United States International University-Africa

DATABASE SYSTEMS

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USIU AFRICA

WEEK 3 AGENDA

Entity Relationship (ER) Modeling

- Writing good names
- Definitions (entities, relationships, and attributes)
- Relationships (unary, binary, and ternary)
- E-R diagrams(composite attribute, multivalued attribute, derived attribute, associative entity)
- Cardinality constraints (minimum and maximum)
- E-R diagram for common business situations
- Converting many-to-many relationship to an associative entity type
- Model time-dependent data using relationships in an E-R diagram

Course Textbook: Carlos Coronel, Steven Morris, Peter Rob and Keeley Crockett Database Principles: Fundamentals of Design, Implementation, and Management, 14th Edition, 2022, ISBN-13978-0357673034.

Writing good names

- **The names of entities/relations/tables should be meaningful based on the real life names of the entities, for example a table containing details of students should be called student.**
- **The attribute names on a table should be prefixed with the name of the relation or table. This means any foreign keys will be recognizable.**
- **The names of all items should all be unique.**

Table name: PRODUCT **Database name: Ch03_SaleCo**
Primary key: PROD_CODE
Foreign key: VEND_CODE

PROD_CODE	PROD_DESCRIPT	PROD_PRICE	PROD_ON_HAND	VEND_CODE
001278-AB	Claw hammer	12.95	23	232
123-21UUY	Houselite chain saw, 16-in. bar	189.99	4	235
QER-34256	Sledge hammer, 16-lb. head	18.63	6	231
SRE-657UG	Rat-tail file	2.99	15	232
ZZX/3245Q	Steel tape, 12-ft. length	6.79	8	235

link

Table name: VENDOR
Primary key: VEND_CODE
Foreign key: none

VEND_CODE	VEND_CONTACT	VEND_AREACODE	VEND_PHONE
230	Shelly K. Smithson	608	555-1234
231	James Johnson	615	123-4536
232	Annelise Crystall	608	224-2134
233	Candice Wallace	904	342-6567
234	Arthur Jones	615	123-3324
235	Henry Ortozo	615	899-3425

Task: Write names of for Course-Lecturer tables

Definitions (entities, relationships, and attributes)

Entity

- is a, place, thing, or event about which data will be collected and stored.
- represents a particular type of object in the real world with “distinguishable” members that are unique and distinct eg a CUSTOMER is an entity with many distinguishable customer occurrences, such as Kamau, Ouma, Kemunto, Amina.
- may be physical objects like customers or products or imaginary or abstractions like flight routes or musical concerts.

Attribute

- is a characteristic of an entity, usually used to describe the entity eg. a CUSTOMER entity would be described by attributes such as customer last name, customer first name, customer phone number, customer address, and customer credit limit.
- Attributes are the equivalent of fields in tables.

Task: **List at least five entities each with at least three attributes.**

Definitions (entities, relationships, and attributes)

Relationship

- **A description of an associations among entities, eg a relationship exists between customers and agents that can be described as follows: an agent can serve many customers, and each customer may be served by one agent.**

Types of relationships

- **One-to-many, 1:M or 1.. *, eg a painter creates many paintings;**
- **many-to-many, M:N or *..*, eg. an empoyee has many skills, a skill is mastered by many employees**
- **One-to-one, 1:1 or 1..1 eg. one manager one store; one store has only one manager;**

Task: List at least five entities each with at least three attributes.

Definitions (constraint, business rule)

Constraint

- A constraint is a restriction placed on the data.
- Constraints ensure data integrity
- Examples:
  - An employee's salary must have values that are between 6,000 and 350,000;
  - A student's GPA must be between 0.00 and 4.00.
  - Each class must have one and only one teacher.

Business rule

- is a brief, precise, and unambiguous description of a policy, procedure, or principle within a specific organization.
- they apply to any organization, large or small, that stores and uses data to generate information.
- Get them from a detailed description of an organization's operations showing how actions are created and enforced within the organization's environment.

Task: formulate constraints and business in a learning environment.

- **Relationship degrees (unary, binary, and ternary)**

A relationship degree is the number of entities or participants associated with a relationship.

A unary relationship exists when an association is maintained within a single entity.

A binary relationship exists when two entities are associated.

