

Review Questions – ER Model

1. Explain in your own words or through an example the following terms: entity type, weak entity, attribute, key attribute, derived attribute, multivalued attribute, entity-relationship model.

Answer:

Entity type: A collection of entities that share common properties or characteristics. For example, in the database of a University, STUDENT is an entity type. There are many students in a University, and they share common characteristics such as: each one has a name, a SSN or is part of one of the departments in the University.

Weak entity: A weak entity is an entity type whose existence depends on some other entity type. For example, in the database of a company EMPLOYEE is an entity type. Some companies keep information about the dependents of each employee. In this case, the entity DEPENDENT is a weak entity, since the existence of one of its instances depends on the existence of the corresponding instance in the EMPLOYEE entity type.

Attribute: A property or characteristic of an entity type that is of interest to the organization. For example: name is an attribute of the entity STUDENT.

Key attribute: An attribute that uniquely identifies individual instances of an entity type. For example SSN is a key attribute of the STUDENT entity type. Each student has a unique SSN.

Derived attribute: An attribute whose value can be calculated from related attribute values. For example, the attribute “Years of experience” for the entity type EMPLOYEE, can be derived from the difference of the current year with the value at the attribute “Start date” (date of employment).

Multivalued attribute: An attribute that may take on more than one value for a given entity instance. For example, “Skills” is an attribute of the entity type EMPLOYEE. This is a multivalued attribute since an employee may have more than one skill.

Entity-relationship model: A logical representation of the data for an organization or for a business area. The E-R model consists of entities, relationships between the entities and attributes.

2. Explain through an example (other than the ones discussed in the book) the contrast between the following terms:
 - a. entity type; entity instance
 - b. strong entity type; weak entity type
 - c. entity type; entity relationship
 - d. simple attribute; composite attribute
 - e. stored attribute; derived attribute

Answer:

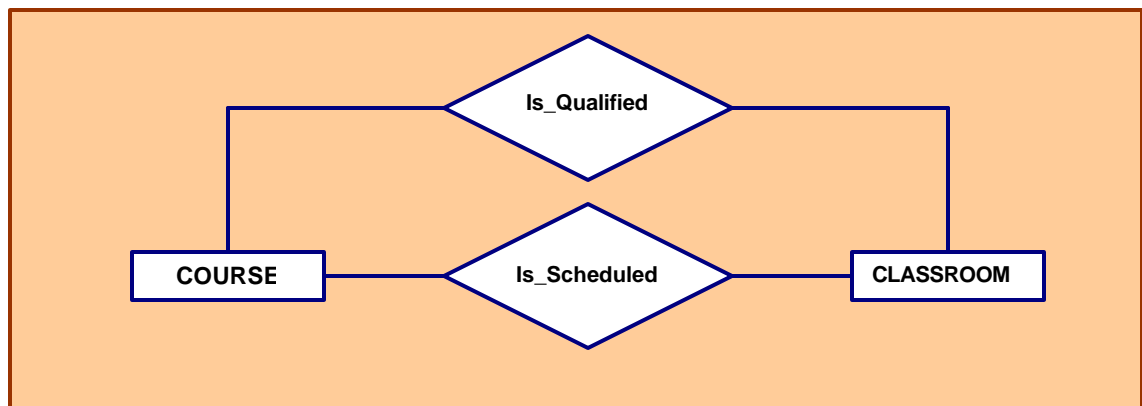
- a. An entity instance is a single occurrence of an entity type. For example, STUDENT is an entity type in the database of a University, and Jon Doe, a student in the University, is an instance of the STUDENT entity type.
- b. Strong entity is an entity type that exists independently of other entity types, in contrast with the weak entity type, whose existence depends on some other entity type. For example,

MEMBER is an entity type in the database of an insurance company. Entity type DEPENDENT, keeps information about the dependents of each instance of the entity type MEMBER. For example Mike is a member, and he has two children Jane and George. The company keeps information about Mike in the entity type MEMBER and the information about Jane and George in the entity type DEPENDENT. If Mike decides not to be a member of the insurance company anymore, his information together with his children is removed from the database. However, if Jane decides not to be a dependent anymore, that would not impact Mike, he still is a member of the company.

- c. Entity relation is a meaningful association between (or among) entity types. For example, the relation between STUDENT and COURSES OFFERED entity types is that each student in the University takes some of the courses offered in the University.
- d. Simple attributes, different from composite attributes, cannot be broken down into smaller components. For example, consider STUDENT entity type. SSN is a simple attribute, while Name is a composite attribute since it consists of First Name and Family Name.
- e. Derived attributes, different from stored attributes, are such that their value can be derived (calculated) from other related attribute values that are stored in the database. For example, ALUMNUS is an entity type of the database of a University. "Years of study" is an attribute of this entity type, whose value can be easily calculated using the attributes "Start date" (of the studies) and "Graduation date".

3. Give an example of multiple relationship entities. Draw the E-R diagram.

Answer:



4. Under what conditions a relationship is converted to an associative entity type? Give an example.

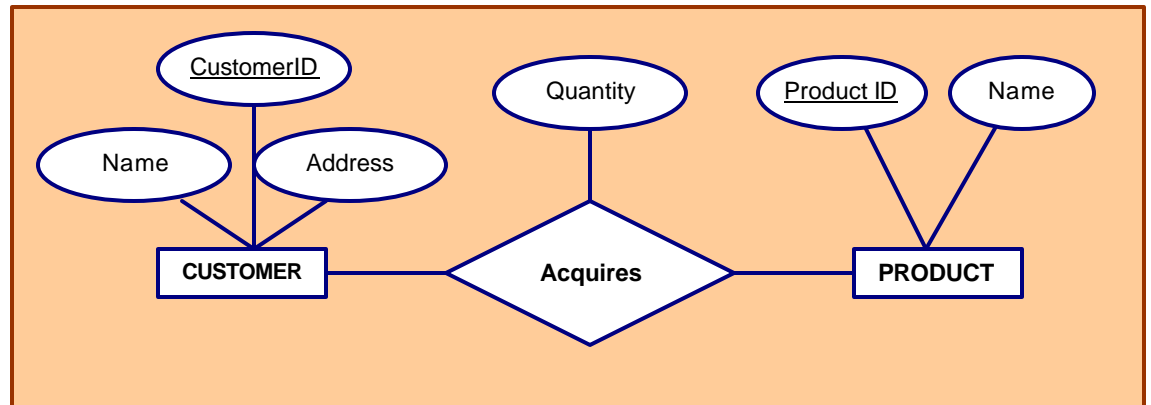
Answer:

A relationship is converted to an associated entity type if:

1. All of the relationships for the participating entity types are "many" relationships.
2. The resulting associative entity type has independent meaning to end users, and preferable can be identified with a single-attribute identifier.
3. The associative entity has one or more attributes, in addition to the identifier.

4. The associative entity participates in one or more relationships independent of the entities related in the associated relationship.

Example:

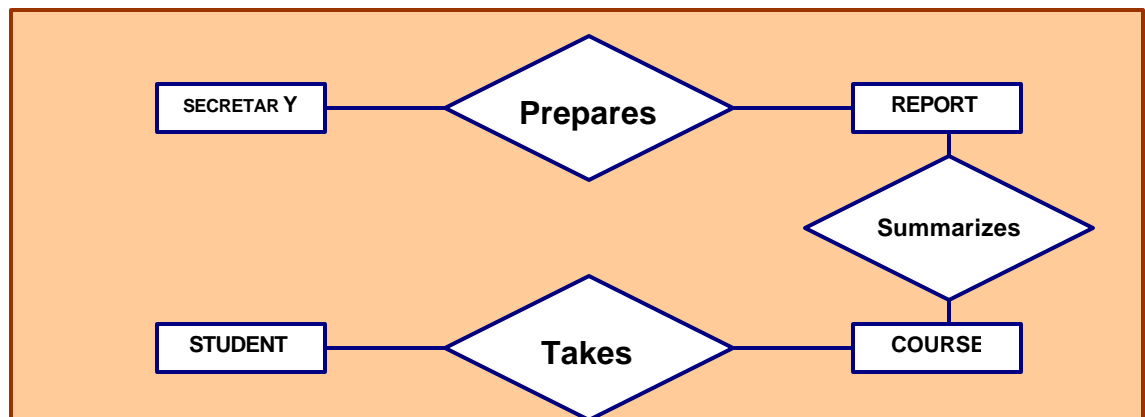


5. Explain in your own words the reasons why we study the E-R model of a database.

Answer:

The E-R model of a database is studied since:

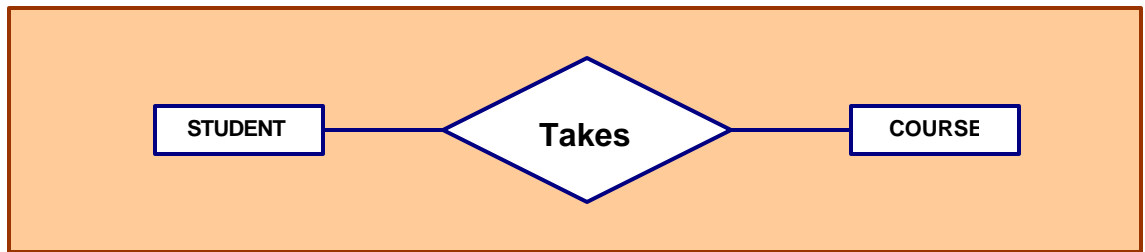
1. It helps the database designers to understand the relationship between different entities in a database. It is used as a conceptual data model, which represents the structure and the constraints of a database that is independent of the software.
 2. It is a tool for communications between database designers and end users during the analysis phase of database development.
6. A department in a University keeps the information about the students and courses offered in a database. The secretary manages the database. In the end of the semester, the secretary prepares a report about each course.



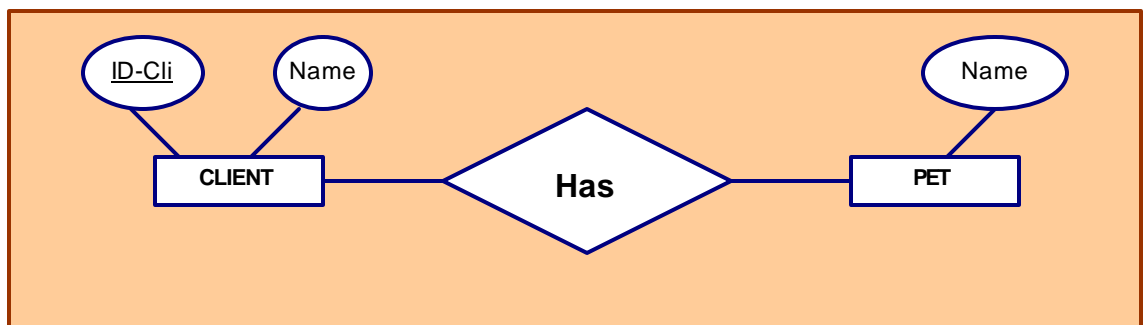
Is the above E-R diagram of the database correct? If no, explain why and draw the correct diagram.

Answer:

The above diagram is not correct. The REPORT should not be a separate entity of the database. In fact, in the end of the semester the report are created using the information about STUDENT and COURSE from the database. The following is the correct E-R diagram:

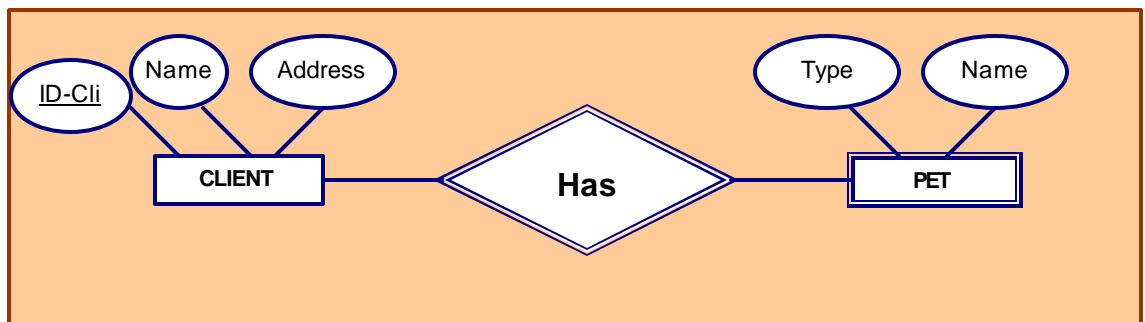


7. A veterinary doctor keeps the information about his clients and their pets in a database. The following is the E-R diagram of the database.



Complete the diagram. Add, if necessary, other attributes.

Answer:



8. Explain in your own words what the term “degree of a relationship” means. Give a simple example for each of the three types of relationships described in this chapter and draw the corresponding E-R diagrams.

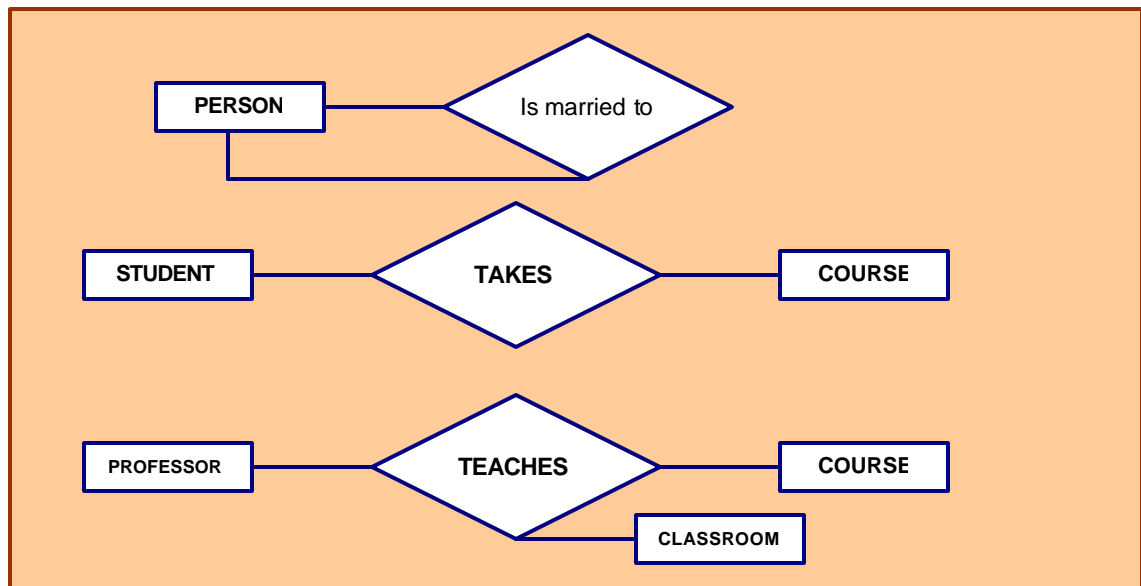
Answer:

“Degree of a relationship” is the number of entity types that participate in a relationship.

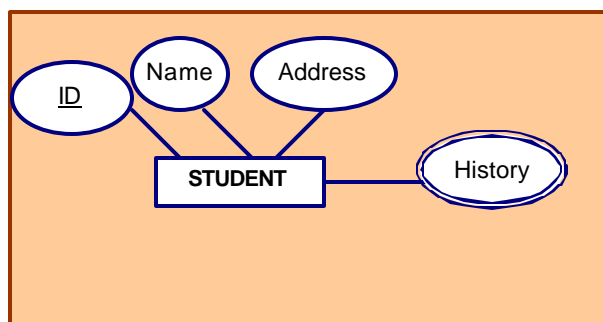
Unary relationship is a relationship between the instances of a single entity type.

Binary relationship is a relationship between the instances of two entity types.

Ternary relationship is a relationship among the instances of three entity types.

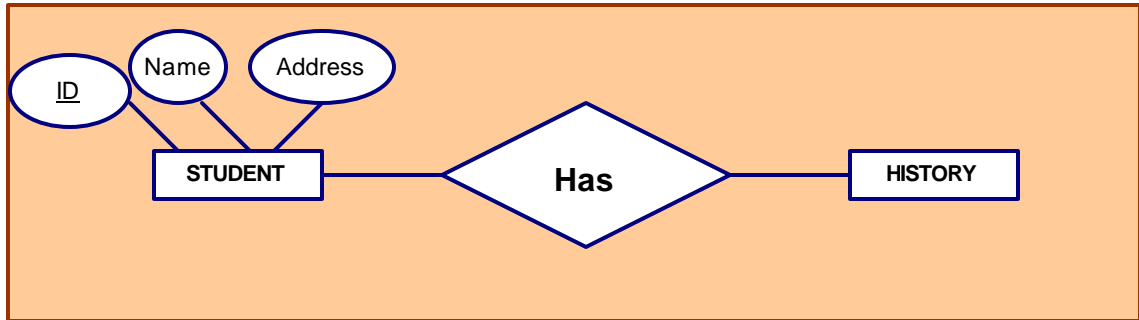


9. The University keeps a detailed database of the students' information. The following is the E-R diagram of entity student:



Draw an alternative E-R diagram for this database.

Answer:



10. Discuss the criteria for choosing one of the attributes as the identifier of an entity type.

Answer:

Some entities may have more than one candidate identifier. The following are some of the criteria for selecting identifiers:

1. Choose an identifier that will not change its value over the life of each instance of the entity type.
2. Choose an identifier such that for each instance of the entity, the attribute is guaranteed to have valid values and not to be null (or unknown).
3. Avoid the use of the so-called intelligent identifiers, whose structure indicates classifications, locations, and so on. Such codes are often changed, which renders the identifier values invalid.
4. Consider substituting single-attribute surrogate identifiers for large composite identifiers.

Review Questions – EER Model

1. “Enhanced ER diagrams provide more flexibility in designing a database than ER diagrams.” Support this statement with an example.

Answer:

EER-models are used to represent the new modeling constructs that have been added to the original ER-models. EER-models provide more flexibility than ER-models. EER-models allow supertype/subtype relationships. For example: Company XYZ has three basic types of employees: hourly employees, salaried employees and contract consultants. Attributes of each type of employee are:

- ◊ Hourly employee: SSN, Name, Address, Date_hired, Hourly_rate
- ◊ Salaried employee: SSN, Name, Address, Date_hired, Annual_salary, Stock_option
- ◊ Contract consultant: SSN, Name, Address, Date_hired, Contract_number, Billing_rate

The three employee types have few attributes in common: SSN, Name, Address, Date_hired. In addition, each employee type has one or more distinct attributes. EER-diagrams allow us to incorporate these features of the entity type employee, into the database.

2. Define through an example the following terms: subtype, subtype discriminator, disjoint rule, overlapping rule. Show how they relate to each other.

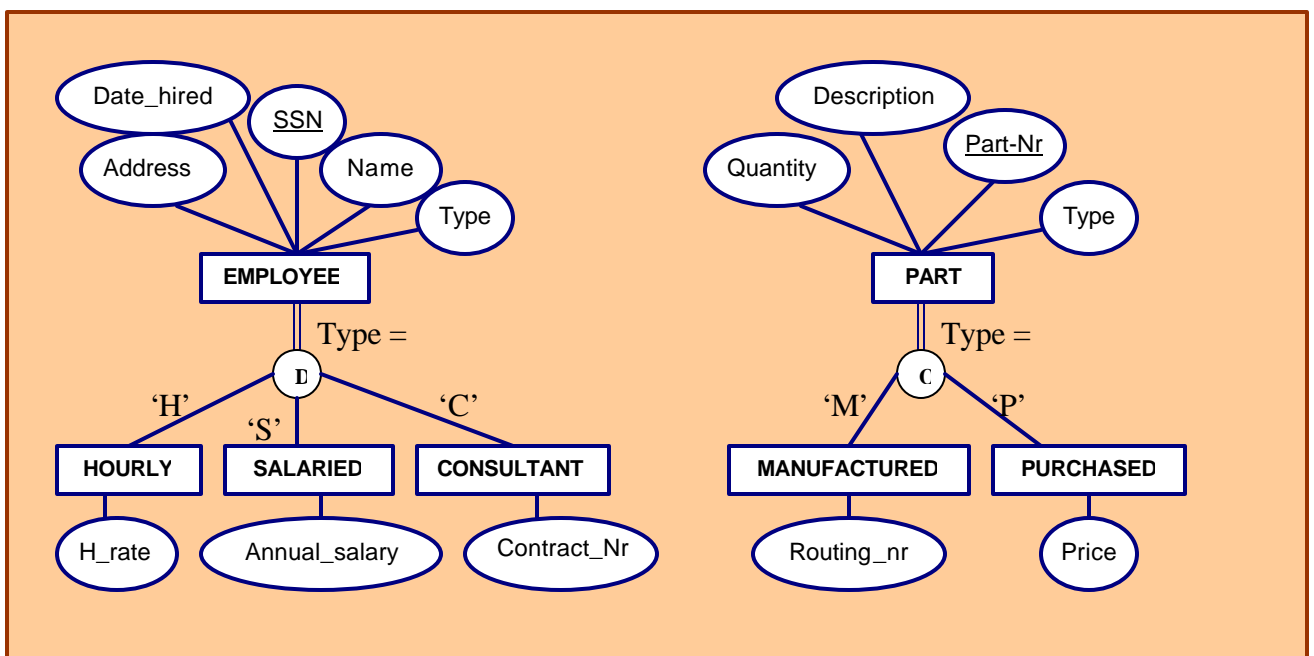
Answer:

Subtype: Is a sub-grouping of the entities in an entity type that is meaningful to the organization and that shares common attributes or relationships distinct from other sub-groups. For example, the entity employee has the following three subtypes: hourly employees, salaried employees and contract consultants.

