Exercise 1

Question 1

UNSW is part of the Group of 8 universities (Go8) and consistently ranked in the top 100 universities worldwide. UNSW Library is one of Australia's major research libraries, with extensive scholarly information resources. It serves a large population of academic staff and students on two campuses and affiliated research institutes. To improve the management efficiency, the manager wants to build a Library Management System. Please help the manager to draw an ER diagram based on the following specifications. State your assumptions if any.

● A book is uniquely identified by its book id. For each book, we also record its title, price, and availability. A reader is uniquely identified by his/her reader id and we also record his/her name, phone number, expire date and address. The address is composed of street and suburb.

● A publisher is uniquely identified by its publisher id. For each publisher, the name is also recorded. An author is uniquely identified by his/her author id. For each author, the name, phone number and birth date are also recorded.

● A reader can borrow zero or more books and a book can be borrowed by zero or more readers. Thus, we need to record the starting date and ending date for the borrowing relationship.
● A publisher can publish zero or more books and a book is published by exactly one publisher. We also need to record the date of publication.
● An author can write zero or more books and a book is written by one or more authors.

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 2 into a relational model.

Question 3

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 4
Convert your ER-diagram from Question 3 into a relational model.

Question 5

A government founded project aims to collect statistics about university professors and their research projects. As a database system student, the first idea comes to your mind is to build a database to assist this purpose. Now, here is your task:
- Each research project has to be supported by a funding. A funding is uniquely identified by its ID, and we also need to know its amount.
- For a research project, we also need to know the name, area, expected outcome, starting time and expected duration. A project may touch several different areas.
- A research project is carried out by at least one researcher, and a researcher can work on zero or more research projects. The time a researcher works on a project is in need.
- A researcher can be uniquely identified by his/her email. We also record his/her address, which is composed of city and street.
- A researcher can be either a Professor or a PhD student. A PhD student has to be supervised by exactly one professor. A professor can supervise multiple PhD students.
- We need to know the year a PhD student started his/her PhD program.
- We need to know the number of students a professor is supervising.
- A research project can have a leading professor, and a professor can lead at most one project.
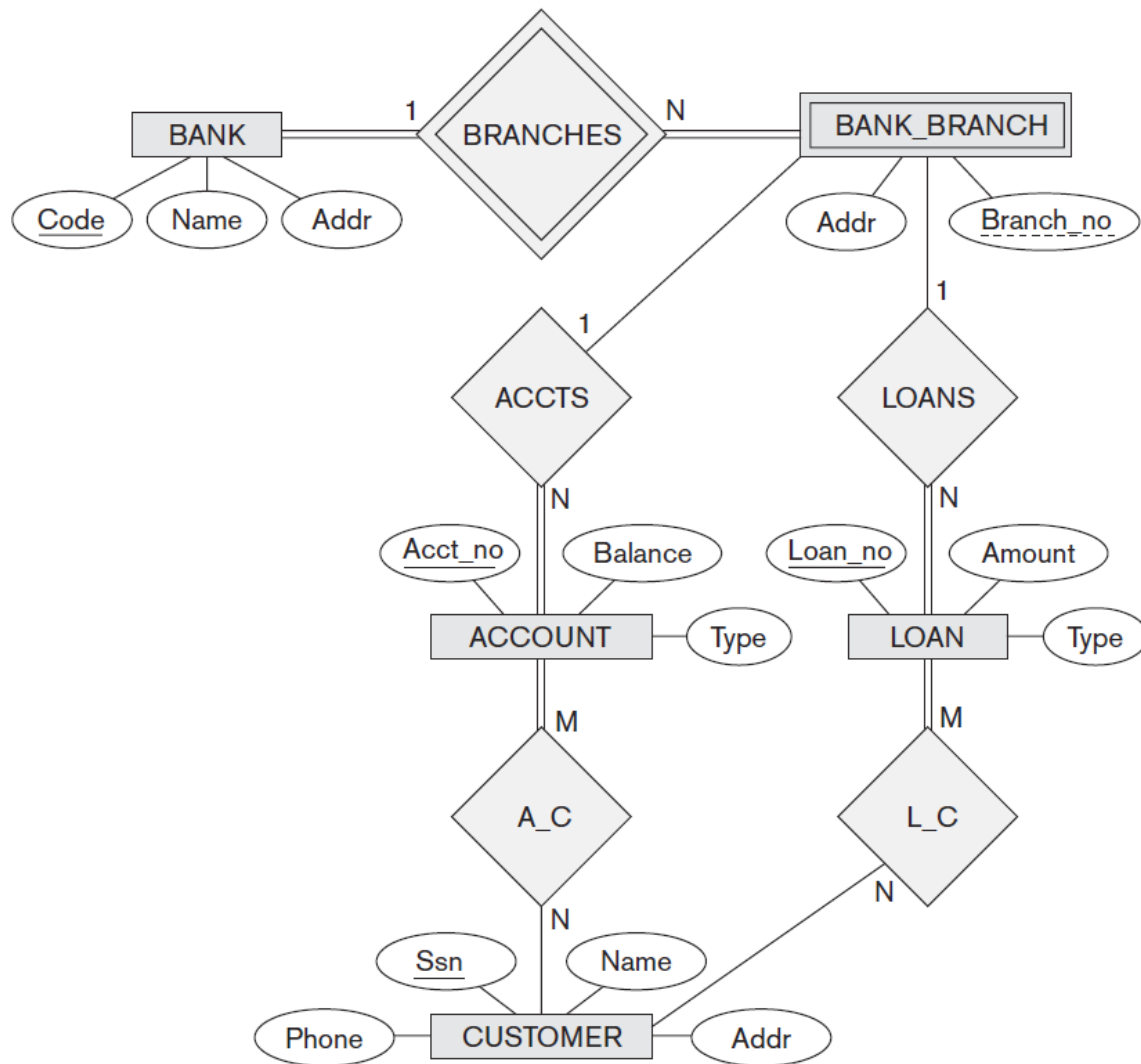
Draw an ER diagram to represent this scenario, and clearly state the assumptions you make if any.

Question 6
Convert your ER-diagram from Question 5 into a relational model.

Question 7

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 8

List concisely the user requirements that led to the ER schema design in Question 7.

Question 9

Consider an entity type SECTION in a UNIVERSITY database, which describes the section offerings

of courses. The attributes of SECTION are SectionNumber, Semester, Year, CourseNumber, Instructor, RoomNo (where section is taught), Weekdays (domain is the possible combinations of weekdays in which a section can be offered {MWF, MW, TT, etc.}), Hours (when section is taught). Assume that SectionNumber is unique for each course within a particular semester/year combination (that is, if a course if offered multiple times during a particular semester, its section offerings are numbered 1, 2, 3, etc.). There are several composite keys for SECTION, and some attributes are components of more than one key. Identify three composite keys and show how they can be represented in an ER schema diagram.

Question 10

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