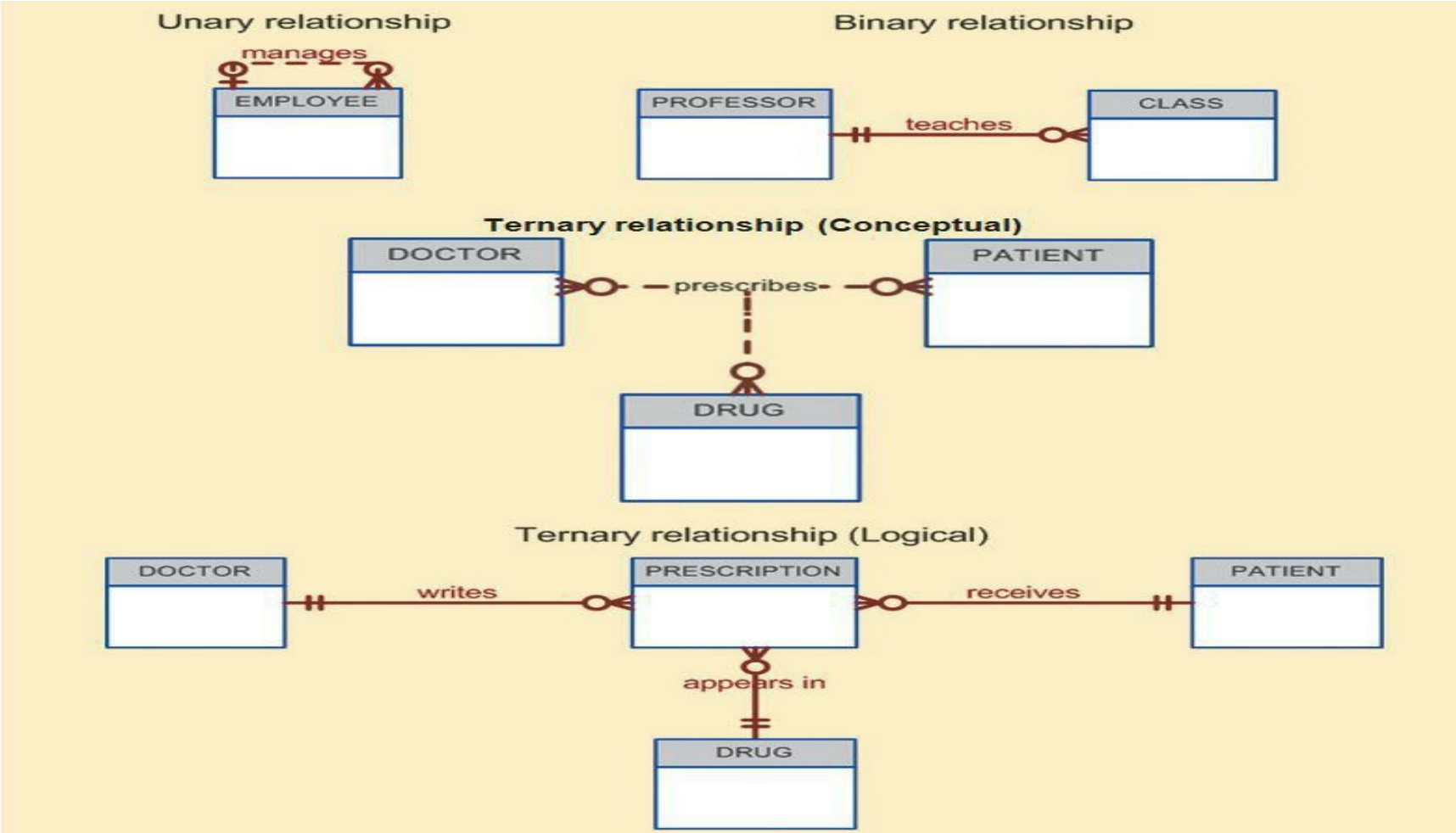
A ternary relationship exists when three entities are associated.

Although *higher degrees exist*, they are rare and are not specifically named, eg., an association of four entities is described simply as a four-degree relationship.

Task: Summarize the relationship degrees.

Relationship degrees (unary, binary, and ternary)

A relationship degree is the number of entities or participants associated with a relationship.



Task: How does a five degree relationship look like?.

E-R diagrams(composite attribute, multivalued attribute, derived attribute, associative entity)

Composite attribute – one that can be further subdivided to yield additional attributes eg. ADDRESS can be subdivided into street, city, state, and zip code or PHONE_NUMBER that can be subdivided into area code and exchange number.

Simple attribute- one that cannot be subdivided eg. age, weight, or marital status.

- **For detailed queries, change composite attributes into a series of simple attributes.**

Single-valued attribute- an attribute that can have only a single value eg. a person can age or a manufactured part can have only one serial number.

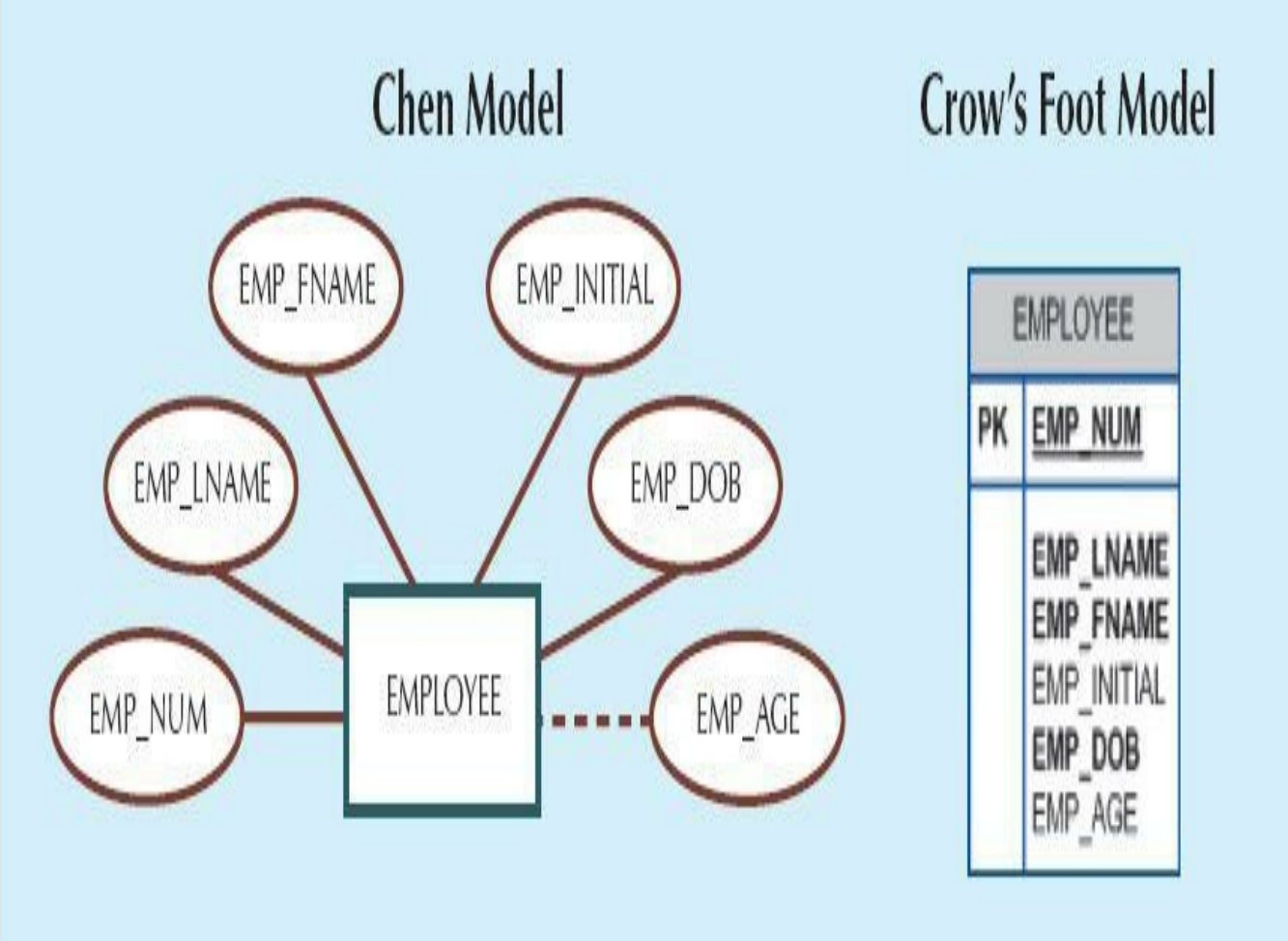
Multivalued Attributes- are attributes that can have many values eg a person may have several college degrees or a household may have several different phones