Subtype discriminator: Is an attribute of the supertype whose value determines the target subtype or subtypes. For example, the attribute Type is a subtype discriminator.

Disjoint rule: Specifies that if an entity instance (of the supertype) is a member of one subtype, it cannot simultaneously be a member of any other subtype. This rule applies in the case of the entity employee: an employee can either be an hourly employee, or a salaried employee or a consultant.

Overlapping rule: Specifies that an entity instance can simultaneously be a member of two (or more) subtypes. This rule is true in the case of entity Part. A particular part type can be manufactured, as well as can be bought from a supplier.



Subtype, subtype discriminator, disjoint rule, and overlapping rule are related to each-other in the following way: subtype discriminator determines the subtype of a particular entity. Disjoint and overlapping are the rules that determine whether an entity can or cannot simultaneously be a member of two or more subtypes.

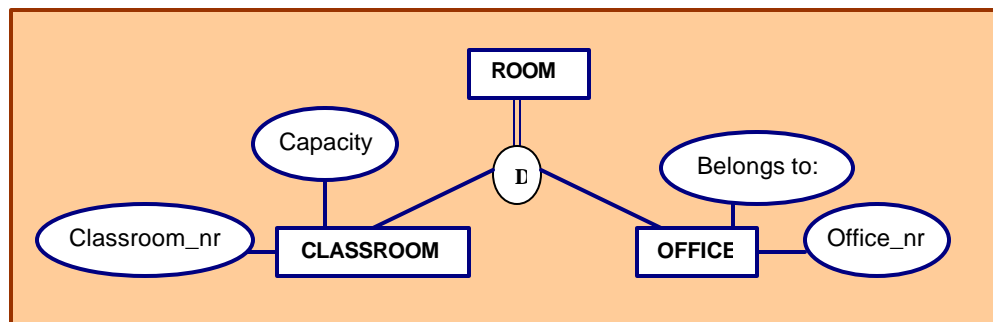
3. Explain through an example the reasons why a database designer considers using subtype / supertype relationships.

Answer:

An entity type is a collection of entities that share common characteristics. However, a major challenge in data modeling is to recognize and clearly represent entities that are almost the same; that is entities that share common properties but also have one or more distinct properties that are of interest for the organization. This is the reason why the ER-models have been extended to include supertype / subtype relationships.

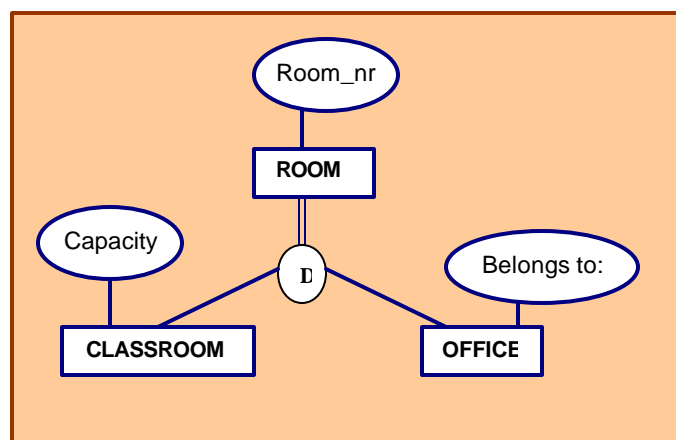
For example: Company XYZ keeps the information about the employees in a database. Entity Employee has three subtypes: Hourly employee, Salaried employee and Contract consultant. The three entity subtypes have common attributes such as: SSN, Name, Address and Hiring_date, however there are attributes that are peculiar to a particular entity type. For example, Hourly_rate is an attribute of the hourly employee type only, or Contract_rate is an attribute of Contract consultants only.

4. The diagram below is part of the EER diagram of the University database. Is the diagram correct? If no, explain why and draw the correct diagram.



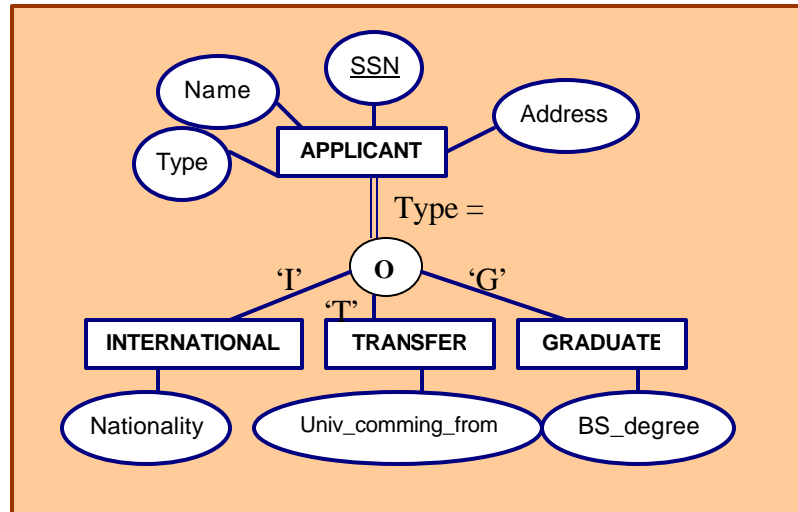
Answer:

The diagram is not correct. Office number and classroom number are the same attribute. The following would be the correct diagram.



5. The admission office in a University keeps the information about the University entrance applications in a database. In order to facilitate processing of the applications, the applicants are classified into: freshman, transfer, graduate and international students.
 - a. Draw the EER diagram of this database. Identify a unique attribute for each entity subtype.
 - b. Add a subtype discriminator for each of the subtypes of the entity applicant.

Answer:



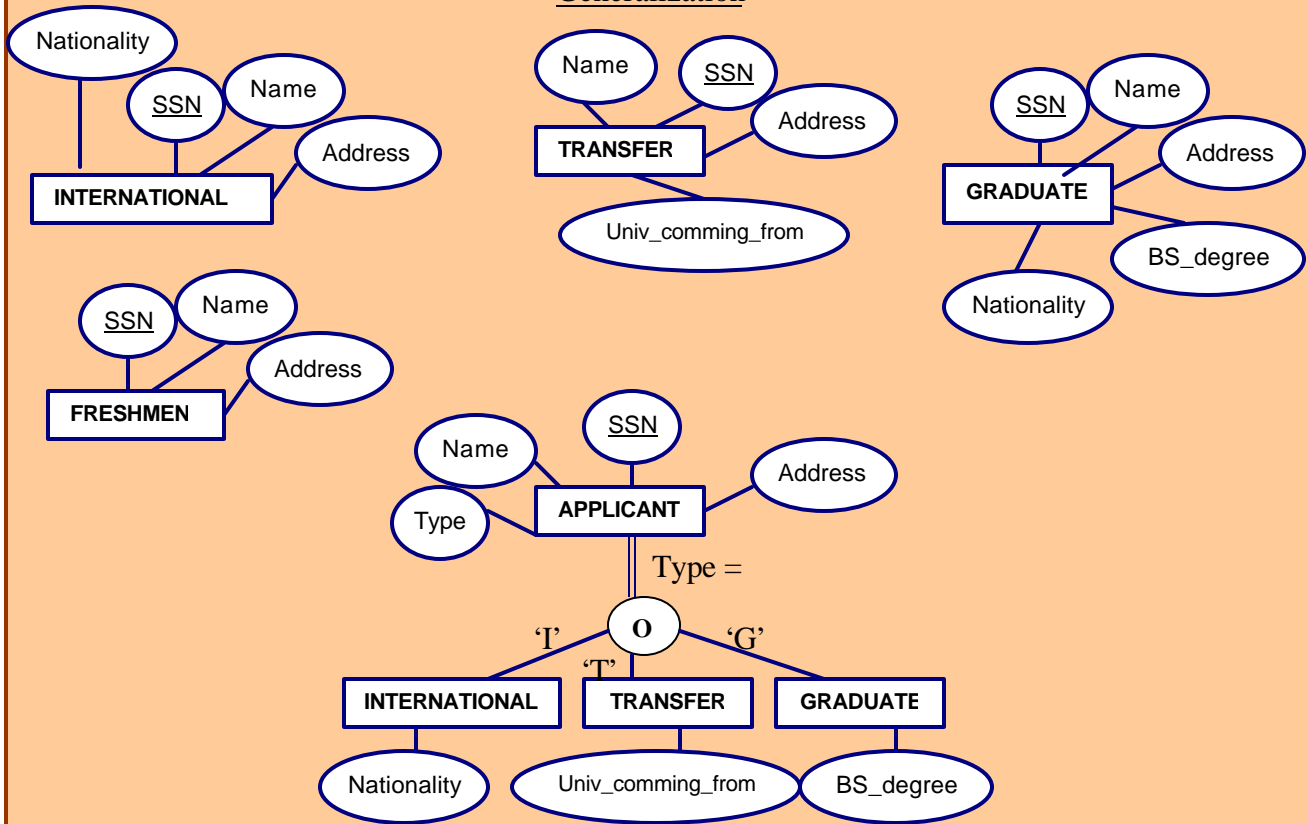
6. Explain through an example the difference between the generalization rule and specialization rule.

Answer:

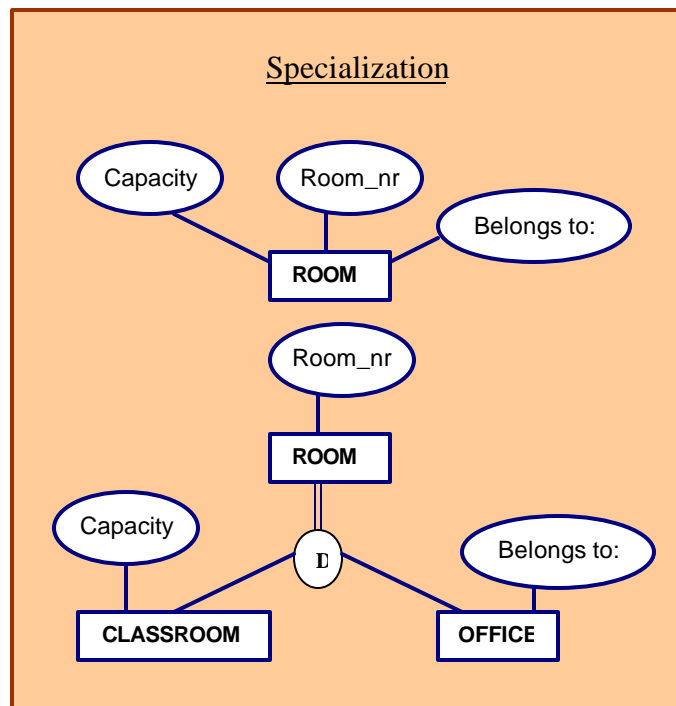
Generalization is the process of defining a more general entity type from a set of more specialized entity types. Specialization on the other side is the process of defining one or more subtypes of the supertype, and forming supertype / subtype relationships. Generalization rule is the opposite of the specialization rule. An example of specialization rule is shown in the figure below. The figure shows the entity type Room together with its attributes: Room_nr, Capacity and Belongs_to. Since Capacity is an attribute of a classroom only and Belongs to: is an attribute of an office only, we create the following two subtypes for this entity: Classroom and Office.

An example of generalization rule is shown in the figure below. The figure presents the entities: Graduate student, Transfer student, International student and Freshmen. A closer look to these entities, and we can see that they share common attributes: SSN, Name and Address. This fact suggests that these entities are different versions of a more general entity type: APPLICANT.

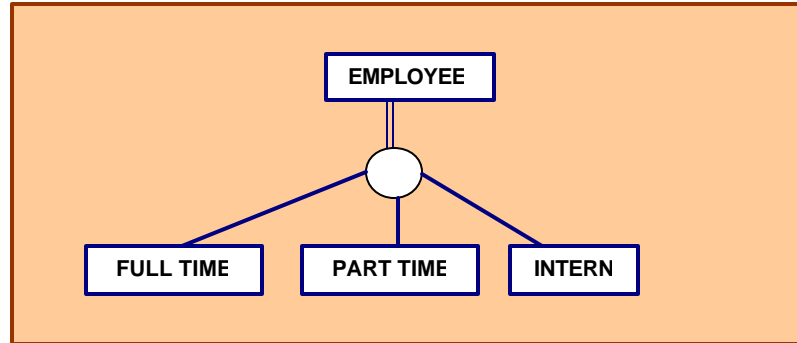
Generalization



Specialization



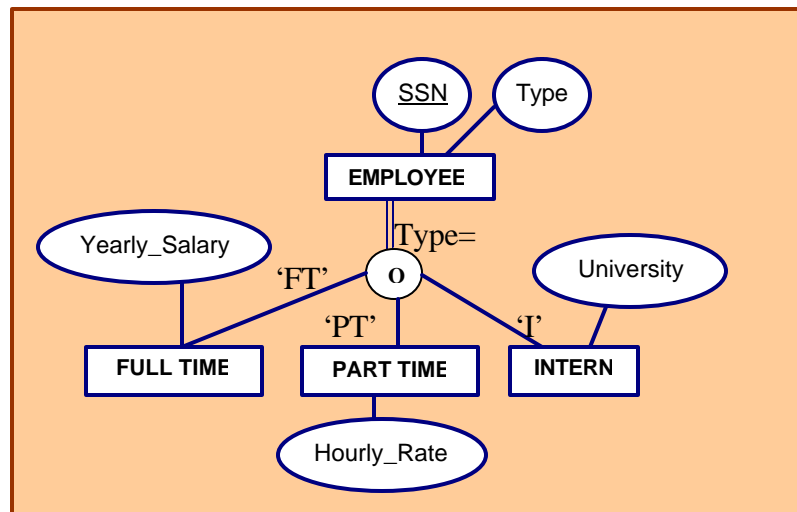
7. The accounting department in a Company keeps the information about their employees in a database. The employees are classified into: part time employees, full time employees and interns. Interns are usually students that work with the company during the summer time.



Complete the diagram above by:

- Add a unique attribute (relationship) for each entity subtype.
- Add an attribute shared by all entities.
- Identify whether the disjoint or overlap rule applies.
- Identify whether the total specialization or partial specialization rule applies.
- Add a subtype discriminator for each of the subtypes shown in the diagram. Show the discriminator values that assign instances to each subtype.

Answer:



Hands-On ER Model

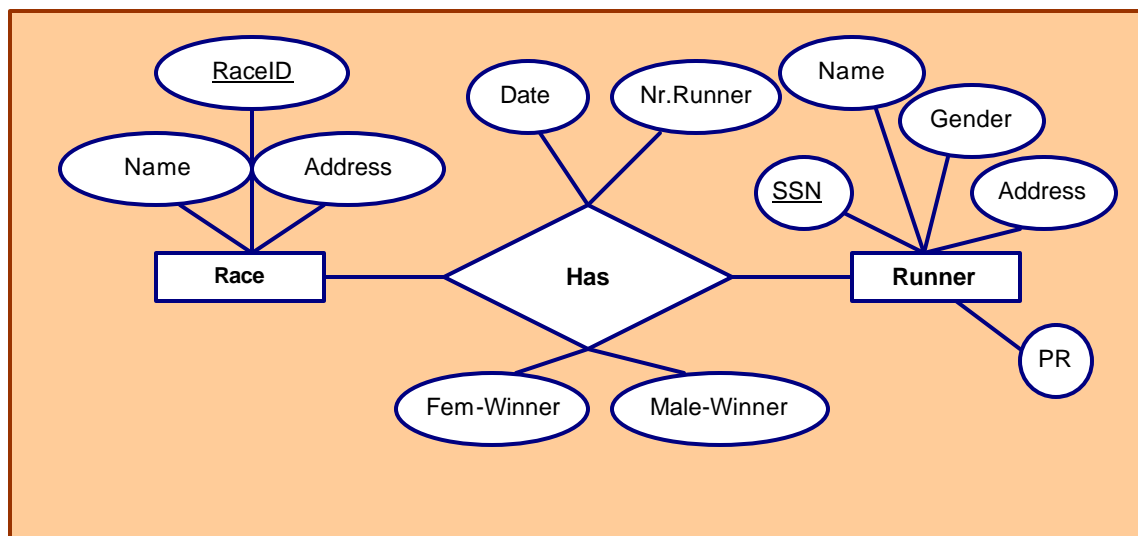
Problem 1

The annual Bolder Boulder is one of America's top 10 Km races. The race is held each Memorial Day in Boulder, Colorado. This race attracts world-class runners as well as casual joggers. The race has grown to approximately 20,000 runners. The race is a point-to-point race beginning at the Bank of Boulder at the northeast corner of the city winding throughout the city streets, ending near to the town center in the University of Colorado's football stadium.

The organizers record the following information for each race: the date of the race, total number of runners registered for the race (on-line pre-registration is possible), the actual number of participants, the number of female runners, the number of male runners, the name of the man winner, the name of the woman winner, the name of the man master (runner of age more than 40) winner, the name of the woman master winner. In addition, the following information about each participant is recorded as well: social security number, name, birthday, gender, address, and certified personal record (PR) running times for a 10 Km race.

Draw an E-R diagram for this application. Specify the key attribute of each entity type.

Answer:



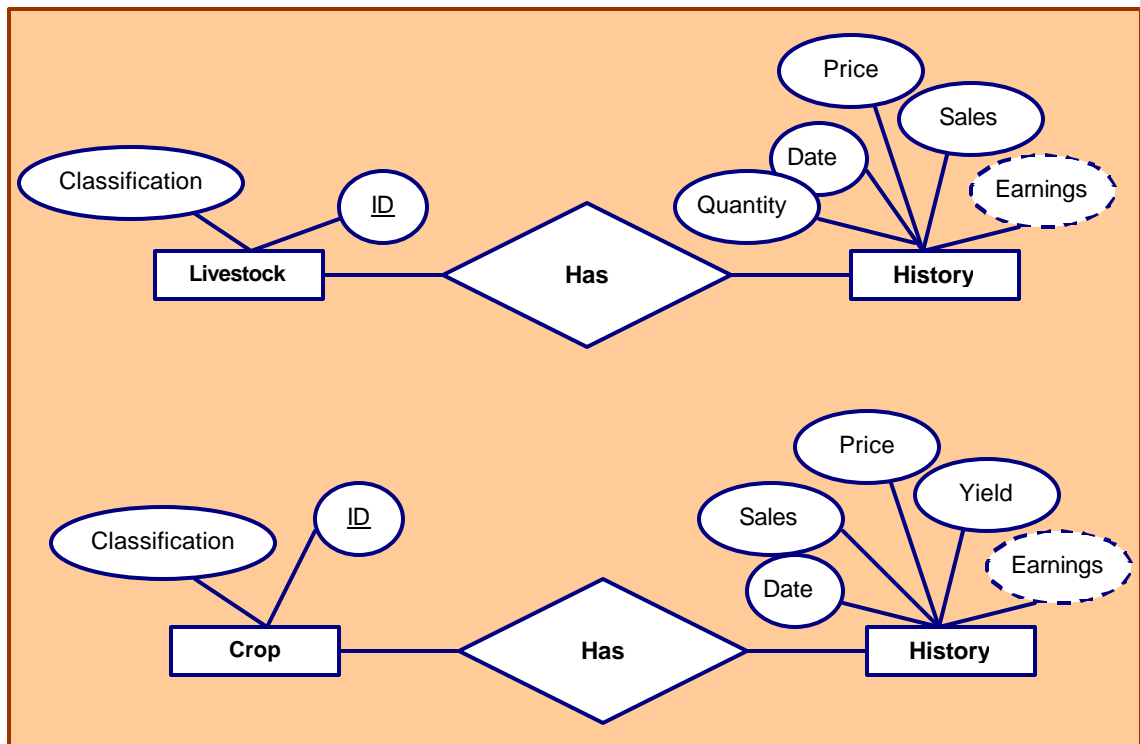
Problem 2

John's family owns and operates a 640-acre farm for several generations. Since the farm business is growing, John is thinking to build a database that would make easier the management of the activities in the farm. He is considering the following requirements for the database:

1. For each livestock classification group (for example: cow, horse etc.), John keeps track of the following: identification number, classification, total number of livestock per classification group (for example: number of cows, number of horses etc.).
2. For each crop the following information is recorded: crop identification number and classification.
3. John has recorded the yield of each crop classification group during the last ten years. The records consist of the crop identification number, date, yield, sales, price of the crop and the amount of money earned.
4. John has recorded the yield of each livestock classification group during the last ten years. The records consist of the following historical data: livestock identification number, date, (historical) selling price per head, number of livestock in the end of the year, number of livestock sold during one-year period, and the total amount of money earned.

Draw an E-R diagram for this application. Specify the key attribute of each entity type.

