Author Information

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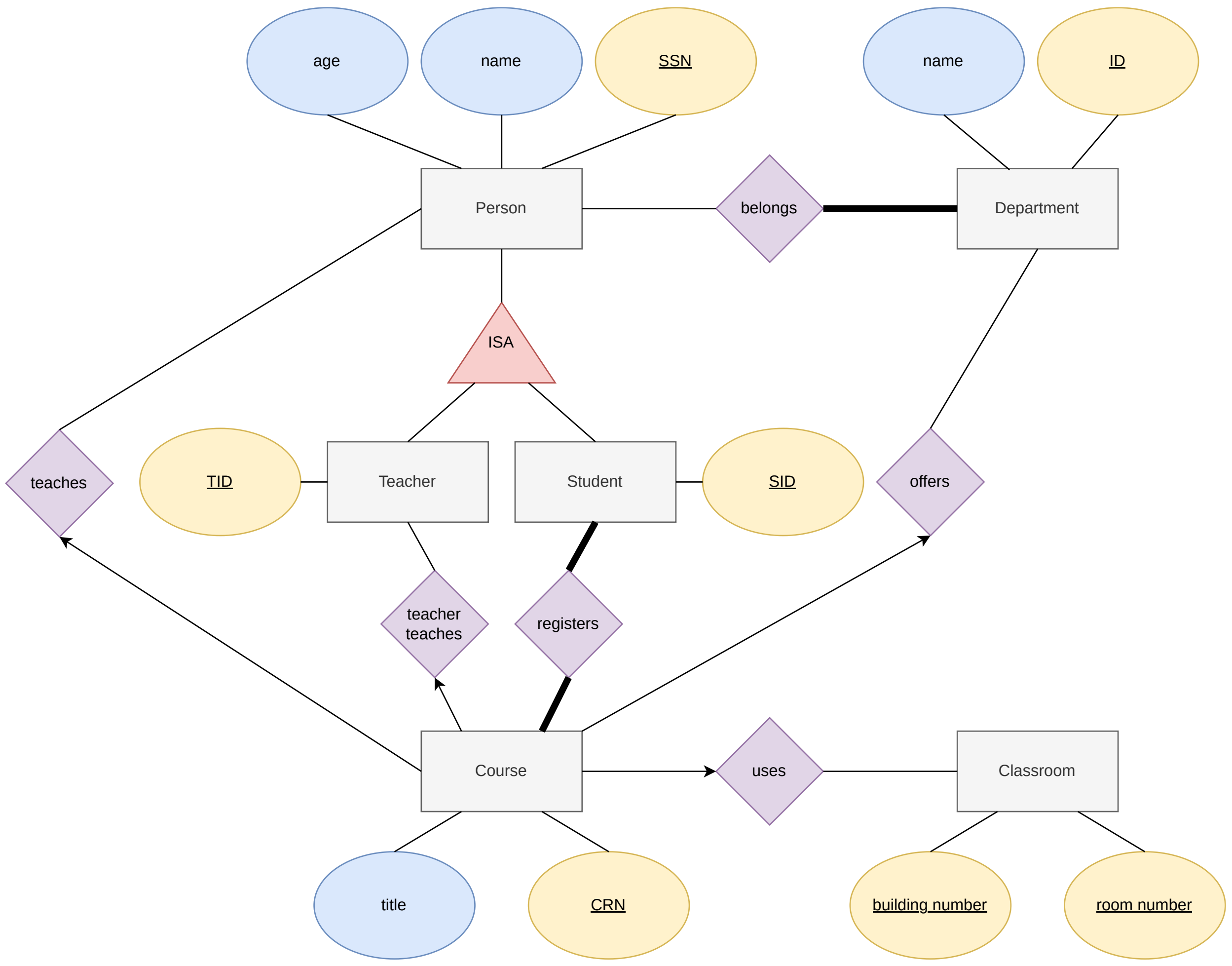
Part 1



Relationships

Person

- Both students and teachers belong to Person and have their own unique Student ID (SID) and Teacher ID (TID), respectively.

Person = Course

- **We exclude drop-out (休學) conditions here.**
- (*Requirement*) Each student can register for multiple courses.
    - (*Hypothesis*) (**Total Participation**) No student has zero courses. If you are a college student at CCU, you are required to study at least 16 credits except for senior students, who are required to study at least 8 credits.
- (*Requirement*) A course has many students registered for it.
    - (*Hypothesis*) (**Total Participation**) A course must have at least one student registered for it.
- (*Requirement*) A teacher can teach many courses, which means a teacher may not teach any course.
- (*Requirement*) (**One-to-many**) A course is taught by at most one **person**.
    - TA courses are included.
- (*Hypothesis*) A person may teach zero, one, or multiple courses.
- (*Hypothesis*) (**One-to-many**) A course must have at most one teacher.