Chen ERM, multivalued attributes- shown by a double line connecting the attribute to the entity.

Crow's Foot notation does not identify multivalued attributes.

Task: Discuss various types of attributes in ER modeling.

E-R diagrams(composite attribute, multivalued attribute, derived attribute, associative entity)



Derived Attributes (or computed attr.)

- **is an attribute whose value is calculated (derived) from other attributes eg. an employee's age, EMP_AGE, from the difference between the current date and the EMP_DOB and in MS Access is INT((DATE() – EMP_DOB)/365).**
- **in the Chen notation: use dashed line that connects the attribute and the entity.**
- **In the Crow's Foot notation: no method for distinguishing the derived attribute from other attributes.**
- **balance the design in accordance with storage constraints.**

E-R diagrams(composite attribute, multivalued attribute, derived attribute, associative entity)

Table name: STUDENT

Database name: Ch04_CollegeTry

STU_NUM	STU_LNAME
321452	Bowser
324257	Smithson

Associated entity ENROLL

Table name: ENROLL

CLASS_CODE	STU_NUM	ENROLL_GRADE
10014	321452	C
10014	324257	B
10018	321452	A
10018	324257	B
10021	321452	C
10021	324257	C

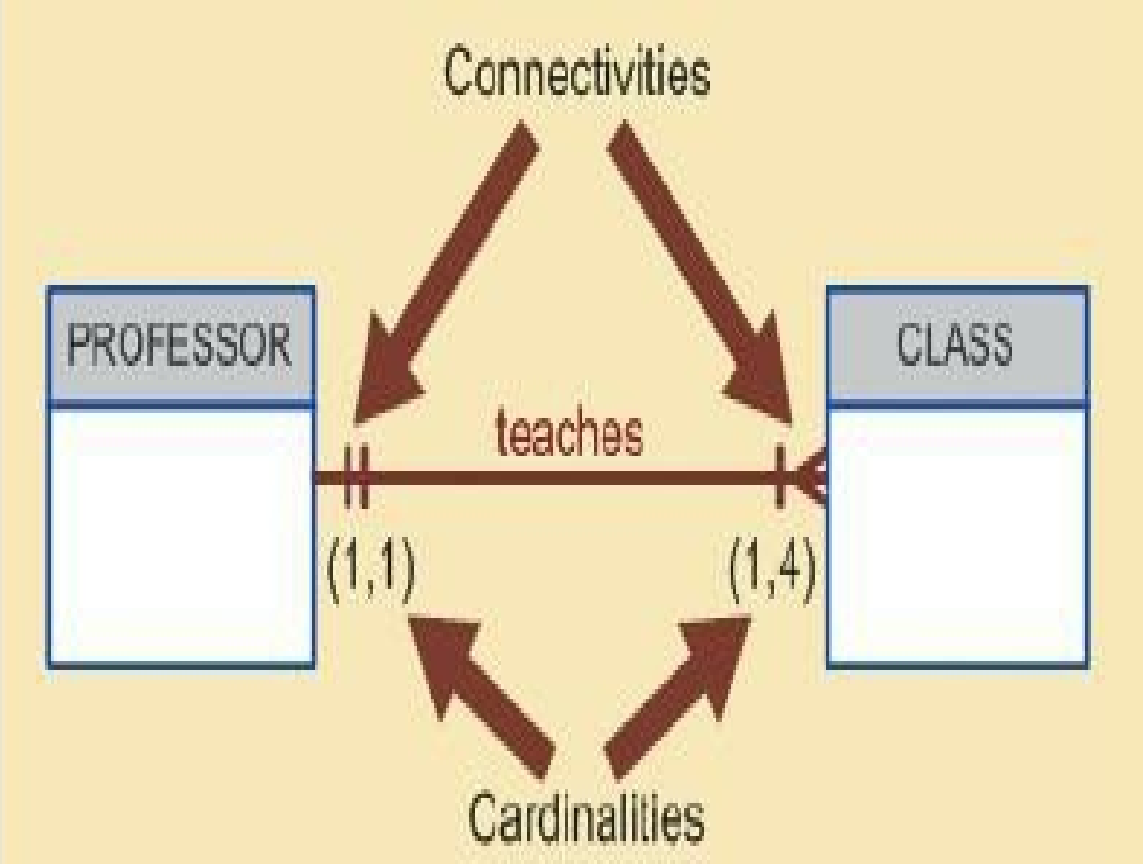
Table name: CLASS

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	ROOM_CODE	PROF_NUM
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10018	CIS-220	2	MWF 9:00-9:50 a.m.	KLR211	114
