Database Management System (DBMS)

L-6:

Entity Relationship Modelling

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Lecture Content

- Entity Relationship (ER) Model
- Entities, Attributes, Relationships
- Degree of Relationships
- Single-value, Multi-value attributes
- Strong, Week entities
- Keys
- Structural Constraints

Why Modelling ?

- *The fact that database designers, programmers, and end-users view the data and its use differently*

- *To solve this problem we need to have a model for communication which is -*

  - non-technical
  - free of ambiguities
  - Entity-Relationship (ER) model is one of them

ER Model

Top-down approach following the steps -

- ➔ *Identify important data called* ***entities***
- ➔ *Identify* ***relationships*** *between data*
- ➔ *Identify* ***attributes*** *of entities*
- ➔ *Identify* ***constraints*** *on entities, relationships and attributes*

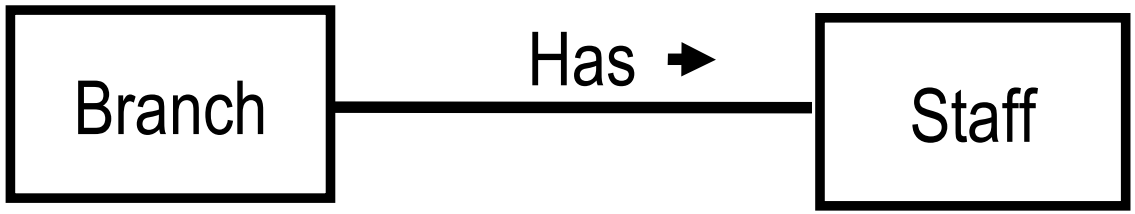
Entity Types

- **Entity Type:** A group of objects with the same properties, which are identified by the enterprises as having an independent existence.
- **Entity Occurrence:** A uniquely identifiable object of a entity type.

- Rectangle labeled with the name of the entity.
- In UML representation, the first letter of the entity name is a capital letter.

Relationship Types

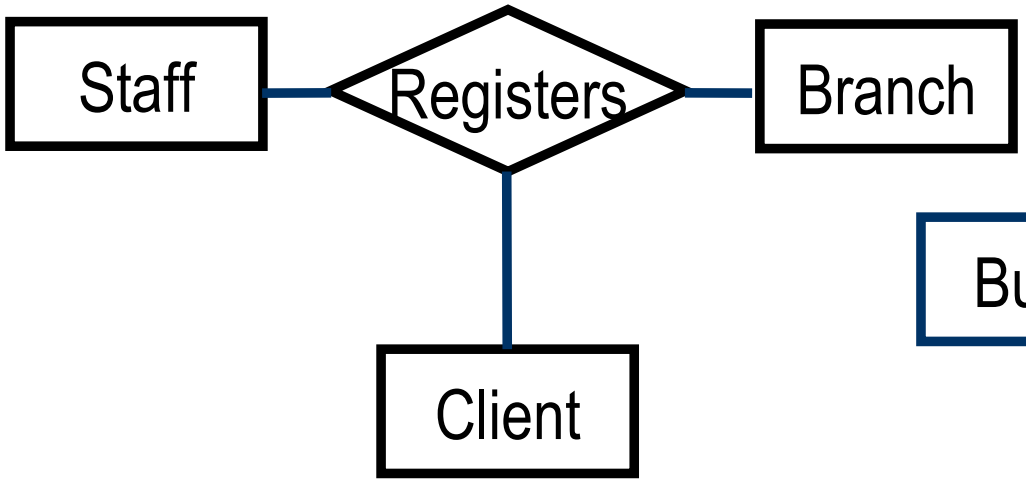
- **<u>Relationship Type</u>:** A set of meaningful associations among entity types.
- **<u>Relationship Occurrence</u>:** A uniquely identifiable association, which includes one occurrence from each participating entity type.



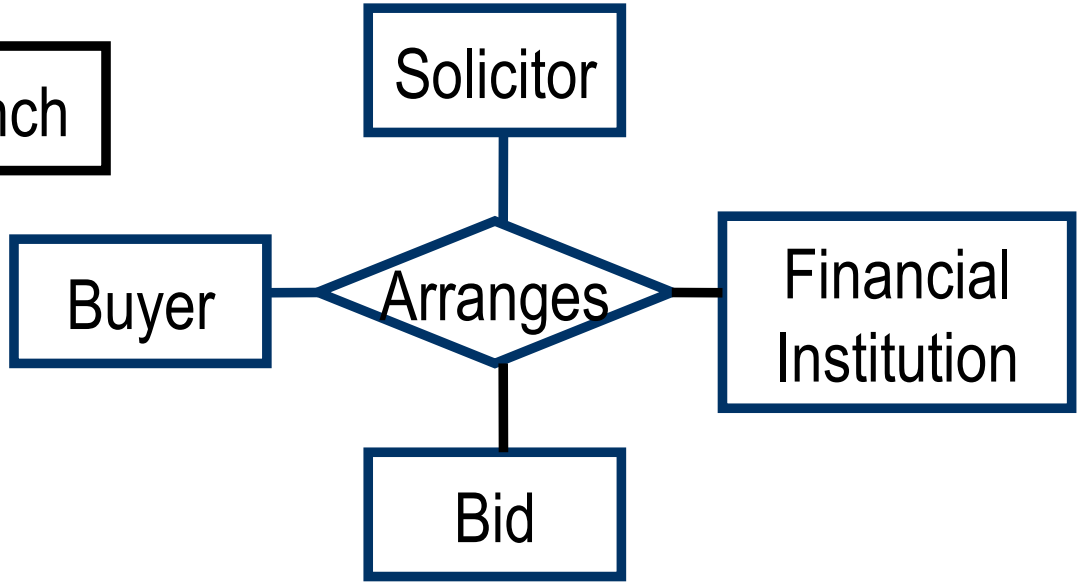
- First capital letter.
- Only labeled in one direction.
- Arrow simbol