Person = Department

- (*Requirement*) Each person can belong to multiple departments. It means that a person may not belong to any department.
- (*Requirement*) Every department also has many people associated with it.
    - (*Hypothesis*) (**Total Participation**) Every department must have at least one person associated with it.

Course = Department

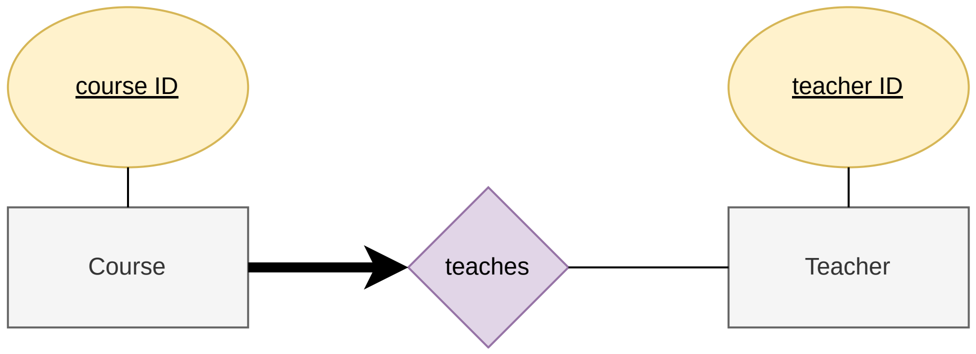
- (*Requirement*) A department can offer many courses, which means a department may not offer any course.
- (*Requirement*) (**One-to-many**) A course is offered by at most one department.

Course = Classroom

- (*Requirement*) (**One-to-many**) A course uses at most one classroom.
    - Some courses may not use any classroom. e.g. PE class.
- (*Requirement*) A classroom can be used for more than one course, which means that a classroom may not be used for any course.

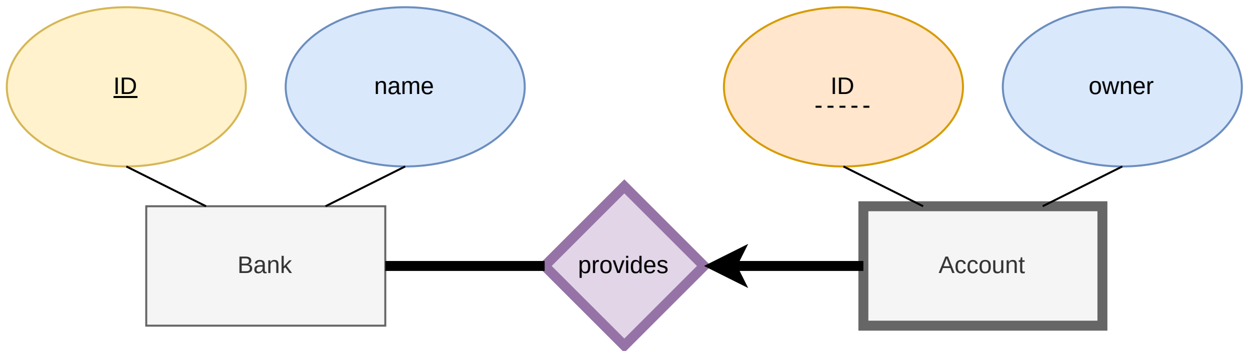
Part 2A

Total participation and **one-to-may** constraints.