Answer:



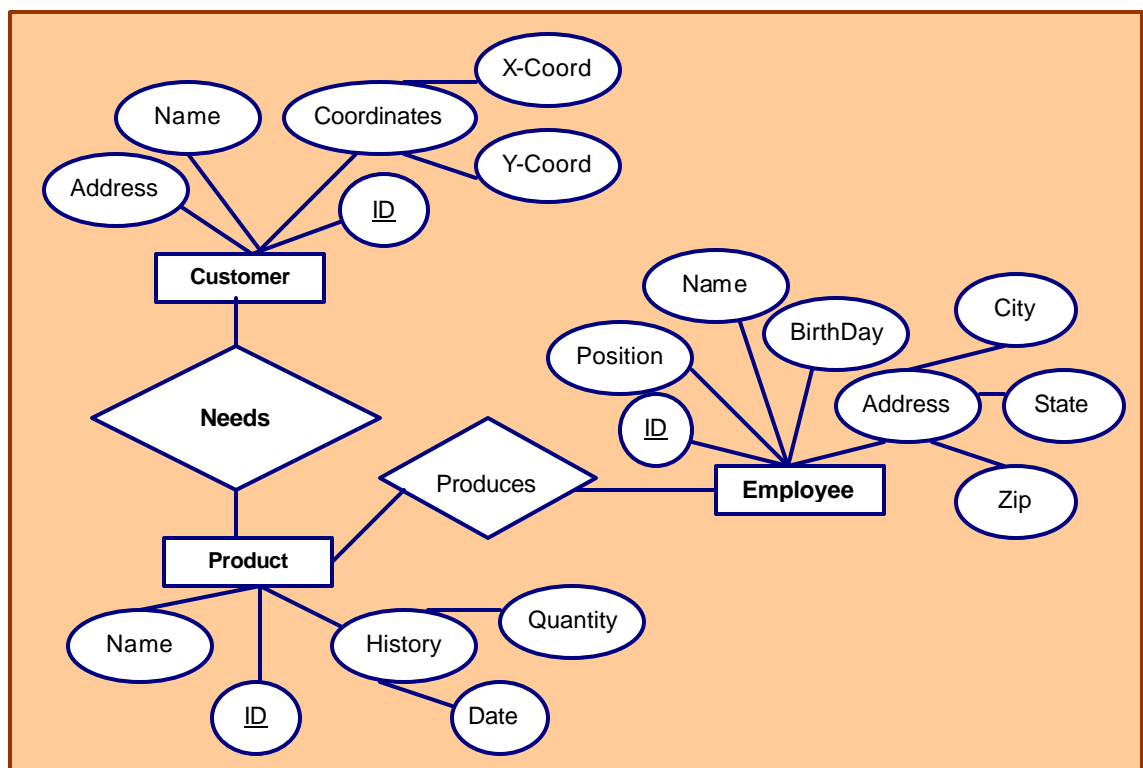
Problem 3

Coca Cola Co. in Atlanta, Georgia produces a wide range of products that are delivered to the customers once a week. The Coca Cola Co. keeps the information about the employees, products, and customers in a database. The database considers the following set of tables:

1. The company keeps the following information about each customer: customer identification number, name, address, X (longitude) and Y (latitude) coordinates of their location, amount of time (fraction of an hour) required to make a stop at a customer, type of product that is used by a customer, mean rate at which customer uses product per day in a week, standard deviation of this usage rate, the limit on how much inventory of a product can be held at a customer, initial inventory of product at a customer.
2. Each employee has an employee identification number, name, address (the address consists of: street number, apartment number, city, state and zip code), sex, birthday, position in the company, wage earned per hour of regular timework, wage earned per hour of overtime work, number of dependents, and number of years working for Coca Cola Co.
3. Each product has a product identification number, price and number of units produced per day.

Draw an E-R diagram for the Coca Cola Co and add the minimum and maximum relationship cardinalities. Identify the: (a) key attributes for each entity (b) composite attributes (c) derived attributes.

Answer:

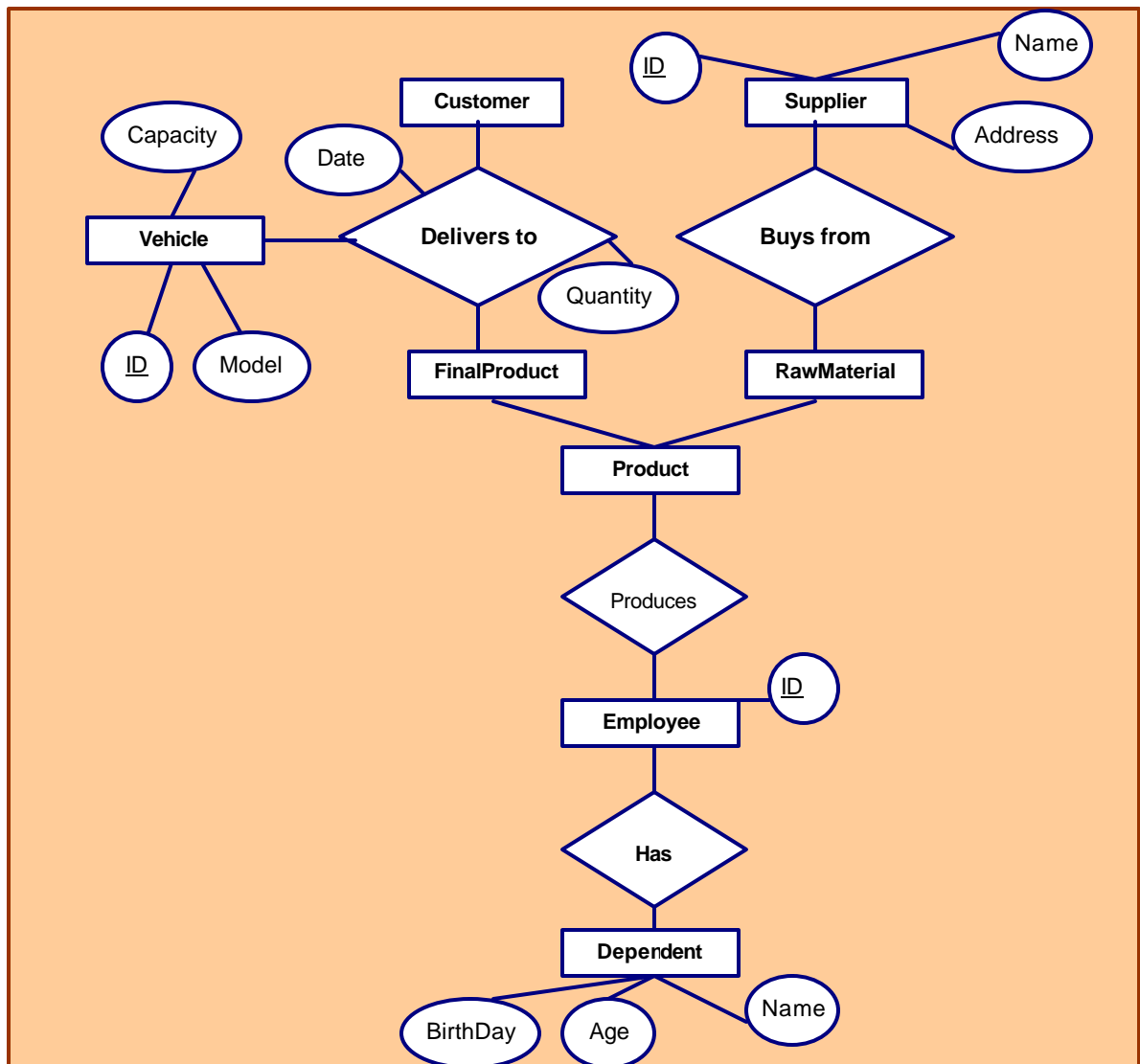


Problem 4

Consider the database given in problem 3. Update the E-R diagram for the cases described below. For each entity identify the key attribute (attributes).

1. For tax purposes, the Coca Cola Co. will extend the data kept for each employee to include the information about their dependents. This information consists of dependent's name, birthday and age.
2. The company has decided to keep information about their suppliers. This information includes: a supplier identification number, address, name of the contact person, X (longitude) and Y (latitude) coordinates of their location.
3. The company keeps a fleet of vehicles to facilitate the distribution of the products to the customers. Each vehicle has an identification number, model, and capacity.

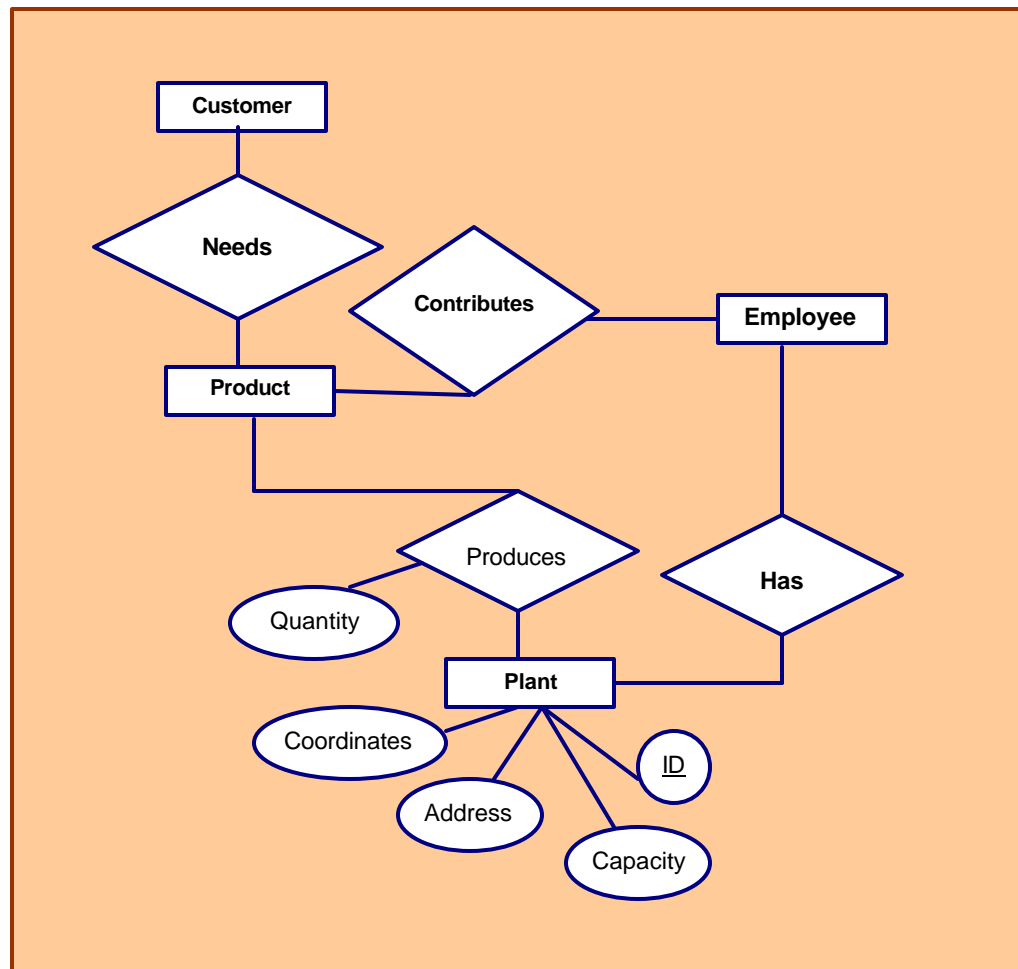
Answer:



Problem 5

Consider the database given in problem 3. Coca Cola Co. has few plants that are distributed over all Georgia. For each plant the following information is stored in the database: a plant identification number, address, X (longitude) and Y (latitude) coordinates of plant location, type of products produced. Note that the inventory level, inventory capacity and quantity produced of a particular product differ by plant.

Answer:



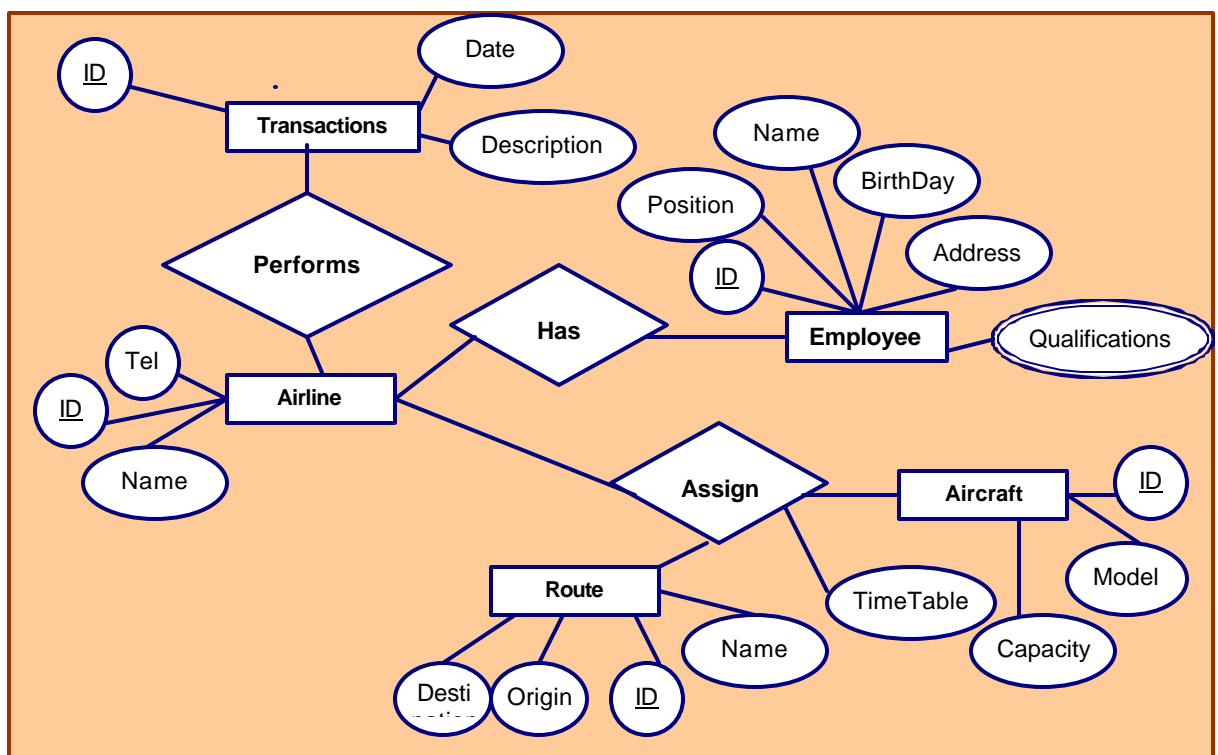
Problem 6

Major airlines companies that provide passenger services in Taiwan are: UniAir, TransAsia Airways, Far Eastern Transport, Great China Airlines etc. Taiwan's Federal Aviation Administration (TFAA) keeps a database with lots of information on all airlines. This information is made accessible to all airlines in Taiwan with the intention of helping the companies assess their competitive position in the domestic market. The information kept consists of:

1. Each airline has an identification number, name and address, name of the contact person and telephone number, total number of employees, total number of aircrafts. For each aircraft an aircraft identification number, capacity, and model is recorded.
2. Each employee has an employee identification number, name, address, birthday, sex, position with the company, and qualification.
3. Each route has a route identification number, airports visited, classification (into domestic or international route), distance of the route, and price charged per passenger. Note that different airlines fly the same routes, however the frequency of flying a particular route, cost per flight (including wages, maintenance, fees paid at the airports), time length of the flight, flight capacity, and size of the fleet vary by airline.
4. Each airline keeps information about their buy/sell transactions (for example selling an airplane ticket is a sell transaction, paying for maintenance is a buy transaction). Each transaction has a transaction identification number, date, description, and amount of money paid/received.

Draw an E-R diagram for the database presented above. Make sure to identify the associative entity (entities) and provide corresponding key attribute (attributes).

Answer:

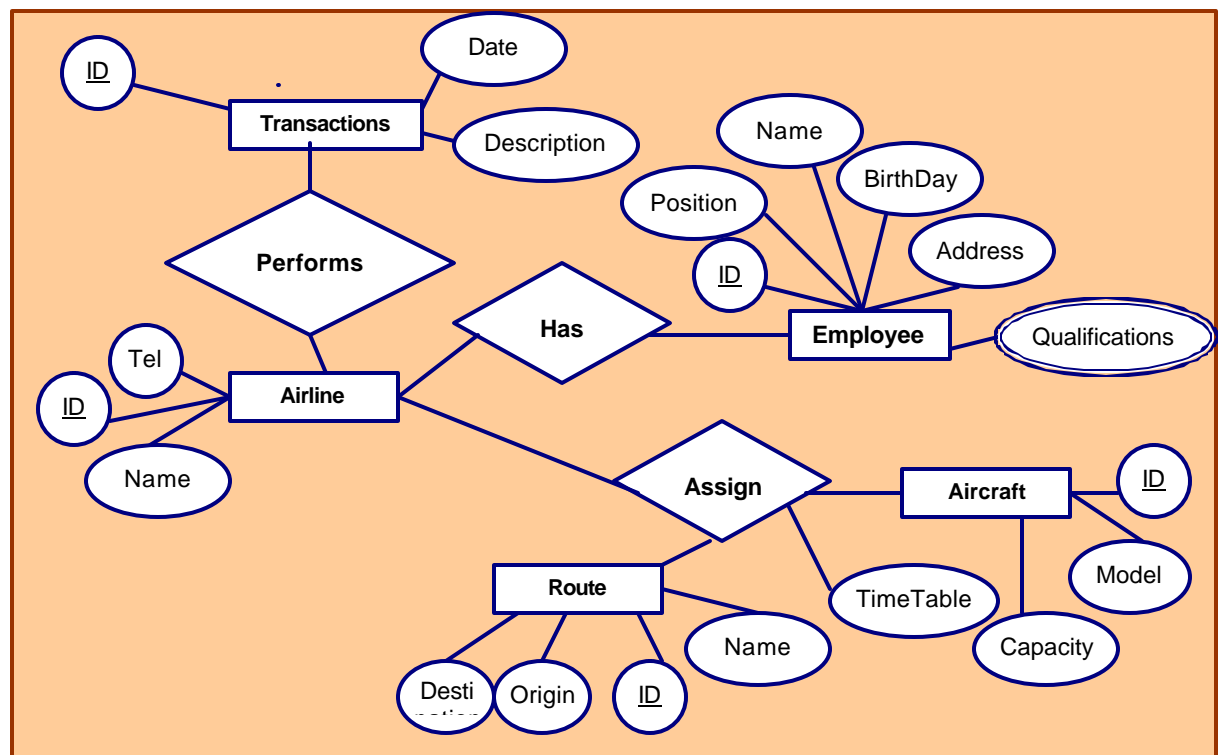


Problem 7

Consider the database described on problem 6. Each airline owns different aircraft models and for each model aircrafts of different capacity. Depending on the length of the route and classification (into domestic or international) the aircrafts are assigned to different routes. The relationship between the airlines, aircrafts and routes is a ternary relationship. Each flight carries a number of passengers, has a particular time length (that depends on the distance of the route and the model of the aircraft), departure and arrival time.

Draw the E-R diagram for this database.

Answer:



Problem 8

Electronic commerce is one of the most used terms in the business world. Electronic commerce is the buying and selling of goods and services on the Internet. One of the most popular products for e-commerce is compact disc. This problem describes the database of a CD warehouse.

The database will be used by the customers and company's employees. Assume that customers have access to company's web site and they are able to open an account by providing their social security number, name, address, and music preferences. Every time a customer orders a product, the system updates the customer's account (the amount of money due is updated as well the name and amount of product ordered is recorded).

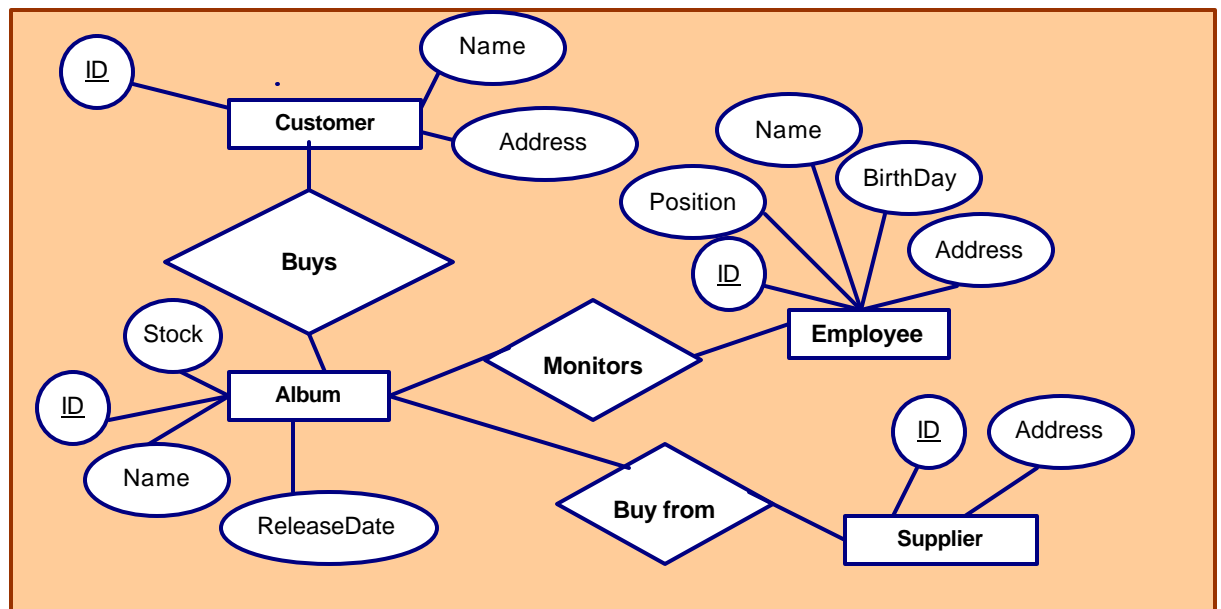
For each employee the following information is recorded: an employee identification number, name, address, birthday, and the title of the position with the company.