Degree of Relationship Types

- **<u>Degree of Relationship type</u>:** the number of participating entity types in a relationship.
- A relationship of degree two is called **binary**, a relationship of degree three is called **ternary**...



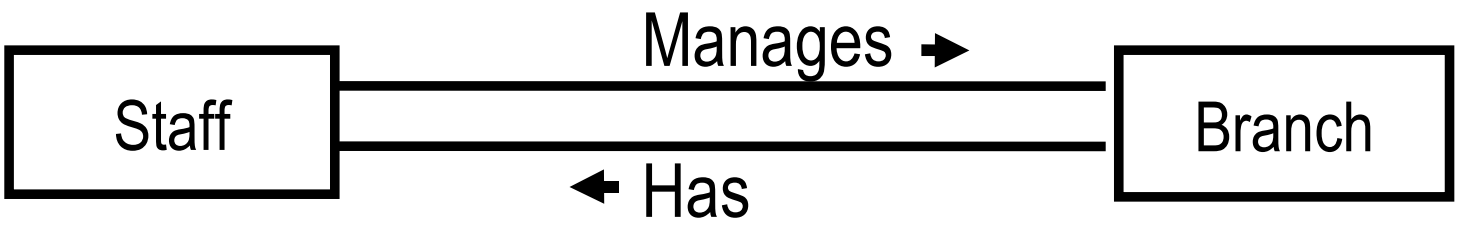
"Staff registers a client at a branch"



"A solicitor arranges a bid on behalf of a buyer supported by a financial institution"

Recursive Relationship

- **<u>Recursive Relationship</u>:** A relationship type where the same entity type participates more than once in different roles.



Attributes

- **Attribute:** A properity of an entity or a relationship type. For example: staffNo, name, position... To describe the entity Staff.
- **Attribute Domain:** The set of allowable values for one or more attributes.
- Attributes can be classified as being: *simple* or *composite*; *single-valued* or *multi-valued*; or *derived*.

Simple and Composite Attributes

- **Simple Attribute**: An attribute composed of a single component with an independent existence. E.g position and salary of the Staff entity.
- **Composite Attribute**: An attribute composed of multiple components, each with an independent existence.
- E.g adress attribute of the branch entity that can be subdivided into street, city and postcode attributes.

Single-Valued and Multi-Valued Attributes

- **Single-Valued Attribute:** An attribute that holds a single valuefor each occurrence of an entity type. E.g branchNo.
- **Multi-Valued Attributes:** An attribute that holds multiple values for each occurrence of an entity type. E.g telephoneNo.

Derived Attributes

- **Derived Attributes:** An attribute that represents a value that is derivable from the value of a related attribute or set of attributes, not necessarily in the same entity type.
- E.g attribute duration which value is derived from the rentStart and rentFinish attributes.

Keys

- **Candidate Key** (never NULL): The minimal *set* of attributes that uniquely identifies each occurrence of an entity type.