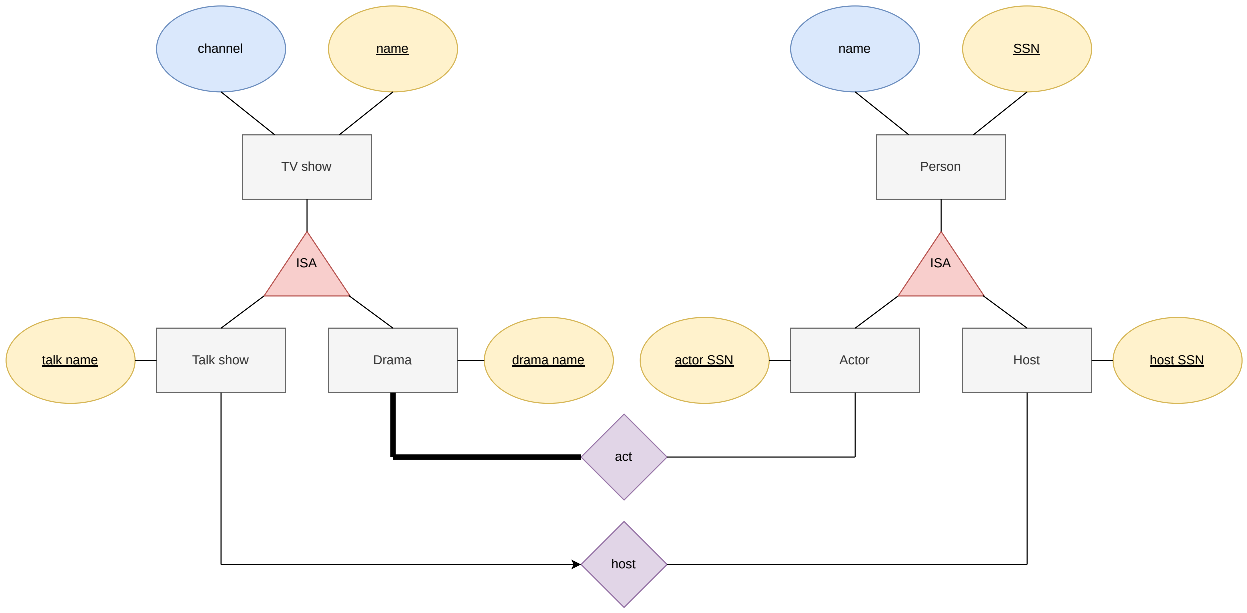
- (**Total Participation**) (**One-to-many**) A course must be taught by exactly one teacher.
- A teacher may not teach any courses and may teach multiple courses.

Part 2B



- (**Total Participation**) (**One-to-many**) Any accounts are provided by exactly one bank.
- (**Total Participation**) A bank provides at least one account.
- A bank account cannot be distinguished by the account number. Perhaps there is another same account number provided by another bank.
- A bank account is dependent on the existence of the particular provider.
- Every particular bank account is distinguished by both the bank ID and the account number. e.g. 700 (post office in Taiwan) - 004xxxx xxxxxxx (bank account).

