**Q.No.1)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 following binary relationships, suggest cardinality ratios based on the common-sense meaning of the entity types. Clearly state any assumptions you make**.

Student - SocialSecurityCard
Cardinality Ratio: One-to-one (1:1)
Assumption: Each student has a unique Social Security Card, which is assigned to a certain student.

Student - Teacher
Cardinality Ratio: Many-to-many (M:N)
Assumption: A student can have multiple teachers (one for each class), and a teacher can have numerous students.

ClassRoom - Wall
Cardinality Ratio: One-to-many (1:M)
Assumption: A classroom contains numerous walls, but each wall is a part of that classroom.

Country - CurrentPresident
Cardinality Ratio: One-to-one (1:1)
Assumption: A country has only one current president at a time, and a president leads one country at a time.

Course - TextBook
Cardinality Ratio: Many-to-many (M:N)
Assumption: A course may require multiple texts, and one textbook may be utilized for multiple courses.

Item (that can be found in an order) - Order
Cardinality Ratio: Many-to-one (M:1)
Assumption: An order can contain multiple items, but each item in the context of an order is associated with a specific order.

Student - Class
Cardinality Ratio: Many-to-many (M:N)
Assumption: A student can enroll in multiple classes, and each class can have many pupils.

Class - Instructor
Cardinality Ratio: Many-to-one (M:1)
Assumption: A class is normally taught by a single instructor, but an instructor may teach multiple classes.

Instructor - Office
Cardinality Ratio: One-to-many (1:M)
Assumption: An instructor can have one or more offices (main and satellite campuses), but an office is assigned to one instructor.

E-bay auction item - Ebay bid
Cardinality Ratio: One-to-many (1:M)
Assumption: An eBay auction item can get several bids, but each bid is associated with a single auction item.

Based on the Entity-Relationship diagram in the image, here are the answers to the questions:

1. Strong Entity Types: The strong entity types in this ER diagram are BANK_BRANCH, ACCOUNT, LOAN, and CUSTOMER.

2. Weak Entity Type: Yes, there is a weak entity type: BRANCHES. Its partial key is Branch_No and its identifying relationship is “has.”

3. Partial Key Constraint for BRANCHES: The partial key constraint for BRANCHES is Branch_No and it’s identified by the “has” relationship with BANK_BRANCH.

4. Relationship Types and Their (min, max) Constraints:

   BRANCHES (BANK to BANK_BRANCH): (1,N) A bank has at least one or many branches, but a branch belongs to exactly one bank.

   ACCTS (BANK_BRANCH to ACCOUNT): (1,N) A bank branch has at least one or many accounts.

   LOANS (BANK_BRANCH to LOAN): (1,N) A bank branch has at least one or many loans.

   A_C (ACCOUNT to CUSTOMER): (1,M) An account must be associated with at least one customer, but a customer can have many accounts.

   L_C (LOAN to CUSTOMER): (1,M) A loan must be associated with at least one customer, but a customer can have many loans.