10021	QM-261	1	MWF 8:00-8:50 a.m.	KLR200	114

Associative entity (or computed attr.)

- **In ER model the associative entity is used to represent an M:N relationship between two or more entities.**
- **associative entity, is also called a composite or bridge entity, is in a 1:M relationship with the parent entities and is composed of the primary key attributes of each parent entity.**
- **The associative entity can have additional attributes of its own, see the the ENROLL associative entity**
- **in Crow's Foot notation: the associative entity is identified as a strong (identifying) relationship, as indicated by the solid relationship lines between the parents and the associative entity.**

Cardinality constraints (minimum and maximum)



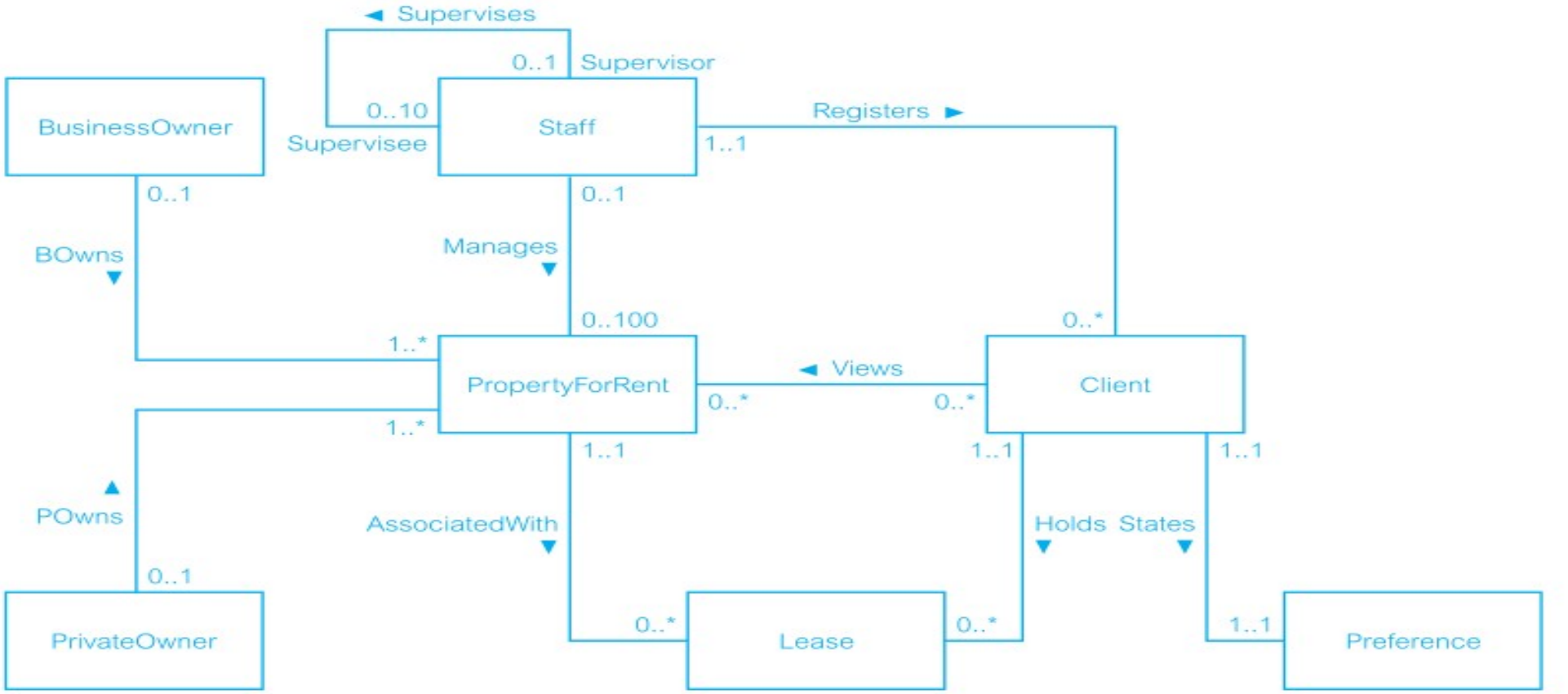
Connectivity – description of the relationship classification.

Cardinality- the minimum and maximum number of entity occurrences associated with one occurrence of the related entity.

- **In the ERD, cardinality is indicated by placing the appropriate numbers beside the entities, using the format (x,y). The first value represents the minimum number of associated entities, while the second value represents the maximum number of associated entities.**
- **In Crow's Foot modeling notation do not depict the specific cardinalities on the ER diagram**

Task: why should we have all these levels of schema?