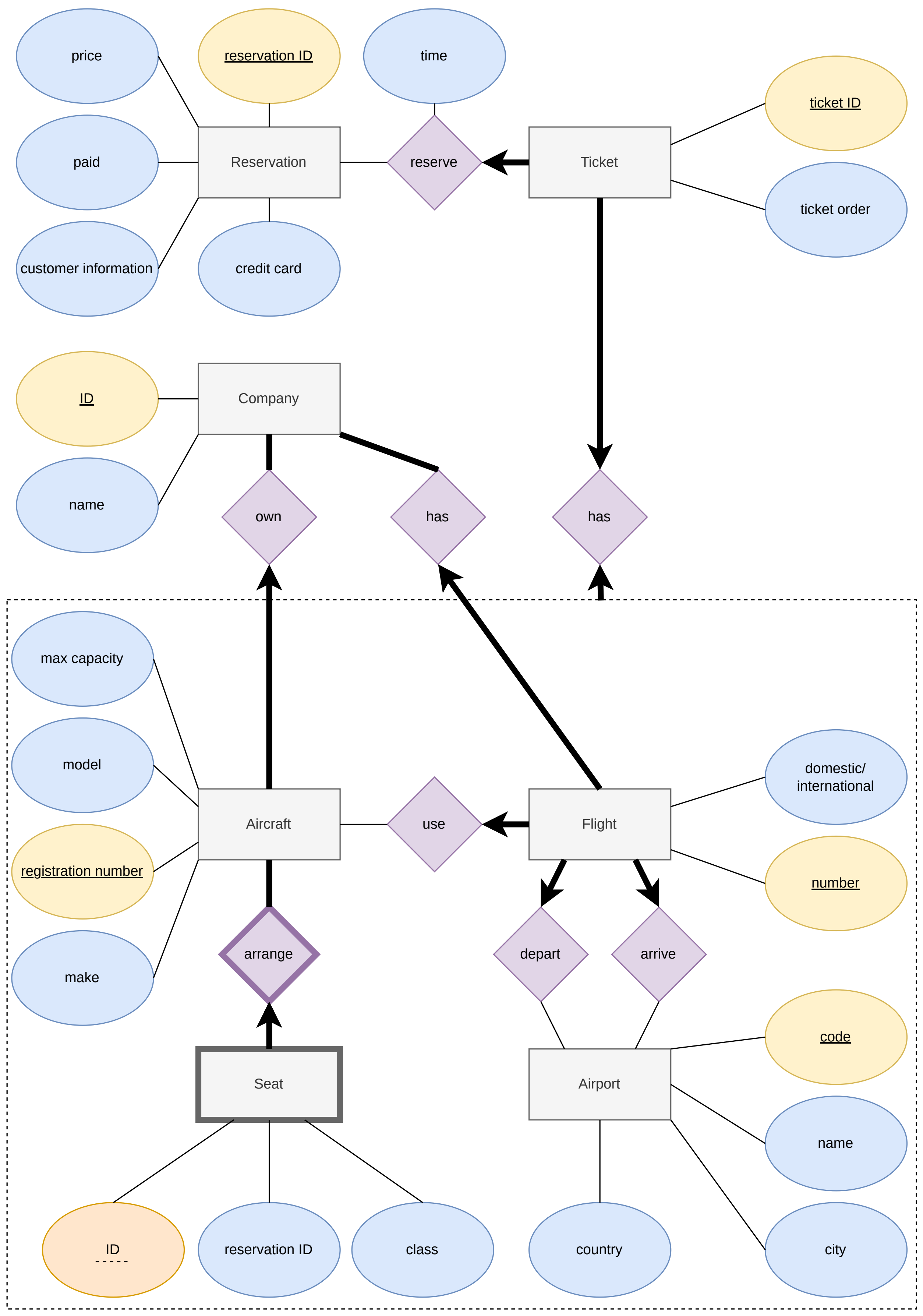
Part 2C



- (*Requirement*) Both talk shows and drama are TV shows.
- (*Requirement*) Both hosts and actors are people.
- (*Requirement*) (**One-to-many**) Every talk show has **at most one** host.
- (*Requirement*) A drama has many actors.

  (*Hypothesis*) (**Total Participation**) A drama must have at least one actor.

Part 5A


price
reservation ID
time
ticket ID
paid
Reservation
reserve
Ticket
customer information
credit card
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ID
Company
name
own
has
has
max capacity
model
Aircraft
use
Flight
domestic/ international
registration number
number
make
arrange
depart
arrive
code
Seat
Airport
name
ID
reservation ID
class
country
city

Design Pattern

- (*Requirement*) The reservation system will create a unique ID for identifying a single reservation.
- (**Total Participation**) Each reservation contains at least one ticket.
  - (**Total Participation**) (**One-to-many**) Each ticket contains exactly one departure and one arrival.
  - If your flight requires a layover at an intermediate airport, you will receive two tickets.
    - For example: TPE to GOT (瑞典 - 哥德堡 - 蘭德維特機場). You'll get two tickets: TPE to FRA (德國 - 法蘭克福機場), and FRA to GOT.
- (*Requirement*) Each seat records reservation ID.
  - (*Requirement*) For each flight, the system should store a list of available seats.
    - If the reservation ID of a record in the table Seat is NULL, then it means that the seat has not been reserved by anyone yet.
  - The reservation system can retrieve seat information by matching the seat's reservation ID with the desired reservation ID to be queried.
- (*Requirement*) Each flight has three seat classes: First Class, Business Class, and Economy class. We set the "class" attribute in the "Seat" entity.
- The seat is a weak entity because it is meaningless without being assigned by an aircraft.

Relationship

Reservation = Ticket

- (*Requirement*) Customers can make reservations without reserving seats.
  - Again, transfer flights cause multiple tickets.
- (*Hypothesis*) (**Total Participation**) (**One-to-many**) Each ticket belongs to exactly one reservation.

Ticket = Aggregation[Aircraft, Flight, Airport, Seat]

- (*Requirement*) (**Total Participation**) (**One-to-many**) Each seat can only be reserved for one customer and thus each ticket is assigned by exactly one aggregation of flight, aircraft, departure, arrival, and seat, and *vice versa*.

Company = Flight

- (*Requirement*) Each company has many flights.
  - (*Hypothesis*) (**Total Participation**) There is no airline that has zero flights.
- (*Hypothesis*) (**Total Participation**) (**One-to-many**) Each flight belongs to exactly one airline.

Company = Aircraft

- (*Requirement*) Each company has an ID and owns many aircraft.
  - (*Hypothesis*) (**Total Participation**) There is no airline that owns zero aircraft.
- (*Hypothesis*) (**Total Participation**) (**One-to-many**) Each aircraft belongs to exactly one airline.

Flight = Aircraft

- (*Hypothesis*) Each aircraft can be used for different flights, or not be used for any flight.
- (*Hypothesis*) (**Total Participation**) (**One-to-many**) Each flight uses exactly one aircraft.

