[1DV503] Database Technology and Modeling

Gellért Szalai
School of Computer Science, Physics
and Mathematics, Linnaeus University, Sweden
gs222un@student.lnu.se

Task 1. The Hospital database (25 points)

1.1 Identify all entities and their attributes from the description of database requirements using the following Table template:

Entity	Attribute	Attribute Type	Key Attribute	Value type of attribute
Department	DepartmentID	Simple	true	Integer, not null, unique
Department	Name	Simple	false	String, not null
Department	HeadPhysician	Simple	false	String, null
Physician	PhysicianID	Simple	true	Integer, not null, unique
Physician	Name	Simple	false	String, not null
Physician	PhoneNumber	Simple	false	String, null
Physician	Address	Simple	false	String, null
Patient	PatientID	Simple	true	Integer, not null, unique
Patient	Name	Composite	false	String, not null
Patient	Address	Simple	false	String, null
Patient	PhoneNumber	Simple	false	String, null
Patient	InsuranceCode	Simple	false	String, null
Test	TestID	Simple	true	Integer, not null, unique
Test	Date	Simple	false	Date, not null
Test	Type	Simple	false	String, null
Test	Result	Simple	false	String, null
Appointment	AppointmentID	Simple	true	Integer, not null, unique
Appointment	StartDate	Simple	false	Date, not null
Appointment	EndDate	Simple	false	Date, not null
Room	RoomNumber	Simple	true	Integer, not null, unique
Room	Type	Simple	false	String, null
Room	Availability	Simple	false	String not null
Nurse	NurseID	Simple	true	Integer, not null, unique
Nurse	Name	Simple	false	String, not null
Nurse	PhoneNumber	Simple	false	String, null
Nurse	Specialization	Simple	false	String, null
Medication	MedicationID	Simple	true	Integer, not null, unique
Medication	ATCCode	Simple	false	String, null
Medication	Name	Simple	false	String, null
Medication	Type	Simple	false	String, null
Medication	Description	Composite	false	String, null
Procedure	ProcedureID	Simple	true	Integer, not null, unique
Procedure	Name	Simple	false	String, null
Procedure	Cost	Simple	false	Integer, null

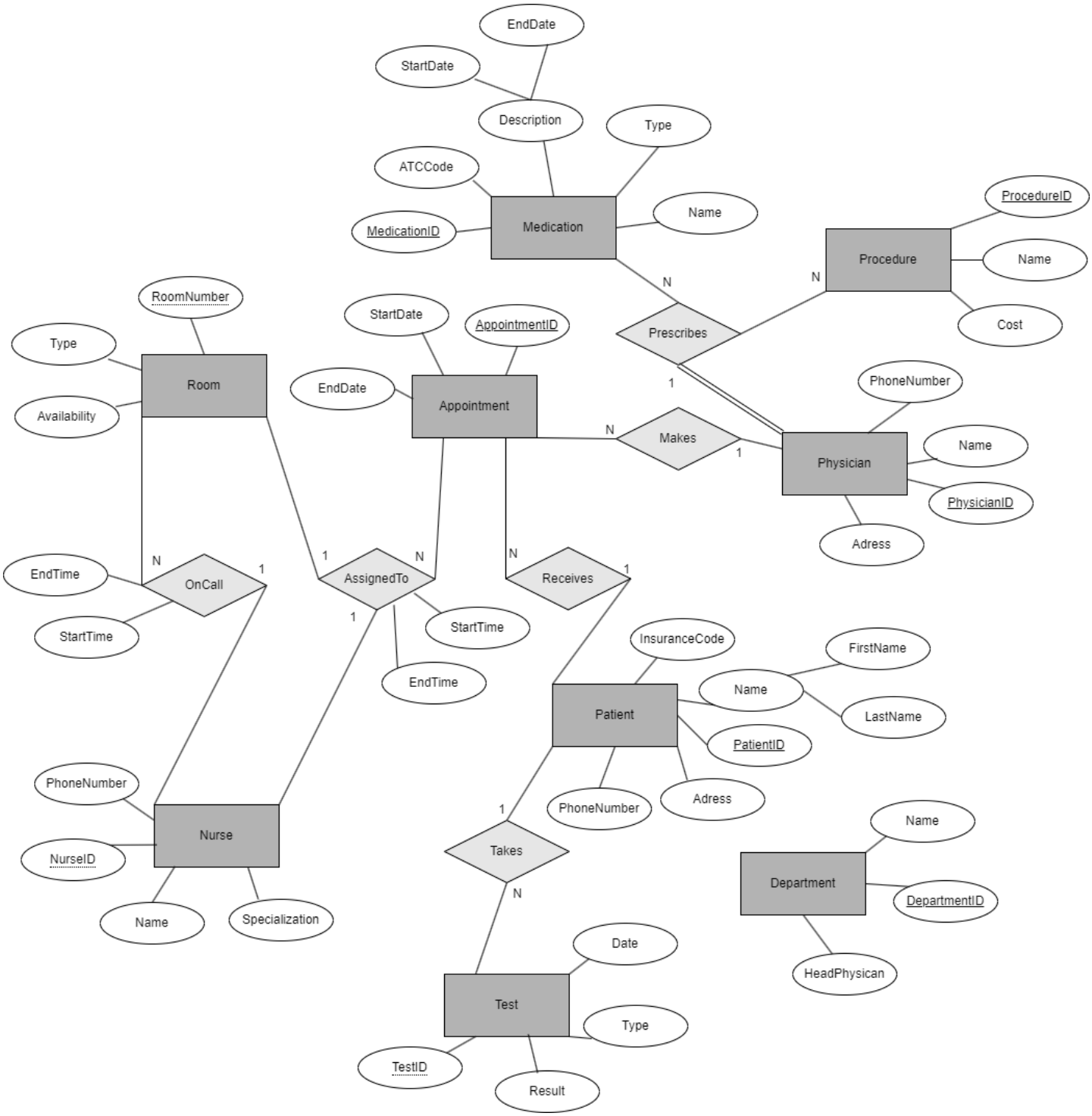
1.2 Identifying the relationship between entity sets using the following table template:

Entity A	Relationship Name	Entity B	Cardinality Ratio	Attribute of Relationship	Justify your decision
Physician	Makes	Appointment	1:N	None	A physician makes appointments with many patients, but a patient has appointments with one physician.
Physician	Prescribes	Procedure, Medication	1:N	None	Each prescription is associated with exactly one physician, but a physician can prescribe many procedures and medications.
Patient	Receives	Appointment	1:N	None	Each appointment is associated with exactly one patient, but a patient can have many appointments.
Patient	Takes	Test	1:N	None	Each test is associated with exactly one patient, but a patient can take many tests.
Room	AssignedTo	Appointment	1:N	None	Each appointment is assigned to exactly one room, but a room can be assigned to many appointments
Nurse	AssignedTo	Appointment	1:N	StartTime, EndTime	Each nurse can be on call for many rooms, but a room can have at most one nurse on call.
Nurse	OnCall	Room	1:N	StartTime, EndTime	Each nurse can be on call for many rooms,

					but a room can have at most one nurse on call.

1.3 Design an ER schema for hospital database based on information provided in task 1, and entities defined in 1.2 with relationships defined in 1.3.

The ER schema should contain entities with their corresponding attributes, key attributes of each entity, relationship types, and their corresponding cardinality ratio.



Task 2 Conference Review Database (25 points)

2.1 Identify all entities and their attributes from the description of Conference review database requirements using the following Table template:

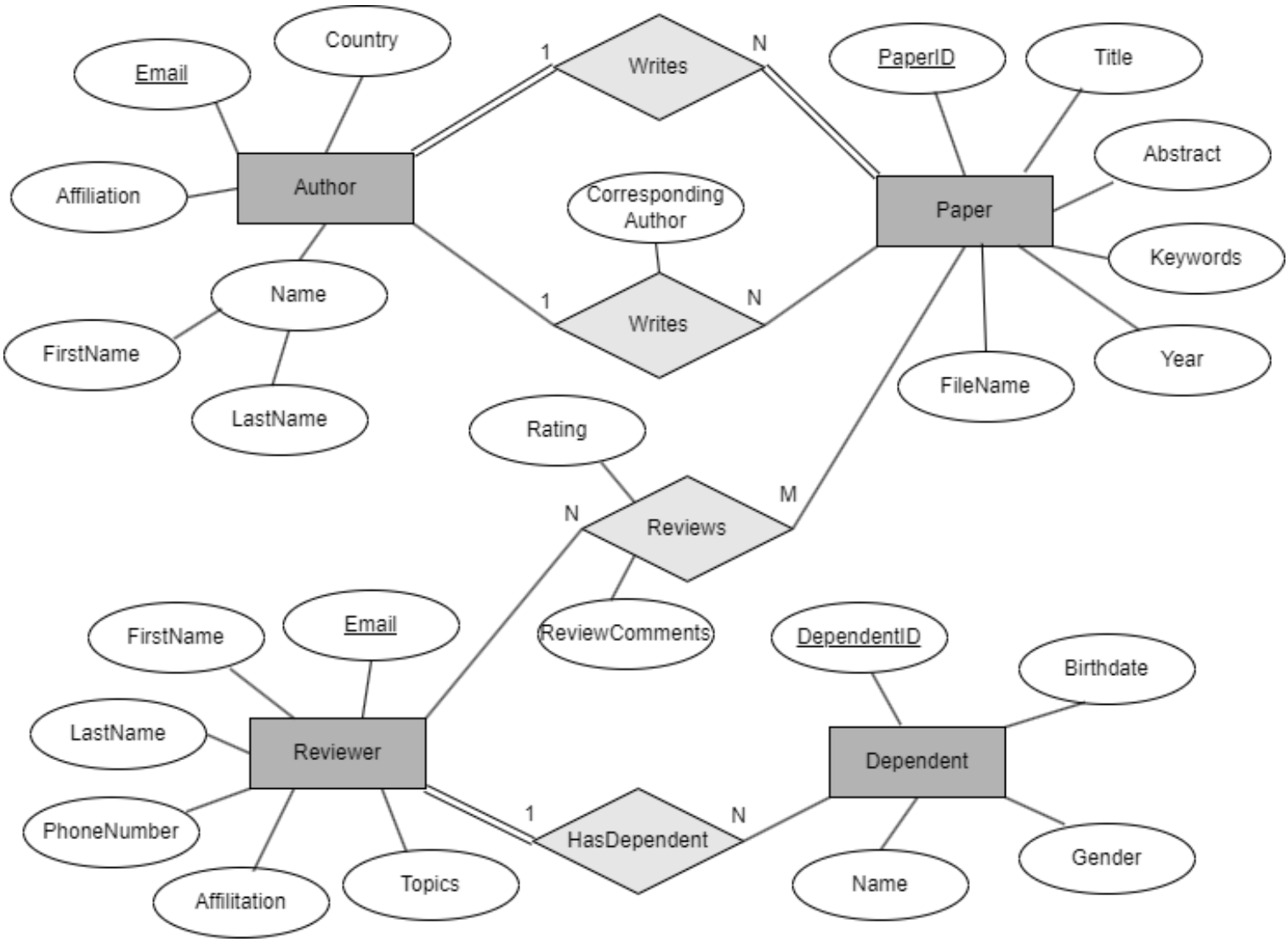
Entity	Attribute	Attribute Type	Key Attribute	Value type of attribute
Author	Email	Simple	true	String, not null, unique
Author	Name	Composite	false	String, not null
Author	Affiliation	Simple	false	String, not null
Author	Country	Simple	false	String, not null
Paper	PaperID	Simple	true	Integer, not null, unique
Paper	Title	Simple	false	String, not null
Paper	Abstract	Simple	false	String, not null
Paper	Keywords	Multivalued	false	String, not null
Paper	Year	Simple	false	Integer, not null
Paper	FileName	Simple	false	String, not null
Reviewer	Email	Simple	true	String, not null, unique
Reviewer	FirstName	Simple	false	String, not null
Reviewer	LastName	Simple	false	String, not null
Reviewer	PhoneNumber	Simple	false	, null
Reviewer	Affiliation	Simple	false	String, not null
Reviewer	Topics	Multivalued	false	String, null
Dependent	DependentID	Simple	true	Integer, not null, unique
Dependent	Name	Simple	false	Integer, not null
Dependent	Gender	Simple	false	Integer, not null
Dependent	Birthdate	Simple	false	Date, not null

2.2 Identifying the relationship between entity sets using the following table template:

Entity A	Relationship Name	Entity B	Cardinality Ratio	Attribute of Relationship	Justify your answer
Author	Writes	Paper	1:N	-	An author can write 0 or more papers, and each paper is written by at least one author.

Paper	Writes	Author	N:1	CorrespondingAuthor	A paper can have multiple authors, but only one is marked as the corresponding author.
Reviewer	Review	Paper	N:M	Rating, ReviewComments	A reviewer can review 0 or more papers, and a paper can be reviewed by 2 to 4 reviewers.
Reviewer	HasDependent	Dependent	1:N	-	A reviewer can have 0 or more dependents.

2.3 Design an ER schema for review database based on information provided in task 2, and entities defined in 2.1 with relationships defined in 2.2. You are free to make additional assumptions if you feel that some information is missing. Make sure to **document all assumptions** that you make. Please justify your assumptions.