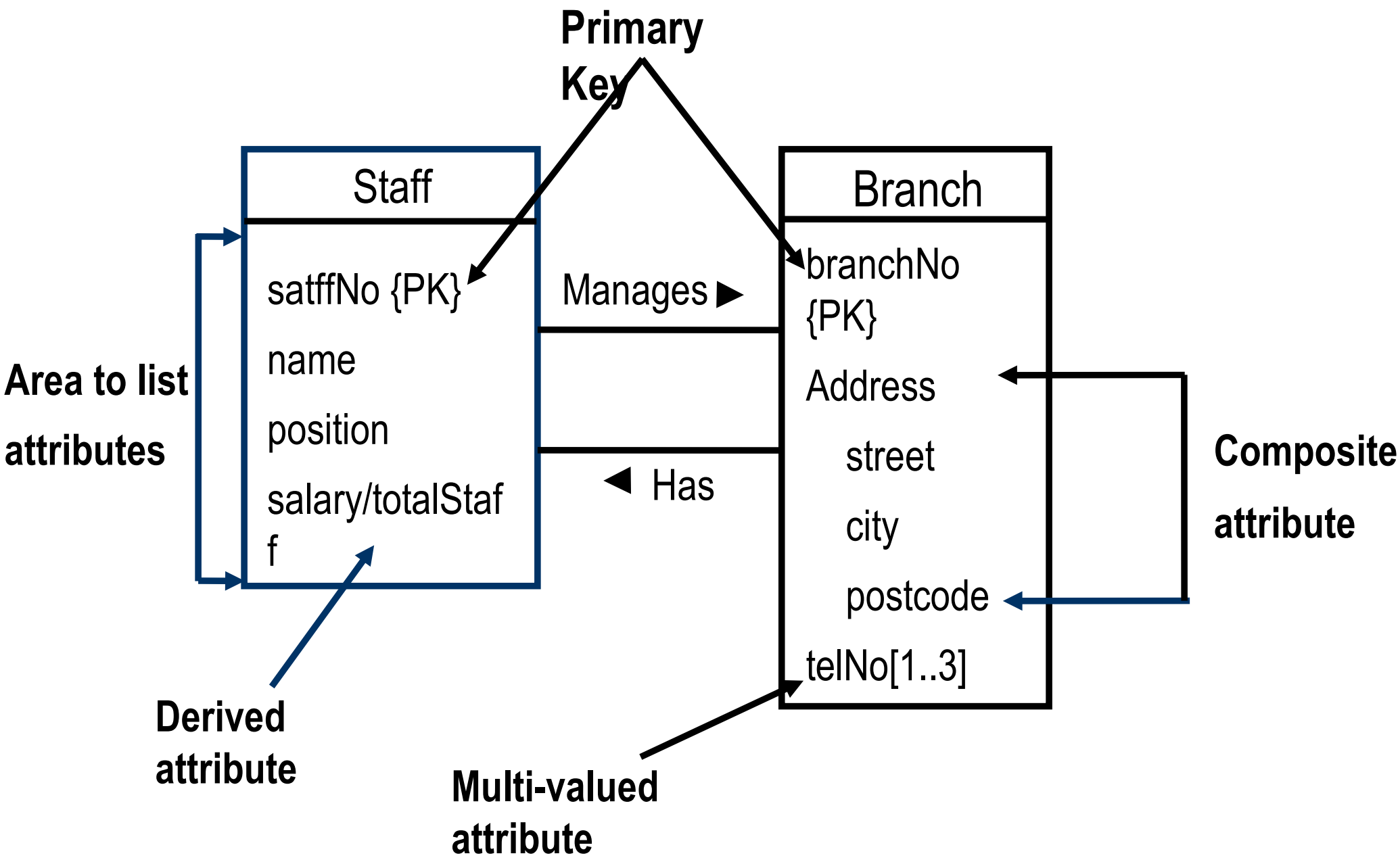
  E.g: branchNo in entity Branch.

- **Primary Key**: The candidate key that is selected to uniquely identify each ocurrence of an entity type.

  E.g:National Insurance Number.

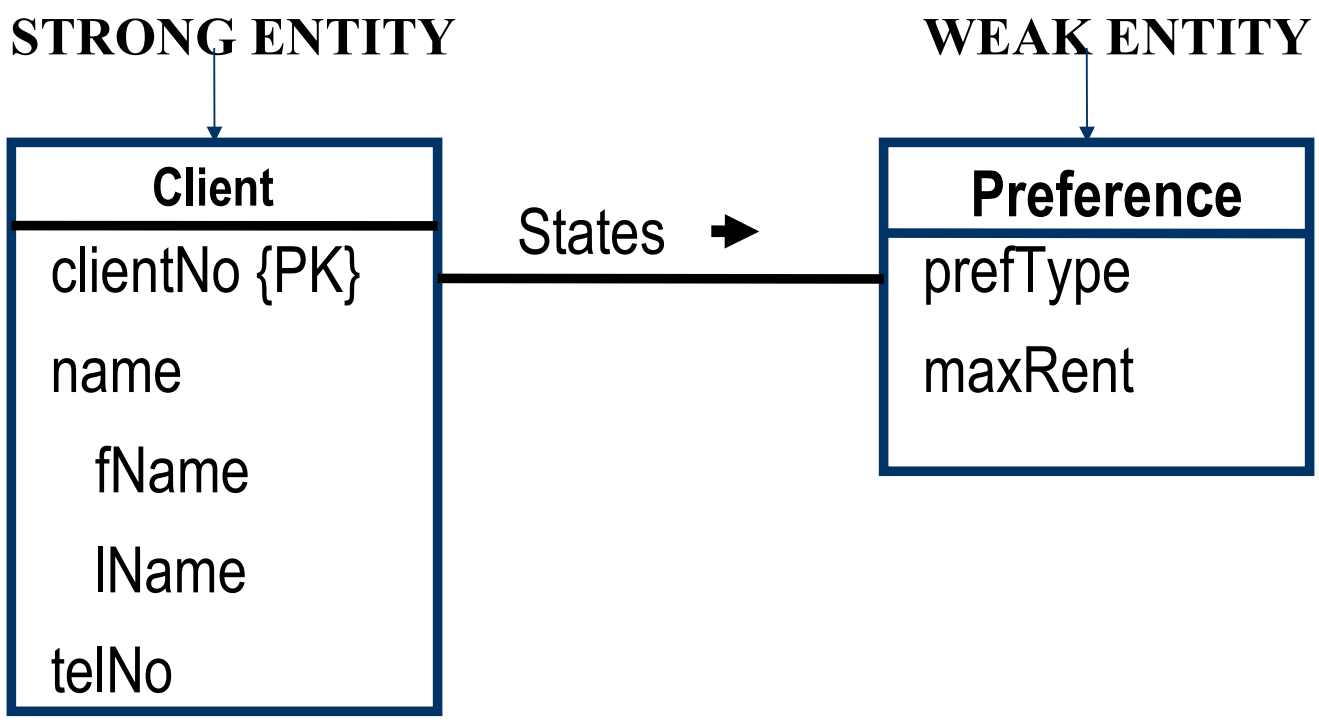
- **Composite Key**: A candidate key that consist of two or more attributes.