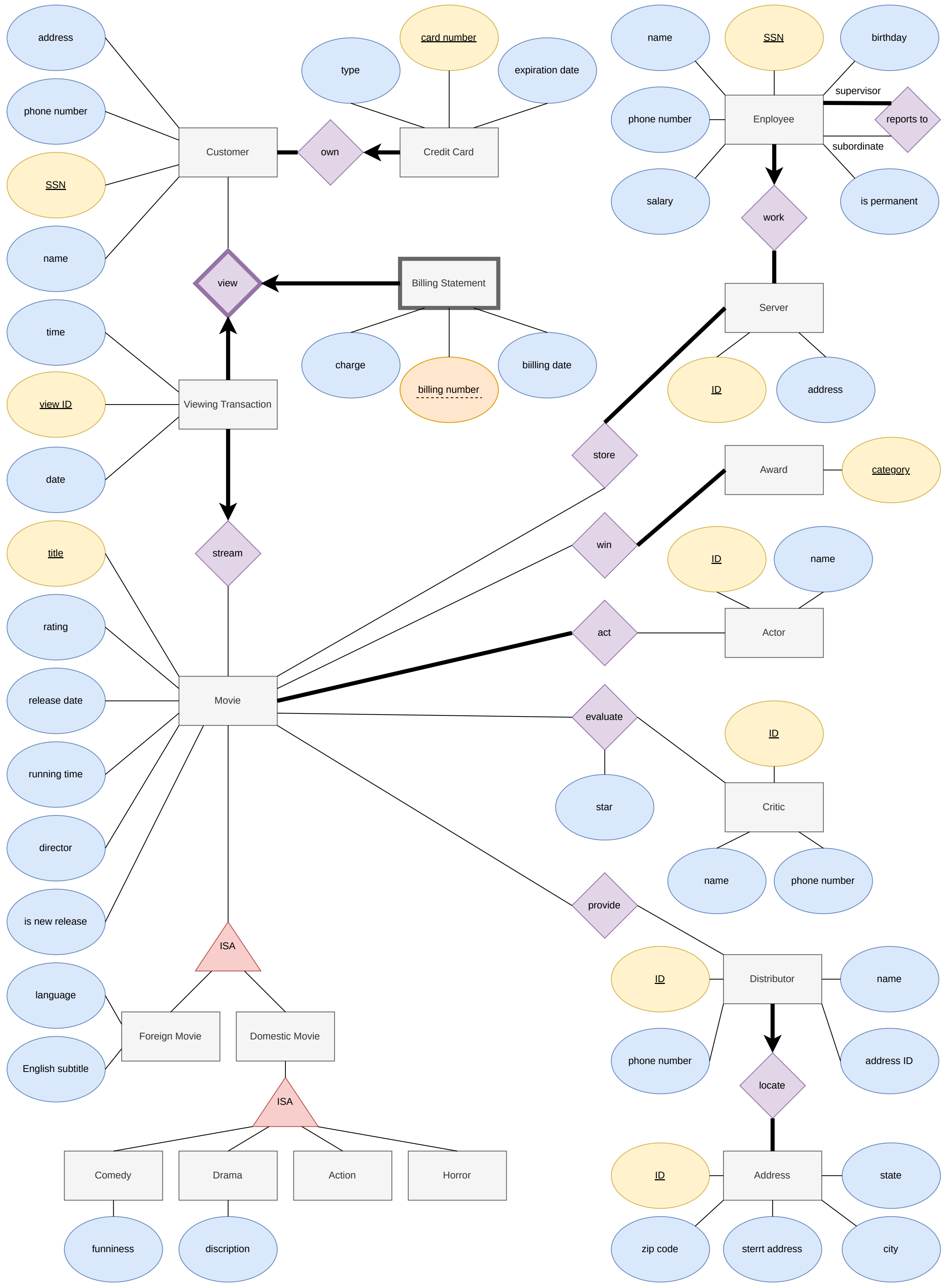
Aircraft = Seat

- (*Requirement*) (**Total Participation**) (**One-to-many**) The seat arrangements are associated with aircraft.
- (*Hypothesis*) (**Total Participation**) Each aircraft has multiple seats and has at least one seat.

Flight = Airport

- (*Requirement*) (**Total Participation**) (**One-to-many**) Each flight departs from and arrives at registered airports.
  - Here we define that each ticket contains only a one-way trip, which means there is only exactly one departure and one arrival.
- (*Hypothesis*) An airport may be used for many flights, or not be used for any flight.

Part 6A


address
phone number
SSN
name
Customer
own
type
card number
expiration date
Credit Card
name
SSN
birthday
phone number
Enployee
supervisor
reports to
subordinate
salary
work
is permanent
view
Billing Statement
charge
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Server
ID
address
time
view ID
date
Viewing Transaction
store
Award
category
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ID
name
stream
title
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running time
director
is new release
Movie
act
Actor
evaluate
ID
star
Critic
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phone number
provide
ISA
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English subtitle
Foreign Movie
Domestic Movie
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Design Pattern

Customer = Viewing Transaction = Movie

- A unique viewing transaction is created when a customer views a movie.
    - (*Requirement*) Each customer can view movies from a video server.
    - (*Hypothesis*) (**Total Participation**) (**One-to-many**) Each view transaction streams exactly one movie.
    - (*Hypothesis*) A movie may be viewed by one, multiple, or zero customers.
    - (*Hypothesis*) (**Total Participation**) (**One-to-many**) Each view transaction is created for exactly one customer.
    - (*Hypothesis*) A customer may view one, multiple, or zero movies.

