Assignment 3

Question 1

Consider the following relational schema describing the data for a particular instructor's grade book.
`COURSE_CATALOG (Cno, Ctitle)`
`STUDENT (Sid, Fname, Lname, Minit)`
`COURSE (Term, Sec_no, Cno, A, B, C, D)`
`ENROLLS (Sid, Term, Sec_no)`
Specify the following queries using relational algebra.

1.1

Find a specific student's enrollment details (Term and Sec_no) (You can assume any student ID):

Answer

π_Term, Sec_no (σ__Sid='S123' (ENROLLS))

1.2

List students enrolled in any class during the fall 2009 term:

Answer

π_Sid (σ_Term='Fall 2009' (ENROLLS))

1.3

Retrieve the Sid values of students enrolled in CP363 or CP164:

Answer

π_Sid ((σ__Cno='CP363' (ENROLLS)) $\cup$ (σ_Cno='CP164' (ENROLLS)))

1.4

Retrieve the names of students who have not enrolled in any class:

Answer

π_Fname, Lname (STUDENT) - π_Fname, Lname ((STUDENT $\bowtie$ Sid=Sid ENROLLS))

Question 2

Let's consider a generic schema with two tables:
`EMPLOYEES (EmpID, EmpName, Department, Salary, ManagerID)`
`PROJECTS (ProjectID, ProjectName, Department, Budget)`
`ASSIGNMENTS (EmpID, ProjectID, HoursWorked)`
What will be the result of the following queries written in relational algebra:

2.1

π_ProjectID, ProjectName, Budget (σ_Budget > (π_AVG(Budget) (PROJECTS))

Answer

This will return the columns: `ProjectID`, `ProjectName`, and `Budget` for all projects where the budget is greater than the average budget of all projects.

2.2

π_EmpID, EmpName ((σ_Department='IT' (ASSIGNMENTS $\bowtie$ PROJECTS)) $\cap$ (σ_Department='Finance' (ASSIGNMENTS $\bowtie$ PROJECTS))

Answer

This will return the columns `EmpID` and `EmpName` of **only** employees who are assigned to a project in **both** the `IT` and `Finance` departments.

2.3

Department, AVG(HoursWorked) (ASSIGNMENTS $\bowtie$ PROJECTS) | (Group by Department)

Answer

This will return the `Department` and the average `HoursWorked` by employees in each department.

2.4

π_ManagerID, EmpName (EMPLOYEES $\bowtie$ ρ_EmpID=ManagerID (EMPLOYEES))

Answer

This will return the `ManagerID` and `EmpName` of all employees who are managers.

Question 3

Based on the given data, you have to answer the following questions:

StudentID	StudentAddress	Contactno
S001	8 Jefferson Way, Portland, OR 97201	503-555-3618, 503-555-2727, 503-555-6534
S002	City Center Plaza, Seattle, WA 98122	206-555-6756, 206-555-8836
S003	14 – 8th Avenue, New York, NY 10012	212-371-3000
S004	16 – 14th Avenue, Seattle, WA 98128	206-555-3131, 206-555-4112
S005	14 – 8th Avenue, New York, NY 10012, 16 – 14th Avenue, Seattle, WA 98128	503-444-123, 219-564-890

3.1

Determine whether the table is in 1NF or not. You must check whether the table follows the first normal form rules to do this. If it does, it is in 1NF; otherwise, it is not.

Answer

This table is not in the **First Normal Form (1NF)**. This is because in order for a table to be in the 1NF every attribute of a table must be an indivisible(atomic) value however `StudentID`'s `S001, S002, S003, S004, S005` all have multiple values in the `Contactno` field and `S1005` has multiple values in the `StrudentAddress` field.

3.2

Convert the table to 3NF. This means analyzing the table and ensuring its data is organized to satisfy the third normal form rules. This includes ensuring that each attribute in the table depends on the primary key and that there are no transitive dependencies between non-key attributes.

Answer

According to the Normalization rules 3NF must be in 2NF and 2NF must be in 1NF.
Therefore the first step is to convert the table into 1NF:

StudentID	StudentAddress	Contactno
S001	8 Jefferson Way, Portland, OR 97201	503-555-3618
S001	8 Jefferson Way, Portland, OR 97201	503-555-2727
S001	8 Jefferson Way, Portland, OR 97201	503-555-6534
S002	City Center Plaza, Seattle, WA 98122	206-555-6756
S002	City Center Plaza, Seattle, WA 98122	206-555-8836
S003	14 – 8th Avenue, New York, NY 10012	212-371-3000

StudentID	StudentAddress	Contactno
S004	16 – 14th Avenue, Seattle, WA 98128	206-555-3131
S004	16 – 14th Avenue, Seattle, WA 98128	206-555-4112
S005	14 – 8th Avenue, New York, NY 10012	503-444-123
S005	16 – 14th Avenue, Seattle, WA 98128	503-444-123
S005	14 – 8th Avenue, New York, NY 10012	219-564-890
S005	16 – 14th Avenue, Seattle, WA 98128	219-564-890

Then we check if this table satisfies the requirements of 2NF which it does because all non-key attributes are dependent on the primary key

Then we check if this table satisfies the requirements of 3NF which it does because there are no transitive dependencies