The products for the CD warehouse are the albums. The database keeps the following information about each album: an album identification number, name, group name, release date, musical category, name of the vocalist, names of the other band members, the record label, song titles, duration of the songs and the number of CDs on stock.

The database keeps information about suppliers: a supplier identification number, address, name of the company, and name of the contact person.

Draw an E-R diagram for the CD warehouse database. Identify the relationship cardinalities and the key attribute of each entity.

Answer:



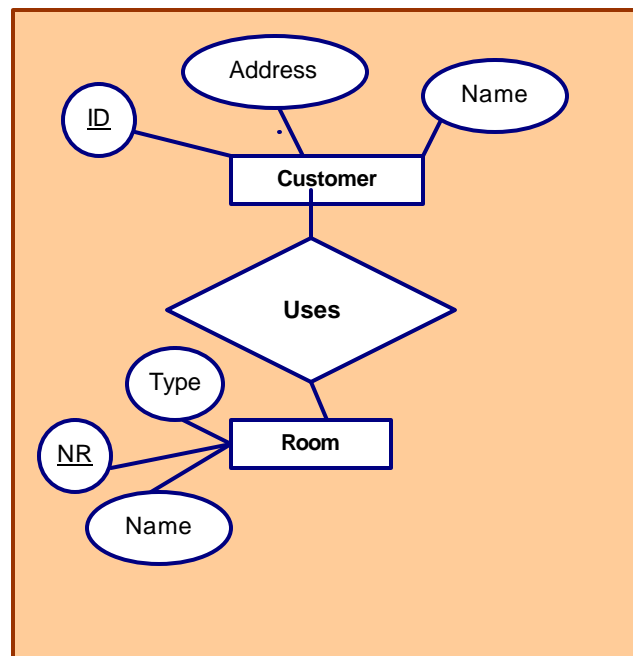
Problem 9

One of the three star hotels in the Miami area is in the process of updating their database. The hotel has various rooms on each of its floors. The rooms may be regular, deluxe, or suite type and can be either single, double, or triple. The suites have ocean view and are bigger than regular rooms. The deluxe type rooms are as big as suites, but they do not have ocean view and all rooms have air conditioning. Most of the rooms are non-smoking, but the hotel has smoking rooms as well. The hotel has different number of a particular room type in a floor. The price of each room differs by the size of the room, view and location (first floor, second floor etc.).

The customers are charged on a per-day basis. The number of days is computed based on the check-in time and the check-out time. Customers should provide details such as: name, address, type of room, check-in date, check-out date, payment details, etc. If rooms are available they may be allotted. In addition to the room charges there may be extras such as telephone, fax services, extra beds, and room service.

Draw an E-R diagram for the hotel database (state any assumptions you believe you need to make in order to develop a complete diagram). Identify key attribute (attributes) for each entity and composite attributes.

Answer:



Problem 10

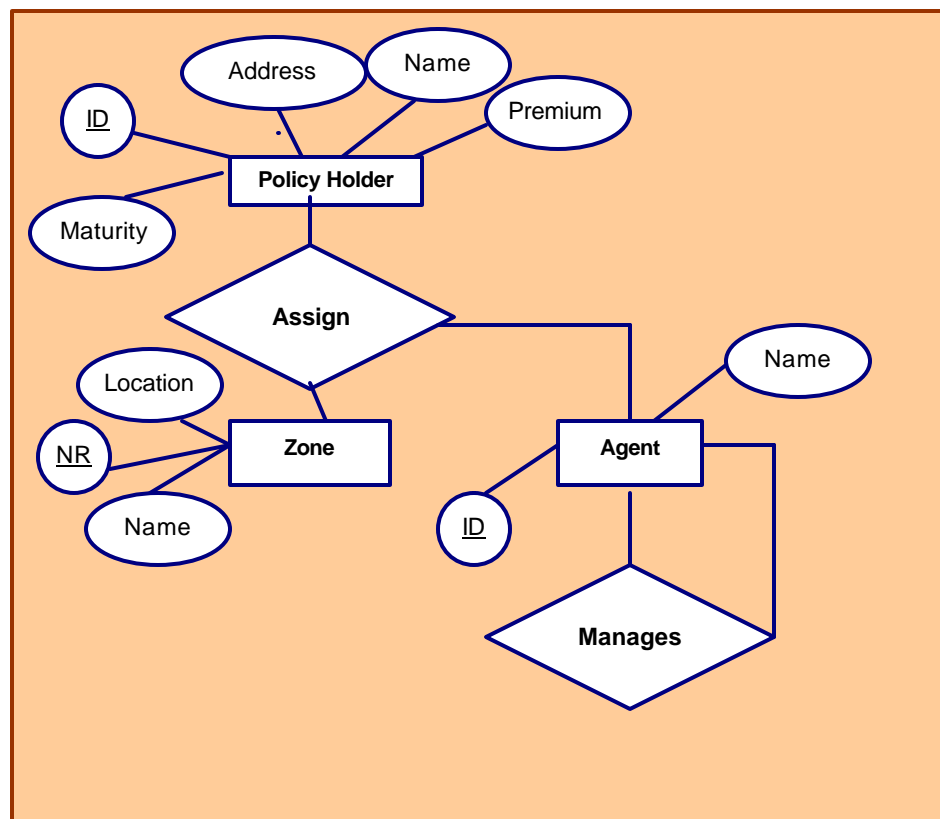
The Newark divisional office of the Life Insurance Corporation of America keeps all the necessary information about the policy holders in a database. A policy holder pays a premium until the maturity of the policy or his death, at which time the sum assured and bonus is paid to the nominee. The premium to be paid is worked out based on the age of the person proposed and the term of the policy.

Newark division keeps the following information about each policy holder: social security number, name, address, date of birth, description of the terms of the policy and the annual premium.

The corporation has divided its Newark division into 15 zones for its convenience. Each zone has its manager. Every zone has a number of agents allotted, typically ranging from 10 to 20. Every agent must procure a minimum of 10 customers.

Draw an E-R diagram for the Corporation database (state any assumptions you believe you need to make in order to develop a complete diagram). Identify the key attribute (attributes) for each entity and the cardinality of each entity relationship.

Answer:



Problem 11

Ford distribution centers provide automotive parts to authorized dealers and the dealers distribute the parts to customers throughout North America. Ford is faced with pressure to provide excellent customer service at minimum cost. Maintaining a well organized database of information, will contribute to achieving this goal.

Ford keeps the following information about each of its distribution centers: identification number, location (X longitude coordinate and Y latitude coordinate), address (city, state, zip code) and name of the contact person. The following information is kept about each dealer: identification number, dealer's location (X longitude coordinate and Y latitude coordinate), address (name of the city, state, zip code), name of the contact person, and the identification number of the primary distribution center to serve this dealer.

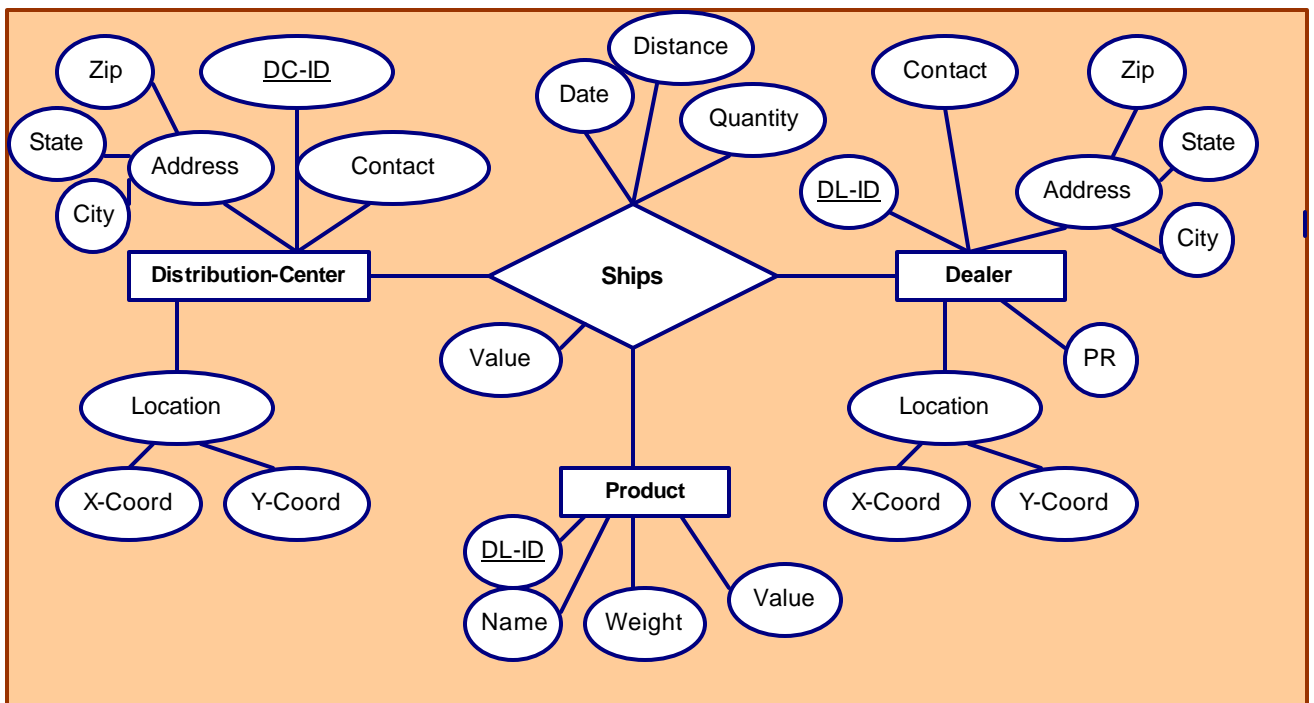
A distribution center sends a shipment to its dealers every week. The distribution centers keep the following information about each shipment: the date, an identification number of the product shipped, an identification number of the dealer that receives the shipment, and the demand in hundreds of pieces per week for the site/product combination.

The following information is kept about each product: a product identification number, the number of pounds per hundred pieces of product, and the number of dollars per hundred pieces of product.

Ford keeps the following information about the flow and cost data for all distribution centers to dealer channels: distribution center identification number, dealer identification number, product identification number, the number of miles between each distribution center and its dealers using the road network, the amount of money (in \$) per hundred of pieces paid for shipping, the flow of products moving through the channel in hundred of pieces, the total production cost per hundred of pieces of flowing the products through the distribution channel, the average shipment size in pounds, the material handling costs (the cost is calculated based on standard time needed to handle hundred pieces, multiplied by an hourly wage rate).

Draw an E-R diagram for the Ford database. State any assumptions you believe you have to make in order to develop a complete diagram.

Answer:



Problem 12

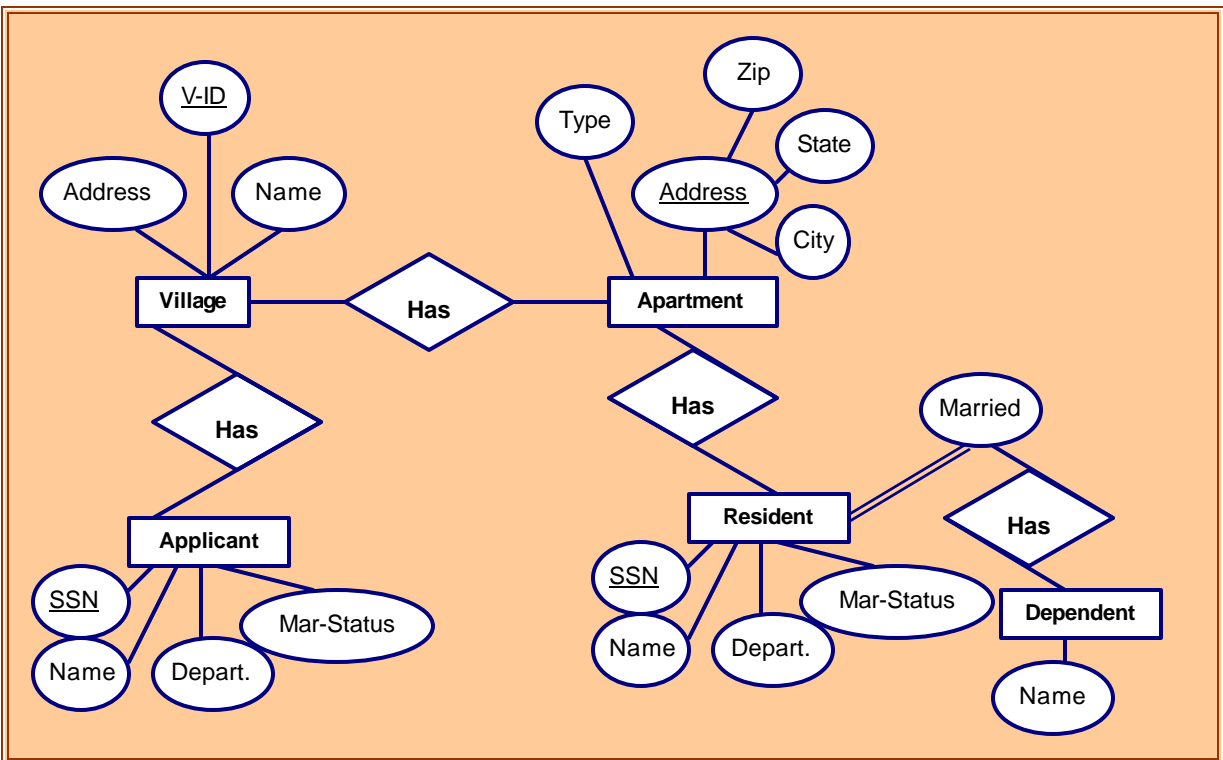
The University Housing Office receives many applications from graduate and married students requesting an apartment on campus. The housing villages are sited in five different locations and each village has about 500 apartments. Each apartment falls into one of the apartment categories. An apartment category is determined based on: village location, whether the apartment has: dish washer or not, a single or double bedroom, central or window unit air conditioner, furniture or not.

Housing office keeps the following information about the current residents: the SSN of the family head, name, address, telephone number, marital status, the name of the major college and department in which the family head is enrolled in.

Housing office keeps the following information about the students that have applied for in campus housing, but have not been assigned to an apartment yet: SSN of the applicant, name, address, telephone number, marital status, the name of the major college and department in which the family head is enrolled in, the preference about the apartment category.

Draw an E-R diagram for the University Housing Office database. State any assumptions you need to make in order to develop a complete diagram.

Answer:



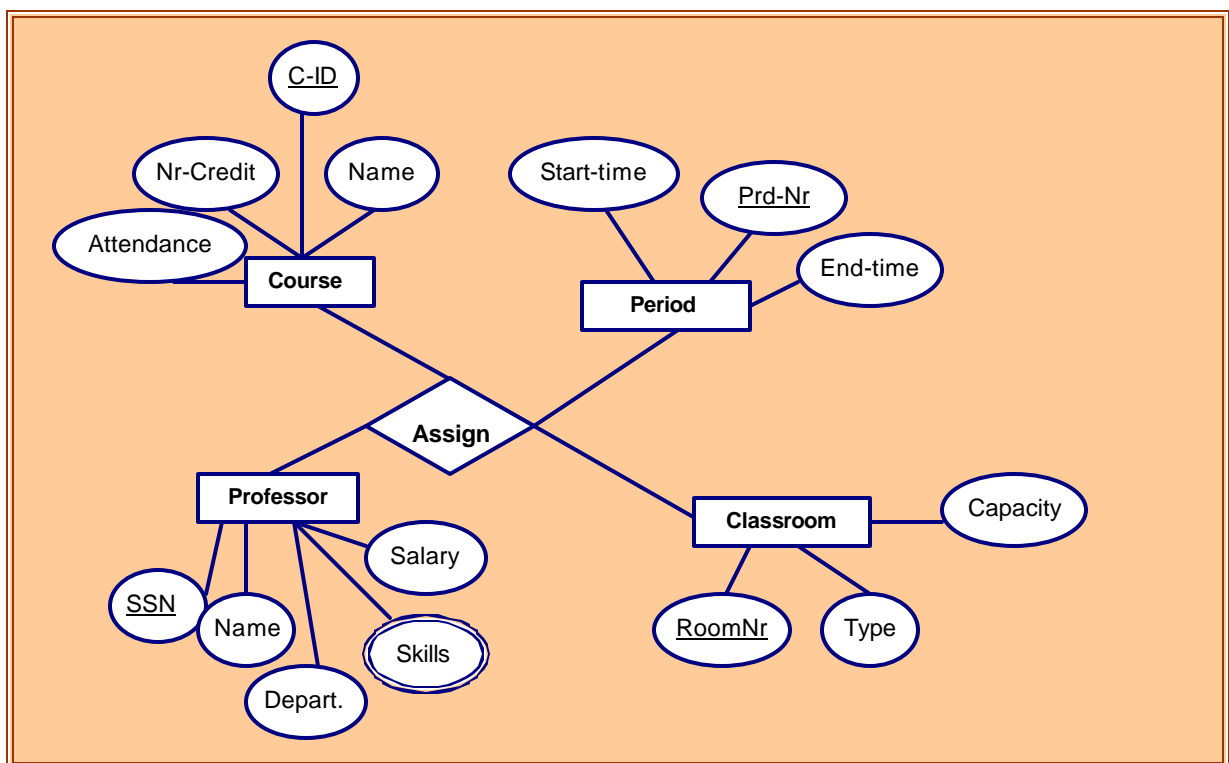
Problem 13

This database includes information about the course timetable of an academic institution. For each course the following information is recorded: an identification number, name of the course, name of the teacher assigned to teach the course, the number of periods each week it will be taught, the number of students attending the course, and the name of the group of courses to which it belongs.

For each teacher the following information is recorded: SSN, name, the name of the department he/she works with, the area of specialization, the yearly salary. For each class period the following information is recorded: period number, starting time, ending time. For each room the following information is recorded: room number, room type (classroom, office, auditorium, and computer lab), capacity.

The above information is used in order to make the right assignment of a teacher that teaches a particular course to a time period and a classroom. Draw an E-R diagram for this database. State clearly any assumptions you make.

Answer:



Problem 14

A database is being constructed to keep track of the teams, players and games of the national intercollegiate football championship. For each football player the following information is recorded: SSN, name, address, age, position he plays on the team, the university he represents, the number of years he is playing with the team, the number of year with the university (freshman, sophomore, junior or senior).

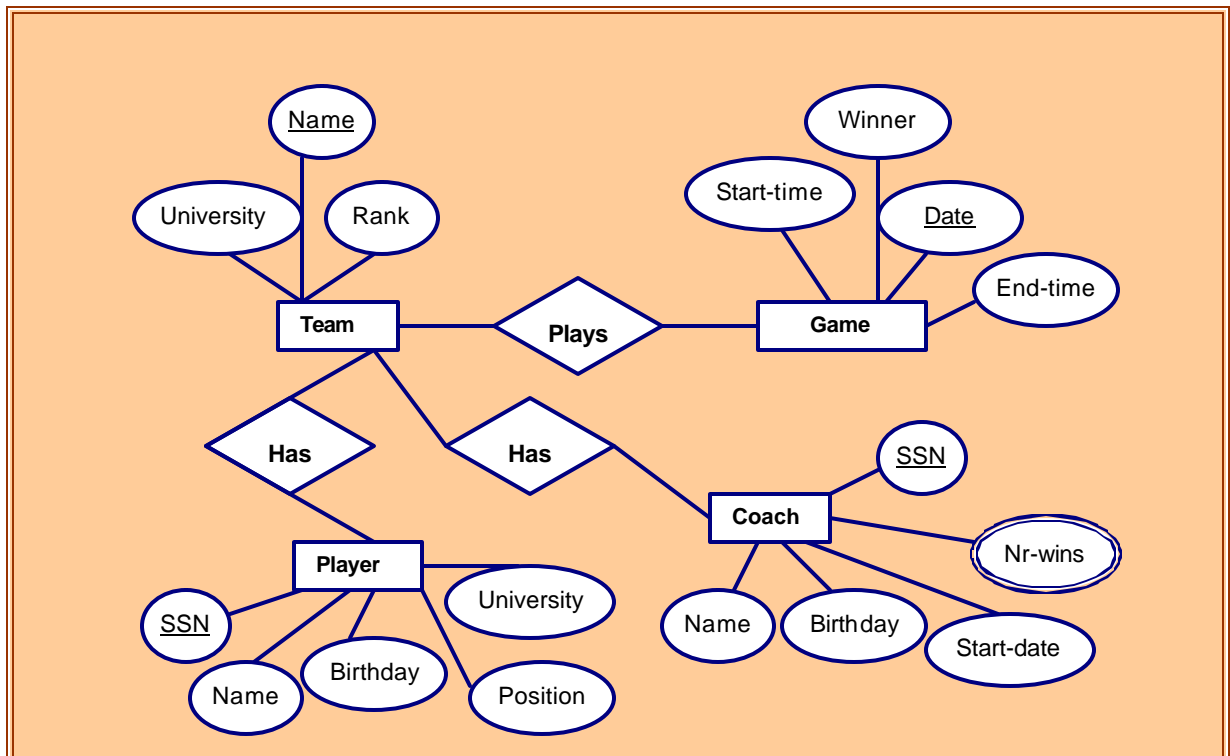
For each team that participates in the football championship the following information is recorded: name of the team, name of the coach, name of the university it represents, the rank of the team in the current season, number of games the team won and number of games the team lost in the current season.