Customer = Viewing Transaction = Billing Statement

- (*Requirement*) Each customer receives one bill statement after each viewing transaction.
- (*Requirement*) (**Weak Entity**) A billing number is unique for a particular customer. It is not unique across different customers.

Release Charge Information

- (*Requirement*) We define a new attribute "is new release" to mark the movie.
    - We then further use this information to determine the fee.
- (*Requirement*) We have to check the "view" relation table if the customer *has seen this movie* when creating a new viewing transaction in order to determine the fee.

Relationship

Movie = Critic

- (*Requirement*) Each movie could be viewed by one or more critics, which means a movie may not be viewed by any critics.
- (*Hypothesis*) A critic may evaluate zero, one, or multiple movies.

Movie = Award

- (*Requirement*) A movie may have won one or more academy awards, which means a movie may not win any awards.
- (*Hypothesis*) (**Total Participation**) An award must be given to at least one movie.

Movie = Server

- (*Requirement*) Each movie is stored on a number of different video servers.
- (*Hypothesis*) (**Total Participation**) A video server must store at least one movie.

Movie = Distributor

- (*Requirement*) Each movie can be supplied by only one distributor, which means that a movie can be supplied by multiple distributors or no distributors.
- (*Requirement*) One distributor might provide several movies, which means that a distributor might not provide any movies.

Movie = Actor

- (*Requirement*) (**Total Participation**) A movie has one or more actors.
- (*Hypothesis*) An actor may act in one, multiple, or zero movies.

Server = Empolyee

- (*Requirement*) (**Total Participation**) (**One-to-many**) An employee works at the location of one of the video servers.
- (*Hypothesis*) (**Total Participation**) A video server must have at least one employee.

Distributor = Address

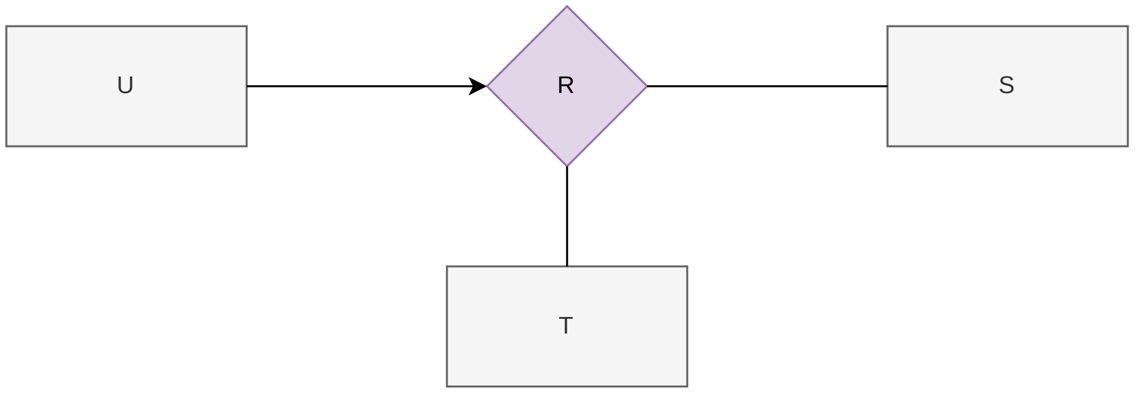
- (*Hypothesis*) (**Total Participation**) (**One-to-many**) A distributor is located at exactly one address.
- (*Hypothesis*) (**Total Participation**) The table "Address" is created for the table "Distributor". Thus, an address must contain at least one distributor.

Customer = Credit Card

- (*Requirement*) (**Total Participation**) Each customer must have one or more credit cards.
- (*Hypothesis*) (**Total Participation**) (**One-to-many**) A credit card belongs to exactly one customer.

Part 7

We redraw the figure as follows:



There is only a *one-to-many* constraint. Thus, 1 instance in entity U contains 0 or 1 instance in entity S and T within 1 relation R.

7A

- Since $r = 1$, then there is only one relation for U, S, and T.
- The number of instances of $u = 4$, $s = 3$, and $t = 2$ is all greater than 1.

