

Indian Institute of Technology Kharagpur
Department of Computer Science and Engineering
CS30202 : Database Management Systems (DBMS)

Date: 4th Feb 2025 Class Test - 1 Marks: 20 Time: 45 mins

1. Design a database for a worldwide package delivery company (e.g., DHL or FedEx). The database must be able to keep track of customers who ship items and customers who receive items; some customers may do both. Each package must be identifiable and trackable, so the database must be able to store the location of the package and its history of locations. Locations include trucks, planes, airports, and warehouses.

Your design should include an E-R diagram, a set of relational schemas, and a list of constraints, including primary-key and foreign-key constraints.

(Hint: You may explore the concepts of specialization/generalization and aggregation)
(10 Marks)

2. Consider the following relations containing airline flight information: **(10 Marks)**

Flight_schedules(fno, from, to, distance, departs, arrives)

Aircraft(aid, aname, cruisingrange)

Certified(eid, aid)

Employees(eid, ename, salary)

Note that the Employees relation describes pilots and other kinds of employees as well; every pilot is certified for some aircraft (otherwise, he or she would not qualify as a pilot), and only pilots are certified to fly. Flight_schedules indicate the flight trips between source and destination cities and the distance between them. In Aircraft relation *cruisingrange* indicates the maximum distance that can be travelled by the aircraft in single hop.

- (i) Find the eids of pilots certified for some Boeing aircraft?

$\pi_{eid} (\sigma_{aname='Boeing'} (Aircraft \bowtie Certified))$

- (ii) Find the names of pilots certified for some Boeing aircraft?

$\pi_{ename} (\sigma_{aname='Boeing'} (Aircraft \bowtie Certified \bowtie Employees))$

- (iii) Find the aids of all aircraft that can be used on non-stop flight_schedules from Bonn to Madrid?

$\rho(BonnToMadrid, \sigma_{from='Bonn' \wedge to='Madrid'} (Flight_schedules))$

$\pi_{aid} (\sigma_{cruisingrange > distance} (Aircraft \bowtie t \times BonnToMadrid))$

- (iv) Identify the flight_schedules (fno) that can be piloted by every pilot whose salary is more than \$100,000.

$\pi_{fno} (\sigma_{distance < cruisingrange \wedge salary > 100,000} (Flight_schedules \bowtie Aircraft \bowtie Certified \bowtie Employees)))$

- (v) Find the names of pilots who can operate planes with a range greater than 3,000 miles but are not certified on any Boeing aircraft?

$\rho(R1, \pi_{eid} (\sigma_{cruisingrange > 3000} (Aircraft \bowtie Certified)))$

$\pi_{ename} (Employees \bowtie (R1 - \pi_{eid} (\sigma_{aname='Boeing'} (Aircraft \bowtie Certified))))$

The above picture shows E-R diagram for the package delivery company. Note that it uses **specialization/generalization** and **aggregation**. Also the **specialization** is both **total** and **disjoint**.

Relation Schemas:

customer(**customer id**, name, phone_number, address)

package(**package id**, mass, shape, extra_care_note, sent_from, sent_to, timestamp_sent, timestamp_arrived, timestamp_expected_to_arrive)

location(**location id**)

truck(**location id**, truck_license_plate, color)

plane(**location id**, plane_id)

airport(**location id**, airport_name, city, country)

warehouse(**location id**, latitude, longitude, altitude)

location_of_package(**package id, location id**, start_timestamp, end_timestamp)

Note that we have merged the relationship set package_sent and the entity set package when changing the E-R diagram to a relational schema above into the relation package.

The primary key of truck, plane, airport, and warehouse is location_id.

Note also that their primary key is also a foreign key to the location relation.

Another foreign-key can be found in the package relation. Both sent_from and sent_to Attributes are foreign-keys from the package relation referencing the customer relation.

The location_id of the relation location_of_packages references the location relation.

The package_id of the relation location_of_packages references the package relation.