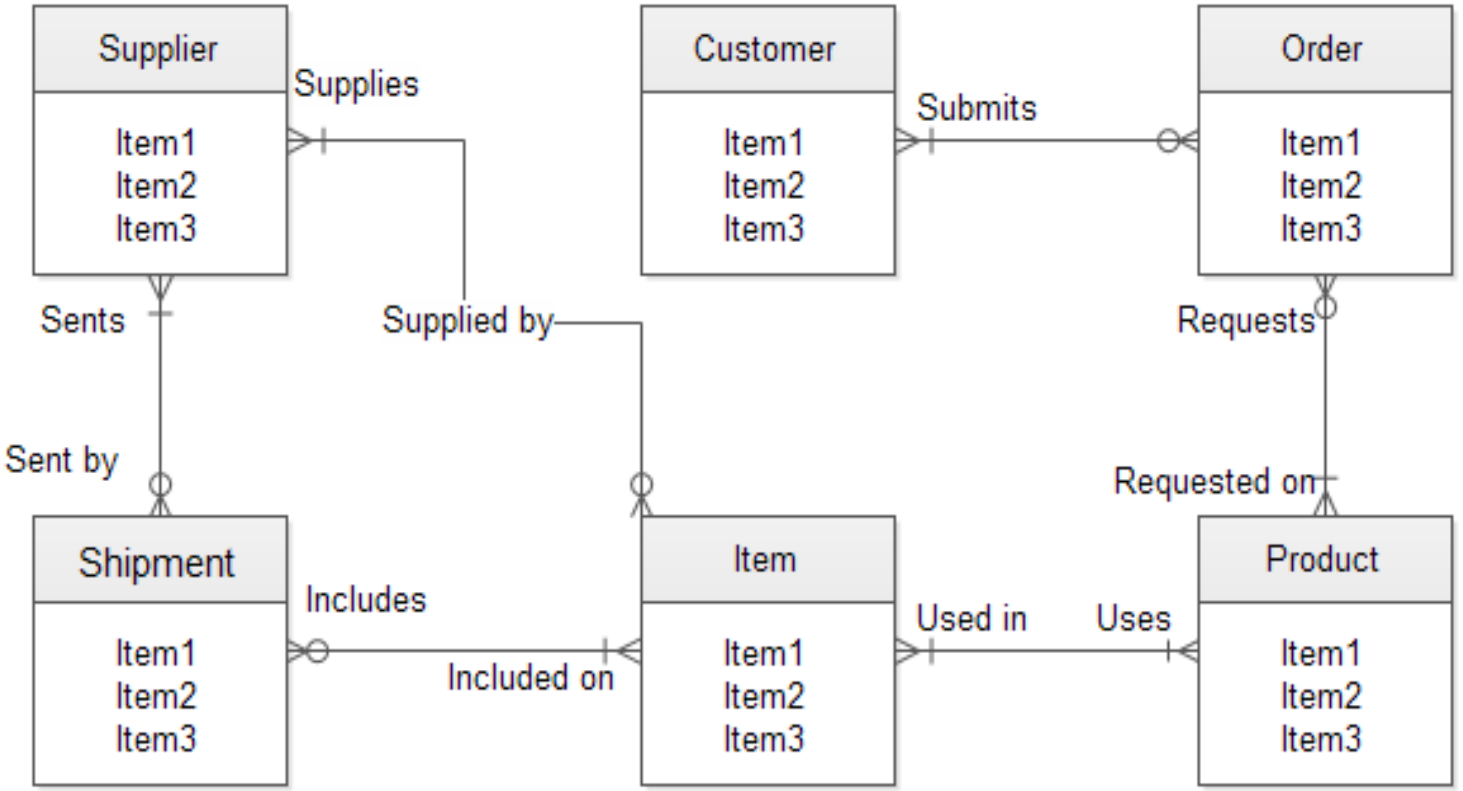
E-R diagram for common business situations(dreamhome)



Source: THOMAS M. CONNOLLY, CAROLYN E. BEGG (2021).

Task: why should we have all these levels of schema?