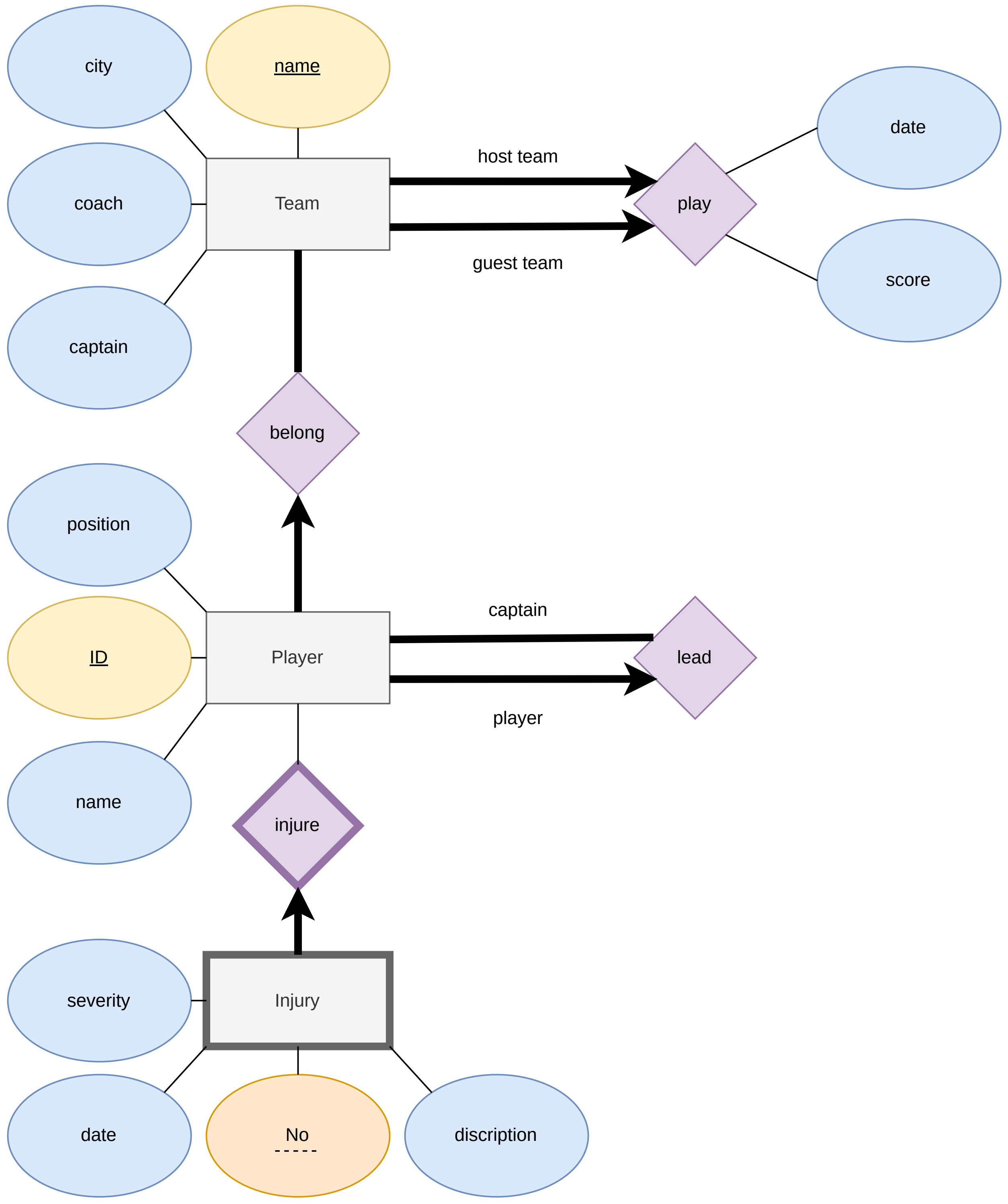
Answer: Yes (Valid)

7B

- Since $s = 1, t = 1$, and entity U has a *one-to-many* constraint to S and T, all possible combinations are {None, s, t, {s, t}}, 4 kinds of possibilities.
- We know that $u = 50$, which means there are $50 \times 4 = 200$ different relations.
- $r = 100 \leq 200.$

Answer: Yes (Valid)

Part 8



Relationship

Team = Player

- (*Hypothesis*) (**Total Participation**) A team has at least one player.
- (*Requirement*) (**Total Participation**) (**One-to-many**) Each player belongs to only one team.

Team

- (*Requirement*) (**Total Participation**) (**One-to-many**) There must have exactly two different teams joining a match.