Diagramatic Representation of attributes



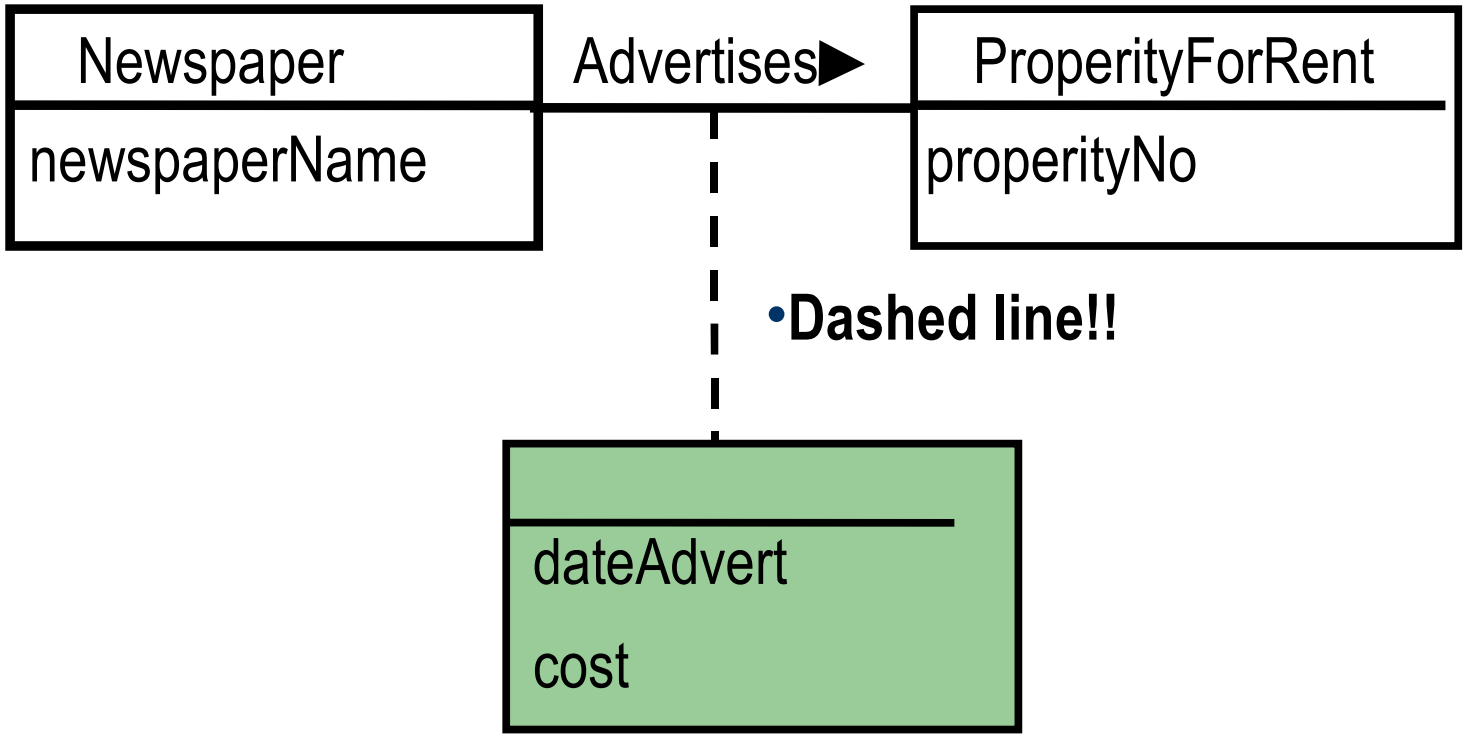
Strong and Weak Entity Types

- **Strong Entity Type:** An entity type that is not existence-dependent on some other entity type.
- **Weak Entity Type:** An entity type that is existence-dependent on some other type.