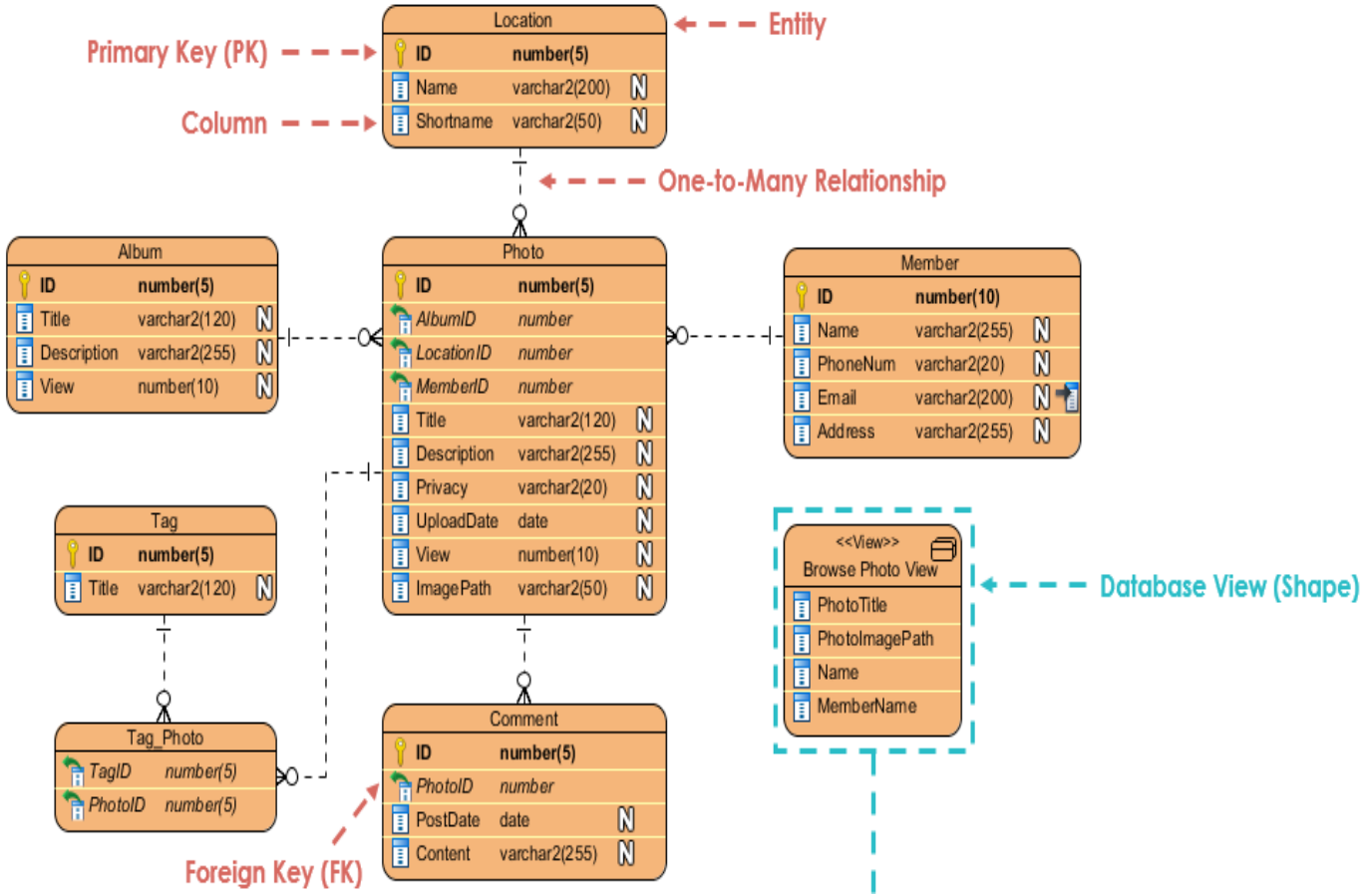
E-R diagram for common business situations(Order processing)



Source: https://www.edrawsoft.com/entity-relationship-diagrams.html

Task: why should we have all these levels of schema?

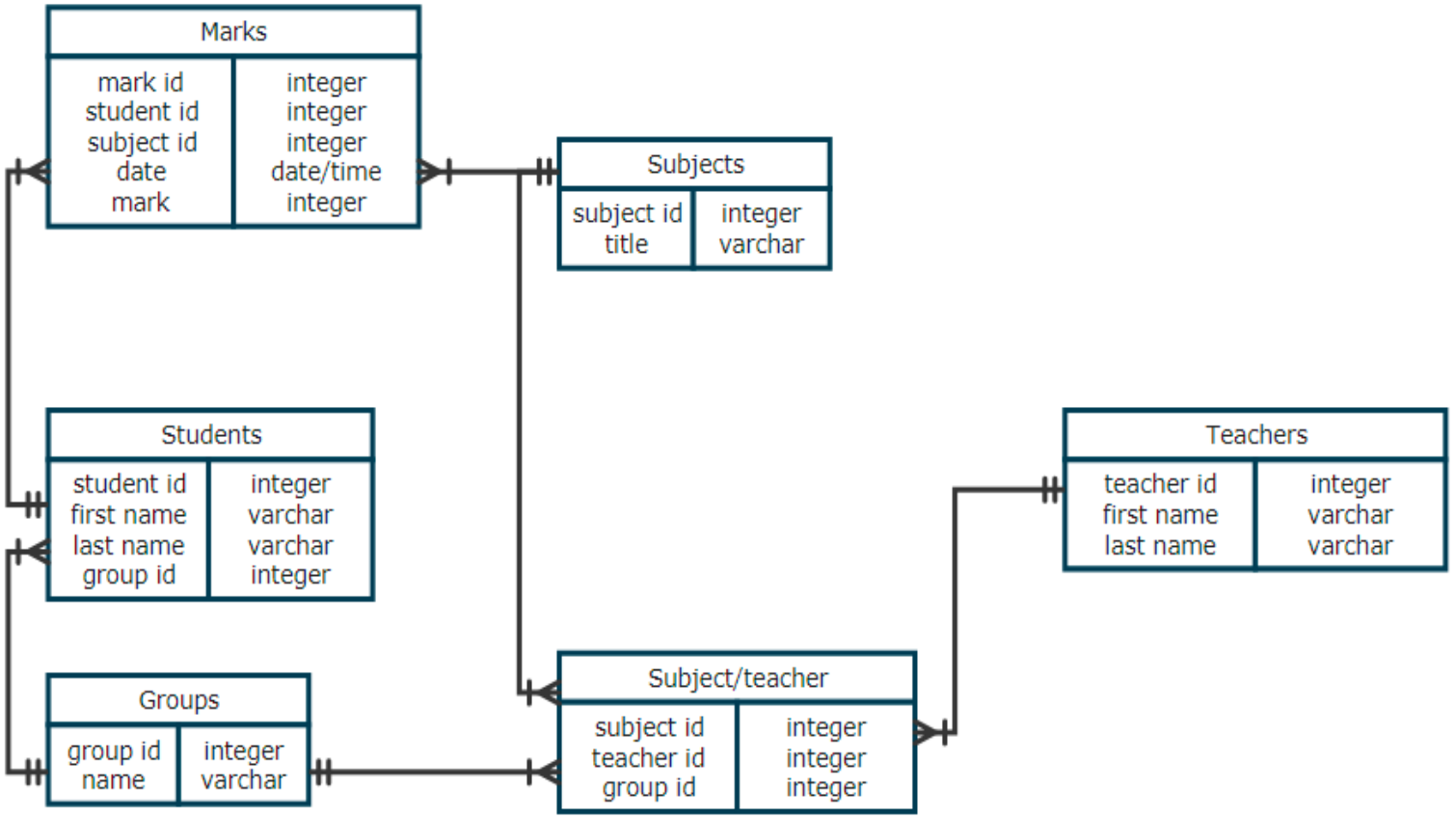
E-R diagram for common business situations(online photo album)



