Exercise 1

Question 1

The CBD and South East Light Rail is a new light rail network for Sydney, currently under construction. The 12km route will feature 19 stops, extending from Circular Quay along George Street to Central Station, through Surry Hills to Moore Park, then to Kensington and Kingsford via Anzac Parade and Randwick via Alison Road and High Street. Construction will be completed, and services will start running in 2019.

As part of a Public Private Partnership with the NSW State Government, the construction company ACCIONA is responsible for delivering the infrastructure for this iconic addition to Sydney's transport network and a key initiative of Sydney's Long-Term Transport Master Plan, thus playing an important role in the light rail construction. In order to improve the management efficiency, the construction manager should be very familiar with the construction teams. Please help the manager to draw an ER diagram based on the following specifications about the construction company ACCIONA. State your assumptions if any.

- The company has multiple construction teams, identified by their team id. Team name and member number are also recorded. Each team has zero or more workers, only one of which is the team leader. In addition, each team has at least one vehicle.
- A worker must work only in one team and is identified by his/her id. We also need to record the name, phone number and salary. Each leader can only lead one team to guarantee work quality. Drivers and team leader are workers as well.
- Each vehicle is identified by its plate number. Its model, colour and purchase date are also recorded.
- Each vehicle has different drivers, and a driver may drive different vehicles. Some vehicles may not be owned by any team but must be owned by only one team if any.
- The company receives construction orders identified by order ID, construction location, working duration and price. Each order is conducted by multiple teams and a team can conduct only one order.

Draw an ER diagram to represent this scenario, and clearly state the assumptions you make if any.

Question 2

Convert your ER-diagram from Question 1 into a relational model.

Question 3

A civil aviation organization hires you to design a small database with the following requirements:

- An aircraft is uniquely identified by its RegistrationCode. For each aircraft, we record its model and capacity. Each aircraft is owned by only one airline.
- An airline is uniquely identified by its AirlineCode. For each airline, its name, country will be recorded. Each airline could have multiple phone numbers. The number of aircrafts belonging to this airline is needed.
- A pilot is uniquely identified by his/her PilotID. For each pilot, we also record his/her name, gender and DoB (Date of Birth).
- A flight is uniquely identified by its FlightID. For each flight, its flight number, route and time are recorded. The route is composed by an origin and a destination.
- A passenger is uniquely identified by his/her PassengerID. For each passenger, we also record his/her name and contact number.
- A passenger must book at least one flight, and a flight could have zero or more passengers. Whenever a passenger books a flight, the booking reference is recorded.
- A flight must be performed by at least one pilot, but a pilot may perform zero or more flights.
- A flight must be operated by one aircraft, but an aircraft may operate zero or more flights.
- An airline should own at least one aircraft and at least one pilot. Whenever a pilot starts to work in an airline, his employment date is recorded.

