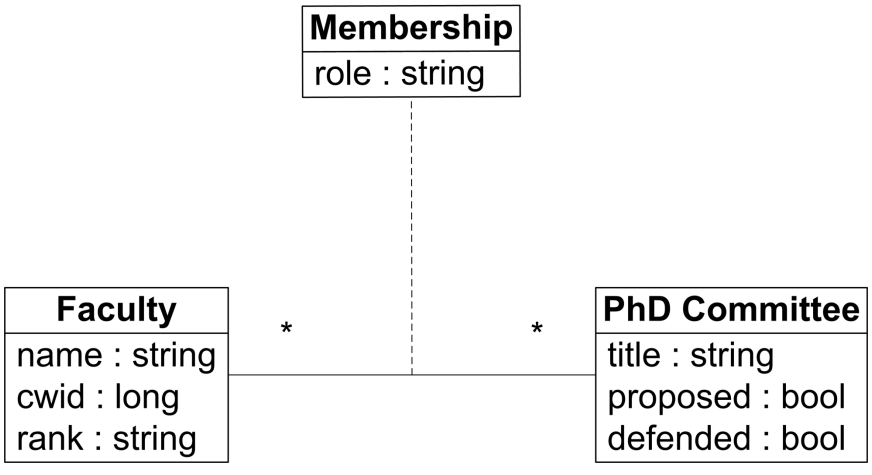
Reification of Committee Membership



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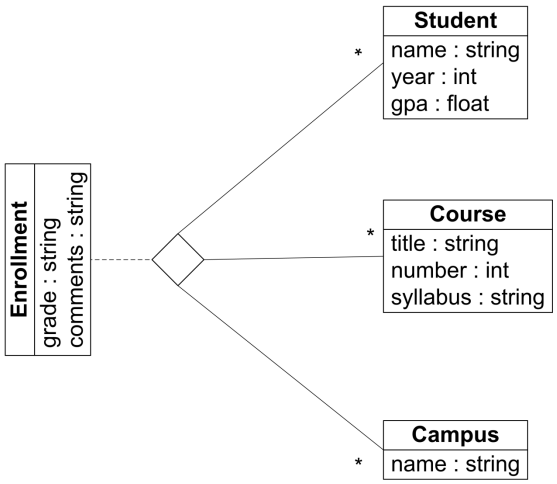
Reification of Enrollment



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RELATIONAL DATA MODEL

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Relational Data Model

- A database is comprised of tables
  - Ex: Customers and Products tables
- A table is comprised of one of more columns
  - Attributes
  - Ex: Customers: Name, Address, City, State, etc.
  - Each column has an associated data type
- Each table has zero or more records

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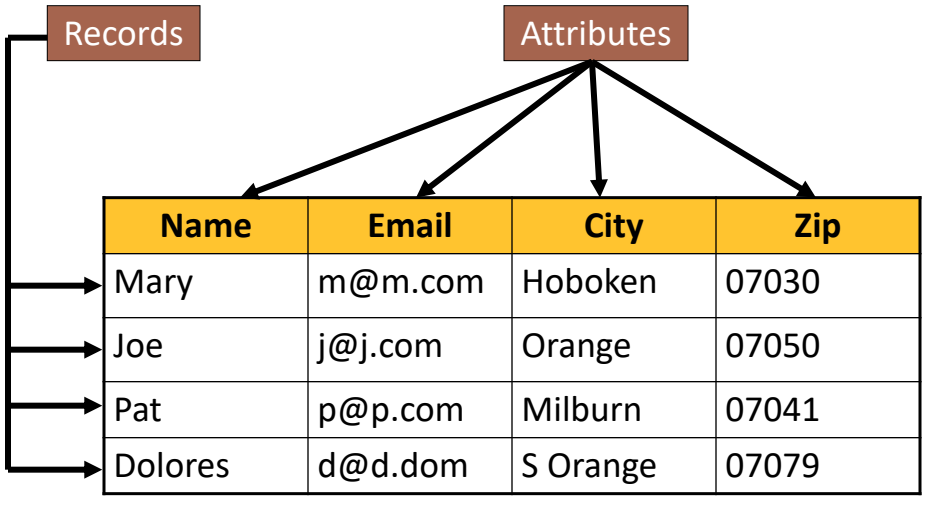
Relational Data Model



Name	Email	City	Zip
Mary	m@m.com	Hoboken	07030
Joe	j@j.com	Orange	07050
Pat	p@p.com	Milburn	07041
Dolores	d@d.dom	S Orange	07079