Source: **https://www.edrawsoft.com/entity-relationship-diagrams.html**

Task: **why should we have all these levels of schema?**

E-R diagram for common business situations(class environment)



Source: **https://www.edrawsoft.com/entity-relationship-diagrams.html**

Task: **why should we have all these levels of schema?**

Converting many-to-many relationship to an associative entity type

- Consider tables related in an M:N relationship
- The composite entity structure includes—as foreign keys—at least the primary keys of the tables that are to be linked.
- Defining a composite table's primary key: use the combination of those foreign keys OR create a new primary key.
- each entity in the ERM is represented by a table.
- A composite entity eg. ENROLL table can be created to link the tables for example CLASS and STUDENT.
- Here ENROLL table's primary key is the combination of its foreign keys CLASS_CODE and STU_NUM.
- In MS Access users may use the Autonumber data type to generate such line values automatically.

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Task: Summarize the importance of associative types

Converting many-to-many relationship to an associative entity type

Table name: STUDENT
Primary key: STU_NUM
Foreign key: none

Database name: Ch03_CollegeTry2

STU_NUM	STU_LNAME
321452	Bowser
324257	Smithson

Table name: ENROLL
Primary key: CLASS_CODE + STU_NUM
Foreign key: CLASS_CODE, STU_NUM

CLASS_CODE	STU_NUM	ENROLL_GRADE
10014	321452	C
10014	324257	B
10018	321452	A
10018	324257	B
10021	321452	C
10021	324257	C

Table name: CLASS
Primary key: CLASS_CODE
Foreign key: CRS_CODE

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	CLASS_ROOM	PROF_NUM
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
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Task: Summarize the importance of associative types

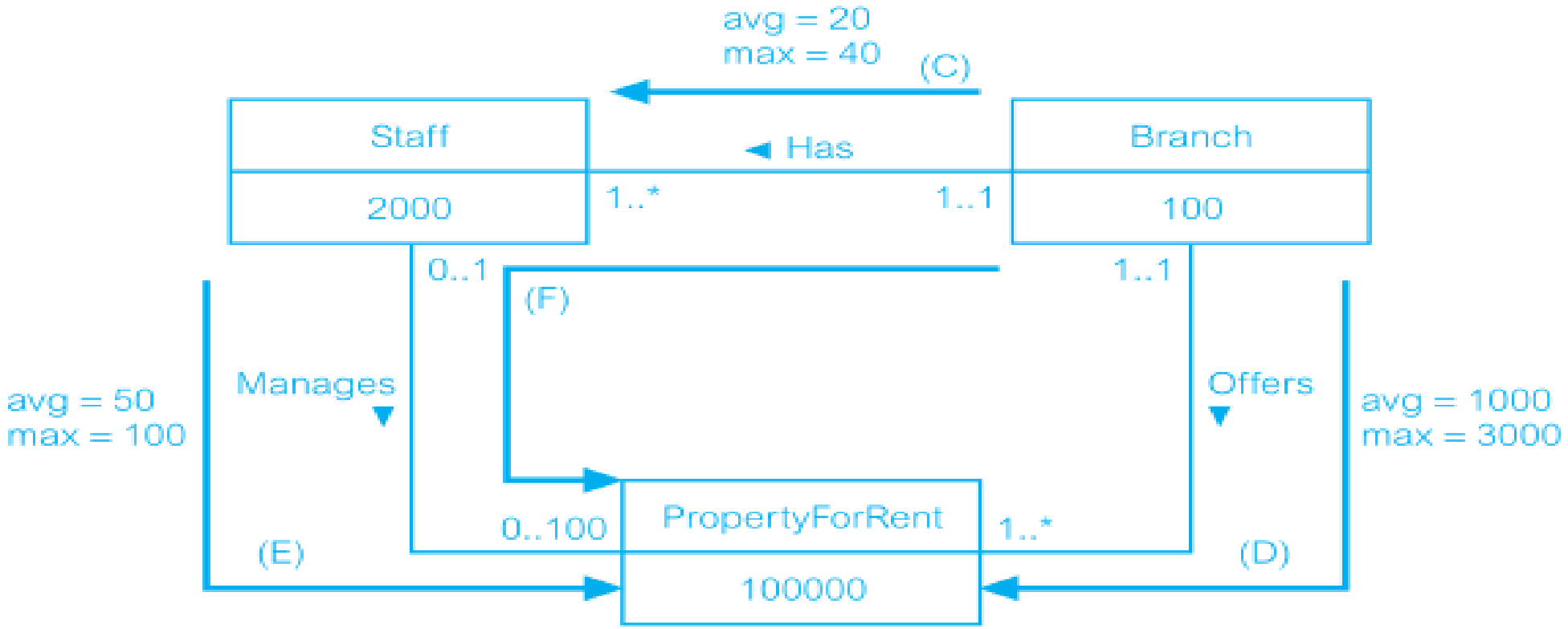
Modeling time-dependent data using relationships in an E-R diagram