Attributes on Relationships

- Attributes can also be assigned to relationships.

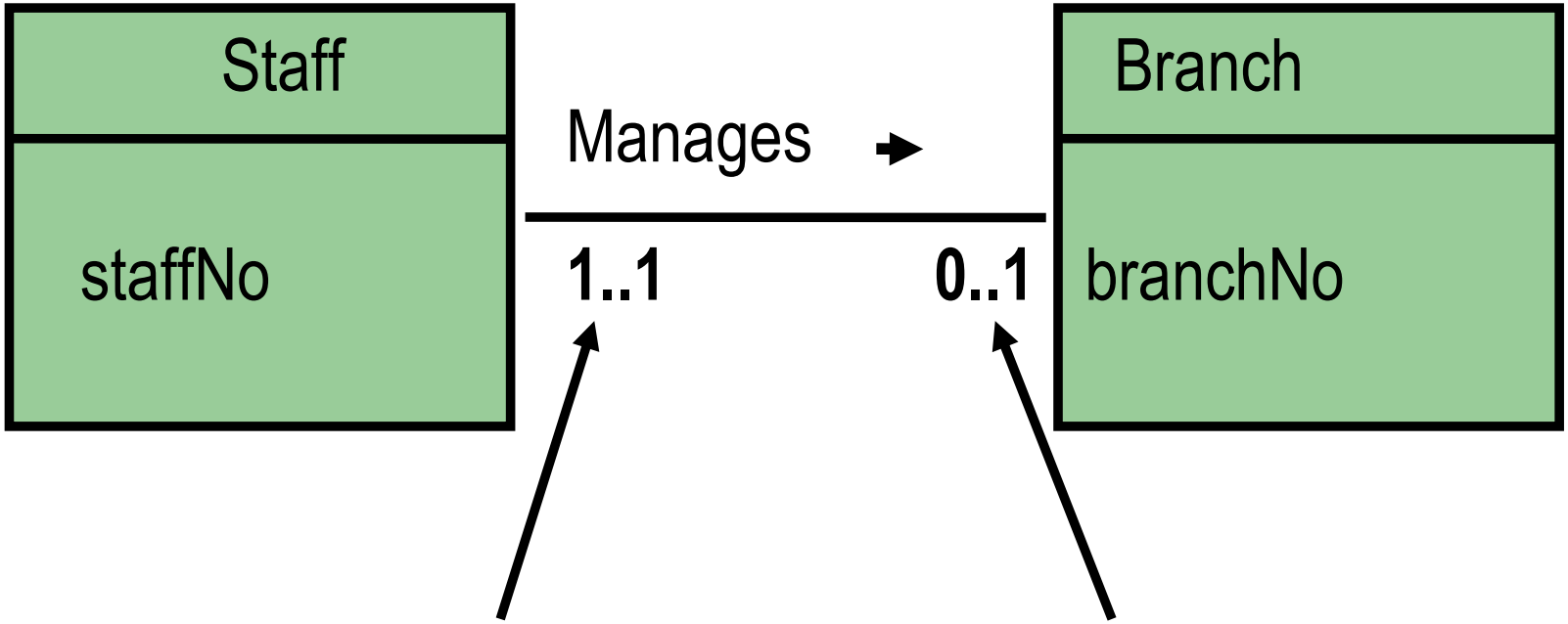


Structural Constraints

- **Multiplicity:** The number (or range) of possible occurrences of an entity type that may relate to a single occurrence of an associated entity type through a particular relationship.

