CS-317 Data Management and Information Processing
Spring 2003

Midterm Solutions

Problem 1

NULL Value:

A value of a given attribute which is unspecified (i.e. is not) from the domain of the attribute or is different from any other value of that domain is called a NULL value. It may mean any of the following:

- Missing entry
- Unknown value
- Not applicable

And hence it is ambiguous.

Role:

Role is the nature (or function) of an entity in a given relationship.

Problem 2

A weak entity class cannot be directly represented as a schema as it does not have an unique key. It can be represented as a schema in which the key consists of

- Key attributes from the entity class involved in the relationship
- Discriminators from the weak entity class itself

Problem 3

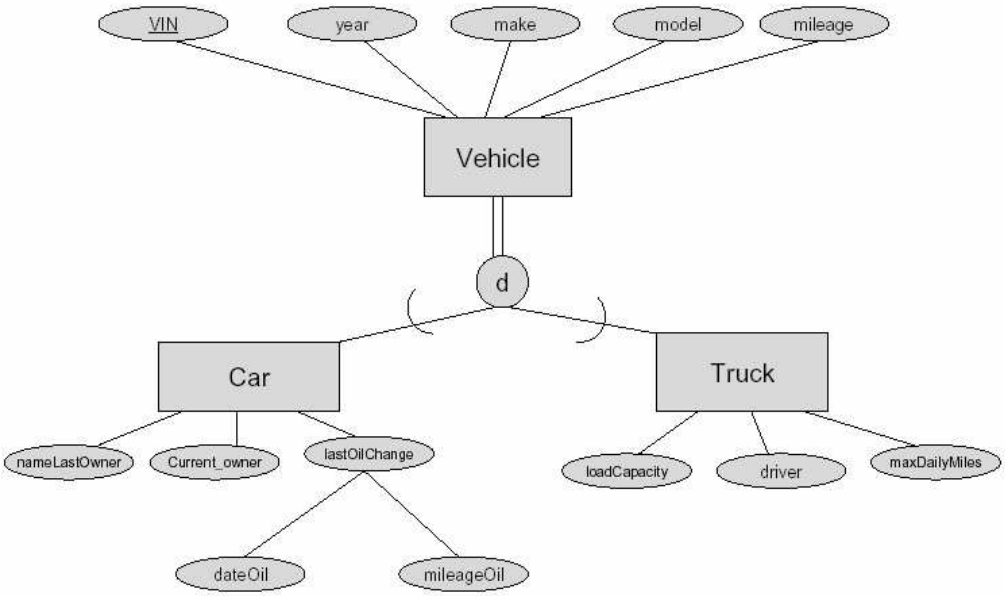
Following is the relation based schema of the given ER diagram:

Entity_1 (key_1, attribute_1)

Entity_2 (key_2, attribute_2)

Rel_12 (key_1, key_2, rel_attribute)

Problem 4
Following is the ER diagram representing the problem domain specified in the problem



Since it is a disjoint specialization, all of the following conversions apply:

Possible answer 1:
Vehicle (VIN, year, make, model, mileage)
Car (VIN, nameLastOwner, currentOwner, dateOil, mileageOil)
Truck (VIN, loadCapacity, driver, maxDailyMiles)

Possible answer 2:
Car (VIN, year, make, model, mileage, nameLastOwner, currentOwner, dateOil, mileageOil)
Truck (VIN, year, make, model, mileage, loadCapacity, driver, maxDailyMiles)

Possible answer 3:

Vehicle (VIN, year, make, model, mileage, nameLastOwner, currentOwner, dateOil, mileageOil, loadCapacity, driver, maxDailyMiles)

Problem 5
The given relational schema is R (A, B, C, D, E, F, G, H)
Given functional dependencies are:
FD1: A -> C, D
FD2: B -> E, F, G
FD3: C -> E, F

Reflexivity:
From FD2 we obtain
FD3: B, D -> E, F, G, D

Augmentation:
From FD2 (augmenting with H) we obtain:
FD4: B, H -> E, F, G, H

Transitivity:
Decomposing FD1 we obtain:
FD5: A -> C
Using FD5 and FD3 we obtain:
FD6: A -> E, F

Decomposition:
Decomposing FD1 we obtain:
FD7: A -> D

Union:
Using FD1 and FD6 we obtain:
FD8: A -> C, D, E, F

Pseudo-Transitivity:
Using FD7 and FD3 we obtain:
FD9: B, A -> E, F, G, D

Problem 6
1NF specifies that every attribute of a schema must take its values from an atomic domain. It is now primarily of interest from a historical perspective.

Problem 7

The set of functional dependencies that are full, maximal and non-trivial are:
FD1: A, B -> C, D, E, F, G, H
FD2: A -> C, D
FD3: B -> E, F, G

FD2 and FD3 violate 2 NF, so the relational schema R (A, B, C, D, E, F, G, H) must be broken down. As you would notice below, it has to be broken down twice and the order is not relevant.

R (A, B, C, D, E, F, G, H)
- R12 (A, B, E, F, G, H)
  - ***R121 (A, B, H)***
  - ***R122 (B, E, F, G)***
- ***R22 (A, C, D)***

Alternatively
R (A, B, C, D, E, F, G, H)
- R12 (A, B, C, D, H)
  - ***R121 (A, B, H)***
  - ***R122 (A, C, D)***
- ***R22 (B, E, F, G)***