- Where time is involved as an item of description it will be included as one of the attributes.
- In some cases especially for operational data, which the current transactions may be affected by time as load and number of transactions vary with time.
- The data representing the flow of data through time may be compiled and even projected.
- Some statistical or other models may be used.
- The time stamps or time IDs can be used.
- Expected transaction numbers may also be included in the E-R diagram.
- The things that can be checked include:
- the transactions that run frequently and will have a significant impact on performance;
- the transactions that are critical to the operation of the business;
- the times during the day/week when there will be a high demand made on the database (called the peak load).

Task: Investigate how time can affect the performance of the database

Modeling time-dependent data using relationships in an E-R diagram

- **Where time is involved as an item of description it will be included as one of the attributes.**
- **In some cases especially for operational data, which the current transactions may be affected by time as load and number of transactions vary with time.**



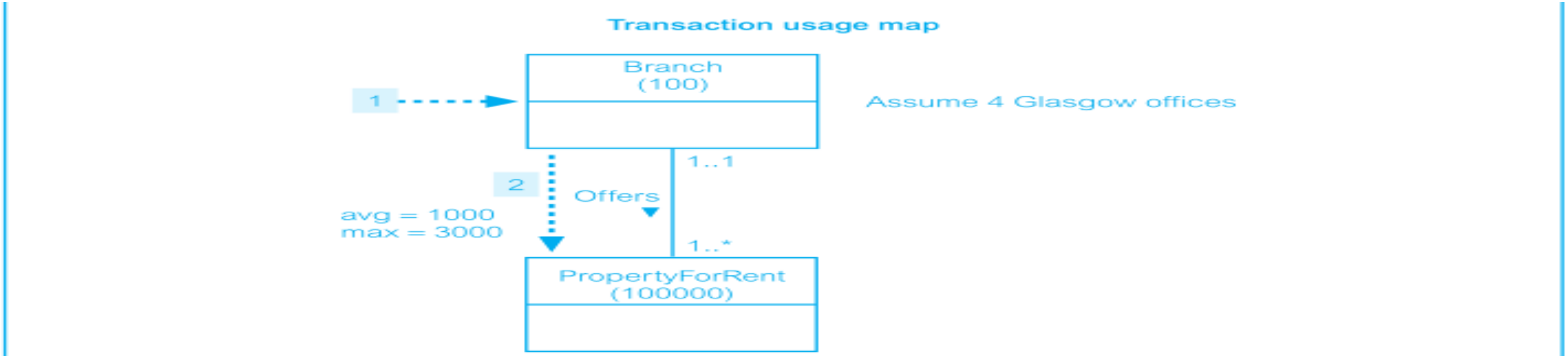
Task: Investigate how time can affect the performance of the database

Week 3 exercises

1) Describe how to write good names and definitions for entities, relationships, and attributes.
2) Distinguish unary, binary, and ternary relationships and give a common example of each.
3) Model each of the following constructs in an E-R diagram: composite attribute, multivalued attribute, derived attribute, associative entity, identifying relationship, and minimum and maximum cardinality constraints.
4) Draw an E-R diagram to represent at least two common business situations.
5) Convert a many-to-many relationship to an associative entity type given the entities PRODUCT and MANUFACTURER.
6) Model simple time-dependent data using relationships in an E-R diagram for student performance in the national examination for form four leavers.

Modeling time-dependent data using relationships in an E-R diagram

- **Where time is involved as an item of description it will be included as one of the attributes.**
- **In some cases especially for operational data, which the current transactions may be affected by time as load and number of transactions vary with time.**



Access	Entity	Type of Access	No. of References		
			Per Transaction	Avg Per Hour	Peak Per Hour
1 2	**Branch** (entry) **PropertyForRent**	R R	100 4000–12000	5000 200000–600000	10000 400000–1200000
Total References			**4100–12100**	**205000–605000**	**410000–1210000**

Task: Investigate how time can affect the performance of the database

Week 3 Exercises

1)Write good names and definitions for entities, relationships, and attributes.
2)Distinguish unary, binary, and ternary relationships and give a common example of each.
3)Model each of the following constructs in an E-R diagram: composite attribute, multivalued attribute, derived attribute, associative entity, identifying relationship, and minimum and maximum cardinality constraints.
4)Draw an E-R diagram to represent common business situations.
5)Convert a many-to-many relationship to an associative entity type.
6)Describe how to model time-dependent data using relationships in an E-R diagram.

Week 3 Session References

- **[Course Text] Carlos Coronel, Steven Morris, Peter Rob and Keeley Crockett Database Principles: Fundamentals of Design, Implementation, and Management, 14th Edition, 2022, ISBN-13978-0357673034.**

- **Thomas M. Connolly, Carolyn E. Begg (2021). Database Systems: A Practical Approach to Design, Implementation, and Management. Published by Pearson (July 14th 2021). ISBN-13: 9780137517053**

Thank You