CSCB20

SOLUTIONS:

List the appropriate primary keys for each table

TABLE	PRIMARY KEY(S)
Branch	Branch_name
Customer	Customer_name
Loan	Loan_number
Borrower	Customer_name, Loan_number
Bank_Account	Account_number
Depositor	Customer_name, Account_number

NOTE – remember to underline your primary keys
(if you have a primary key that is also a foreign key,

Given your choice of primary keys, identify the appropriate foreign keys

TABLE	FOREIGN KEY(S)
Branch	Branch_name
Customer	Customer_name
Loan	Loan_number
Borrower	Customer_name
Bank_Account	Branch_name
Depositor	Customer_name

NOTE – remember to use a dotted-underline for your foreign keys

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Find the names of all branches located in 'Chicago'

$$\sigma_{\text{branch\_city} = \text{'Chicago'}}(\text{branch})$$

Find the names of all borrowers who have a loan branch in 'Down-town'

$$\pi_{\text{loan\_number, branch\_name}}((\text{borrower} \bowtie \text{loan}) \bowtie \text{branch})$$

Find all loan numbers with a loan value greater than $10,000

$$\pi_{\text{loan\_number}}\left(\sigma_{\text{amount}>10000}(\text{loan})\right)$$

Find the names of all depositors who have an account with a value greater than $6000

$$\pi_{\text{customer\_name}}\left(\sigma_{\text{bank\_account.balance}>6000}(\text{depositor} \bowtie \text{bank\_account})\right)$$

Indicate the attributes of each relation

The **attributes** of a relation are referring to the **columns** of the table

Accounts – acctNo, type, balance
Customers – firstName, lastName, idNo, account

Indicate the tuples of each relation

The **tuples** of a relation are referring to the **rows** of the table

Accounts:

- (12345, savings, 12000)
- (23456, chequing, 1000)
- (34567, savings, 0)

Customers:

- (Eugene, Krabs, 420-699, 12345)
- (Pearl, Krabs, 805-123, 12345)
- (Pearl, Krabs, 805-123, 23456)

Indicate the components of one tuple from each relation:

Consider the tuple (Eugene, Krabs, 420-699, 12345) from the relation Customers:

- **firstName**: Eugene
- **lastName**: Krabs
- **idNo**: 420-699
- **account**: 12345

Indicate the relation schema for each relation:

Accounts – Accounts(acctNo, type, balance)
Customers – Customers(firstName, lastName, idNo, account)

Indicate the database schema:

Accounts(acctNo, type, balance)
Customers(firstName, lastName, idNo, account)

Indicate a suitable domain for each attribute:

Accounts:

- acctNo: $integer$
- type: $string$
- balance: $integer$

Customers:

- firstName: $string$
- lastName: $string$
- idNo: $string$
    - This is only a string because there is a hyphen between the numbers
- account: $integer$

Indicate another equivalent way to present each relation:

Show another valid relation that matches the domain you stated above

For Accounts:

ACCOUNTS		
acctNo	**type**	**balance**
11111	savings	0
22222	savings	1000000
33333	chequing	42069

For Customers:

CUSTOMERS			
firstName	**lastName**	**idNo**	**account**
Alice	Allison	123-456	11111
Bob	Boberto	234-567	22222
Chad	Chadwick	345-456	33333

What PC models have a speed of at least 3.00?

$R1 \coloneqq \sigma_{\text{speed}\geq 3.00}(PC)$
$R2 \coloneqq \pi_{\text{model}}(R1)$

Which manufacturers make laptops with a hard disk of at least 100 GB?

$R1 \coloneqq \sigma_{hd\geq 100}(laptop)$
$R2 \coloneqq R1 \bowtie Product$
$R3 \coloneqq \pi_{maker}(R2)$

Find the model number and price of all products (of any type) made by manufacturer B

$R1 \coloneqq \sigma_{maker=B}(Product \bowtie PC)$
$R2 \coloneqq \sigma_{maker=B}(Product \bowtie Laptop)$
$R3 \coloneqq \sigma_{maker=B}(Product \bowtie Printer)$
$R4 \coloneqq \pi_{model,price}(R1)$
$R5 \coloneqq \pi_{model,price}(R2)$
$R6 \coloneqq \pi_{model,price}(R3)$
$R7 \coloneqq R4 \cup R5 \cup R6$