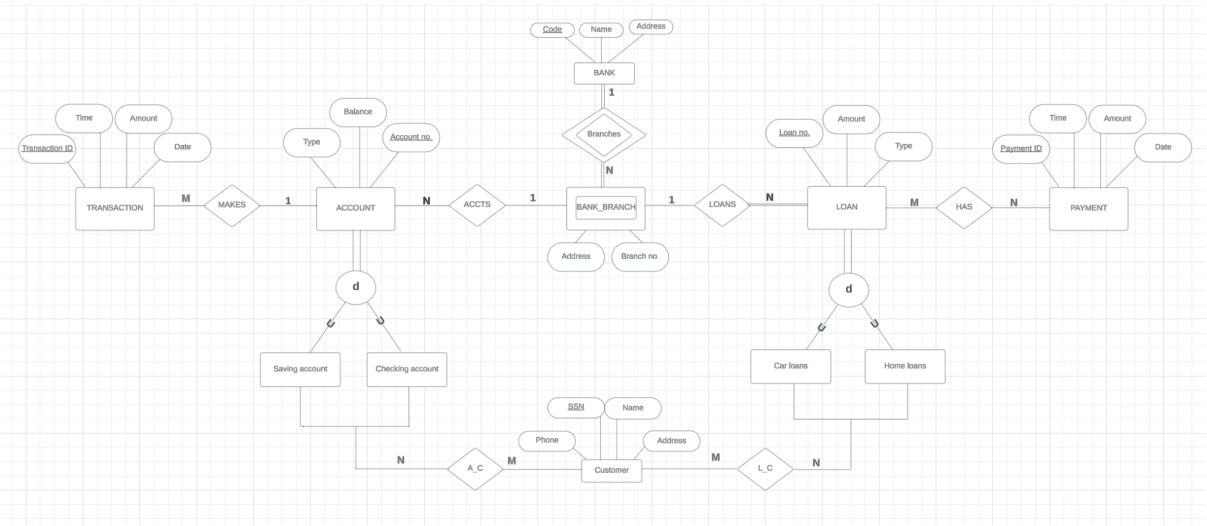
5. User Requirements:

- A bank can have several branches.
- Each branch can have several accounts and loans but it should be one bank branch.
- Each client has at least one account or maybe more accounts and loans.
- The maximum number of loans a bank branch can have is 1000.

6. Constraints:

- For the A_C relationship, the (min, max) constraint for CUSTOMER would change to (1,N), reflecting that each customer must have at least one account.
- For the L_C relationship, the (min, max) constraint for CUSTOMER would be (0,2), reflecting that a customer can have no loans or at most two loans.
- For the LOANS relationship, the (min, max) constraint for BANK_BRANCH could be (1,1000), reflecting that a branch must have at least one loan but cannot exceed 1,000 loans. However, this specific numerical constraint (1000) typically would not be shown in an ER diagram but rather would be enforced through business rules or database constraints.

Q.No.2) Consider the BANK ER schema in Figure 1.2, and suppose that it is necessary to keep track of different types of ACCOUNTS (SAVINGS_ACCTS, CHECKING_ACCTS, ...) and LOANS (CAR_LOANS, HOME_LOANS, ...). Suppose that it is also desirable to keep track of each ACCOUNT's TRANSACTIONS (deposits, withdrawals, checks, ...) and each LOAN's PAYMENTS; both of these include the amount, date, and time. Modify the BANK schema, using ER and EER concepts of specialization and generalization. State any assumptions you make about the additional requirements.



Q.No.3)