  - **One-to-one (1:1)**
  - **One-to-many (1:*)**
  - **Many-to-many (*:*)**

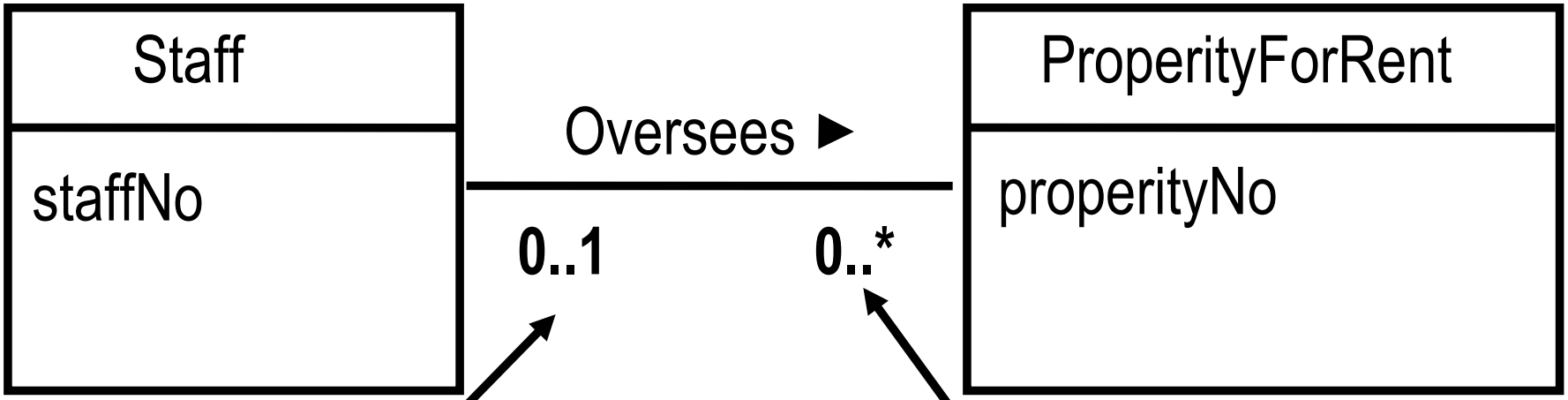
One-to-One (1:1)



"Each branch **is managed** by One member of the staff"

"A member of staff **can manage** zero or one branch"

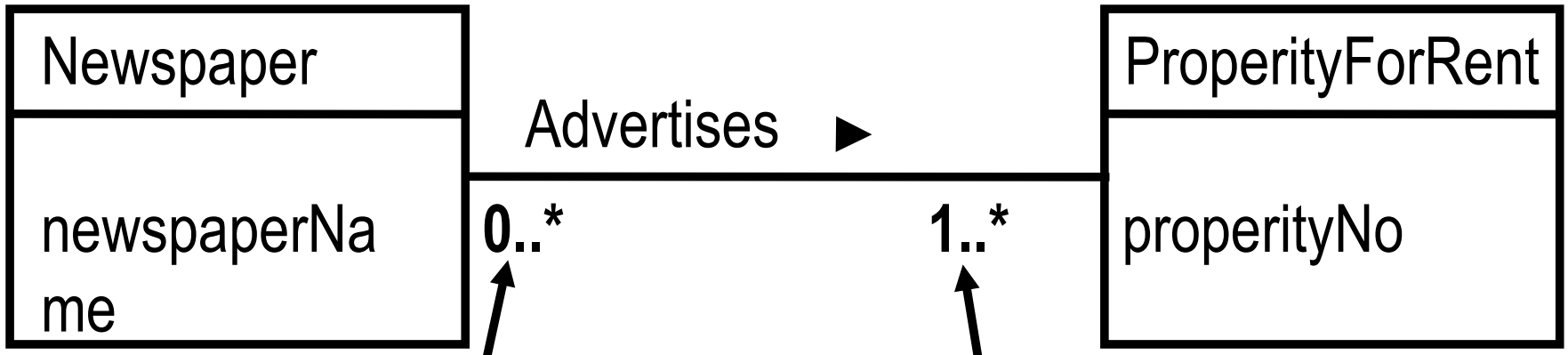
One-to-Many (1:*)



"Each property for rent **is overseen** by zero or one member of staff"

"Each member of staff **oversees** zero or more properitys for rent"

Many-to-Many (*:*)