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Primary Keys

- A column that uniquely identifies each record in a table
  - Ex: customer ID, product ID

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Identity Columns

- If no natural primary key column
- Create a numeric column
  - Mark as primary key
  - Mark as identity column
- Values generated by DBMS

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Identity Columns

Cust ID	Name	Email	City	Zip
1	Mary	m@m.com	Hoboken	07030
2	Joe	j@j.com	Orange	07050
3	Pat	p@p.com	Milburn	07041
4	Dolores	d@d.dom	S Orange	07079

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RELATIONSHIPS IN THE RELATIONAL MODEL

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Rela

Data Duplication
- Difficult to maintain
- Wasted space in storage
- Hard to query efficiently

EmpID	Name	Email	Dept	Manager
1	Mary	m@m.com	IT	Mary
2	Joe	j@j.com	IT	Mary
3	Pat	p@p.com	Sales	Pat
4	Dolores	d@d.dom	Executive	Dolores
5	Tina	t@t.com	HR	Tina
6	Bruce	b@b.com	Executive	Dolores

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Relationships

EmpID	Name	Email	DeptID
1	Mary	…	1
2	Joe	…	1
3	Pat	…	2
4	Dolores	…	3
5	Tina	…	4
6	Bruce	…	3

DeptID	Name
1	IT
2	Sales
3	Exec
4	HR

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Relationships

- Three kinds of relationships:
  - One-to-one
    - Ex: Customer preferences

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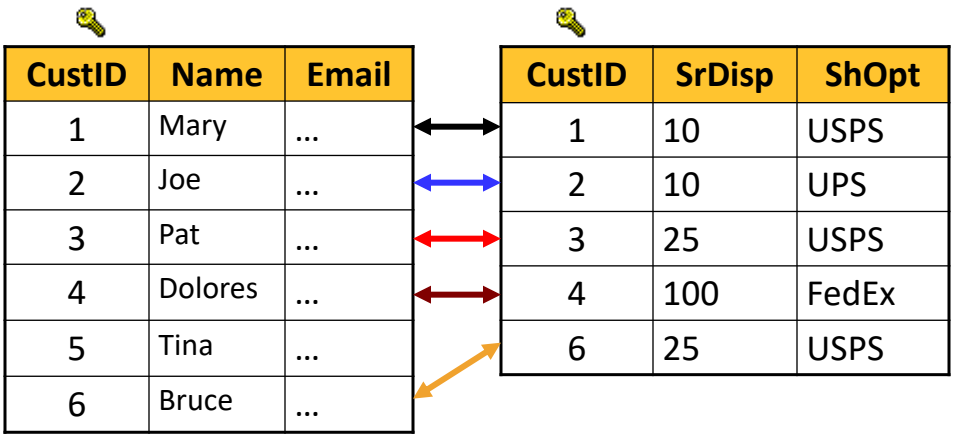
One-to-one



CustID	Name	Email
1	Mary	…
2	Joe	…
3	Pat	…
4	Dolores	…
5	Tina	…
6	Bruce	…

CustID	SrDisp	ShOpt
1	10	USPS
2	10	UPS
3	25	USPS
4	100	FedEx
6	25	USPS

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```
<Person>
   <Id>123456</Id>
   <Name>John Smith</Name>
   <Department>Finance</Department>
   <Salary>50</Salary>
   <Contact>
      <Email>js@email.com</Email>
      <Telephone>555-6789</Telephone>
   </Contact>
</Person>
<Person>
   <Id>654321</Id>
   <Name>Jane Doe</Name>
   <Department>Marketing</Department>
   <Salary>39</Salary>
   <Contact>
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</Person>
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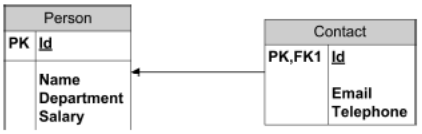

Person:

Id	Name	Department	Salary
123456	John Smith	Finance	50
654321	Jane Doe	Marketing	39

Contact:

Id	Email	Telephone
123456	js@email.com	555-6789
654321	jd@email.com	555-1234

(b) Representation in relational model

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Relationships

- Three kinds of relationships:
  - One-to-one
    - Ex: Customer preferences
  - One-to-many
    - Ex: Customer posts on a blog
    - Ex: Replies to a blog post
    - Ex: Customer comments on a picture gallery