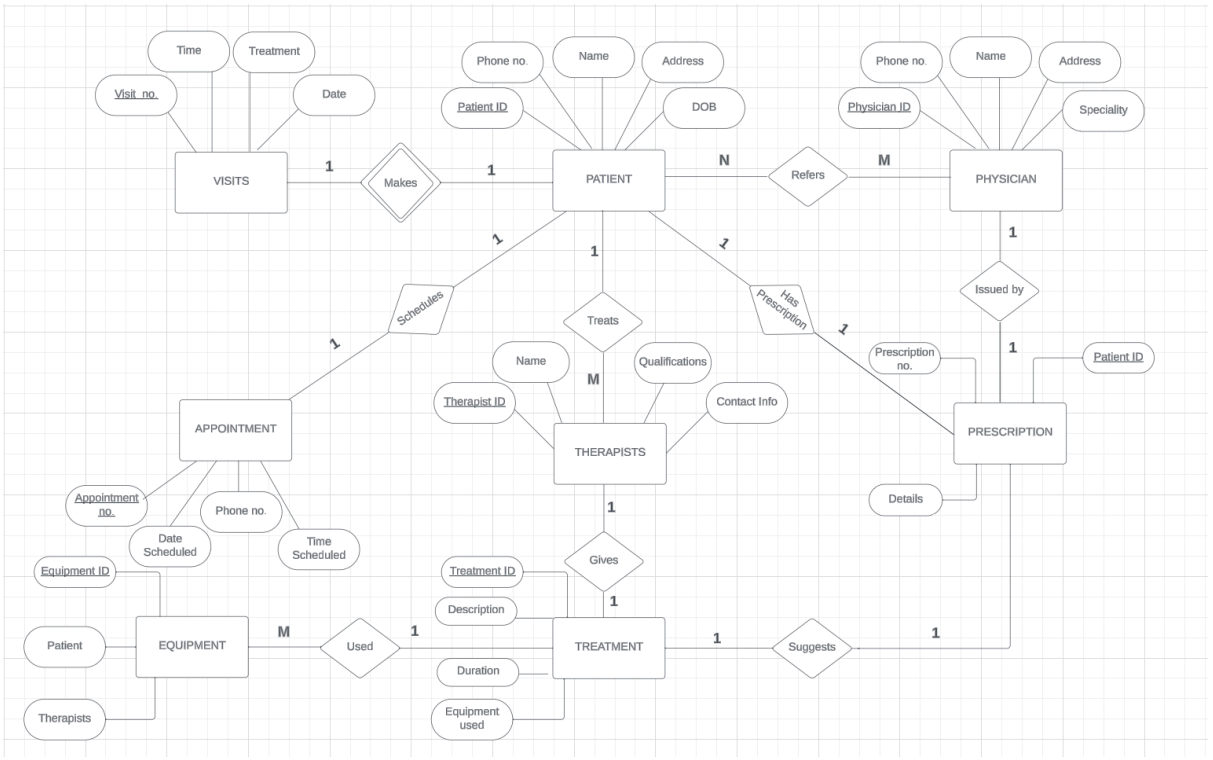
Max Cardinality Constraints:

Each Computer can have multiple Accessories (1:N), but each Accessory is sold with exactly one Computer (1:1), meaning every accessory is uniquely associated with a computer.
A Computer can have multiple Components (1:N), indicating that a computer can have many components like memory, video cards, and sound cards.
Each Computer can have multiple Software installed (1:N), but each Software can be installed on many Computers (M:N), reflecting the fact that software can be installed on various computers.
Each Operating System is a type of Software, and it supports many Components (M:N), which means various components can work with different operating systems.