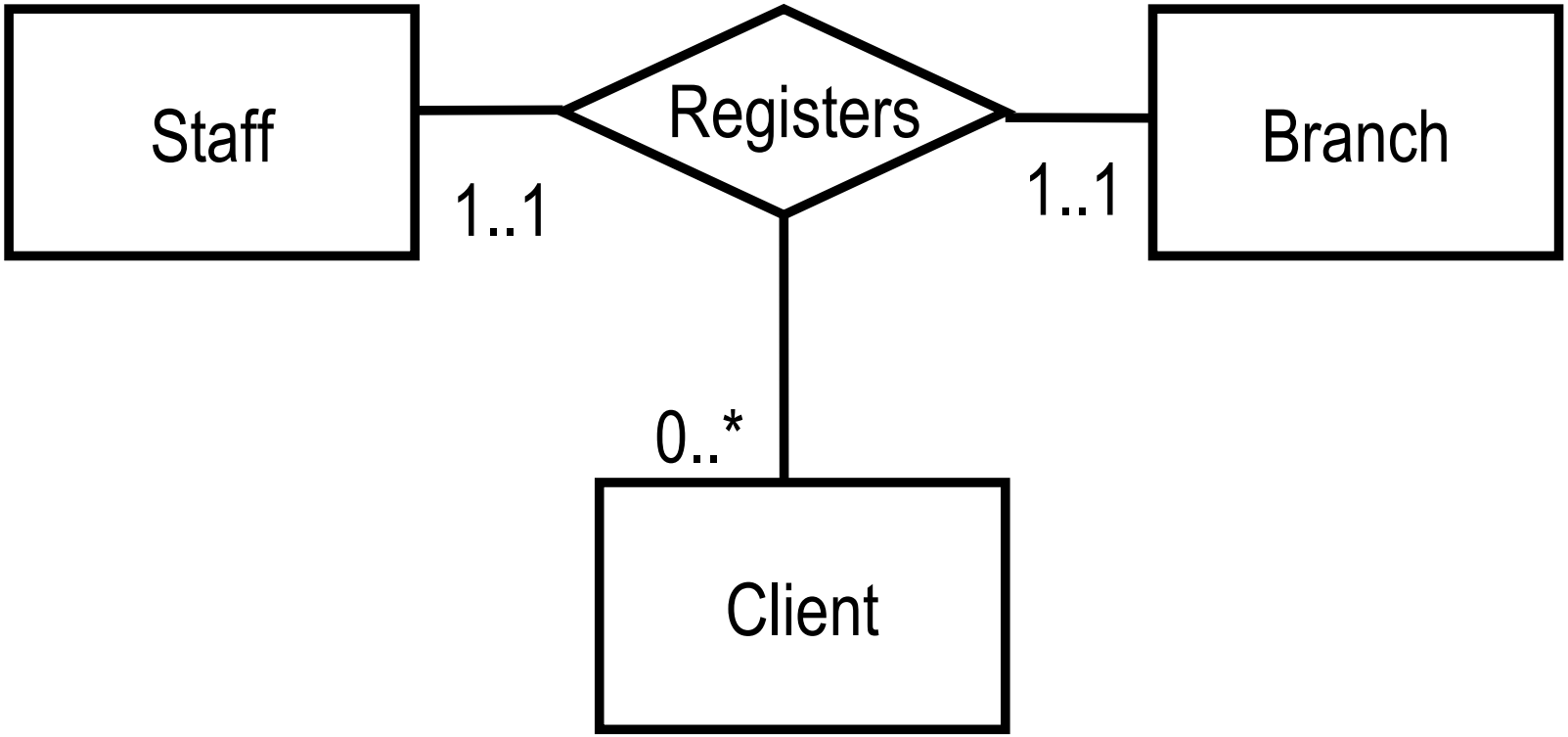


"Each property for rent **is advertised** in zero or more newspapers"

"Each newspaper **advertises** one or more properties for rent"

Multiplicity for Complex Relationships

- **Multiplicity** (complex relationships): The number (or range) of possible occurrences of any entity type in any n-ary relationship when the other (n-1) values are fixed.



ERD: An Example

- ✔ I need to maintain the information I use to contact people
- ✔ Maintain contact information
- ✔ Maintain some social information

An Example: Address Book cont.

"I use the address book to look up addresses and phone numbers of friends and businesses. I also contact some people by email and look at businesses' Web sites. Some friends are on my holiday list, and I want to send them cards that are addressed with spouse and children's names. I send some friends birthday cards."

An Example : Address Book cont.

*"I use the address book to look up addresses and phone numbers of **friends** and **business**es. I also contact some **people** by email and look at businesses' Web sites. Some friends are on my **holiday list**, and I want to send them cards that are addressed with spouse and children's names. I send some friends birthday cards."*

ERD: An Example cont.

Noun = Entity

Verb = Relationship

Piece of Information = Attribute of an Entity

An Example: Address Book cont.

Preliminary Entities:

Friends

Business

People

Holiday list

Address Book: Preliminary Attributes

Friends

Business

People

Holiday list

- friendName
- friendAddress
- friendPhone
- friendFax
- friendEmail

Address Book: Preliminary Attributes

Friends

Business

People

Holiday list

- friendName
- friendAddress
- friendPhone
- friendFax
- friendEmail
- businessName
- businessContact
- businessContactPos
- businessPhone
- businessFax
- businessEmail
- businessURL

Address Book: Preliminary Attributes

Friends

Business

People

Holiday list

- friendName
- friendAddress
- friendPhone
- friendFax
- friendEmail
- businessName
- businessContact
- businessContactPos
- businessPhone
- businessFax
- businessEmail
- BusinessURL
- Spouse
- Kids Name
- birthday

Address Book: Preliminary Attributes

Friends

Business

People

Holiday list

- friendName
- friendAddress
- friendPhone
- friendFax
- friendEmail
- businessName
- businessContact
- businessContactPos
- businessPhone
- businessFax
- businessEmail
- BusinessURL
- Spouse
- Kids Name
- Birthday
- HolidayList

Address Book: Entity & Attributes

Friends

friend1stName
friendLastName
friendStreet
friendCity
friendState
friendZIP
friendAC
friendPhoneNo
friendFaxAC
friendFaxNo
friendEmail
spouse
kidnames
birthMon
birthDay
holidayList

Businesses

businessName
contact1Name
contactLastName
businessContactPos
businessStreet
businessCity
businessState
businessZIP
businessAC
businessPhoneNo
businessFaxAC
businessFaxNo
businessEmail
businessURL