The database keeps information about the team coach. This information includes: SSN, name, address, age, university he/she represents, number of years of coaching the current team, total number of years of coaching, number of times the team he/she lead won a championship, number of times he/she took a team to the semifinals.

The following information is recorded about each game: the date and place of the event, winning team, the name of the coach of the winning team, and the result (the score) of the game.

Draw an E-R diagram for this database. Clearly state any assumptions you make.

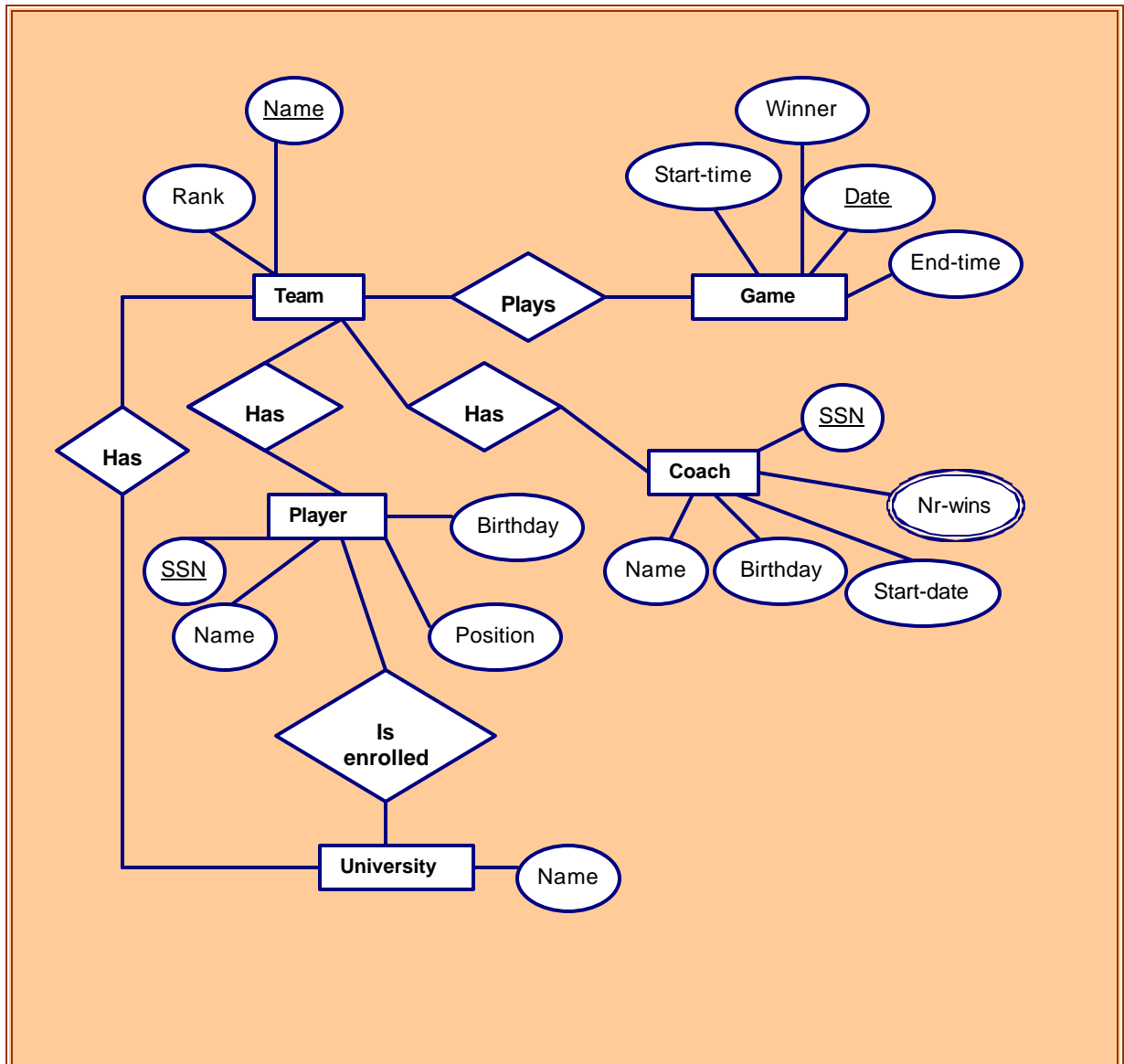
Answer:



Problem 15

Consider the database described in problem 14. Each player of a football team not only plays for a college, but in the same time is enrolled in that college. This is an example of multiple relationship entities. Update the E-R diagram to count for this information.

Answer:



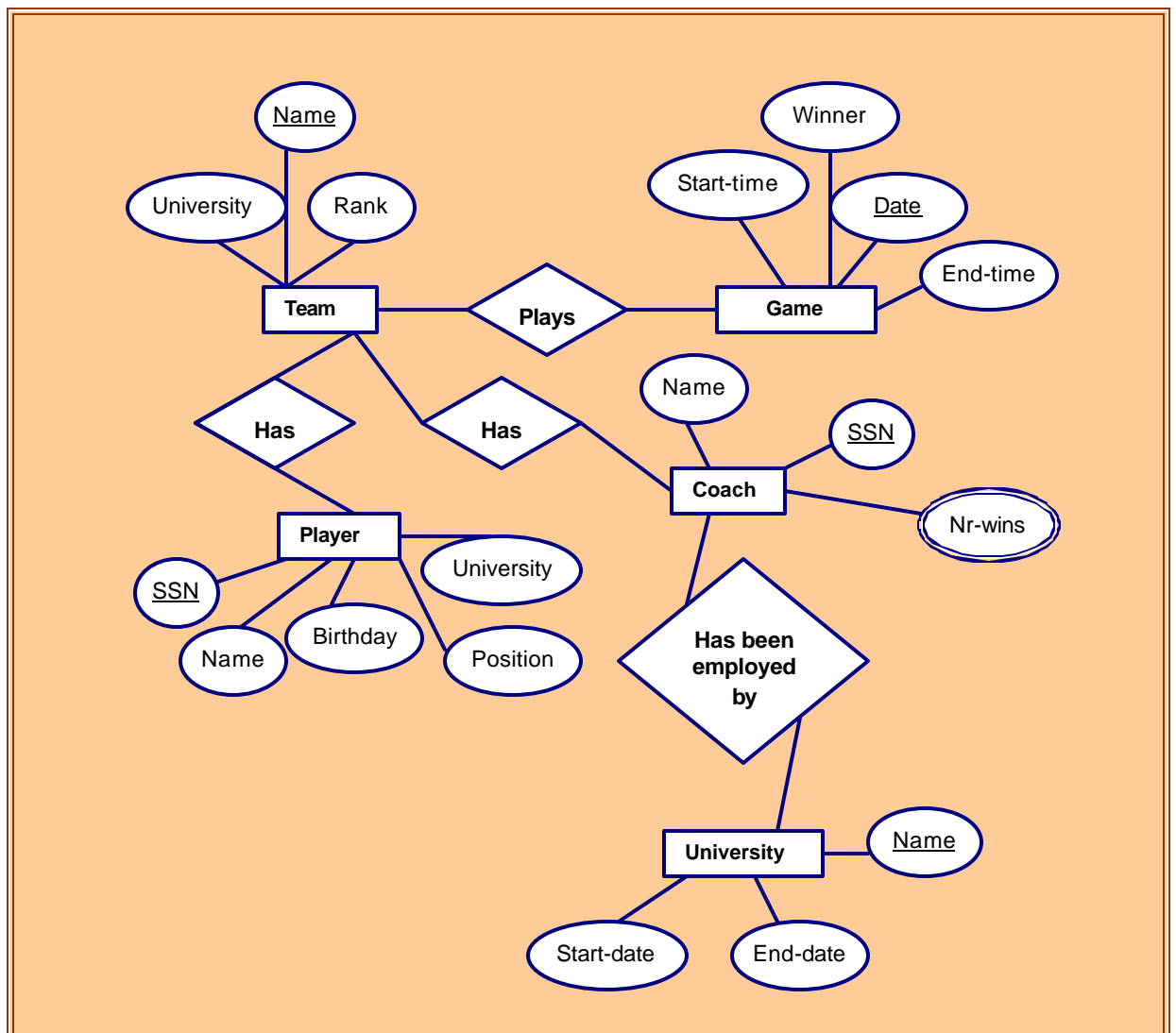
Problem 16

Consider the database described in problem 14. Suppose we want to design an attribute for the coach entity type to keep track of previous employments. Such an attribute will have one entry for each college he/she worked with. Each entry will be composed of college name, start and end date of employment, title of the position (coach, assistant coach, etc.).

This problem shows that composite and multi-valued attributes can be nested to any number of levels. Design an attribute to hold this information.

Give an alternative design for the attribute described above that uses only entity types (for example weak entity type) and relationship types.

Answer:



Problem 17

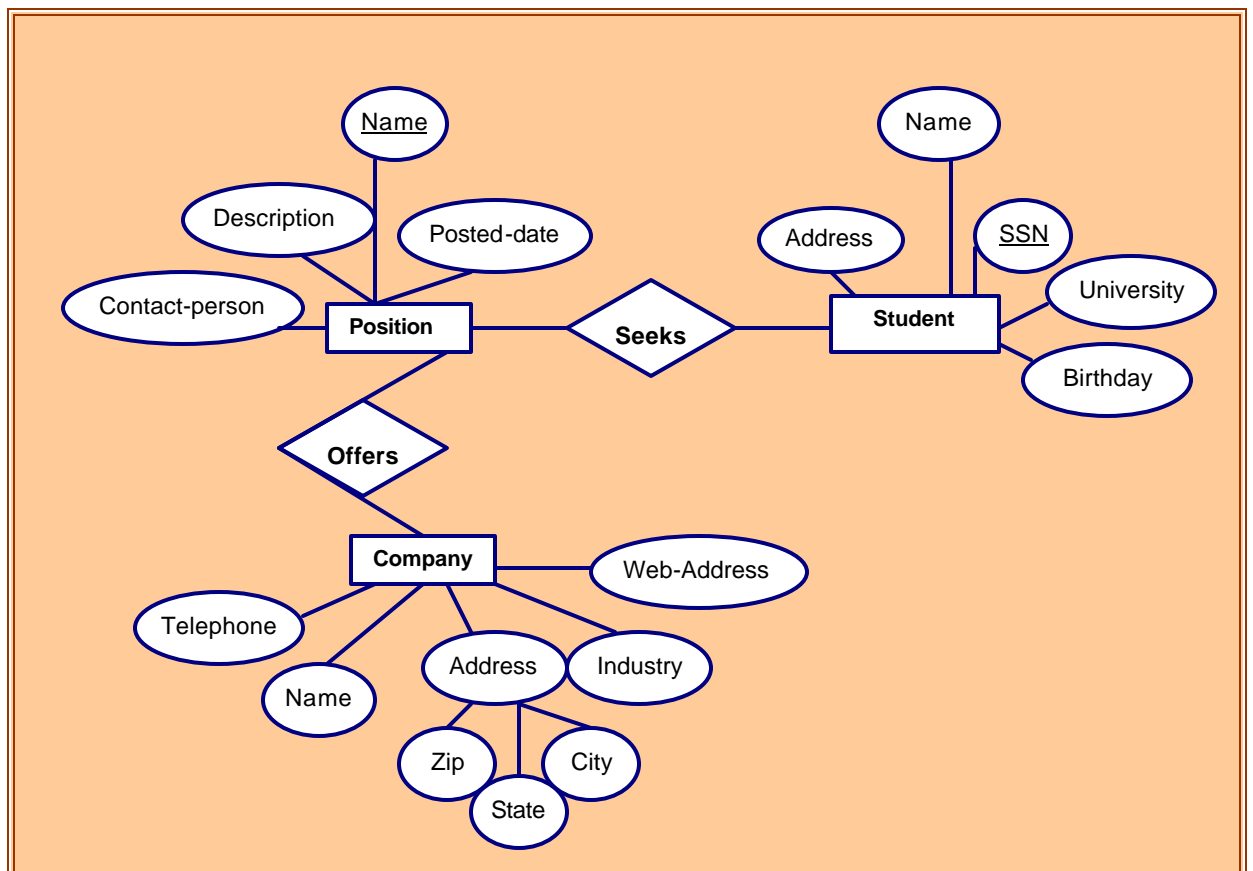
JobSearch.com is an internet based company. The company provides information about opened positions to students looking for a job and in the same time provides information about candidates to the companies. Both companies and the students can access the database. Students access the database to post their resume and look for opened positions in their area of study. Companies access the database to post their job openings as well as to look for the candidates that best fit their needs.

For every student the following information is kept in the database: student identification number, name (first name, middle initials, last name), birthday, telephone number, address (street, city, state, zip code), e-mail address, gender, country of citizenship, immigration status, major department, degree program, skills and resume.

For every company the following information is recorded: name, address (street, city, state, zip code), telephone number, fax number, website address, and industry. When a job opening is submitted, the companies specify the following: posted date, job description, skills required, type of job (full time, part time, co-op etc.), and number of openings. A contact person that works with the company looks into the database, chooses candidates, schedules the interviews and interviews the students.

Draw an E-R diagram for the JobSearch.com database. Clearly state any assumptions you make.

Answer:



Problem 18

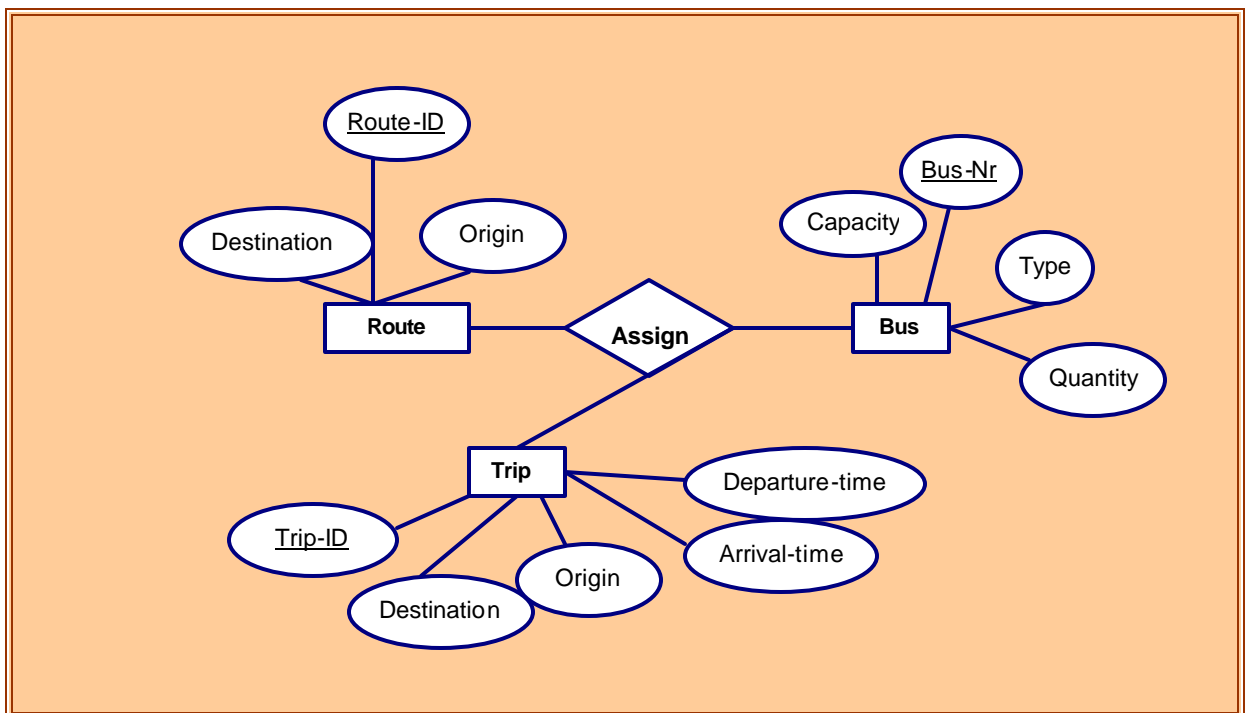
Florida Bus Traveling Agency needs to computerize their reservation database systems. The corporation has 18 buses spread over 20 routes to various destinations in Florida. There are two types of buses: 10 regular buses, with 48 seating capacity and 8 super deluxe buses with 36 seating capacity.

The buses travel certain routes. For each route the following information is recorded: route identification number, name of the city of the origin, name of the destination, and type of bus that is assigned on that route.

Customers usually book trips that do not necessary have to correspond to bus routes. A trip starts in one of the cities that is visited by a route (not necessary the city of the origin of the route), and ends in another city visited by that route (not necessary the city of the destination of the route). For every trip that a customer books his/her ticket for, the following information is recorded: trip identification number, city of origin, city of destination, departure time, and arrival time.

Draw an E-R diagram for the Florida Bus Traveling Agency database. Clearly state any assumptions you make.

Answer:



Problem 19

SunRise hotel is located in Palm Beach. The hotel keeps a detailed database of the rooms and special services offered, as well as a database of employees and customers. Keeping a detailed database of the rooms helps better managing the everyday activities of the hotel. The customer information (such as name and address) is used to notify the customers about special promotions.

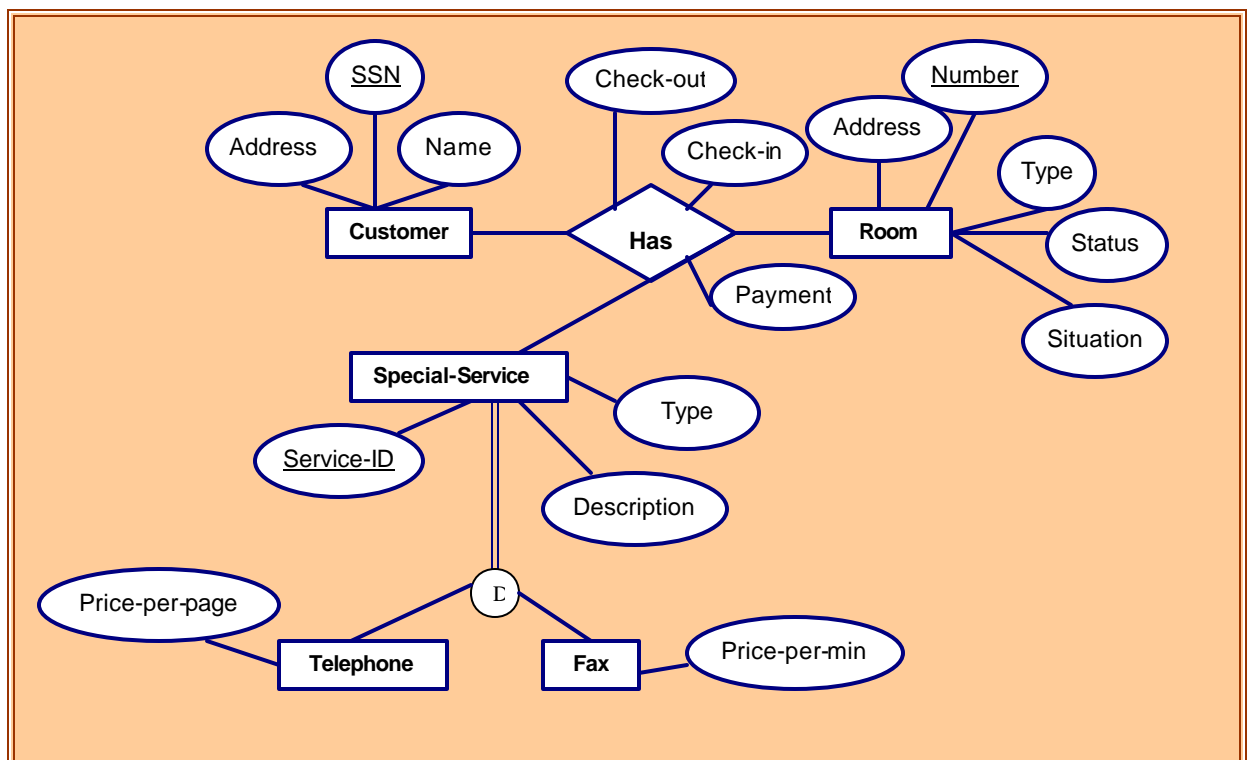
The hotel keeps information about each customer: identification number, name, address, telephone number, birthday, identification number of the room he/she stayed in, the checking in date and time and checking out date and time.

For every room, the following information is recorded: room identification number, location (first floor, second floor, etc.), status (available or not available), situation, rate, room type (regular or luxurious), bad type, air conditioning type (central or window unit).

The hotel offer special services to customers if requested. For the special offers the following information is recorded: identification number, rate, service type. The hotel offers other services (not classified as special services) such as fax service and phone service. For the fax service, the following information is recorded: fax identification number, rate per page and per destination (interstate, international etc.). When a fax is requested, the price paid by the customers depends on the number of pages, and the destination. For the phone service the following information is recorded: identification number, and phone rates. The phone rates depend on the call destination and length of the call.

Draw an E-R diagram for the SunRise hotel database. Clearly state any assumptions you make.