Find the model numbers of all color laser printers

$R1 := \sigma_{color=True \text{ AND } type=laser}(printer)$
$R2 := \pi_{model}(R1)$

Find those manufacturers that sell laptops but not PCs

$R1 := \sigma_{type=laptop}(Product)$
$R2 := \sigma_{type=PC}(Product)$
$R3 := \pi_{maker}(R1)$
$R4 := \pi_{maker}(R2)$
$R5 := R3 - R4$

Find those hard disk sizes that occur in two or more PCs

$R1 := \rho_{PC1}(PC)$
$R2 := \rho_{PC2}(PC)$
$R3 := R1 \bowtie_{PC1.hd=PC2.hd \text{ AND } PC1.model<>PC2.model} (R2)$
$R4 := \pi_{hd}(R3)$

Find those pairs of PC models that have both the same speed and RAM. A pair should only be listed once (e.g. the list (i,j) but not the list (j,i))

$R1 := \rho_{PC1}(PC)$
$R2 := \rho_{PC2}(PC)$
$R3 := R1 \bowtie_{PC1.speed=PC2.speed \text{ AND } PC1.ram=PC2.ram \text{ AND } PC1.model<PC2.model} (R2)$
$R4 := \pi_{PC1.model,PC2.model}(R3)$

Find those manufacturers of at least two different computers (PC's or laptops) with speeds of at least 2.80

$$R1 \coloneqq \pi_{model}\left(\sigma_{speed \geq 2.80}(PC)\right) \cup \pi_{model}\left(\sigma_{speed \geq 2.80}(Laptop)\right)$$
$$R2 \coloneqq \pi_{maker,model}(R1 \bowtie Product)$$
$$R3 \coloneqq \rho_{R4}(model2, speed2)(R2)$$
$$R4 \coloneqq R2 \bowtie_{maker=maker2 \text{ AND } model<>model2} (R3)$$
$$R5 \coloneqq \pi_{maker}(R4)$$

Find the manufacturer(s) of the computer (PC or laptop) with the highest speed

$$R1 \coloneqq \pi_{model,speed}(PC)$$
$$R2 \coloneqq \pi_{model,speed}(Laptop)$$
$$R3 \coloneqq R1 \cup R2$$
$$R4 \coloneqq \rho_{R4(model2,speed2)}(R3)$$
$$R5 \coloneqq \pi_{model,speed}\left(R3 \bowtie_{speed<speed2} R4\right)$$
$$R6 \coloneqq R3 - R5$$
$$R7 \coloneqq \pi_{maker}(R6 \bowtie Product)$$

Find the manufacturers of PCs with at least three different speeds

$$R1 \coloneqq \pi_{maker,speed}(Product \bowtie PC)$$
$$R2 \coloneqq \rho_{R2(maker2,speed2)}(R1)$$
$$R3 \coloneqq \rho_{R3(maker3,speed3)}(R1)$$
$$R4 \coloneqq R1 \bowtie_{maker=maker2 \text{ AND } speed<>speed2} (R2)$$
$$R5 \coloneqq R4 \bowtie_{maker=maker3 \text{ AND } speed<>speed3 \text{ AND } speed3<>speed2} (R3)$$
$$R6 \coloneqq \pi_{maker}(R5)$$

Find the manufacturers who sell exactly three different models of PC

$$R1 \coloneqq \pi_{maker,model}(Product \bowtie PC)$$
$$R2 \coloneqq \rho_{R2(maker2,model2)}(R1)$$
$$R3 \coloneqq \rho_{R3(maker3,model3)}(R1)$$
$$R4 \coloneqq \rho_{R4(maker4,model4)}(R1)$$
$$R5 \coloneqq R1 \bowtie_{maker=maker2 \text{ AND } model<>model2} (R2)$$
$$R6 \coloneqq R3 \bowtie_{maker=maker3 \text{ AND } model3<>model2 \text{ AND } model3<>model} (R5)$$
$$R7 \coloneqq R4 \bowtie_{maker=maker4 \text{ AND } (model4=model \text{ OR } model4=model2 \text{ OR } model4=model3)} (R6)$$
$$R8 \coloneqq \pi_{maker}(R7)$$