Addresses

friendStreet
friendCity
friendState
friendZIP

Address Book: Entity & Attributes

Friends	Businesses	Addresses	Telephones
friend1stName	businessName	street	friendAC
friendLastName	contact1Name	city	friendPhoneNo
friendAC	contactLastName	state	
friendPhoneNo	businessContactPos	ZIP	
friendFaxAC	businessAC		
friendFaxNo	businessPhoneNo		
friendEmail	businessFaxAC		
spouse	businessFaxNo		
kidnames	businessEmail		
birthMon	businessURL		
birthDay			
holidayList			

Address Book: Entity & Attributes

Friends
friend1stName
friendLastName
friendAC
friendPhoneNo
friendFaxAC
friendFaxNo
friendEmail
spouse
kidnames
birthMon
birthDay
holidayList

Businesses
businessName
contact1Name
contactLastName
businessContactPos
businessAC
businessPhoneNo
businessFaxAC
businessFaxNo
businessEmail
businessURL

Addresses
street
city
state
ZIP

Telephones
friendAC
friendPhoneNo
phoneType

Address Book: Entity & Attributes

Friends	Businesses	Addresses	Telephones	Kids
friend1stName	businessName	street	AC	kidnames
friendLastName	contact1Name	city	phoneNo	
friendEmail	contactLastName	state	phoneType	
spouse	businessContactPos	ZIP		
kidnames	businessEmail			
birthMon	businessURL			
birthDay				
holidayList				

Address Book: Entity & Attributes

Friends	Businesses	Addresses	Telephones	Kids
friend1stName	businessName	street	AC	kidnames
friendLastName	contact1Name	city	phoneNo	*kidKey
friendEmail	contactLastName	state	phoneType	
spouse	businessContactPos	ZIP	*phonekey	
birthMon	businessEmail	*addkey		
birthDay	businessURL			
holidayList	*bkey			
*fkey				

Rules for Foreign Key Assignment

- **One-to-one:** Copy the primary key from the dominant table as a foreign key as subordinate table.
- **One-to-Many:** Copy the primary key from the “One” side as the foreign key into the “Many” side.
- **Many-to-Many:** Insert a third table between the two tables, and copy the primary key from each table into the new third table. The only field in this new table will be these foreign keys.

Address Book: Entity Relationships

Friends
friend1stName
friendLastName
friendEmail
spouse
birthMon
birthDay
holidayList
***fkey**

Businesses
businessName
contact1Name
contactLastName
businessContactPos
businessEmail
businessURL
***bkey**

Addresses
street
city
state
ZIP
***akey**
+bkey

Telephones
AC
phoneNo
phoneType
***phonekey**

Kids
kidnames
***kidKey**

Address Book: Entity Relationships

Friends	Businesses	Addresses	Telephones	Kids
friend1stName	businessName	street	AC	kidnames
friendLastNam e	contact1Name	city	phoneNo	*kidKey
friendEmail	contactLastName	state	phoneType	
spouse	businessContactPos	ZIP	*phonekey	
birthMon	businessEmail	*akey	+bkey	
birthDay	businessURL	+bkey		
holidayList	*bkey			
*fkey				

Address Book: Entity Relationships

Friends	Businesses	Addresses	Telephones	Kids
friend1stName	businessName	street	AC	kidnames
friendLastNam e	contact1Name	city	phoneNo	*kidKey
friendEmail	contactLastName	state	phoneType	
spouse	businessContactPos	ZIP	*phonekey	
birthMon	businessEmail	*akey	+bkey	
birthDay	businessURL	+bkey	+akey	
holidayList	*bkey			
*fkey				

Address Book: Entity Relationships

Friends
friend1stName
friendLastNam
e
friendEmail
spouse
birthMon
birthDay
holidayList
***fkey**

Businesses
businessName
contact1Name
contactLastName
businessContactPos
businessEmail
businessURL
***bkey**

Addresses
street
city
state
ZIP
***akey**
+bkey

Telephones
AC
phoneNo
phoneType
***phonekey**
+bkey
+akey

Kids
kidnames
***kidKey**

Friends/Kids
+fkey
+kidKey

Address Book: Entity Relationships

Friends	Businesses	Addresses	Telephones	Kids
friend1stName	businessName	street	AC	kidnames
friendLastNam e	contact1Name	city	phoneNo	*kidKey
friendEmail	contactLastName	state	phoneType	
spouse	businessContactPos	ZIP	*phonekey	
birthMon	businessEmail	*akey	+bkey	
birthDay	businessURL	+bkey	+akey	
holidayList	*bkey			
*fkey				

Friends/Kids	Friends/Telephones	Friends/Addresses
+fkey	+fkey	+fkey
+kidKey	+phonekey	+akey

Summary

From this lecture we have learned the details of

- Entities, attributes, relationships
- Different types of attributes
- Different Multiplicity constraints on entity relationships
- How to find entities, attributes, relationships
- How to deal with one-to-one, one-to-many, many-to-many relationships
- How to find primary and foreign keys