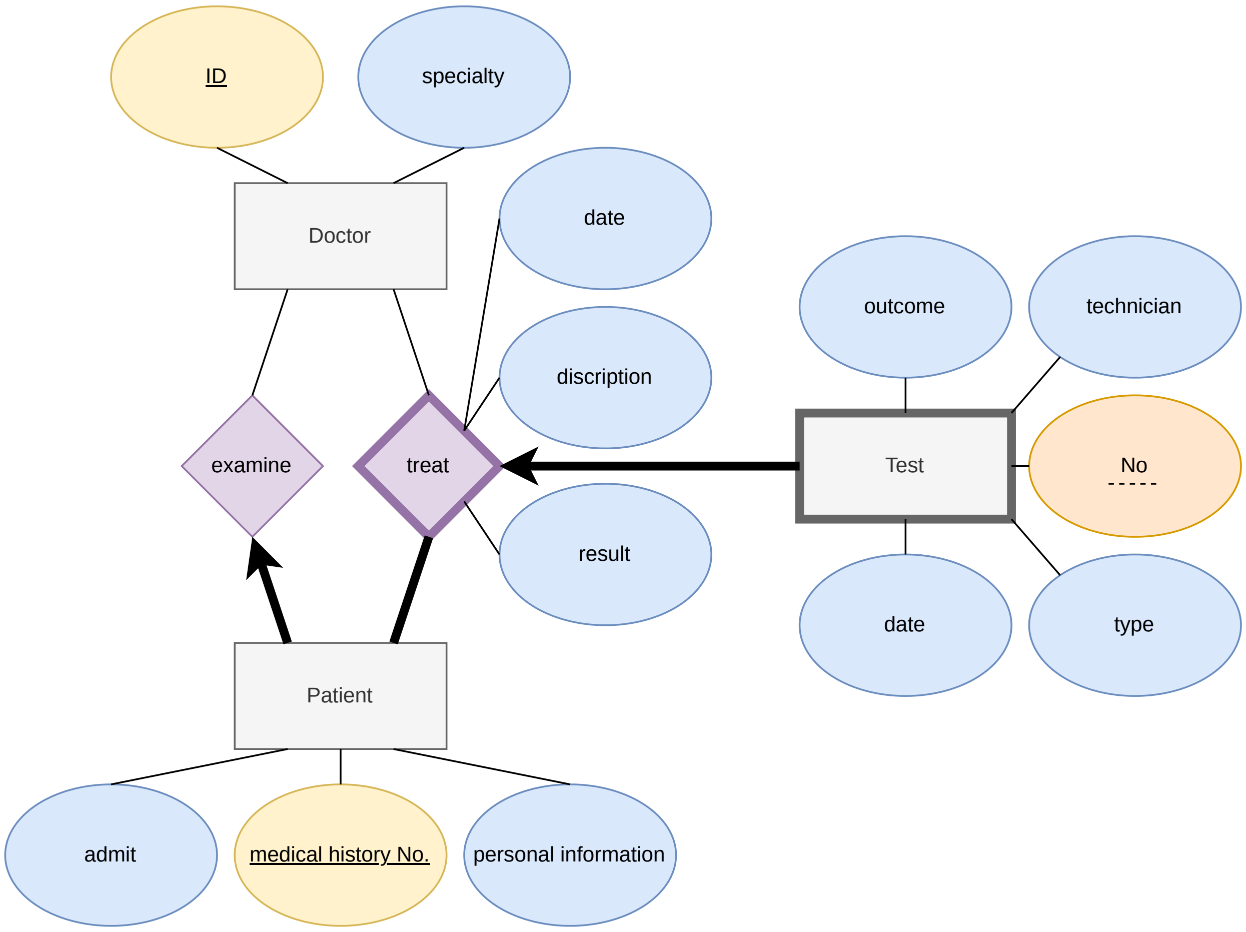
Player

- (*Requirement*) A team captain is also a player.
  - (*Hypothesis*) (**Total Participation**) A captain leads at least one player.
  - (*Hypothesis*) (**Total Participation**) (**One-to-many**) A player has exactly one captain.

Player = Injury

- (*Requirement*) (**Weak Entity**) An injury record is owned by a particular player.

Part 9



Design Pattern

- (*Hypothesis*) For each patient, we have an attribute called "admit", which describes whether this patient is the first visit or not.
- (*Requirement*) (**Total Participation**) (**One-to-many**) If this patient is the first visit to this hospital, then this patient is examined by exactly one doctor.
- (*Requirement*) (**Total Participation**) Otherwise, this patient is treated by at least one doctor.

Relationship

Doctor = Patient

- (*Hypothesis*) A doctor may examine zero, one, or multiple patients.
- (*Hypothesis*) A doctor may treat zero, one, or multiple patients.

Patient = Test

- (*Requirement*) (**Weak Entity**) A test is owned by a particular patient.