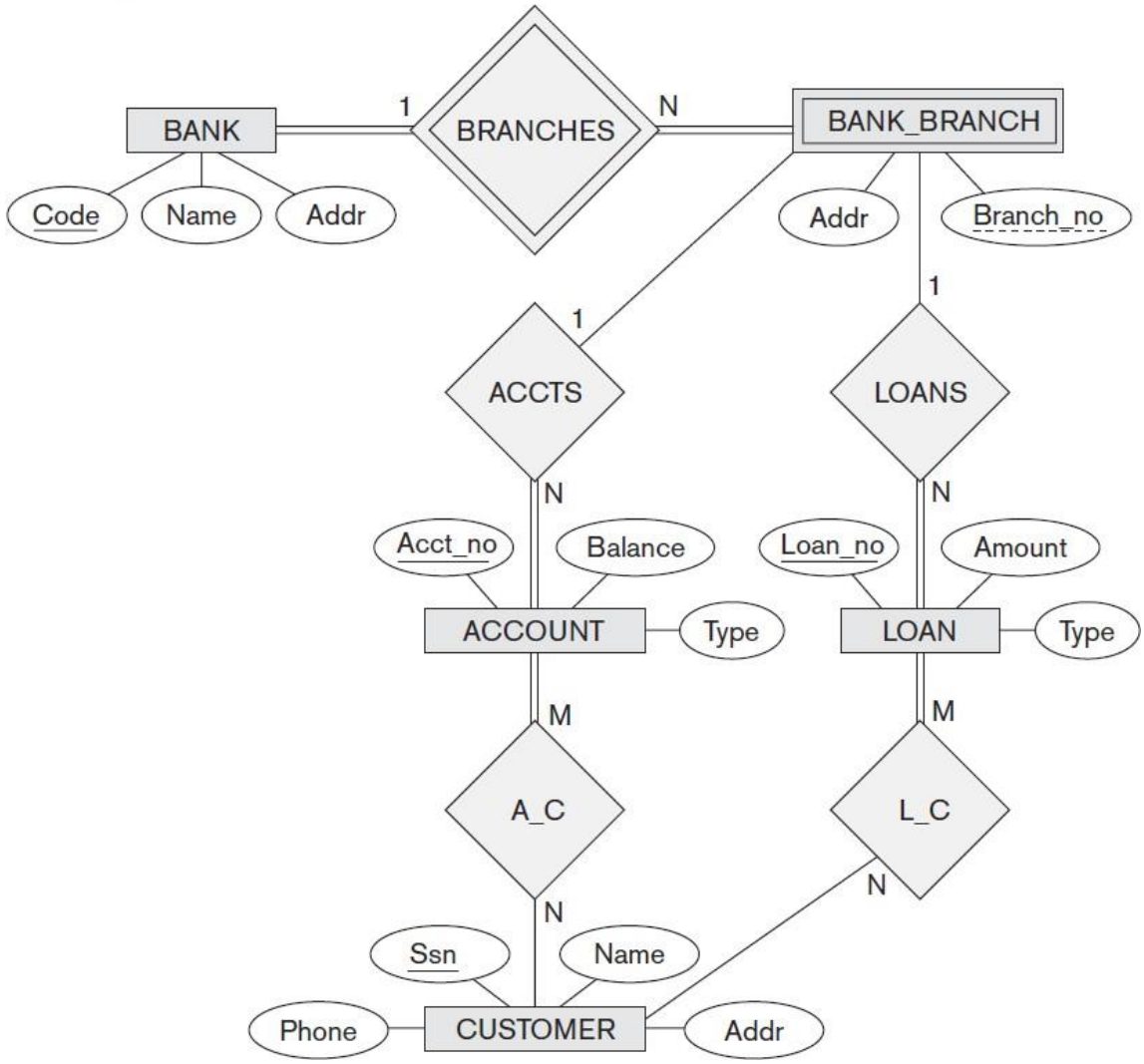
Draw an ER diagram to represent the scenario, clearly state the assumptions you make if any.

Question 4

Convert your ER-diagram from Question 3 into a relational model.

Question 5

An ER diagram for a BANK database schema.



Consider the ER diagram shown above for part of a BANK database. Each bank can have multiple branches, and each branch can have multiple accounts and loans.

(a) List the strong (non-weak) entity types in the ER diagram.

(b) Is there a weak entity type? If so, give its name, its partial key, and its identifying relationship.

(c) What constraints do the partial key and the identifying relationship of the weak entity type specify in this diagram?

Question 6

List concisely the user requirements that led to the ER schema design in Question 5.

Question 7

Cardinality ratios often dictate the detailed design of a database. The cardinality ratio depends on the real-world meaning of the entity types involved and is defined by the specific application. For the binary relationships below, suggest cardinality ratios based on common-sense meaning of the entity types. Clearly state any assumptions you make.

	Entity 1	Cardinality Ratio	Entity 2
1.	Student		SocialSecurityCard
2.	Student		Teacher
3.	ClassRoom		Wall
4.	Country		CurrentPresident
5.	Course		TextBook
6.	Item (that can be found in an order)		Order
7.	Student		Class
8.	Class		Instructor
9.	Instructor		Office
10.	E-bay Auction item		E-bay bid