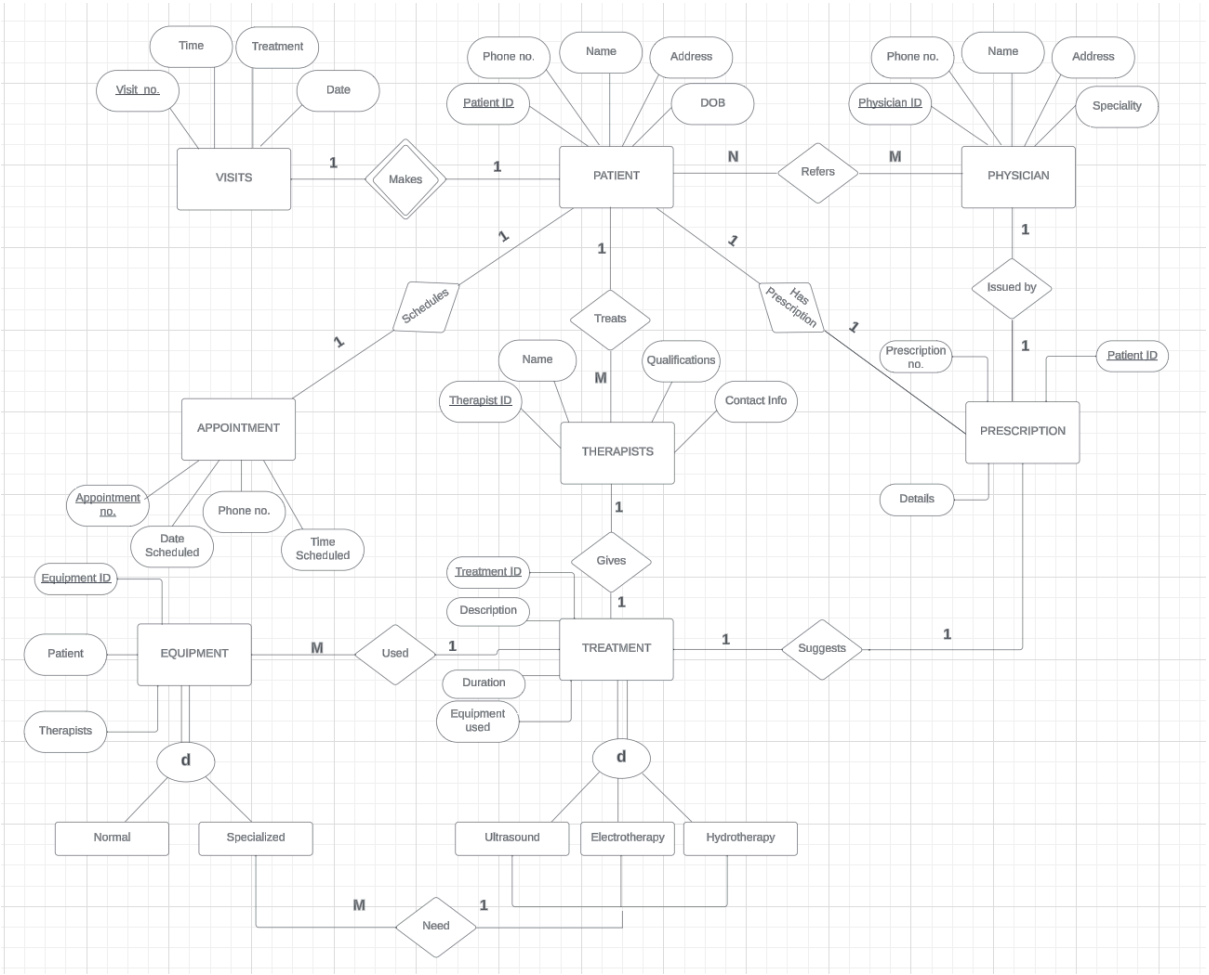
Narrative Description:

The EER diagram uses them as a model to the hardware and software resources for a company. Laptops and desktops are respectively the two variants that computers fall into each of which has definite attributes. Such computers may also have certain installed software that is known as operating systems, which are a specific type of soft ware. And different accessories may be used with computers, such as a keyboard modified mouse or display monitor in every computer. Other internal humanized parts of this model, include the memory hard drive, the graphical card and sound cards, which are each capable to operate on other operating system platforms. The diagram is differentiating between such as generalized types of entities to the more specific ones like computers and laptops or software and operating systems via a specialization method. The interrelations point towards that a computer can be related to various software applications, components and accessories; however the relationships are specific from one accessory to another computer. Such an arrangement helps the easy management and monitoring of the IT asset of the company.

Q.No.4) **A database is needed to keep track of the operations of a physical therapy center. Every patient must be referred by a physician and have a prescription for physical therapy in order to receive treatments. A patient may have different physicians at different times. The database keeps all information about prescriptions and treatments, both past and current. When appointments are made, the information about scheduled date and time is recorded. No patient is ever scheduled for two visits on one day. The center has several physical therapists, and a patient may be treated by different physical therapists on different visits. When a patient makes a visit at an appointed time, the name of the therapist, the treatment, the date, the time, and the equipment used are all recorded for that visit. Each of these has only one value for the visit. This information will be used later for insurance billing, which is not part of this database. Draw a complete E-R diagram for this example.**




Q.No.5) **Develop an EE-R diagram for the physical therapy center described in Exercise 4, but expand it to assume that some visits require the use of specialized equipment for electrotherapy, ultrasound, hydrotherapy, and so on, and the patient is charged for each use of such equipment. Patients may also be supplied with special devices to take home, such as exercise bands, neck pillows, and so on, and the patient is charged for these special supplies.**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