Answer:



Problem 20

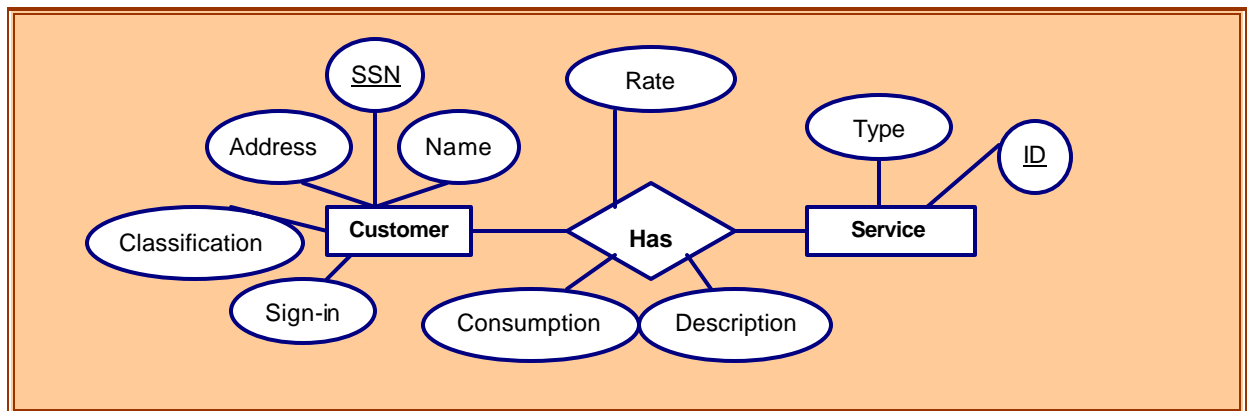
GERU is a regional multi-service utility providing electric (E), natural gas (NG), water (W), and telecommunications (T) services to its customers. GERU is interested in keeping a database of customers, services provided and rates. This database will help GERU maintain their operations and also enable the customers to track their energy consumption, check their payment history, report power failures and tap into an array of services and useful information.

The customers are classified into four major groups: domestic (D), commercial (C), agricultural (A) and Industrial (I). Currently GERU has 4,500 domestic, 1,200 commercial, 100 agricultural and 500 industrial connections. For each customer the following information is recorded: identification number, name, address, classification, type of services offered, and the date s/he first signed in with the company.

Each connection offered by GERU has associated characteristics and rates that depend on the customer classification (for example: domestic rates differ from the industrial rates) and the type of service. For each connection with a customer the following information is recorded: connection identification number, customer identification number, amount of gas, water, etc. consumed in a particular month, amount of money due, and due date.

Draw an E-R diagram for the GERU database. Clearly state any assumptions you make.

Answer:



Problem 21

The VedMed is a Veterinary Hospital. The hospital keeps a database of their clients, pets, employee, and inventory. This information is used to provide a better customer service and manage the everyday operations.

The database includes the following information about each of the customers: customer identification number, name, address, telephone number, and e-mail address. The database records the following information about each pet that visited the hospital: pet name, type, and birth date. In addition, for each pet, a history of the visits to the doctor is kept. For each visit, the date, type of service offered, additional comments and payment amount is recorded.

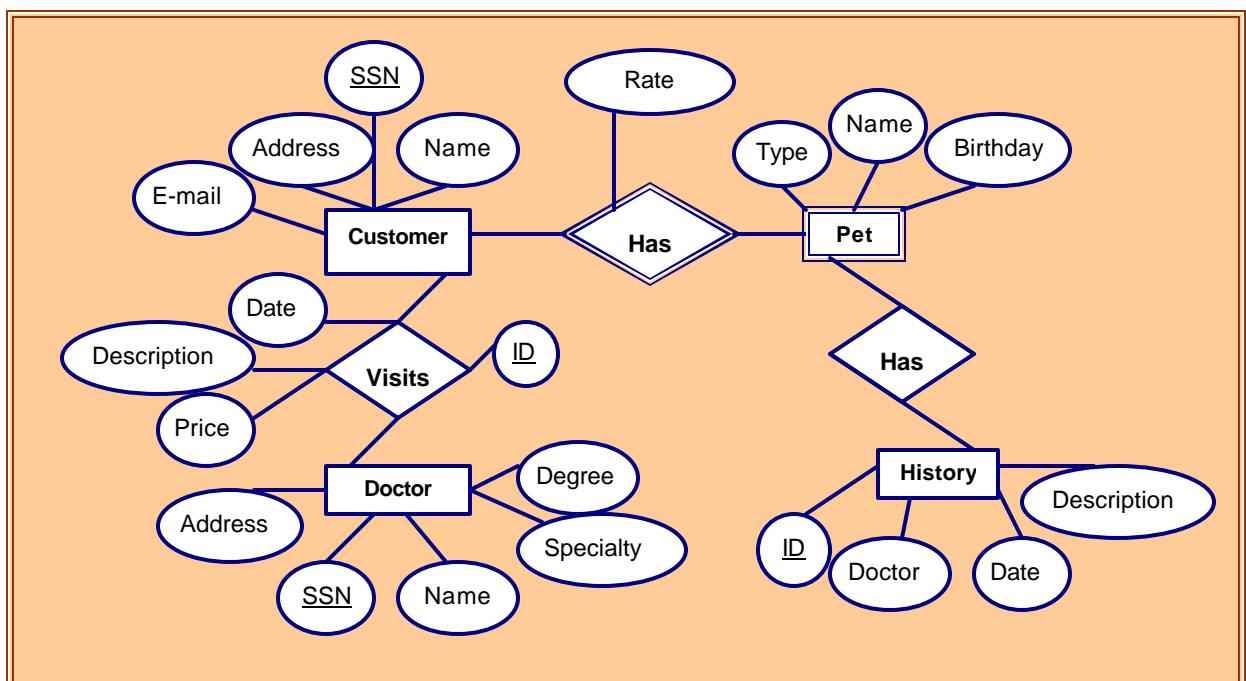
Detailed records about the doctors working with the hospital, is kept on the database. Part of this information is made available to the customers in order to help them with choosing a doctor that better fits their needs. The doctors' database includes: doctor's identification number, name, address (includes the hospitals' address as well as the doctor's room number), gender, birthday, area of specialization, degree earned.

After visiting a pet, the doctor writes a prescription. The prescription includes the name of the pet, name of the doctor, description, name of the medication and the quantity recommended by the doctor.

The hospital has a pharmacy where the customers buy the medications. For every item in the inventory, the following information is recorded: identification number, name, description, price, quantity on hand and safety stock level.

Draw an E-R diagram for the VedMed Hospital database. Clearly state any assumptions you make.

Answer:



Problem 22

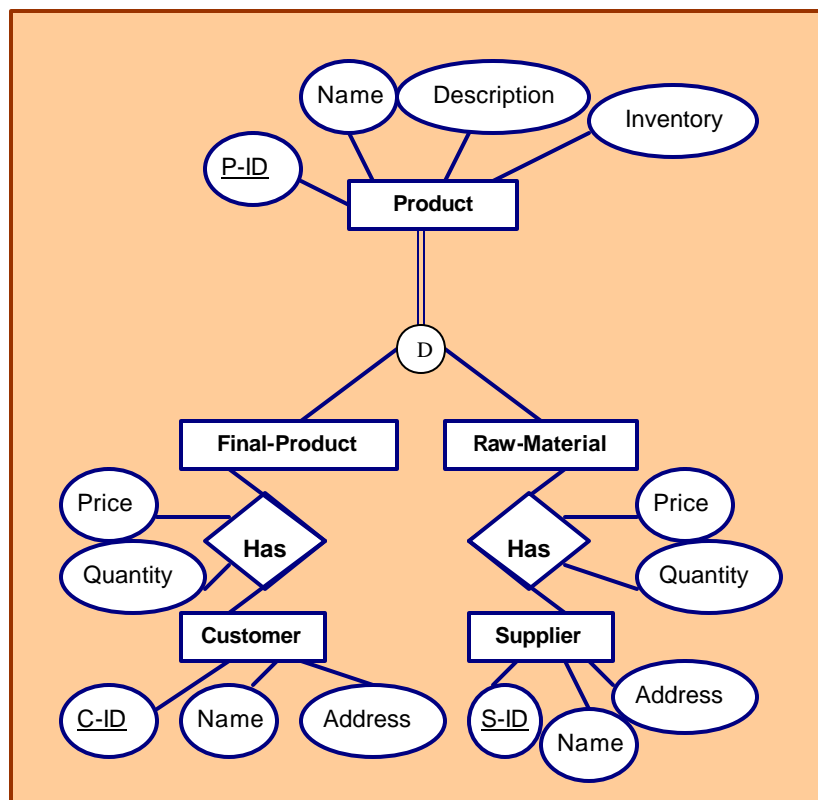
“Memorabilia” is an on-line company that buys sports items from different producers around the country and sells them to on-line customers. Customers visit Memorabilia’s website, select an item and set an order. As soon as the customer’s order is received, the product is delivered to the customer and the inventory level is updated. The company orders a particular product from a supplier when the inventory level drops below a certain level.

The company has decided to keep a detailed database of the employees, customers, suppliers, orders and products that would help in managing the operations. The following information is kept into the database:

1. Customer: name, address, birthday, gender, preferred sport, and a history of the items bought from Memorabilia.
2. Supplier: supplier identification number, name of the company, telephone number, address, name and telephone number of the contact person.
3. Product: product identification number, price per unit, amount in the inventory, amount ordered to the suppliers but not yet received, amount required by the customers but not yet shipped.
4. Order: order identification number, identification number of the product ordered, quantity ordered, and price.

Draw an E-R diagram for Memorabilia’s database. Clearly state any assumptions you make.

Answer:



Problem 23

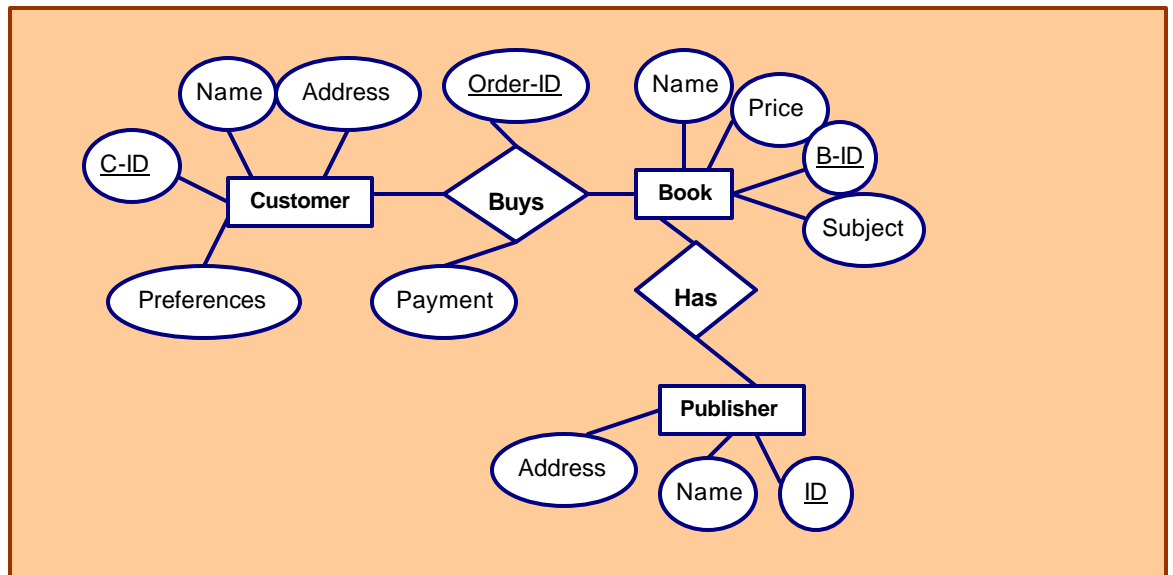
A small size bookstore has been keeping track of its business mainly on paper. The owner is planning to grow the business and would like to have a state-of-the-art database system, which would improve the bookkeeping and service to customers.

As a caring bookstore owner she would like to send information about new books, new editions of a book, or deals to the customers based on their profile. If the customer were a faculty member at a university then she would like to offer free copies of a new textbook or a new edition of an existing textbook. If the customer were a student who likes reading science fiction she would like to send monthly notices about new releases. The system will help the store maintain details about books, publishers, customers, receipts/payments, etc. A book may be a textbook, a novel, a comic, a children's book, or a cookbook. Publishers are the suppliers of the books. The bookstore buys books from different publishers. Typical customers of the store are libraries, institutions, or individuals such as students, faculty, and others. Customers may open an account with the store if they wish and they will be given a customer number. With their customer number and a password that they will set, the customers will be able to login to the database using their PC at home. They will be able to search books, place orders, check their account status, and also submit reviews about books they have read.

The database keeps record of the sell/buy transactions. For example, when the customer places an order, a payment is made. In the case that the inventory level for a particular book drops below a certain limit, the bookstore places an order to the publishers for new copies.

Identify the entity types of the bookstore database. For each entity type, identify corresponding attributes. Draw an E-R diagram. Identify the multiple relationship entities.

Answer:



Problem 24

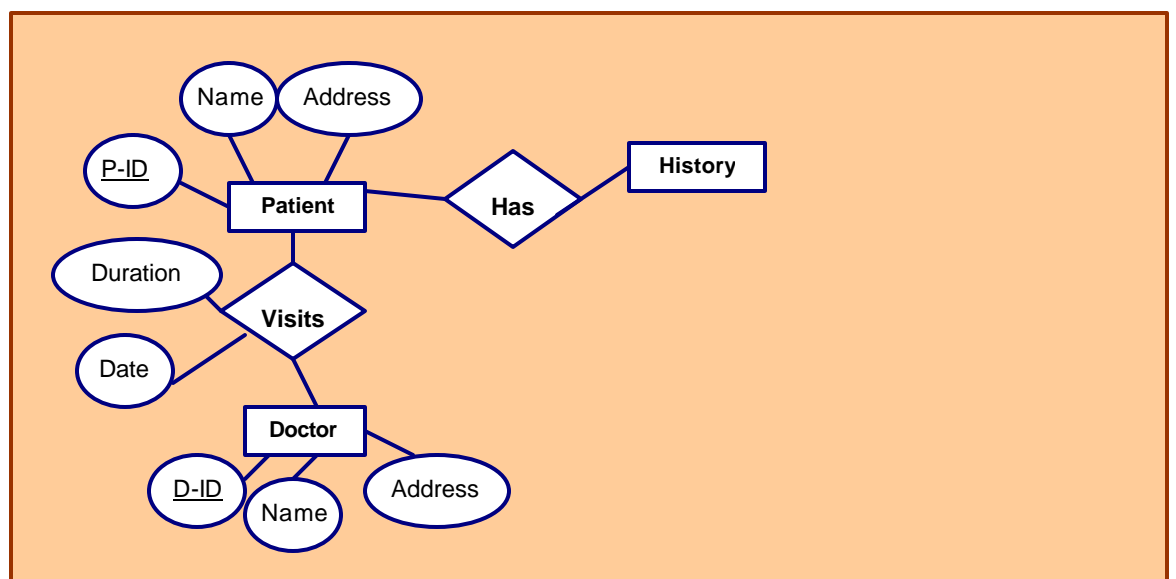
Medicare is a medical service program that provides acute care for hospitalization, visits to a doctor's office, medical tests, and a limited amount of skilled nursing care for patients recuperating from an acute illness. Medicare program covers 12 federally mandated services and several optional services. Medicare is developing a database management system that will help: confirming patient eligibility; assigning a doctor; paying doctors, pharmacists, and hospitals promptly.

The system should be designed to structure, store, retrieve, and analyze critical Medicare management information such as information about patients, doctors, pharmacies, drugs etc. The system stores the following information about:

1. Patients: identification number, name, address, birthday, gender, the identification number and name of the doctor in charge, the date of signing up with the Medicare program and the annual income.
2. Patient history: the patient's identification number and name, and for each visit to the doctor: the date of the visit, the duration of the visit, the diagnose and the medication.
3. Doctors: identification number, name, address, gender, birthday, the field of study.
4. Pharmacy: identification number, address, telephone number, name of contact person.
5. Pharmacy inventory (for every drug kept in the inventory): identification number, name, price, date of the last purchase, amount in the inventory, and the amount ordered (not received yet).
6. Buy/sell transactions at a pharmacy: the date of the transaction, identification number and name of the drug, name of the doctor that issued the prescription, name of the patient, price and quantity purchased/sold.

Draw an E-R diagram for Medicare database management system.

Answer:



Problem 25

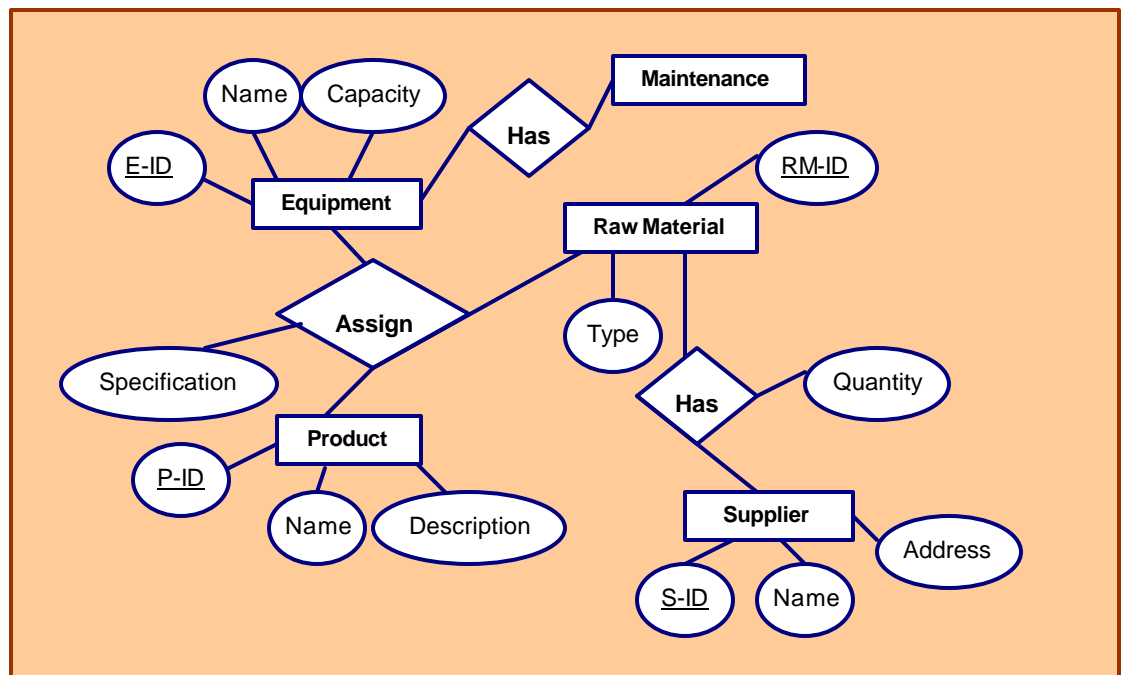
Wood paneling manufacturers face a number of complex decisions in their daily processes. For example, allocating production resources and combining various raw materials to meet production goals require real-time decision making. The management has decided to build a database system that will help in fine-tuning production processes in the existence of changing supply and price situations.

Consider a wood panel manufacturer who produces a furniture grade particle board. Each of the panels consists of a middle layer and two surface layers, which are symmetrical. To enhance its mechanical properties each panel has several stratus of different materials, compositions, and specific gravity. A panel's quality can be controlled by specifying different density profiles and raw material requirements. There are eight different types of raw materials and your database keeps information about their suppliers, quantities available, quantities needed, and the maximum capacity of the bottleneck equipment. The raw material needs can be supplied from six different sources including sawdust, shavings, sawmill, residual, chips, and short or long logs (softwoods, hardwoods). The database should keep a detailed matrix of specifications that shows the quantity of each individual raw material allowable in various layers of the different products.

Another variable that affects the production schedule is the production capacity. The database keeps track of each equipment production capacity, equipment type (name), maintenance date, and a description of its activities.

Draw an E-R diagram of the manufacturer database. Clearly state all the assumptions you need to make in order to build the database.

Answer:



Problem 26

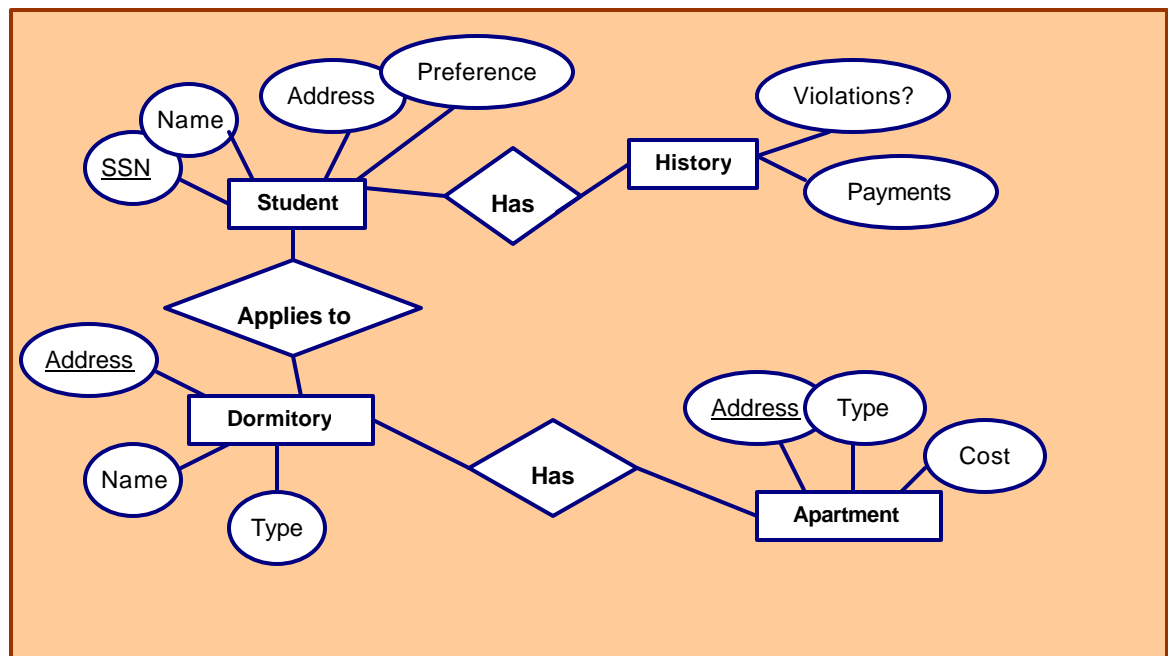
The housing office in a university is facing difficulties in assigning undergraduate students to dormitories. The two difficulties they are facing are: the current system does not consider student preferences, therefore once the assignment is completed and announced, students ask to be reassigned in a different room or even a different building; the number of undergraduate students entering the university is increasing every year.