Assumptions and Justifications:

1. In the **AUTHOR** entity, the **Email** attribute is chosen as the primary key (**PK**) since it is expected to be unique for each author.
2. The **WRITES** relationship is established between **AUTHOR** and **PAPER** with a many-to-many (M:N) cardinality, as a paper can have multiple authors, and an author can write multiple papers.
3. The **CorrespondingAuthor** relationship is introduced to identify the corresponding author for a paper. It is assumed that only one author is marked as the corresponding author for simplicity.
4. The **REVIEWER** entity has a **TopicsOfInterest** attribute to capture the areas of interest for each reviewer.
5. The **REVIEWS** relationship is formed between **REVIEWER** and **PAPER** with a many-to-many (M:N) cardinality, as a reviewer can review multiple papers, and a paper can be reviewed by multiple reviewers.
6. The **HAS_DEPENDENT** relationship links **REVIEWER** with **DEPENDENT** to represent the dependents associated with each reviewer. It is assumed that a reviewer can have multiple dependents.
7. In the **DEPENDENT** entity, **Birthdate** is considered as a **Date** attribute for simplicity.

Task 3. Bank database (25 points)

1. List all strong (non-weak) entities in the ER diagram:
    - Bank
    - Customer
    - Account
    - Loan
2. Is there a weak entity? If so, give its name, partial key, and identifying relationship (owner entity):
    - Yes, the weak entity is "Bank_Branch."
    - Partial key: Branch_no
    - Identifying relationship: Has_Brances (with owner entity "Bank")
3. What constraints do the partial key and the identifying relationship (owner) of the weak entity have in this diagram:
    - The partial key "Branch_no" is unique within each account.
    - The identifying relationship "Has_Branches" indicates that each customer is identified within the scope of an account.
4. List the names of all relations (entities) and specify the (min, max) constraint using total/partial participation of an entity in a relationship (on both sides of the relation: left and right). Justify your answer:

Entity name	**Relationship name**	**(min,max)**	**Justify your answer**
Bank	Has_Branches	(1,N)	This indicates that a bank must have

			at least one branch, and it can have multiple branches (total participation).
Bank_Branch	Has_Branches	(1,1)	Each branch must be associated with exactly one bank (total participation).
Account	Has_Accounts	(0,N)	An account may or may not be associated with a bank branch (partial participation).
Bank_Branch	Has_Accounts	(0,N)	A bank branch may or may not have accounts (partial participation).
Account	A_C	(1,N)	An account must be associated with at least one customer (total participation).
Customer	A_C	(1,N)	A customer must have at least one account (total participation).
Customer	L_C	(0,N)	A customer may or may not have a loan (partial participation).
Loan	L_C	(1,N)	A loan must be associated with at least one customer (total participation).
Loan	Loan	(0,N)	A loan may or may not be associated with a bank branch (partial participation).
Bank_Branch	Loan	(1,N)	A bank branch must have at least one loan (total participation).

Task 4. Airport Management database (25 points)

4.1 Given the constraints shown in the ER schema below, respond to the following statements with True, False, or Maybe.

N	Statement	True/False /Maybe	Justify your answer
1	Every pilot has been a passenger in some flight.	True	Pilot entity has a relation “is a” with Passenger entity
2	Every flight has at least one deadheading pilot.	True	Pilot entity has a relation “Deadheading” with Flight entity with 1:N
3	Every flight has at least 2 pilots.	True	There is a minimum cardinality of 2 on the "Flies" relationship between "Flight" and "Pilot"
4	Every pilot has flown at least 2 times.	Maybe	If there is a N cardinality of the "Assigned" relationship between "Flight" and "Pilot,"
5	There are tickets that do not belong to any flight.	False	The "Belong to" relationship between "Ticket" and "Flight" with a minimum cardinality of (N:1)
6	Some airline does not have flights.	False	Airline entity has a Belong to relationship with Flight with 1:N so it can have N number of flights
7	Some flight does not have assigned aircraft.	False	Flight entity has 1 Aircraft entity with the Assigned relationship
8	Each flight has a departure and arrival airport assigned.	True	"Departure" and "Arrival" relationships between "Flight" and "Airport."
9	A passenger can be a pilot.	True	Between Passenger And Pilot entity there is an “is a” relationship with 1:1
10	Passengers can buy one ticket for the flight.	Maybe	Passenger can Book N Tickets and a Ticket is Belong to 1 Flight so it can book as many Ticket as want
11	There are tickets that do not have a class type (Economy, etc.)	False	Between Ticket and Class there is a Has relationship with 1:N and the N is double line
12	There are some tickets without payment.	True	Tickets may be booked but not paid for in advance.

13	There are some flights without tickets.	False	Between Ticket and Flight there is a Belong relationship with N:1 and with double lines
14	There are some aircraft that are not assigned to a flight.	False	Between Aircraft and Flight there is an Assigned relationship with 1:N and the N is double-lined
15	Some airlines do not have any flights.	True	The Belong to relationship between Airline and Flight with a minimum cardinality of 0