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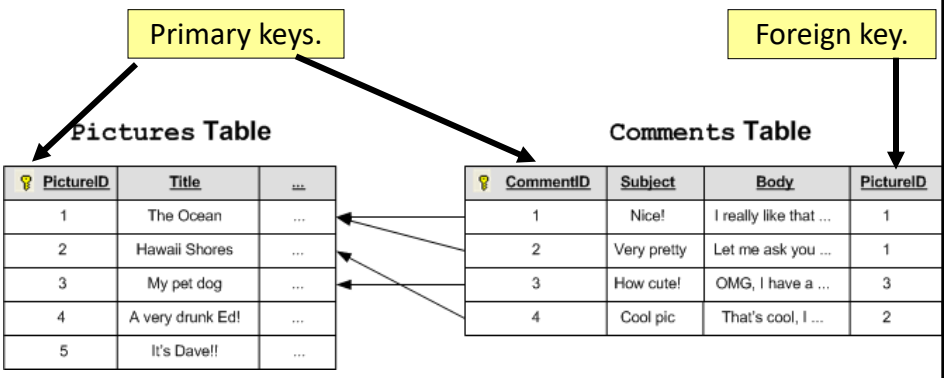
One-to-many



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Relationships

- Three kinds of relationships:
  - One-to-one
    - Ex: Customer preferences
  - One-to-many
    - Ex: Customer posts on a blog
    - Ex: Replies to a blog post
    - Ex: Customer comments on a picture gallery
  - Many-to-many
    - Ex: Students enrolled in courses

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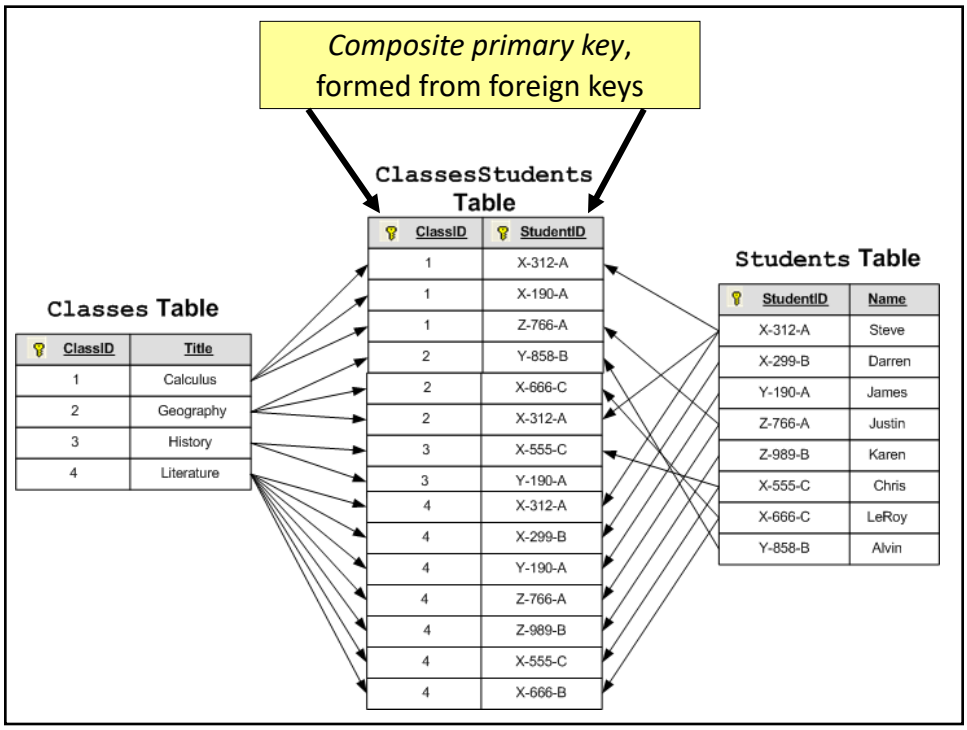

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Referential Integrity

- Don't allow "orphan records"
  - Ex: Comment for non-existent picture
  - Foreign key constraint
    - On foreign key
    - On record deletion

Pictures Table

PictureID	Title	...
1	The Ocean	...
2	Hawaii Shores	...
3	My pet dog	...
4	A very drunk Ed!	...
5	It's Dave!!	...

Comments Table

CommentID	Subject	Body	PictureID
1	Nice!	I really like that ...	1
2	Very pretty	Let me ask you ...	1
3	How cute!	OMG, I have a ...	3
4	Cool pic	That's cool, I ...	2

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