The housing office has decided to build a database management system that will help with assigning students to dormitories. In particular the new system will review students' preferences for their assignment (for example: AC preference, dorm preference and room preference) as well as their record from previous years (for example: payment history, history of rule violations or damages etc.) to determine placement. These factors will be recorded as student information and residential history.

There are ten dormitories in the campus. Each dormitory is classified into: married couples, males only, females only and for co-ed. Each dormitory has up to four floors and each floor has up to ten apartments. An apartment is classified as: single, double or triple room apartment. Some apartments have air conditioning. Each apartment has a pre-set yearly cost and students make one payment for their one-year stay.

Draw an E-R diagram and state any assumptions you make.

Answer:



Problem 27

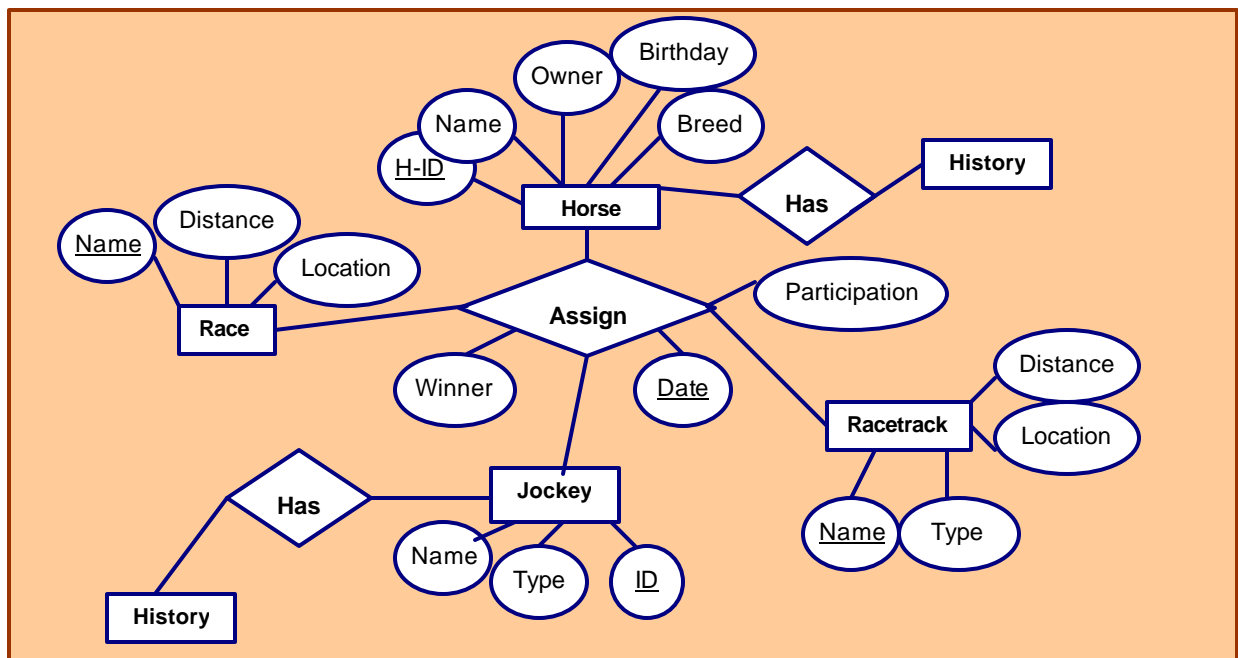
People have bet on the outcome of horse races as long as horses have raced and they have tried to earn large profits from their bets by finding ways of outwitting other betters. A large number and variety of books have been published on horse races and each author claims that following his/her methods will lead to profits. So far you have not been able to make big profits using any of the existing methods. Therefore, you decided to build your own system that would help you place sophisticated bets.

Horse racing is one of the most documented sports. There are thousands of pieces of data published on each upcoming race. This data is available to you and you need to build a database to keep all this information.

1. For each horse, the following information is recorded: name, owner, age, height, weight, breed (what kind of horse is it? Arabian, English?), parents, a history of races attended, races won, injuries etc.
2. For each jockey: SSN (social security number), weight, height, age, the number of years has s/he been racing, race history, major achievements, etc.
3. For each racetrack: name, location (address), type (dirt, turf, etc.), distance and so on.
4. For each race: name, distance, the number of times a year it is organized, where does it take place, the first time it was organized, attendance, prize amount, the winners of each race, etc.

Draw an E-R diagram of this database.

Answer:



Problem 28

The United States Tennis Association (USTA) is concerned about developing a ranking system of the tennis players, which is objective, consistent and broad-based. These qualities are important in a ranking system since rankings directly affect the acceptance of a tennis player's entry and his/her placement in the draw.

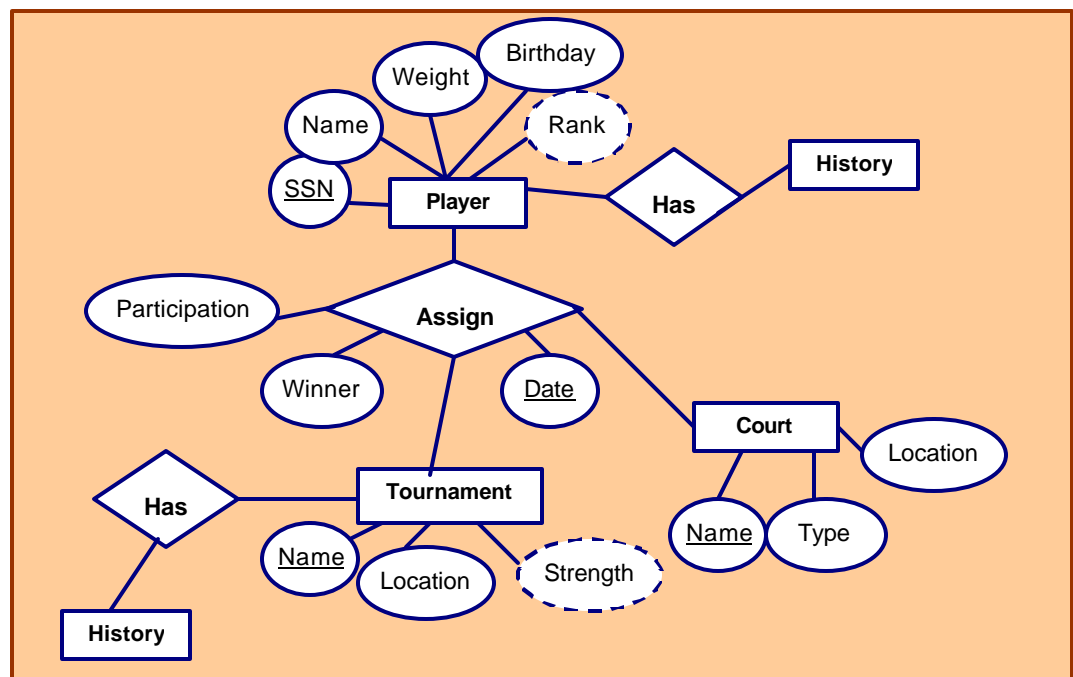
USTA uses a particular formula to give the ranking points for each player. The formula uses the following information: number of tournaments played by the player, tournament points earned, number of matches played, number of wins of the player (say player "i") over player j. The strength of the tournament is a function of the quality of the players and the size of the tournament.

The new system's performance relies in the efficiency of the database. The database keeps record of the following information:

1. For each player: social security number, first name, last name, tournament points earned, number of matches played, number of tournament played, current ranking, age, weight, height, awards, etc.
2. For each court: name, type (grass, clay, hard surface, ...), location, etc.
3. For each tournament: name, location, and tournament strength.

Build an E-R diagram for the database described above. Clearly state your assumptions.

Answer:



Problem 29

The traditional MBA program has been receiving criticism, because it is focused on analytical training. However, the employers are looking for executives with broader education. The American Assembly of Collegiate Schools of Business (AACSB) requires the following components in an MBA curriculum: common body of knowledge in management, a field of specialization, general competence for overall management.

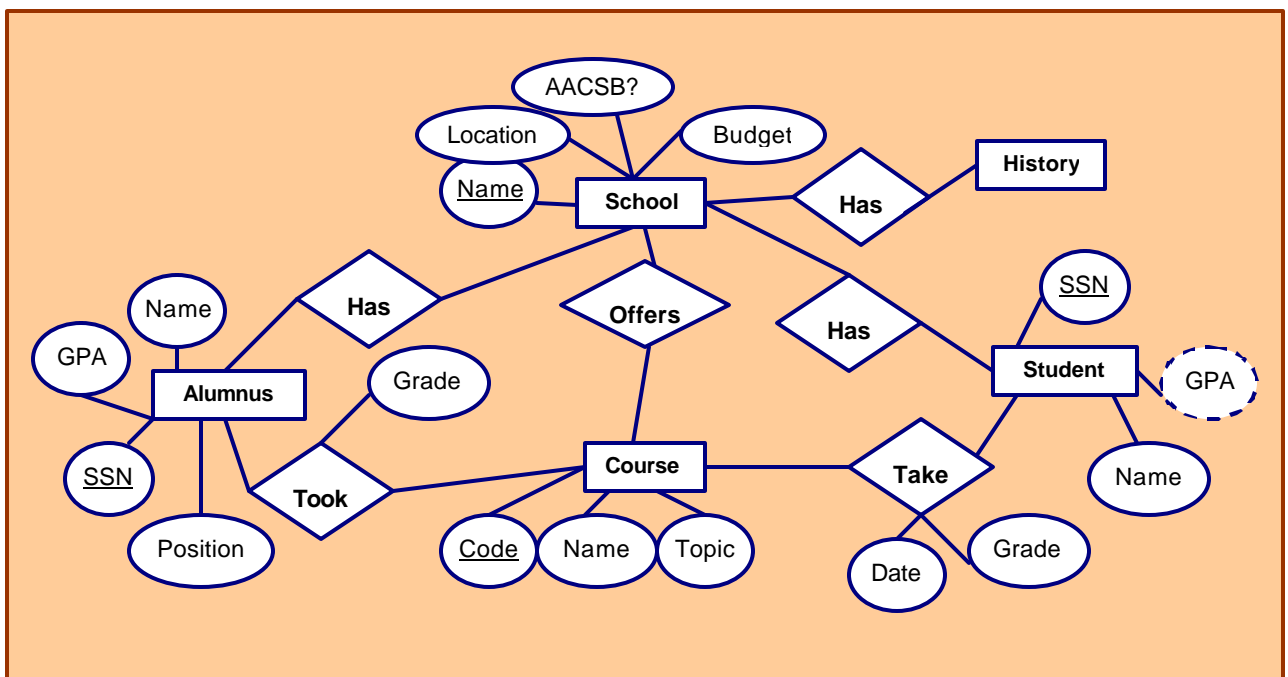
Most of the schools are trying to improve their MBA programs and this is not an easy task. As a first step through this process, AACSB has identified building a database that contains information about students and alumni, schools and courses offered etc. This information will be useful in preparing the new curriculum for the MBA program.

The database consists of the following entities:

1. For each school: name, current curriculum, number of MBA graduates every year, size of their library, budget allocated for the MBA program, location (suburban, major city, etc.), whether it is AACSB accredited or not. (AACSB accredit those schools that meet certain requirements. Being AACSB accredited is important for schools since it is an indication of their quality.)
2. For each alumnus: name, SSN, school s/he graduated from, current position, current salary, GPA at graduation, etc.
3. For each course: name, code, type of course (foundational, functional, general, sectoral or institutional), topics covered, etc.
4. For each of the current student: SSN, name, current GPA, courses completed, the date s/he started the program, expected graduation date.
5. For the current curriculums: curriculum code, the courses offered, etc.

Draw an E-R diagram for this database. Clearly state any assumptions you make.

Answer:



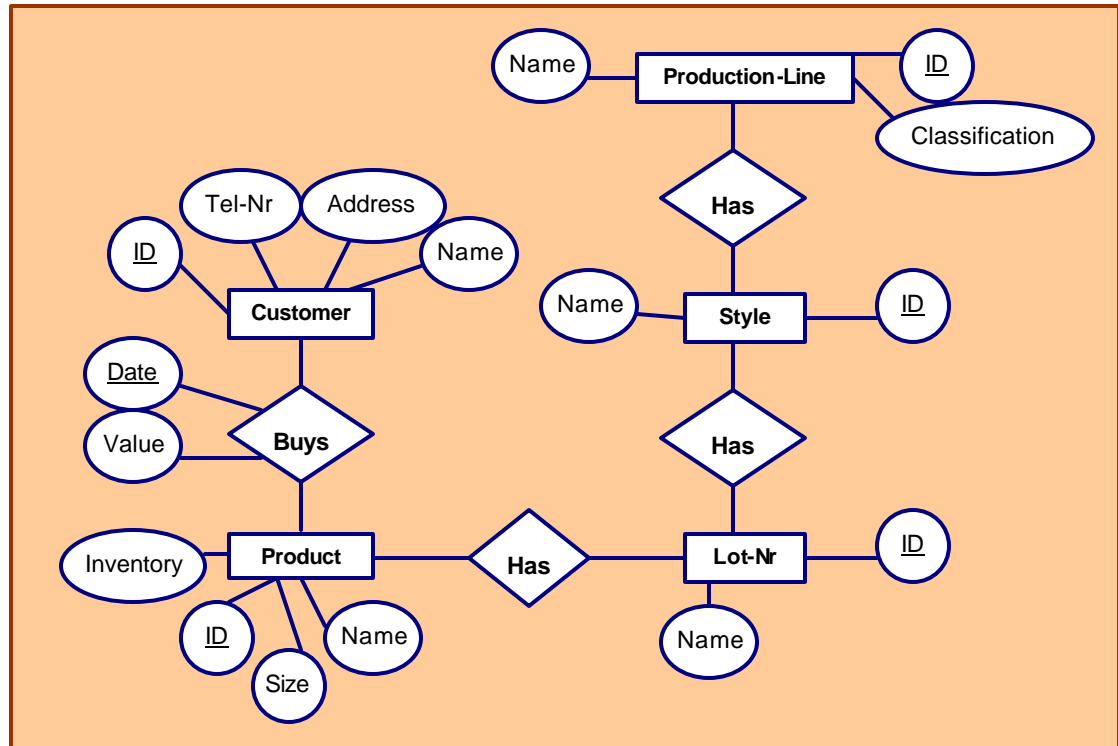
Problem 30

Blue Bell is a large apparel manufacturer. They manufacture jeans and several other lines of sports and casual apparel for men, women and children in the USA and have a substantial international business. Each of the above production lines breaks down into styles, lots and sizes and stock keeping units (SKU). With time the management realized that the number of product lines, styles, and SKUs had grown tremendously. The production process had incorporated several new automated manufacturing operations in response to change in the customer tastes. The management was concerned about the high investment in working capital. A large part of the working capital is inventories. In this process of extending the business, crucial for Blue Bell is an effective coordination of their activities. A well organized database management system will help Blue Bell to manage their inventories. The database includes the following entities:

1. Production line: name (for example, jeans, t-shirts, swimwear etc.) and identification number, classification (for example, menswear, womenswear, boyswear and kids).
2. Style: style name (for example, straight-leg jeans, boot-leg cut jeans etc.) and identification number, identification number of the corresponding production line (for example, jeans production line).
3. Lot number: identification number, name (for example blue, green etc.), identification number of the product style.
4. Product: identification number and name, size, inventory level and monthly production.
5. Customer: identification number, name, address, and telephone number.
6. Transaction: transaction date, name of the customer, type of product sold, the amount sold and the corresponding value (in \$).

Draw an E-R diagram for the Blue Bell database. Clearly state any assumptions you make.

Answer:



Hands-on EER Model

Problem 1

The main library of a university is interested in developing a database management system. The library carries the following items: books, journals, conference proceedings, reference textbooks, and copies of some recorded lectures on CD. These items are loaned to members in various categories.

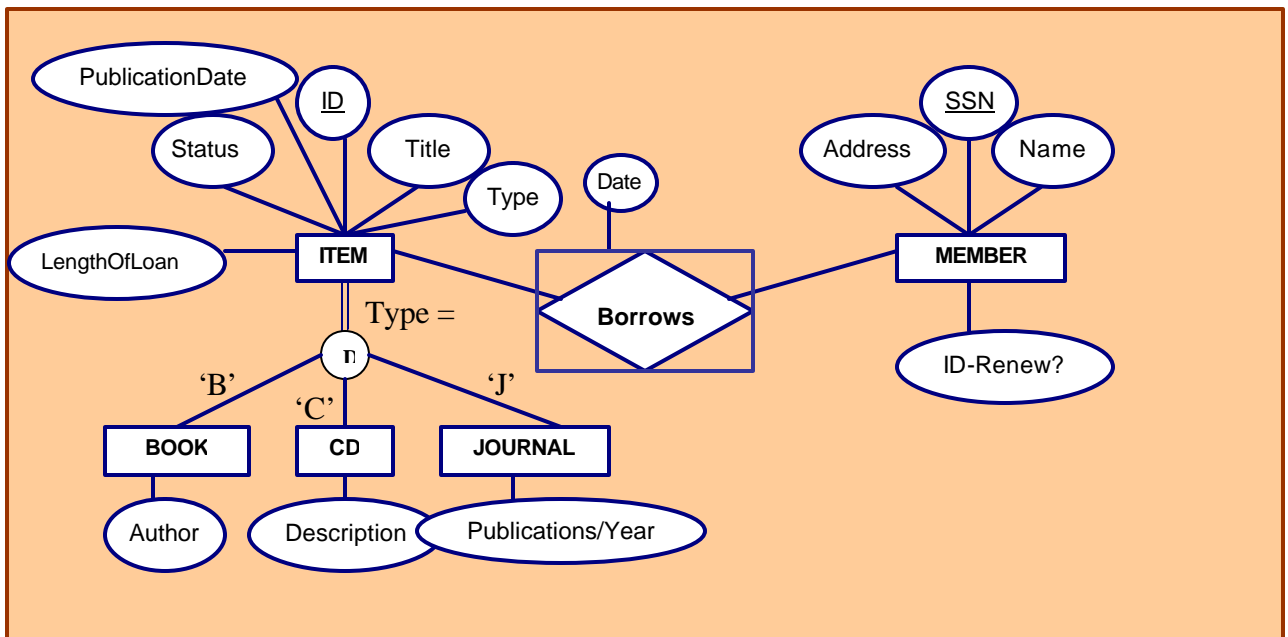
The library has a total of 250,000 items. The library uses a coding scheme for classifying the items. Using this code the librarian will be able to identify the type of the item (book, journal, CD, etc.), the subject, the title, the author(s), whether the item is on loan, overdue, or on shelf.

Members of the library are under-graduate and graduate students, faculty members, staff, part-time students, and visiting scholars. All members are issued an ID card by the university which can also be used at the library. Students and visiting scholar renew their ID card every semester. Faculty and staff ID are valid as long as they are still employed. The database records SSN, name and address of each member.

A member who borrows a CD cannot take it outside the library and has to use the computers in the library to watch it. Journals and conference proceedings can be borrowed for 2 days, reference textbooks can be taken on loan overnight only. Faculty and graduate students can borrow books for a period of 3 weeks, other students and visiting scholars can borrow them for 2 weeks, and staff can borrow books for 1 week only. Note that different than books, Journals do not have a single author. Journals are published few times in a year.

Draw an EER diagram for the university library database. Clearly state your assumptions.

Answer:



Problem 2

A financial institution offers different investment schemes to its customers such as shares and debentures. The company also accepts fixed deposits from the general public, institutions, and its employees. The company keeps a database with valuable information about its customers (such as ID, name, and address) and financial instruments.

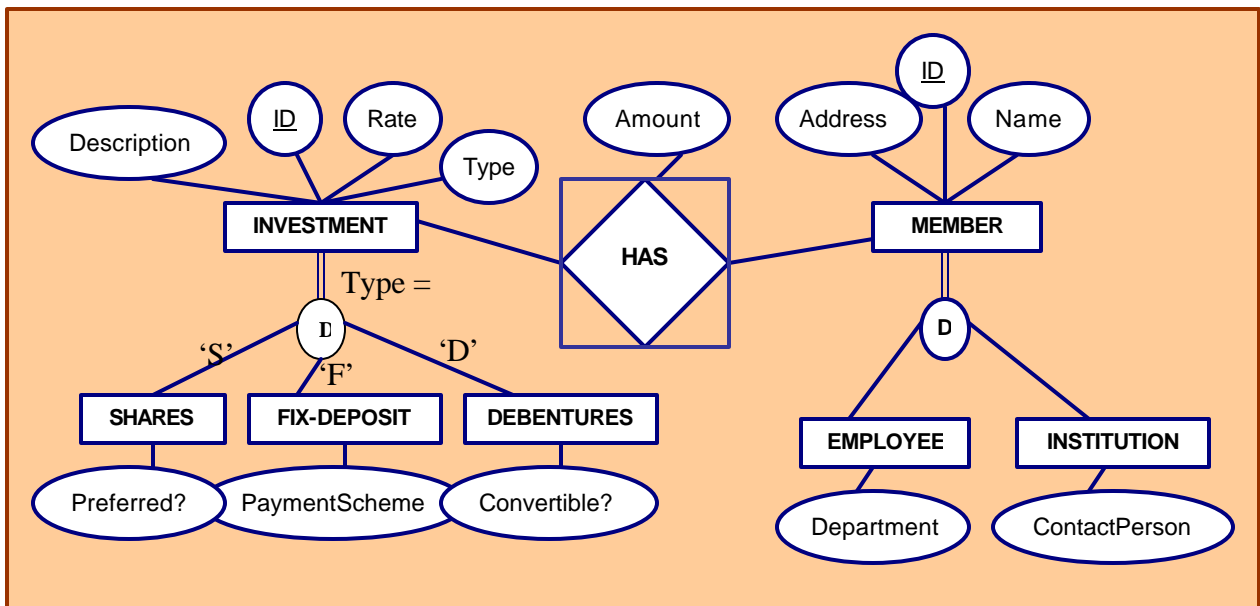
Fixed deposits have varying terms of 1, 2, or 3 years. For fixed deposits there are currently two payment schemes. Under the first scheme, the investors get the principal plus the interest on maturity. Under the second scheme, they get the principal on maturity, but interest is paid periodically. The interest rates for fixed deposits under the first scheme may be paid quarterly, semi-annually, or annually. Investors have the option to renew their deposits on maturity.

The company also raises debentures periodically. The debentures may be either convertible or non-convertible. Debentures are issued for periods of 1, 2 or 3 years.

The company also calls for shares periodically. The company issues two kinds of shares: equity shares and preferred shares. The dividend is declared at the end of the year. The system keeps track of the dividend rates, dividend issued to the shareholders, etc.

Draw the EER diagram of this database. Identify (if any) the subtypes of entity financial instrument and member. Identify one (or more) unique attribute (relationship) for each subtype as well as one (or more) attribute that is shared by all entity subtypes.

Answer:



Problem 3

“Great Marbles” is a small size company in Venezuela that produces two main types of products : Gems and Marbles. They produce two different sizes of Gems, and about six different sizes of Marbles. Both products are offered in 25 different colors. The different kinds of decoration marbles distinguish by color, size, and shape. Each Gem is classified as a matt or a luster Gem.

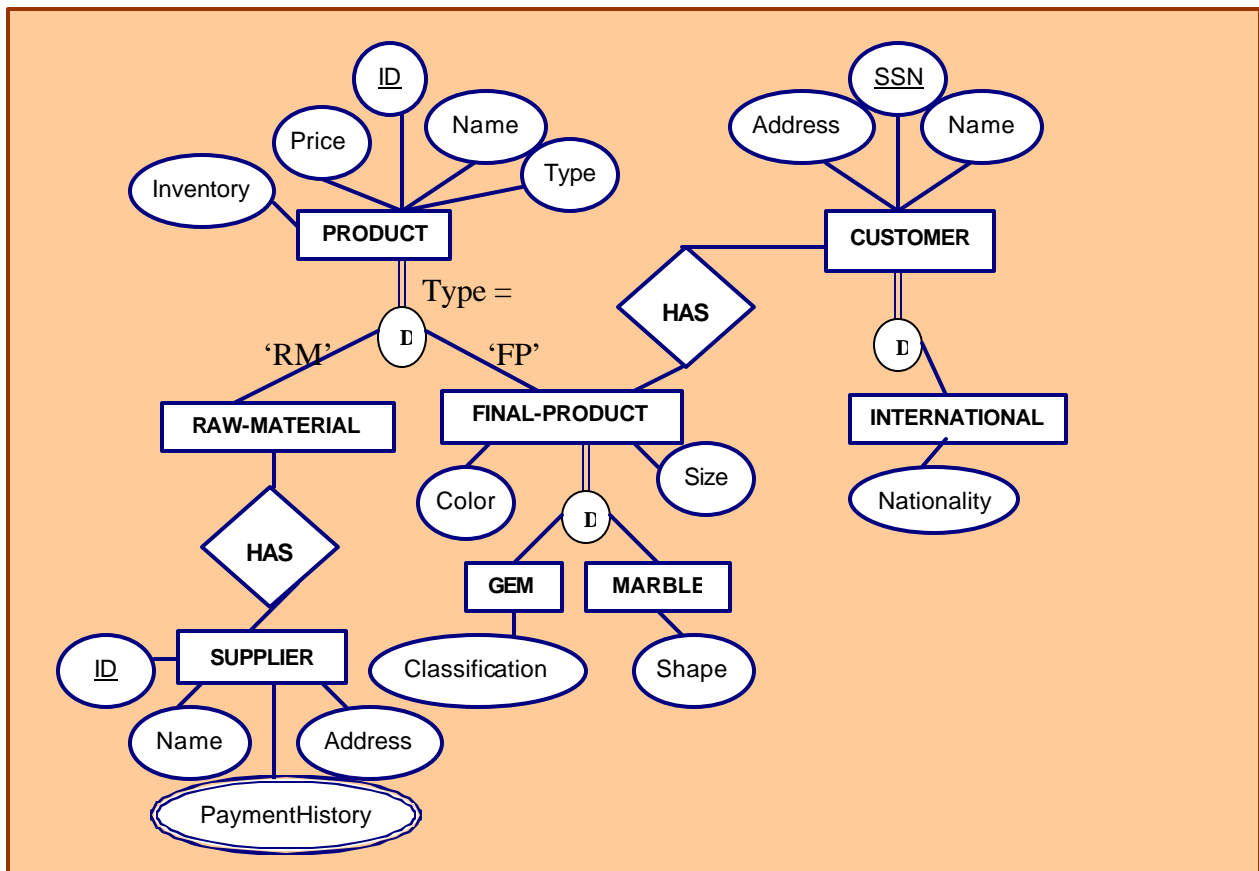
The database system keeps track of the inventory levels, the backorder level (orders not satisfied yet), and the number of outstanding orders (orders that are not received yet). This information is used by the management to decide when and how much to produce.

Other than the information about the products, the database keeps information about the raw materials, suppliers and customers. For each type of raw materials, the database keeps the following information: identification number, name, price per unit, identification number of the product that it is used on, and name of the suppliers. For each supplier, the database records: supplier identification number, name, address, orders and payments history.

The company sells its products in Venezuela as well as in USA and other Latin American countries. For the international customers, the company provides special packaging, and charges different rates. For each customer the following information is recorded: identification number, name, address, orders and payments history.

Draw an EER diagram for the database described above. Clearly state any assumption you make.

Answer:



Problem 4

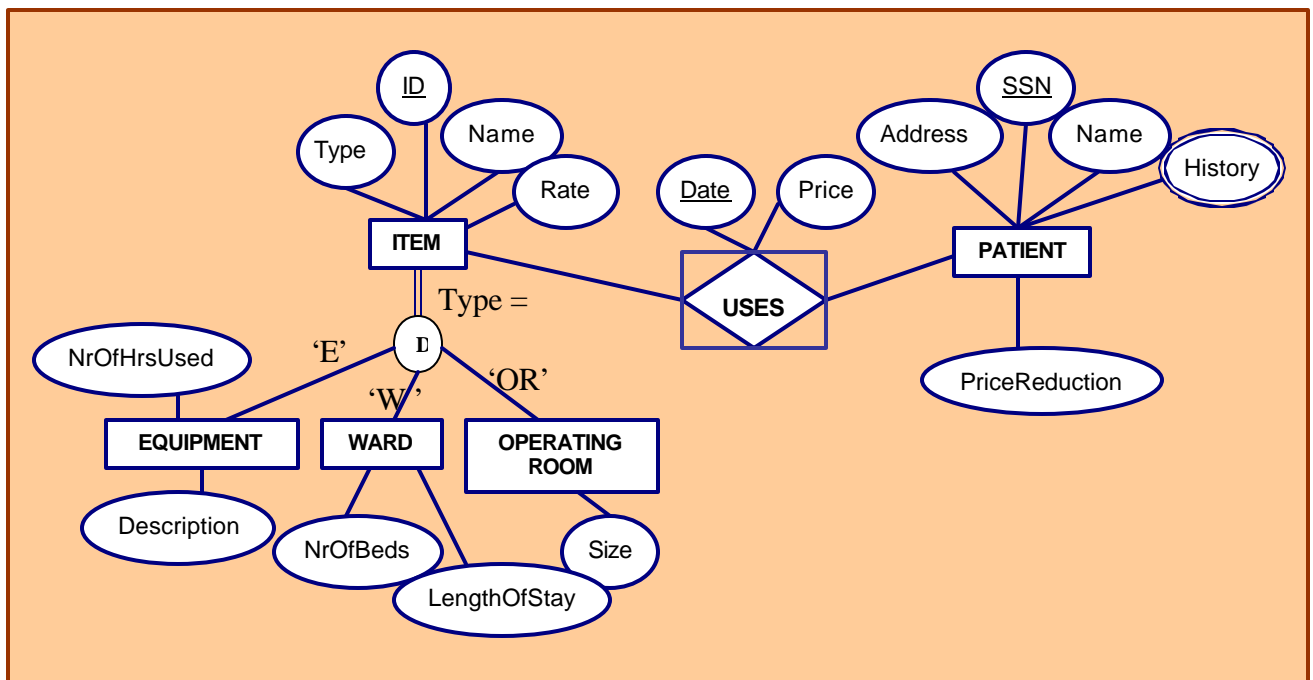
The medical school at the University of Florida serves the students as well as the public as a medium sized hospital. The hospital stores information about patients such as name of the patient, address, date of visit, doctor's name, etc. in a database. The hospital does not charge the students for their services and charges special rates if the patient is a faculty member or staff at the University of Florida.

Data about wards, equipments, and operating rooms are also maintained. The hospital has three types of operating rooms used for major, minor and small operations, respectively. There are two types of wards: general and special. The hospital has 55 general wards and 35 special wards. The general wards have a capacity of eight beds each. The special wards have one or two beds. The hospital also has an intensive care unit with a capacity of 4 beds. The patients are charged on a per day basis and the rates depend on the type of the wards.

The hospital uses the following equipment to examine the patients: the X-ray machine, the CT-Scan machine and the ultrasonic imager. Patients are charged in case they use these equipments. The charges are based on the number of hours the machine is used. The X-ray machine costs \$350 an hour. Each hour of the CT-Scan machine is \$750 and the ultrasonic imager is \$150 an hour.

Draw an EER diagram for this database. Clearly state any assumptions you make.

Answer:



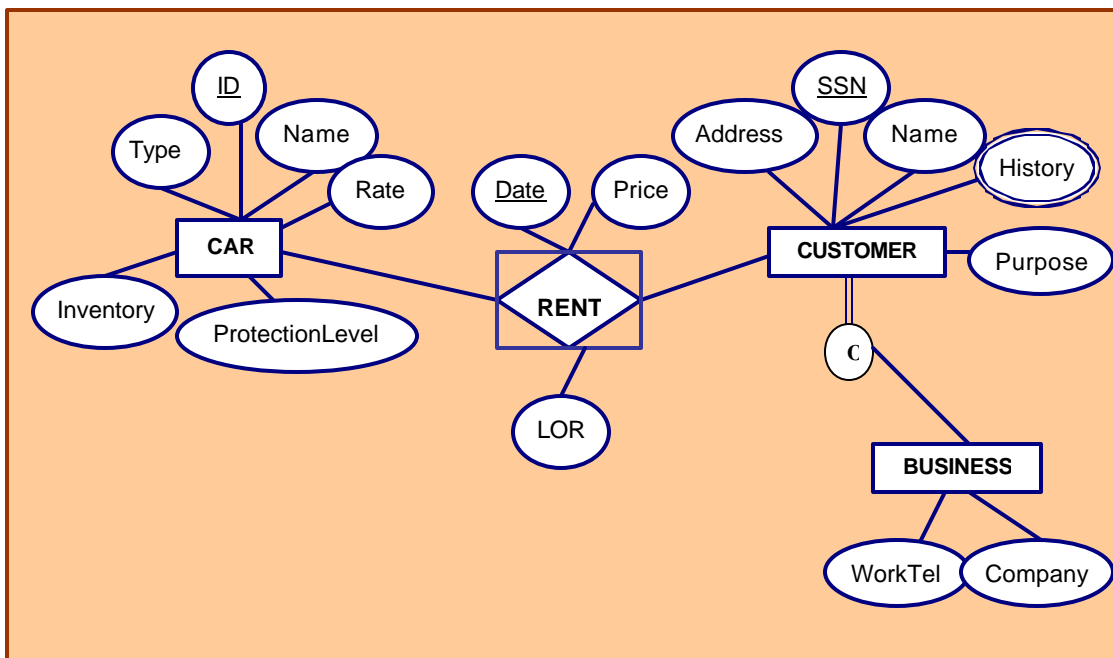
Problem 5

National Car Rental keeps a detailed database of its inventory (cars to rent) and customers. Customers rent a car mainly for two purposes: business and leisure. For each customer, National records: identification number, name, address, telephone number. If the customer rents the car for business purposes, in addition to the above information, National records the name of the company, and the work phone number of the customer. In order to provide a better service to the customers, National prioritizes bookings based on length-of-rent (LOR).

National offers to the customer different types of cars such as: luxury, midsize, and economy cars. For each type of car, the company calculates protection level. A protection level is the number of cars that should be reserved for the demand in the current class. The company keeps track of the number of cars of a particular type available as well. National charges customers a daily rate depending on the type of car they rent and LOR.

Draw an EER diagram for this database. Clearly state your assumptions.

Answer:

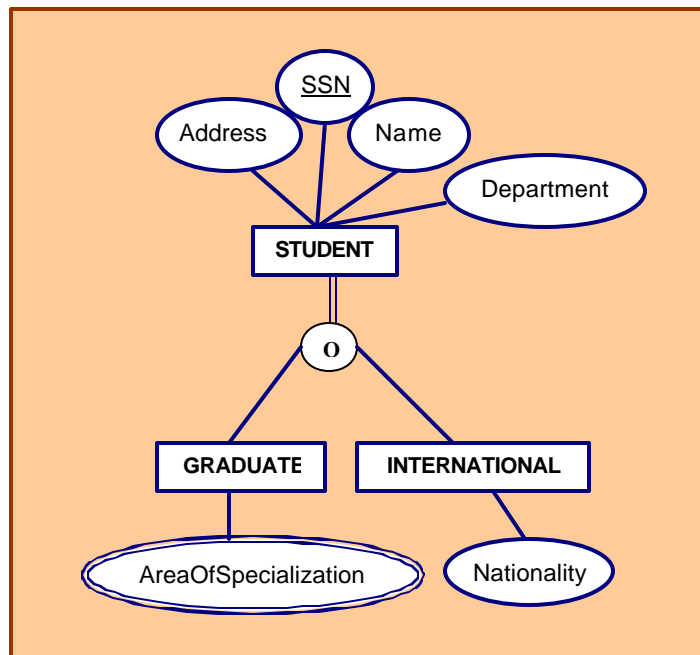


Problem 6

The ISE department in a University keeps a database of its students. Students are classified into undergraduate, graduate, and international students. There are few reasons for grouping the students into these three categories. For example the department's secretary informs: the undergraduate students about new undergraduate courses offered, the graduate students about graduate courses and professional conferences and international students about new emigration laws.

Identify (if any) the subtypes of entity students. Identify a unique attribute (relationship) for each subtype. Draw an EER diagram for the department's database.

Answer:



Problem 7

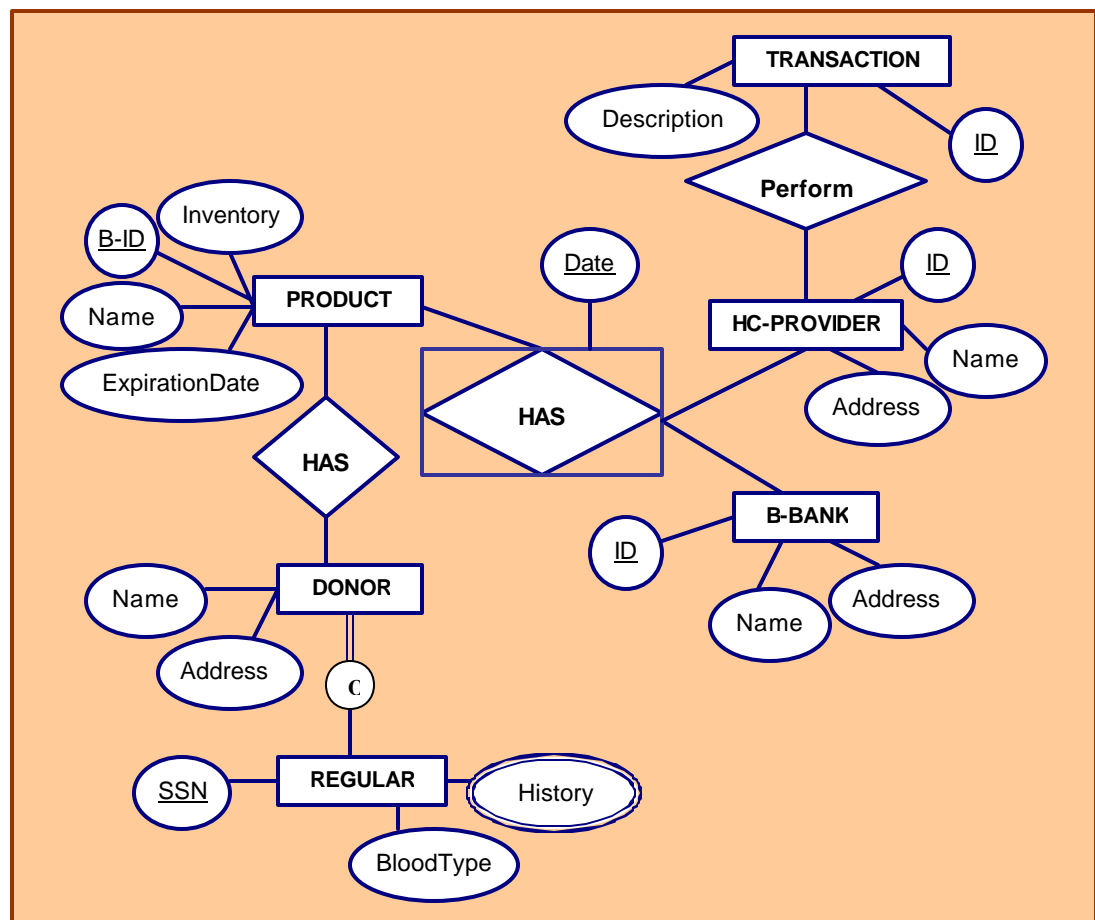
Blood bank is a critical entity in providing required type of blood to the patients at critical time. Their database keeps track of the inventory of the blood, together with relevant information like blood group, date received, location, date of expiry, donor, etc.

The database keeps information such as name, address, and telephone number of other blood banks in the area. The reason for doing so is to get blood of a particular type from other banks in case of emergency. Information about donors is recorded as well. Donors are classified into occasional and regular donors. For the regular donors, the database keeps information such as identification number, blood type and a history of their donations.

A list of healthcare providers in the area along with information such as: address, telephone number etc. is kept. The healthcare providers are the customers of the blood bank. They keep track of the blood transactions performed. These transactions are classified into: normal transactions and unexpected transactions (for example, the motor accidents during the holiday season). The reason for keeping track of the unexpected transactions is to use this information in estimating the extra amount of blood to keep in the inventory for each age group during the coming holiday season.

Draw an EER diagram for this database. Clearly state your assumptions.

Answer:



Problem 8

YXZ is a manufacturing company. The company keeps a list of employees as well as a list of jobs that are scheduled in a particular day. Everyday the management gets a list of jobs required to be done and list of employees who are available. A job is then assigned to the employee that has the skills needed to doing the job (i.e., employee should have enough skill to perform the job assigned). We want to build a database that will make easier the process of assigning employees to jobs.

Employees are classified into three main groups: managers, engineers and workers. Managers take care of managerial issues, engineers are the highly qualified employees that direct production processes, and the workers perform jobs that do require some technical skills.

Jobs are classified into jobs that require: high level of technical skills, moderate level of technical skills, and managerial skills. The classification of employees and jobs into groups facilitates the process of assigning an employee to a job.

Draw an EER diagram for this database. Identify (if any) the subtypes of entity employee. Identify one (or more) unique attribute (relationship) for each subtype as well as one (or more) attribute that is shared by all entity subtypes.

Answer:

