

# 601.315/415/615 ASSIGNMENT 1

Ruyin Zhang

TOTAL POINTS

**88.2725 / 100.23**

QUESTION 1

Database Schema Design 34.98 pts

1.1 ER design 19 / 20

- **0 pts** Correct
  - **3 pts** Did not use primary keys
  - **2 pts** Incorrect mappings
  - **0.1 pts** A minor error
  - **2 pts** incorrectly computes paths
  - **1 pts** Other not so minor mistake
- ✓ - **1 pts** Cannot compute waypoints in past trips  
(requirement dd)
- **1 pts** Cannot compute past trips based on traffic conditions
  - **1.5 pts** Incorrect use of symbols
  - **1 pts** Cannot track which customers are also drivers
- ✓ - **0 pts** Hard to decipher (Consider using a software)
- **0 pts** Unnecessary Compliication
  - **4 pts** Major design flaws
  - **1.5 pts** Incorrectly used derived attributes
  - **1 pts** Incorrect use of Primary keys
  - **2 pts** Logical errors
  - **20 pts** Did not answer

1.2 Relational design 10 / 10

- ✓ - **0 pts** Correct representation
- **1.5 pts** Did not represent all relations and entities
  - **0.1 pts** A minor error
  - **1 pts** Other not so minor mistake
  - **0.5 pts** Can be more concise or can use better names
  - **3 pts** Did not give sample data
  - **0 pts** Unnecessary Compliication
  - **4 pts** Major design flaws

- **1 pts** Incorrectly represented Primary keys
- **10 pts** Did not answer

1.3 RA(c) 0.83 / 0.83

- **0 pts** Correct
  - **0.4 pts** Incorrect assumpptions
- ✓ - **0 pts** Unnecessarily complicated
- **0.41 pts** Used cartesian product instead of natural join
  - **0.83 pts** Did not answer
  - **0.1 pts** Minor eror
  - **0.4 pts** Didnot check if car is not electric

1.4 RA(f) 0.83 / 0.83

- ✓ - **0 pts** Correct
- **0.4 pts** Incorrect assumpptions
  - **0 pts** Unnecessarily complicated
  - **0.41 pts** Used cartesian product instead of natural join
  - **0.83 pts** Did not answer
  - **0.1 pts** Minor eror
  - **0.42 pts** Not all required outputs shown

1.5 RA(h) 0.73 / 0.83

- **0 pts** Correct
  - **0.4 pts** Incorrect assumpptions
  - **0 pts** Unnecessarily complicated
  - **0.41 pts** Used cartesian product instead of natural join
  - **0.83 pts** Did not answer
- ✓ - **0.1 pts** Minor eror
- **0.42 pts** Not all required outputs shown
  - **0.42 pts** Did not check if owner and driver are different
- 💡 specify ssn as person.ssn or owner\_name.ssn

## 1.6 RA(y) 0.41 / 0.83

- **0 pts** Correct
- **0.4 pts** Incorrect assumptions
- **0 pts** Unnecessarily complicated
- **0.41 pts** Used cartesian product instead of natural join
- **0.83 pts** Did not answer
- **0.1 pts** Minor error
- **0.42 pts** Not all required outputs shown
- **0.42 pts** Did not check for driver
- ✓ - **0.42 pts** Did not check if start and end are landmarks
- **0.42 pts** Did not check date

## 1.7 RA(ss) 0.83 / 0.83

- ✓ - **0 pts** Correct
- **0.4 pts** Incorrect assumptions
- **0.83 pts** Did not answer
- **0.1 pts** Minor error
- **0.6 pts** Incorrect

## 1.8 RA(ccc) 0.83 / 0.83

- ✓ - **0 pts** Correct
- **0.4 pts** Incorrect assumptions
- **0.83 pts** Did not answer
- **0.1 pts** Minor error ( eg used min instead of max)
- **0.83 pts** Incorrect
- **0.2 pts** Used cartesian product instead of join
- **0.1 pts** Invalid operator

## QUESTION 2

### Relational Algebra (RA) 51.75 pts

#### 2.1 RA 1 2 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor Syntax Error
- **0.5 pts** Major Syntax Error
- **1.125 pts** Logical Error
- ✓ - **0.25 pts** Syntax Error: Not using table.column = table2.column and instead using column = column2
- **2.25 pts** Incorrect

#### 2.2 RA 2 0.0625 / 2.25

- **0 pts** Correct
  - ✓ - **0.25 pts** Minor Syntax Error
  - ✓ - **0.25 pts** Did not use table.column = table2.column but instead did column = column
  - ✓ - **1.6875 pts** Contained bars that served bud lite
  - **2.25 pts** Incorrect
  - **1.125 pts** Logical Error
  - **0.25 pts** Did not project the right answer
- ① see serves second and third entry to why this won't work
- ② when doing select/project on tables please put parentheses around the tables, ie Project (DRINKER)

#### 2.3 RA 3 2 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor Syntax Error
- **0.5 pts** Major Syntax Error
- **0.5 pts** Did not project the right answer
- ✓ - **0.25 pts** Did not use table.column = table2.column but instead did column = column
- **2.25 pts** Incorrect
- **1.6875 pts** Did not limit the bars to Georgetown
- **1.5 pts** Missed a table
- **1.6875 pts** Logical Error

#### 2.4 RA 4 2 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor Syntax Error
- **0.5 pts** Major Syntax Error
- **0.5 pts** Did not project the right answer
- ✓ - **0.25 pts** Did not use table.column = table2.column but instead did column = column
- **2.25 pts** Incorrect
- **1.5 pts** Missed a table
- **1.6875 pts** Logical Error

#### 2.5 RA 5 2 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor Syntax Error

- 0.5 pts Major Syntax Error
- 0.5 pts Did not project the right answer
- ✓ - 0.25 pts Did not use `table.column` = `table2.column` but instead did `column = column`
- 2.25 pts Incorrect
- 1.5 pts Missed a table
- 1.6875 pts Logical Error

## 2.6 RA 6 1.25 / 2.25

- 0 pts Correct
- 0.25 pts Minor syntax error
- 0.5 pts Major syntax error
- 0.25 pts Inefficient
- ✓ - 1 pts Incomplete answer
  - 1 pts Logical error
  - 2.25 pts Incorrect
- 💡 You need to complete a natural join of DRINKER with (No\_Visit\_Bar AND No\_Covid) to get DName and Age. Currently, the result could not capture age.

## 2.7 RA 7 2.25 / 2.25

- ✓ - 0 pts Correct
- 0.25 pts Minor syntax error
- 0.5 pts Major syntax error
- 1 pts Incomplete answer
- 1 pts Logical error
- 2.25 pts Incorrect
- 💡 Natural join VISIT with JB\_Bar and project out DLicNo, and then subtract those from Every\_bar and natural join with DRINKER to get name and age.

## 2.8 RA 8 2.25 / 2.25

- ✓ - 0 pts Correct
- 0.25 pts Minor syntax error
- 0.5 pts Major syntax error
- 1 pts Incomplete answer
- 1 pts Logical error
- 2.25 pts Incorrect

## 2.9 RA 9 2.25 / 2.25

- ✓ - 0 pts Correct
- 0.25 pts Minor syntax error
- 0.5 pts Major syntax error
- 1 pts Incomplete answer
- 1 pts Logical error
- 2.25 pts Incorrect

## 2.10 RA 10 1.75 / 2.25

- 0 pts Correct
- 0.25 pts Minor syntax error
- ✓ - 0.5 pts Major syntax error
- 1 pts Incomplete answer
- 1 pts Logical error
- 2.25 pts Incorrect
- 2.25 pts Missing question (315)
- 💡 Use natural join instead of cartesian product

## 2.11 RA 11 1 / 2.25

- 0 pts Correct
- 0.25 pts Minor syntax error
- 0.5 pts Major syntax error
- 1 pts One relation is incorrect
- ✓ - 1.25 pts Missed a step
  - 2.25 pts Incorrect
  - 2.25 pts Missing question (315)
  - 2.25 pts Unreadable page
- 💡 This lists all beers that both like, regardless of if any bar serves them

## 2.12 RA 12 1.75 / 2.25

- 0 pts Correct
- 0.25 pts Minor syntax error
- ✓ - 0.5 pts Major syntax error
- 1 pts Incomplete answer
- 1 pts Logical error
- 2.25 pts Incorrect
- 2.25 pts Missing question (315)
- 💡 Bar name, city, and state

## 2.13 RA 13 2.25 / 2.25

- ✓ - **0 pts** Correct
- **0.25 pts** Minor syntax error
- **0.5 pts** Major syntax error
- **1 pts** Incomplete answer
- **1 pts** Logical error
- **2.25 pts** Incorrect
- **2.25 pts** Missing question (315)
- **2.25 pts** Page not readable

- **2.25 pts** Incorrect

## 2.14 RA 14 2.25 / 2.25

- ✓ - **0 pts** Correct
- **1 pts** Used license number instead of name  
Donald Trumo
  - **2.25 pts** Incorrect
  - **0.5 pts** Minor error
  - **2.25 pts** Did not answer
  - **0.5 pts** Used intersection of beers instead of union

## 2.18 RA 18 2.25 / 2.25

- ✓ - **0 pts** Correct
- **1 pts** Didn't check that visitor visited same bar on same day as ivanka
- **0.5 pts** Used a relation as a variable
- **1 pts** Logical Error
- **2.25 pts** didn't answer

## 2.15 RA 15 2.25 / 2.25

- ✓ - **0 pts** Correct
- **1 pts** Used license number instead of name  
Donald Trumo
  - **2.25 pts** Incorrect
  - **0.5 pts** Minor error
  - **2.25 pts** Did not answer

## 2.19 RA 19 2.25 / 2.25

- ✓ - **0 pts** Correct
- **1 pts** Didn't check that people in final result visited same bar as covid people
  - **1 pts** Logical error
  - **2.25 pts** No answer

## 2.16 RA 16 2.25 / 2.25

- ✓ - **0 pts** Correct
- **0.5 pts** Listed Drinker name instead of beer name
- **0.25 pts** Invalid operations
- **2.25 pts** Incorrect
- **2.25 pts** Did not answer

## 2.20 RA 20 2.25 / 2.25

- ✓ - **0 pts** Correct
- **2.25 pts** No answer given
- **1 pts** Didn't natural join with DRINKER
- **1 pts** Didn't check if dates in range
- **2 pts** Incorrect
- **0.5 pts** Minor error

## 2.17 RA 17 2.25 / 2.25

- ✓ - **0 pts** Correct
- **2.25 pts** No answer given
- **0.25 pts** Minor syntax error
- **0.5 pts** Major syntax error
- **0.25 pts** Super Inefficient
- **1 pts** Incomplete answer
- **1 pts** Logical error

## 2.21 RA 21 1 / 2.25

- **0 pts** Correct
- **2.25 pts** Not 415 / 615
- **0.3 pts** Minor syntax error (misspelling, etc)
- **0.5 pts** Major Syntax Error (putting one relation when obviously intended another, etc.)
  - **1 pts** Operation uses incorrect attributes or attributes not found
  - **1 pts** Unsuccessfully get the # of times Joe Biden visited bars
- ✓ - **1.25 pts** Improper use of divide operation
  - **0.5 pts** Projecting incorrect output
  - **2.25 pts** Makes no progress towards solution
  - **0.75 pts** Database assumptions (Hardcoded, will not always work depending on database composition, etc)
  - **0 pts** Inefficient

- **2.25 pts** Missing answer (not sure if 315 / 415)

💬 RHS Line 4 meant JB\_Bar\_Cnt? not deducted because of logic error in line:

Also - the line 4 join will actually get anyone who has gone to any bar the same number of times as Joe Biden. The Divide operation would work better in this spot.

### 2.22 RA 22 1.75 / 2.25

- **0 pts** Correct

- **2.25 pts** Not 415 / 615

- **0.25 pts** Minor syntax error

✓ - **0.5 pts** Major syntax error

- **0.25 pts** Inefficient

- **1 pts** Incomplete answer

- **1 pts** Logical error

- **2.25 pts** Incorrect

💬 Date of vaccine < DateOfDiagnosis

### 2.23 RA 23 2.25 / 2.25

✓ - **0 pts** Correct!

- **1.5 pts** Didn't use division

- **0.5 pts** Used a relation as a variable

- **0.5 pts** Minor error

- **2.25 pts** No answer

## QUESTION 3

### Relational Calculus (RC) 13.5 pts

#### 3.1 RC 1 2.25 / 2.25

✓ - **0 pts** Correct

- **2.25 pts** Not 315 / 415

- **1 pts** Logic Error

- **0.25 pts** Minor syntax error

- **0.5 pts** Major syntax error

- **1 pts** Unsafe

- **2.25 pts** Incorrect

- **0.5 pts** Hardcoded values

- **0 pts** Specifies in Relational Algebra format

#### 3.2 RC 2 0 / 2.25

- **0 pts** Correct

- **2.25 pts** Not 315 / 415

- **1 pts** Logic Error

- **0.25 pts** Minor syntax error

- **0.5 pts** Major syntax error

- **1 pts** Unsafe

✓ - **2.25 pts** Incorrect

- **0.5 pts** Hardcoded values

- **0 pts** Specifies in Relational Algebra format

💬 Gets bars that serve any beer that isn't bud lite

#### 3.3 RC 3 2.25 / 2.25

✓ - **0 pts** Correct

- **2.25 pts** Not 315 / 415

- **1 pts** Logic Error

- **0.25 pts** Minor syntax error

- **0.5 pts** Major syntax error

- **1 pts** Unsafe

- **2.5 pts** Incorrect

- **0.5 pts** Hardcoded values

- **0 pts** Specifies in Relational Algebra format

#### 3.4 RC 4 2.25 / 2.25

✓ - **0 pts** Correct

- **2.25 pts** Not 315 / 415

- **1 pts** Logic Error

- **0.25 pts** Minor syntax error

- **0.5 pts** Major syntax error

- **1 pts** Unsafe

- **2.25 pts** Incorrect

- **0.5 pts** Hardcoded values

- **0 pts** Specifies in Relational Algebra format

#### 3.5 RC 9 2.25 / 2.25

✓ - **0 pts** Correct

- **2.25 pts** Not 315 / 415

- **1 pts** Logic Error

- **0.25 pts** Minor syntax error

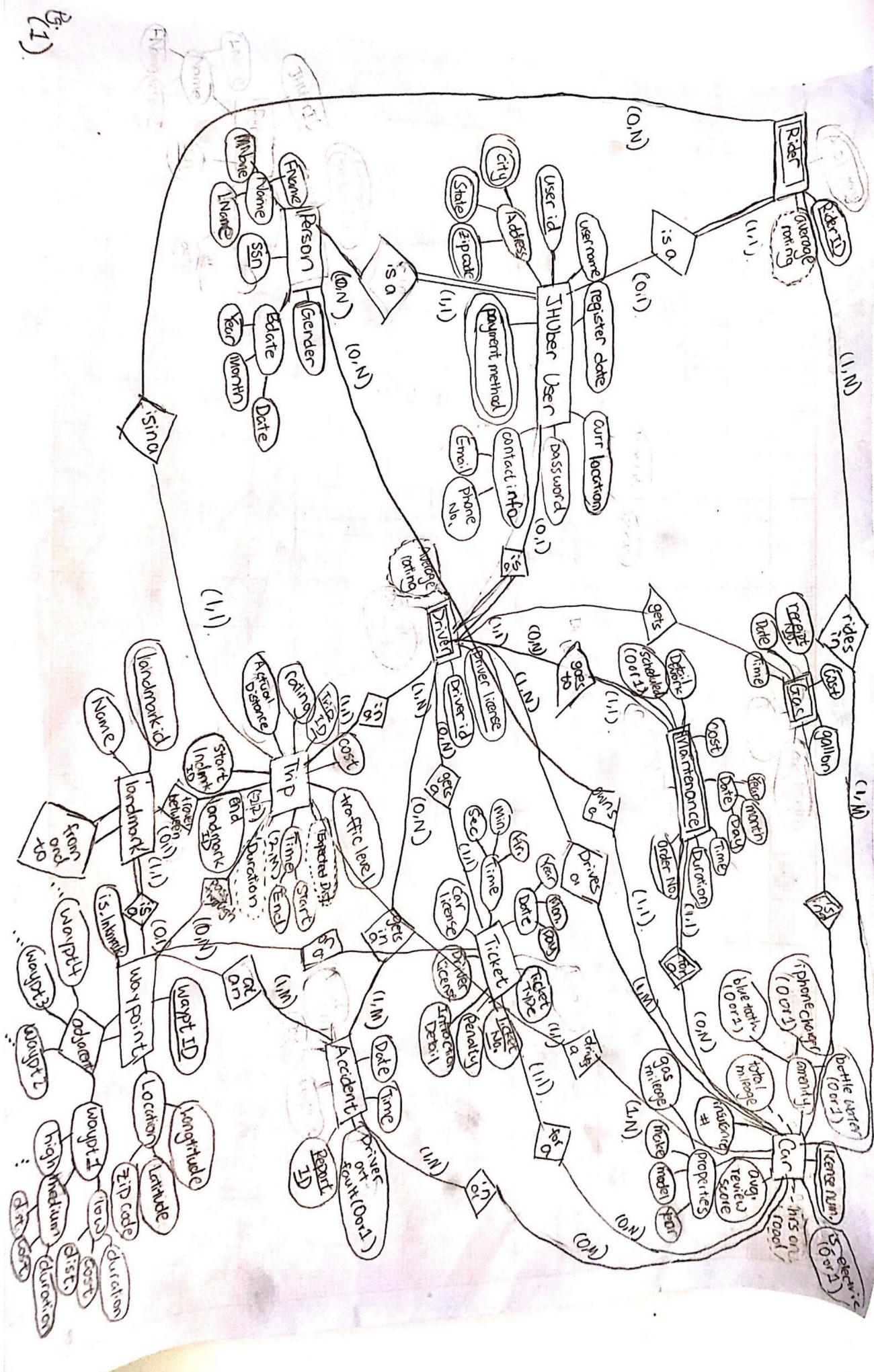
- **0.5 pts** Major syntax error

- **1 pts** Unsafe

- **2.25 pts** Incorrect
- **0.5 pts** Hardcoded values
- **0 pts** Specifies in Relational Algebra format

### 3.6 RC 10 2.25 / 2.25

- ✓ - **0 pts** Correct
- **2.25 pts** Not 315 / 415
- **1 pts** Logic Error
- **0.25 pts** Minor syntax error
- **0.5 pts** Major syntax error
- **1 pts** Unsafe
- **2.25 pts** Incorrect
- **0.5 pts** Hardcoded values
- **0 pts** Specifies in Relational Algebra format



## 1.1 ER design 19 / 20

- **0 pts** Correct
  - **3 pts** Did not use primary keys
  - **2 pts** Incorrect mappings
  - **0.1 pts** A minor error
  - **2 pts** incorrectly computes paths
  - **1 pts** Other not so minor mistake
- ✓ - **1 pts** Cannot compute waypoints in past trips (requirement dd)
- **1 pts** Cannot compute past trips based on traffic conditions
  - **1.5 pts** Incorrect use of symbols
  - **1 pts** Cannot track which customers are also drivers
- ✓ - **0 pts** Hard to decipher (Consider using a software)
- **0 pts** Unnecessary Complication
  - **4 pts** Major design flaws
  - **1.5 pts** Incorrectly used derived attributes
  - **1 pts** Incorrect use of Primary keys
  - **2 pts** Logical errors
  - **20 pts** Did not answer

Entity Tables:

Rider

<u>Rider ID</u>	1234
Average Rating	4.5

JHUber User

<u>User ID</u>	1234
City	Baltimore
State	MD
Zip Code	21211
Payment info	Credit Card
Email	<a href="mailto:12345@gmail.com">12345@gmail.com</a>
Phone Number	123-123-1234
password	1234
Curr_location	Johns Hopkins University
Register date	09/19/2018
User name	johndoe1234

Person

<u>ssn</u>	123-123-1234
FName	John
MName	Mary
LName	Doe
Gender	Male
BYear	1996
BMonth	02
BDay	19

### Gas

<u>Receipt No.</u>	122
Cost	20
Gallon	6
Date	9/29/2020
Time	12:28:09
Driver ID	1225
Car license Number	7OY2409

### Maintenance

<u>Order No.</u>	1
Cost	40
Detail Work	Oil Change
Date	09/29/2020
Time	08:10:09
Duration	30 min
Schedule (0 or 1)	1
Driver ID	1225
Car license plate	7OY2409

### Driver

<u>Driver ID</u>	1225
<u>Driver License</u>	E01YT48
Average Rating	4.90

### Ticket

<u>Ticket No.</u>	12
Driver License	E01YT48
Car License	7OY2409

Time	16:23:03
Date	9/29/2020
Ticket Type	Parking Violation
Infraction Detail	Parking Violation at Charles St.
Penalty	Fine
Waypoint	Charles St.

#### Accident

<u>Report ID</u>	888
Waypoint	Charles St.
Date	09/29/2020
Time	16:30:16
Driver at Fault (0 or 1)	1

#### Trip

Cost	20
Car License	7OY2409
Driver ID	1225
Rider ID	1234
Start Lndmrk ID	Johns Hopkins University
End Lndmrk ID	BWI Airport
<u>Trip ID</u>	089
Traffic Level	Low
Expected Dist.	13 mi
Actual Dist.	13 mi
Date	8/29/2020
Time	20:09:20
Duration	24 min

Rating	5.0
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#### Car

<u>License Num</u>	7OY2409
Owner ssn	144-155-1666
Hrs on Road	156
Avg Review Score	4.8
Make	Honda
Model	HRV
Year	2016
Gas mileage	25 mi/gallon
Insurance Number	N0659234123
Total mileage	20000 mi
Bluetooth ( 0 or 1)	1
Iphone charger (0 or 1)	1
Bottled water (0 or 1)	0
Is electric (0 or 1)	0

#### Landmark

<u>Landmark ID</u>	3
Name	Johns Hopkins University

#### Waypoint

<u>Waypoint ID</u>	5
Longitude	39.278520
Latitude	-76.614470
Zip code	21211
is_landmark	0

## Relation Table

### Person - JHUber User

<u>ssn</u>	123-123-1234
<u>User ID</u>	johndoe1234

### Trip - Waypoint

<u>Trip ID</u>	089
<u>Waypoint ID</u>	5
is_destination (0 or 1)	0

### Rider - Car

<u>Car license Number</u>	7OY2409
<u>Rider ID</u>	1234

### Driver - Car

<u>Car license Number</u>	7OY2409
<u>Driver ID</u>	1225

### Car - Accident

<u>Car license Number</u>	7OY2409
<u>Accident Report ID</u>	888

### Driver- Accident

<u>Driver license Number</u>	E01YT48
<u>Accident Report ID</u>	888

### Waypoint - Waypoint

<u>Waypoint ID</u>	5
<u>Closest Waypoint ID</u>	6
Traffic Level	Low
Duration	2 min

Distance	0.3 mi
Cost	0.5

## 1.2 Relational design 10 / 10

✓ - **0 pts** Correct representation

- **1.5 pts** Did not represent all relations and entities

- **0.1 pts** A minor error

- **1 pts** Other not so minor mistake

- **0.5 pts** Can be more concise or can use better names

- **3 pts** Did not give sample data

- **0 pts** Unnecessary Complication

- **4 pts** Major design flaws

- **1 pts** Incorrectly represented Primary keys

- **10 pts** Did not answer

c)

$$\text{Non-electric-driver} \leftarrow \Pi_{\text{Driver ID}} (\text{Driver} \setminus \text{Driver ID})$$

$$\text{Driver-Car} \setminus \text{Driver ID} = \text{Driver ID}$$

$$\text{Car license Number} (0) = \text{License Num}$$

$$\text{is electric Car} (0) = 0$$

$$\text{Driver-Rider} \leftarrow \Pi_{\text{Driver ID}} (\text{Non-electric-driver} \setminus \text{Driver ID})$$

$$\text{Rider})$$

$$\text{Driver ID} = \text{Rider ID}$$

$$\text{Driver-ssn} \leftarrow \Pi_{\text{ssn}} (\Pi_{\text{User ID}} (\text{Driver-Rider} \setminus \text{Driver ID JHuber User}))$$

$$\text{User ID} = \text{User ID}$$

$$\text{Person-JHuber User} = \text{User ID}$$

$$\text{Result} \leftarrow \Pi_{\text{FName, MName, LName}} (\text{Driver-ssn} \setminus \text{ssn})$$

$$\text{Person})$$

$$\text{ssn} = \text{ssn}$$

f)

$$\text{Owner-name} \leftarrow \Pi_{\text{ssn}} (\text{Person} \setminus \text{ssn})$$

$$(\text{Owner-ssn}, (\text{Car} \setminus \text{license Num} = \text{Car license Number} \text{ Car-Accident}))$$

$$\text{Accident Report ID} = \text{owner-ssn}$$

$$\text{Driver-ssn} \leftarrow \Pi_{\text{ssn}} (\Pi_{\text{User ID}} (\Pi_{\text{Driver ID}} (\text{Driver-Accident} \setminus \text{Driver ID})))$$

$$\text{Driver license Driver} = \text{Driver ID JHuber User} \setminus \text{User ID Person}$$

$$\text{Number} = \text{Driver ID} = \text{User ID}$$

$$\text{License} = \text{User ID} = \text{User ID}$$

$$\text{Driver-name} \leftarrow \Pi_{\text{Driver FName, Driver MName, Driver LName}} (\Pi_{\text{FName, MName, LName}} (\text{Driver-name} \setminus \text{ssn}))$$

$$\text{Person})$$

$$\text{FName} = \text{FName}$$

$$\text{MName} = \text{MName}$$

$$\text{LName} = \text{LName}$$

$$\text{Accident Report ID}$$

$$\text{Result} \leftarrow \Pi_{\text{Date, Time, waypoint,}} (\text{Driver-name} \setminus \text{Accident Report ID})$$

$$\text{Accident} \setminus \text{Report ID} = \text{Report ID}$$

$$\text{owner-name} = \text{Accident Report ID}$$

$$\text{FName, MName, LName, Driver FName, Driver MName, Driver LName}$$

h)

$$\text{Not-owner-ssn} \leftarrow \Pi_{\text{ssn}} (\text{Person-JHuber User} \setminus \Pi_{\text{User ID, Car license Number}} (\text{JHuber User} \setminus \text{User ID}))$$

$$\text{Driver-Car} \setminus \text{Driver ID} = \text{Driver ID}$$

$$\text{Car} = \text{Car license plate}$$

$$\text{License Num} = \text{License Num}$$

$$\text{owner-ssn}$$

$$\text{Owner-name} \leftarrow \Pi_{\text{owner-FName, owner-MName, owner-LName}} (\Pi_{\text{FName, MName, LName}} (\text{Person} \setminus \text{ssn}))$$

$$\text{Person} \setminus \text{ssn} = \text{owner-ssn}$$

$$\text{Not-owner-ssn})$$

$$\text{FName} = \text{FName}$$

$$\text{MName} = \text{MName}$$

$$\text{LName} = \text{LName}$$

$$\text{Result} \leftarrow \Pi_{\text{owner-FName, owner-MName, owner-LName, make, model, year, total mileage}} (\text{Person} \setminus \text{ssn})$$

$$\text{Owner-name} \setminus \text{car license Number} = \text{car license Number}$$

$$\text{Car} = \text{license Num}$$

$$\text{FName, MName, LName}$$

$$\text{make, model, year, total mileage}$$

**1.3 RA(c) 0.83 / 0.83**

- **0 pts** Correct
- **0.4 pts** Incorrect assumptions
- ✓ - **0 pts** Unnecessarily complicated
  - **0.41 pts** Used cartesian product instead of natural join
  - **0.83 pts** Did not answer
  - **0.1 pts** Minor error
  - **0.4 pts** Did not check if car is not electric

c)

$$\text{Non-electric-driver} \leftarrow \Pi_{\text{Driver ID}} (\text{Driver} \setminus \text{Driver ID})$$

$$\text{Driver-Car} \setminus \text{Driver ID} = \text{Driver ID}$$

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$$\text{is electric Car} (0) = 0$$

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$$\text{Rider})$$

$$\text{Driver ID} = \text{Rider ID}$$

$$\text{Driver-ssn} \leftarrow \Pi_{\text{ssn}} (\Pi_{\text{User ID}} (\text{Driver-Rider} \setminus \text{Driver ID JHuber User}))$$

$$\text{User ID} = \text{User ID}$$

$$\text{Person-JHuber User} = \text{User ID}$$

$$\text{Result} \leftarrow \Pi_{\text{FName, MName, LName}} (\text{Driver-ssn} \setminus \text{ssn})$$

$$\text{Person})$$

$$\text{ssn} = \text{ssn}$$

f)

$$\text{Owner-name} \leftarrow \Pi_{\text{ssn}} (\text{Person} \setminus \text{ssn})$$

$$(\text{Owner-ssn}, (\text{Car} \setminus \text{license Num} = \text{Car license Number} \text{ Car-Accident}))$$

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$$\text{Driver-ssn} \leftarrow \Pi_{\text{ssn}} (\Pi_{\text{User ID}} (\Pi_{\text{Driver ID}} (\text{Driver-Accident} \setminus \text{Driver ID})))$$

$$\text{Driver license Driver} = \text{Driver ID JHuber User} \setminus \text{User ID Person}$$

$$\text{Number} = \text{Driver ID} = \text{User ID}$$

$$\text{License} = \text{User ID} = \text{User ID}$$

$$\text{Driver-name} \leftarrow \Pi_{\text{Driver FName, Driver MName, Driver LName}} (\Pi_{\text{FName, MName, LName}} (\text{Driver-name} \setminus \text{ssn}))$$

$$\text{Person})$$

$$\text{FName} = \text{FName}$$

$$\text{MName} = \text{MName}$$

$$\text{LName} = \text{LName}$$

$$\text{Accident Report ID}$$

$$\text{Result} \leftarrow \Pi_{\text{Date, Time, waypoint,}} (\text{Driver-name} \setminus \text{Accident Report ID})$$

$$\text{Accident} \setminus \text{Report ID} = \text{Report ID}$$

$$\text{owner-name} = \text{Accident Report ID}$$

$$\text{FName, MName, LName, Driver FName, Driver MName, Driver LName}$$

h)

$$\text{Not-owner-ssn} \leftarrow \Pi_{\text{ssn}} (\text{Person-JHuber User} \setminus \Pi_{\text{User ID, Car license Number}} (\text{JHuber User} \setminus \text{User ID}))$$

$$\text{Driver-Car} \setminus \text{Driver ID} = \text{Driver ID}$$

$$\text{Car} = \text{Car license plate}$$

$$\text{License Num} = \text{License Num}$$

$$\text{owner-ssn}$$

$$\text{Owner-name} \leftarrow \Pi_{\text{owner-FName, owner-MName, owner-LName}} (\Pi_{\text{FName, MName, LName}} (\text{Person} \setminus \text{ssn}))$$

$$\text{Person} \setminus \text{ssn} = \text{owner-ssn}$$

$$\text{Not-owner-ssn})$$

$$\text{FName} = \text{FName}$$

$$\text{MName} = \text{MName}$$

$$\text{LName} = \text{LName}$$

$$\text{Result} \leftarrow \Pi_{\text{owner-FName, owner-MName, owner-LName, make, model, year, total mileage}} (\text{Person} \setminus \text{ssn})$$

$$\text{Owner-name} \setminus \text{car license Number} = \text{car license Number}$$

$$\text{Car} = \text{make, model, year, total mileage}$$

$$\text{license Num} = \text{license Num}$$

1.4 RA(f) 0.83 / 0.83

✓ - 0 pts Correct

- 0.4 pts Incorrect assumptions
- 0 pts Unnecessarily complicated
- 0.41 pts Used cartesian product instead of natural join
- 0.83 pts Did not answer
- 0.1 pts Minor error
- 0.42 pts Not all required outputs shown

c)

$$\text{Non-electric-driver} \leftarrow \Pi_{\text{Driver ID}} (\text{Driver} \setminus \text{Driver ID})$$

$$\text{Driver-Car} \setminus \text{Driver ID} = \text{Driver ID}$$

$$\text{Car license Number} (0) = \text{License Num}$$

$$\text{is electric Car} (0) = 0$$

$$\text{Driver-Rider} \leftarrow \Pi_{\text{Driver ID}} (\text{Non-electric-driver} \setminus \text{Driver ID})$$

$$\text{Rider})$$

$$\text{Driver ID} = \text{Rider ID}$$

$$\text{Driver-ssn} \leftarrow \Pi_{\text{ssn}} (\Pi_{\text{User ID}} (\text{Driver-Rider} \setminus \text{Driver ID JHuber User}))$$

$$\text{User ID} = \text{User ID}$$

$$\text{Person-JHuber User} = \text{User ID}$$

$$\text{Result} \leftarrow \Pi_{\text{FName, MName, LName}} (\text{Driver-ssn} \setminus \text{ssn})$$

$$\text{Person})$$

$$\text{ssn} = \text{ssn}$$

f)

$$\text{Owner-name} \leftarrow \Pi_{\text{ssn}} (\text{Person} \setminus \text{ssn})$$

$$(\text{Owner-ssn}, (\text{Car} \setminus \text{license Num} = \text{Car license Number} \text{ Car-Accident}))$$

$$\text{Accident Report ID} = \text{owner-ssn}$$

$$\text{Driver-ssn} \leftarrow \Pi_{\text{ssn}} (\Pi_{\text{User ID}} (\Pi_{\text{Driver ID}} (\text{Driver-Accident} \setminus \text{Driver ID})))$$

$$\text{Driver license Driver} = \text{Driver ID JHuber User} \setminus \text{User ID Person}$$

$$\text{Number} = \text{Driver ID} = \text{User ID}$$

$$\text{License} = \text{User ID} = \text{User ID}$$

$$\text{Driver-name} \leftarrow \Pi_{\text{Driver FName, Driver MName, Driver LName}} (\Pi_{\text{FName, MName, LName}} (\text{Driver-name} \setminus \text{ssn}))$$

$$\text{Person})$$

$$\text{FName} = \text{FName}$$

$$\text{MName} = \text{MName}$$

$$\text{LName} = \text{LName}$$

$$\text{Accident Report ID}$$

$$\text{Result} \leftarrow \Pi_{\text{Date, Time, waypoint,}} (\text{Driver-name} \setminus \text{Accident Report ID})$$

$$\text{Accident} \setminus \text{Report ID} = \text{Report ID}$$

$$\text{owner-name} = \text{Accident Report ID}$$

$$\text{FName, MName, LName, Driver FName, Driver MName, Driver LName}$$

h)

$$\text{Not-owner-ssn} \leftarrow \Pi_{\text{ssn}} (\text{Person-JHuber User} \setminus \Pi_{\text{User ID, Car license Number}} (\text{JHuber User} \setminus \text{User ID}))$$

$$\text{Driver-Car} \setminus \text{Driver ID} = \text{Driver ID}$$

$$\text{Car} = \text{Car license plate}$$

$$\text{License Num} = \text{License Num}$$

$$\text{owner-ssn}$$

$$\text{Owner-name} \leftarrow \Pi_{\text{owner-FName, owner-MName, owner-LName}} (\Pi_{\text{FName, MName, LName}} (\text{Person} \setminus \text{ssn}))$$

$$\text{Person} \setminus \text{ssn} = \text{owner-ssn}$$

$$\text{Not-owner-ssn})$$

$$\text{FName} = \text{FName}$$

$$\text{MName} = \text{MName}$$

$$\text{LName} = \text{LName}$$

$$\text{Result} \leftarrow \Pi_{\text{owner-FName, owner-MName, owner-LName, make, model, year, total mileage}} (\text{Person} \setminus \text{ssn})$$

$$\text{Owner-name} \setminus \text{car license Number} = \text{car license Number}$$

$$\text{Car} = \text{make, model, year, total mileage}$$

$$\text{license Num} = \text{license Num}$$

**1.5 RA(h) 0.73 / 0.83**

- **0 pts** Correct
  - **0.4 pts** Incorrect assumptions
  - **0 pts** Unnecessarily complicated
  - **0.41 pts** Used cartesian product instead of natural join
  - **0.83 pts** Did not answer
- ✓ - **0.1 pts** Minor error
- **0.42 pts** Not all required outputs shown
  - **0.42 pts** Did not check if owner and driver are different
- 💬 specify ssn as person.ssn or owner\_name.ssn

(iv)  $\text{Result} \leftarrow \Pi_{\substack{\text{TRIPID}, (\text{O}_{\text{DriverID}} \\ \text{Expected Dist.} > \text{Actual Dist.} (\text{Trip})) \\ \text{Date} = 9/12/20}}$

(ss)  $\text{Landmarks} \leftarrow \Pi_{\text{LandmarkID}} (\text{Landmark})$

$\text{Driver-Lndmrk} \leftarrow (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{startLndmrkID}, (\text{Trip}) \\ \text{Driver ID}}} \\ \text{startLndmrkID} \\ \text{Driver ID}}}) \cup (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{endLndmrkID} (\text{Trip}) \\ \text{DriverID}} \\ \text{endLndmrkID} \\ \text{DriverID}})})$

$\text{Result} \leftarrow \Pi_{\text{DriverID}} (\text{Driver-Lndmrk} + \text{Landmarks})$ .

(ccc).

$\text{result} \leftarrow \Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} (\Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} \setminus (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Gas mileage} = \text{Gas mileage})) \cup (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Gas mileage} = \text{Gas mileage}))$

Part 2.

2.1  $\text{DOV} \leftarrow \Pi_{\text{BNO}}, ((\Pi_{\text{DLicNo}} (\text{Oname} = "Ivanka Trump") \text{DRINKER}) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{= DLicNo}}} \text{VISIT})$

$\text{Result} \leftarrow \Pi_{\text{Oname}}, ((\Pi_{\text{DLicNo}} (\text{VISIT} \setminus \Pi_{\substack{\text{DateFirst} \\ \text{= DateOfVisit} \\ \text{BNO = BNO}}}) \text{DOV}) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{= DLicNo}}} \text{DRINKER})$

2.2  $\text{Bar-Nos} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\substack{\text{O}_\text{City} \\ \text{= "Baltimore" \\ \text{BState} \\ \text{= "MD" }}} \text{BAR}) \setminus \Pi_{\substack{\text{BNO} \\ \text{= BNO}}} (\Pi_{\substack{\text{BeerName} \\ \text{= "Bud Lite" }}} \text{SERVES}))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} (\text{Bar-Nos} \setminus \Pi_{\substack{\text{BNO} \\ \text{= BNO}}} \text{BAR})$ .

1.6 RA(y) 0.41 / 0.83

- **0 pts** Correct
  - **0.4 pts** Incorrect assumptions
  - **0 pts** Unnecessarily complicated
  - **0.41 pts** Used cartesian product instead of natural join
  - **0.83 pts** Did not answer
  - **0.1 pts** Minor error
  - **0.42 pts** Not all required outputs shown
  - **0.42 pts** Did not check for driver
- ✓ - **0.42 pts** Did not check if start and end are landmarks
- **0.42 pts** Did not check date

(iv)  $\text{Result} \leftarrow \Pi_{\substack{\text{TRIPID}, (\text{O}_{\text{DriverID}} \\ \text{Expected Dist.} > \text{Actual Dist.} (\text{Trip})) \\ \text{Date} = 9/12/20}}$

(ss)  $\text{Landmarks} \leftarrow \Pi_{\text{LandmarkID}} (\text{Landmark})$

$\text{Driver-Lndmrk} \leftarrow (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{startLndmrkID}, (\text{Trip}) \\ \text{Driver ID}}} \\ \text{startLndmrkID} \\ \text{Driver ID}}}) \cup (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{endLndmrkID} (\text{Trip}) \\ \text{DriverID}} \\ \text{endLndmrkID} \\ \text{DriverID}})})$

$\text{Result} \leftarrow \Pi_{\text{DriverID}} (\text{Driver-Lndmrk} + \text{Landmarks})$ .

(ccc).

$\text{result} \leftarrow \Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} (\Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} \setminus (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Car})))$ .  
 Gas mileage  
 Gas mileage = Gas mileage  
 Gas mileage copy

Part 2.

2.1  $\text{DOV} \leftarrow \Pi_{\text{BNO}}, ((\Pi_{\substack{\text{DLicNo} \\ \text{DateofVisit}}} (\text{Oname} \text{ DRINKER})) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{DLicNo} = \text{DLicNo}}} \text{ VISIT})$

$\text{Result} \leftarrow \Pi_{\text{Oname}}, ((\Pi_{\substack{\text{DLicNo} \\ \text{Political Party}}} (\text{VISIT} \setminus \Pi_{\substack{\text{DateofVisit} \\ \text{DateofVisit} = \text{DateofVisit}}} \text{ DOV})) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{DLicNo} = \text{DLicNo}}} \text{ DRINKER})$

2.2  $\text{Bar-Nos} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\substack{\text{O}_{\text{BCity}} \\ \text{"Baltimore"} \\ \text{BState} \\ \text{"MD"}}} \text{ BAR}) \setminus \Pi_{\substack{\text{BNO} \\ \text{BNO} = \text{BNO}}} (\Pi_{\substack{\text{O}_{\text{BeerName}} \\ \text{"Bud Lite" }}} \text{ SERVES}))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} (\text{Bar-Nos} \setminus \Pi_{\substack{\text{BNO} \\ \text{BNO} = \text{BNO}}} \text{ BAR})$ .

1.7 RA(ss) 0.83 / 0.83

✓ - 0 pts Correct

- 0.4 pts Incorrect assumptions
- 0.83 pts Did not answer
- 0.1 pts Minor error
- 0.6 pts Incorrect

(iv)  $\text{Result} \leftarrow \Pi_{\substack{\text{TRIPID}, (\text{O}_{\text{DriverID}} \\ \text{Expected Dist.} > \text{Actual Dist.} (\text{Trip})) \\ \text{Date} = 9/12/20}}$

(ss)  $\text{Landmarks} \leftarrow \Pi_{\text{LandmarkID}} (\text{Landmark})$

$\text{Driver-Lndmrk} \leftarrow (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{startLndmrkID}, (\text{Trip}) \\ \text{Driver ID}}} \\ \text{startLndmrkID} \\ \text{Driver ID}}}) \cup (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{endLndmrkID} (\text{Trip}) \\ \text{DriverID}} \\ \text{endLndmrkID} \\ \text{DriverID}})})$

$\text{Result} \leftarrow \Pi_{\text{DriverID}} (\text{Driver-Lndmrk} + \text{Landmarks})$ .

(ccc).

$\text{result} \leftarrow \Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} (\Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} \setminus (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Gas mileage} = \text{Gas mileage})) \cup (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Gas mileage} = \text{Gas mileage}))$

Part 2.

2.1  $\text{DOV} \leftarrow \Pi_{\text{BNO}}, ((\Pi_{\substack{\text{DLicNo} \\ \text{DateofVisit}}} (\text{Oname} = "Ivanka Trump") \text{DRINKER}) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{DLicNo} = \text{DLicNo}}} \text{VISIT})$

$\text{Result} \leftarrow \Pi_{\text{Oname}}, ((\Pi_{\text{DLicNo}} (\text{VISIT} \setminus \Pi_{\substack{\text{DateofVisit} \\ \text{DateofVisit} = \text{DateofVisit}}} \text{DOV})) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{DLicNo} = \text{DLicNo}}} \text{DRINKER})$

2.2  $\text{Bar-Nos} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\substack{\text{O}_{\text{BCity}} \\ \text{BState}}} (\text{BAR}) \setminus \Pi_{\substack{\text{BNO} \\ \text{BNO} = \text{BNO}}} (\text{BeerName} = "Budweiser")) \cup (\Pi_{\substack{\text{O}_{\text{BeerName}} \\ \text{BeerName}}} \text{SERVES}))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} (\text{Bar-Nos} \setminus \Pi_{\substack{\text{BNO} \\ \text{BNO} = \text{BNO}}} \text{BAR})$ .

1.8 RA(ccc) 0.83 / 0.83

✓ - 0 pts Correct

- 0.4 pts Incorrect assumptions
- 0.83 pts Did not answer
- 0.1 pts Minor error ( eg used min instead of max)
- 0.83 pts Incorrect
- 0.2 pts Used cartesian product instead of join
- 0.1 pts Invalid operator

(iv)  $\text{Result} \leftarrow \Pi_{\substack{\text{TRIPID}, (\text{O}_{\text{DriverID}} \\ \text{Expected Dist.} > \text{Actual Dist.} (\text{Trip})) \\ \text{Date} = 9/12/20}}$

(ss)  $\text{Landmarks} \leftarrow \Pi_{\text{LandmarkID}} (\text{Landmark})$

$\text{Driver-Lndmrk} \leftarrow (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{startLndmrkID}, (\text{Trip}) \\ \text{Driver ID}}} \\ \text{startLndmrkID} \\ \text{Driver ID}}}) \cup (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{endLndmrkID} (\text{Trip}) \\ \text{DriverID}} \\ \text{endLndmrkID} \\ \text{DriverID}})})$

$\text{Result} \leftarrow \Pi_{\text{DriverID}} (\text{Driver-Lndmrk} + \text{Landmarks})$ .

(ccc).

$\text{result} \leftarrow \Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} (\Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} \setminus (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Gas mileage} = \text{Gas mileage})) \cup (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Gas mileage} = \text{Gas mileage}))$

Part 2.

2.1  $\text{DOV} \leftarrow \Pi_{\text{BNO}}, ((\Pi_{\text{DLicNo}} (\text{Oname} = "Ivanka Trump") \text{DRINKER}) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{= DLicNo}}} \text{VISIT})$

$\text{Result} \leftarrow \Pi_{\text{Oname}}, ((\Pi_{\text{DLicNo}} (\text{VISIT} \setminus \Pi_{\substack{\text{DateFirst} \\ \text{= DateOfVisit} \\ \text{BNO = BNO}}}) \text{DOV}) \setminus \Pi_{\substack{\text{DLicNo} \\ \text{= DLicNo}}} \text{DRINKER})$

2.2  $\text{Bar-Nos} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\substack{\text{O}_\text{City} \\ \text{= "Baltimore" \\ \text{BState} \\ \text{= "MD" }}} \text{BAR}) \setminus \Pi_{\substack{\text{BNO} \\ \text{= BNO}}} (\Pi_{\substack{\text{BeerName} \\ \text{= "Bud Lite" }}} \text{SERVES}))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} (\text{Bar-Nos} \setminus \Pi_{\substack{\text{BNO} \\ \text{= BNO}}} \text{BAR})$ .

## 2.1 RA 1 2 / 2.25

- **0 pts** Correct
  - **0.25 pts** Minor Syntax Error
  - **0.5 pts** Major Syntax Error
  - **1.125 pts** Logical Error
- ✓ - **0.25 pts** Syntax Error: Not using `table.column = table2.column` and instead using `column = column2`
- **2.25 pts** Incorrect

(iv)  $\text{Result} \leftarrow \Pi_{\substack{\text{TRIPID}, (\text{O}_{\text{DriverID}} \\ \text{Expected Dist.} > \text{Actual Dist.} (\text{Trip})) \\ \text{Date} = 9/12/20}}$

(ss)  $\text{Landmarks} \leftarrow \Pi_{\text{LandmarkID}} (\text{Landmark})$

$\text{Driver-Lndmrk} \leftarrow (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{startLndmrkID}, (\text{Trip}) \\ \text{Driver ID}}} \\ \text{startLndmrkID} \\ \text{Driver ID}}}) \cup (\Pi_{\substack{\text{LandmarkID} (\Pi_{\substack{\text{endLndmrkID} (\text{Trip}) \\ \text{DriverID}} \\ \text{endLndmrkID} \\ \text{DriverID}})})$

$\text{Result} \leftarrow \Pi_{\text{DriverID}} (\text{Driver-Lndmrk} + \text{Landmarks})$ .

(ccc).

$\text{result} \leftarrow \Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} (\Pi_{\substack{\text{make}, \text{model}, \text{Car} \\ \text{Year}}} \setminus (\Pi_{\substack{\text{Gas mileage copy} \\ \text{Gas mileage}}} (\text{Car})))$ .  
 Gas mileage  
 $\text{Gas mileage} = \text{Gas mileage}$   
 $\text{Gas mileage copy}$

Part 2.

2.1  $\text{DOV} \leftarrow \Pi_{\text{BNO}}, ((\Pi_{\text{DLicNo}} (\text{Oname} \text{ DRINKER})) \bowtie_{\substack{\text{DLicNo} \\ \text{= DLicNo}}} \text{VISIT})$

$\text{Result} \leftarrow \Pi_{\text{Oname}}, ((\Pi_{\text{DLicNo}} (\text{VISIT} \bowtie_{\substack{\text{DateFirst} \\ \text{= DateOfVisit} \\ \text{BNO = BNO}} \text{DOV})) \bowtie_{\substack{\text{DLicNo} \\ \text{= DLicNo}}} \text{DRINKER})$

2.2  $\text{Bar-Nos} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\substack{\text{O}_{\text{BCity}} \\ \text{= "Baltimore" \\ \text{BState} \\ \text{= "MD" }}} \text{BAR}) \bowtie_{\substack{\text{BNO} \\ \text{= BNO}}}) \bowtie_{\substack{\text{BeerName} \\ \text{= BeerName}}} (\text{SERVES}))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} (\text{Bar-Nos} \bowtie_{\substack{\text{BNO} \\ \text{= BNO}}} \text{BAR})$ .

## 2.2 RA 2 0.0625 / 2.25

- 0 pts Correct
- ✓ - 0.25 pts Minor Syntax Error
- ✓ - 0.25 pts Did not use table.column = table2.column but instead did column = column
- ✓ - 1.6875 pts Contained bars that served bud lite
- 2.25 pts Incorrect
- 1.125 pts Logical Error
- 0.25 pts Did not project the right answer

1 see serves second and third entry to why this won't work

2 when doing select/project on tables please put parentheses around the tables, ie Project  
(DRINKER)

2.3

$\text{Under-30} \leftarrow \Pi_{\text{DName}, \text{DLicNo}, \text{BNO}} (\sigma_{\text{Age} < 30} \text{ DRINKER})$

$\text{Georgetown-Bar} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Georgetown"$

$\text{People-Visit} \leftarrow \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Under-30}} \text{ VISIT})$   
 $= \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Age} < 30} \text{ VISIT})$   
 $= \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Age} < 30} \text{ DRINKER})$

Result  $\leftarrow$ 

$\Pi_{\text{DName}} (\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES}))$   
 $= \Pi_{\text{DName}} (\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ DRINKER}))$

$\leftarrow \Pi_{\text{DName}} ((\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES})) \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES}))$   
 $= \Pi_{\text{DName}} ((\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ DRINKER})) \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ DRINKER}))$

2.4

$\text{DT-visited} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER})) \times_{\text{DLicNo}} \text{ VISIT})$   
 $= \Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER}) \times_{\text{DLicNo}} \text{ VISIT}$   
 $= "Donald Trump" \times_{\text{DLicNo}} \text{ VISIT}$

Result  $\leftarrow \Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER}) \times_{\text{DLicNo}} \text{ VISIT} \times_{\text{BNO}} \text{ DT-visited}$

2.5

$\text{Towson-bars} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Towson"$

$\text{Visited-all} \leftarrow \Pi_{\text{DLicNo}} (\text{VISIT} \times_{\text{BNO}} \text{Towson-bars})$

Result  $\leftarrow \Pi_{\text{DName}} (\sigma_{\text{Age}} \text{ Visited-all}) \times_{\text{DLicNo}} \text{ DRINKER}$

2.6

$\text{No-Visit-Bar} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ VISIT})$

$\text{No-COVID} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ COVID-DIAGNOSIS})$

Result  $\leftarrow \Pi_{\text{DName}} (\sigma_{\text{Age}} \text{ No-Visit-Bar} \cap \text{No-COVID})$

### 2.3 RA 3 2 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor Syntax Error
- **0.5 pts** Major Syntax Error
- **0.5 pts** Did not project the right answer
- ✓ - **0.25 pts** Did not use `table.column = table2.column` but instead did `column = column`
- **2.25 pts** Incorrect
- **1.6875 pts** Did not limit the bars to Georgetown
- **1.5 pts** Missed a table
- **1.6875 pts** Logical Error

2.3

$\text{Under-30} \leftarrow \Pi_{\text{DName}, \text{DLicNo}, \text{BNO}} (\sigma_{\text{Age} < 30} \text{ DRINKER})$

$\text{Georgetown-Bar} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Georgetown"$

$\text{People-Visit} \leftarrow \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Under-30}} \text{ VISIT})$   
 $= \text{Georgetown-Bar}$

Result  $\leftarrow$ 

$\Pi_{\text{DName}} (\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES}))$

$\leftarrow ((\text{People-Visit} \times_{\text{DLicNo}} \sigma_{\text{BeerName}} \text{ LIKES}) \times_{\text{DLicNo}} \sigma_{\text{BeerName}} \text{ LIKES})$

2.4

$\text{DT-visited} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER})) \times_{\text{DLicNo}} \text{ VISIT})$   
 $= "Donald Trump"$

Result  $\leftarrow \Pi_{\text{DName}} (\text{DRINKER} \times_{\text{DLicNo}} \text{ VISIT} \times_{\text{BNO}} \text{ DT-visited})$

2.5

$\text{Towson-bars} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Towson"$

$\text{Visited-all} \leftarrow \Pi_{\text{DLicNo}} (\text{VISIT} \times_{\text{BNO}} \text{Towson-bars})$

Result  $\leftarrow \Pi_{\text{DName}} (\text{Visited-all} \times_{\text{DLicNo}} \text{ DRINKER})$

2.6

$\text{No-Visit-Bar} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ VISIT})$

$\text{NO-COVID} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ COVID-DIAGNOSIS})$

Result  $\leftarrow \Pi_{\text{DName}} (\text{No-Visit-Bar} \cap \text{NO-COVID})$

## 2.4 RA 4 2 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor Syntax Error
- **0.5 pts** Major Syntax Error
- **0.5 pts** Did not project the right answer
- ✓ - **0.25 pts** Did not use `table.column = table2.column` but instead did `column = column`
- **2.25 pts** Incorrect
- **1.5 pts** Missed a table
- **1.6875 pts** Logical Error

2.3

$\text{Under-30} \leftarrow \Pi_{\text{DName}, \text{DLicNo}, \text{BNO}} (\sigma_{\text{Age} < 30} \text{ DRINKER})$

$\text{Georgetown-Bar} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Georgetown"$

$\text{People-Visit} \leftarrow \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Under-30}} \text{ VISIT})$   
 $= \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Age} < 30} \text{ VISIT})$   
 $= \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Age} < 30} \text{ DRINKER})$

Result  $\leftarrow$ 

$\Pi_{\text{DName}} (\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES}))$   
 $= \Pi_{\text{DName}} (\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ DRINKER}))$

$\leftarrow \Pi_{\text{DName}} ((\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES})) \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES}))$   
 $= \Pi_{\text{DName}} ((\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ DRINKER})) \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ DRINKER}))$

2.4

$\text{DT-visited} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER})) \times_{\text{DLicNo}} \text{ VISIT})$   
 $= \Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER}) \times_{\text{DLicNo}} \text{ VISIT}$   
 $= "Donald Trump" \times_{\text{DLicNo}} \text{ VISIT}$

Result  $\leftarrow \Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER}) \times_{\text{DLicNo}} \text{ VISIT} \times_{\text{BNO}} \text{ DT-visited}$

2.5

$\text{Towson-bars} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Towson"$

$\text{Visited-all} \leftarrow \Pi_{\text{DLicNo}} (\text{VISIT} \times_{\text{BNO}} \text{Towson-bars})$

Result  $\leftarrow \Pi_{\text{DName}} (\sigma_{\text{Age}} \text{ Visited-all}) \times_{\text{DLicNo}} \text{ DRINKER}$

2.6

$\text{No-Visit-Bar} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ VISIT})$

$\text{No-COVID} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ COVID-DIAGNOSIS})$

Result  $\leftarrow \Pi_{\text{DName}} (\sigma_{\text{Age}} \text{ No-Visit-Bar} \cap \text{No-COVID})$

## 2.5 RA 5 2 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor Syntax Error
- **0.5 pts** Major Syntax Error
- **0.5 pts** Did not project the right answer
- ✓ - **0.25 pts** Did not use `table.column = table2.column` but instead did `column = column`
- **2.25 pts** Incorrect
- **1.5 pts** Missed a table
- **1.6875 pts** Logical Error

2.3

$\text{Under-30} \leftarrow \Pi_{\text{DName}, \text{DLicNo}, \text{BNO}} (\sigma_{\text{Age} < 30} \text{ DRINKER})$

$\text{Georgetown-Bar} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Georgetown"$

$\text{People-Visit} \leftarrow \Pi_{\text{DName}, \text{DLicNo}} (\sigma_{\text{Under-30}} \text{ VISIT})$   
 $= \text{Georgetown-Bar}$

Result  $\leftarrow$ 

$\Pi_{\text{DName}} (\text{People-Visit} \times_{\text{DLicNo}} (\sigma_{\text{BeerName}} \text{ LIKES}))$

$\leftarrow ((\text{People-Visit} \times_{\text{DLicNo}} \sigma_{\text{BeerName}} \text{ LIKES}) \times_{\text{DLicNo}} \sigma_{\text{BeerName}} \text{ LIKES})$

2.4

$\text{DT-visited} \leftarrow \Pi_{\text{BNO}} ((\Pi_{\text{DName}} (\sigma_{\text{DName}} \text{ DRINKER})) \times_{\text{DLicNo}} \text{ VISIT})$   
 $= "Donald Trump"$

Result  $\leftarrow \Pi_{\text{DName}} (\text{DRINKER} \times_{\text{DLicNo}} \text{ VISIT} \times_{\text{BNO}} \text{ DT-visited})$

2.5

$\text{Towson-bars} \leftarrow \Pi_{\text{BNO}} (\sigma_{\text{BCity}} \text{ BAR})$   
 $= "Towson"$

$\text{Visited-all} \leftarrow \Pi_{\text{DLicNo}} (\text{VISIT} \times_{\text{BNO}} \text{Towson-bars})$

Result  $\leftarrow \Pi_{\text{DName}} (\text{Visited-all} \times_{\text{DLicNo}} \text{ DRINKER})$

2.6

$\text{No-Visit-Bar} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ VISIT})$

$\text{NO-COVID} \leftarrow (\Pi_{\text{DLicNo}} \text{ DRINKER}) - (\Pi_{\text{DLicNo}} \text{ COVID-DIAGNOSIS})$

Result  $\leftarrow \Pi_{\text{DName}} (\text{No-Visit-Bar} \cap \text{NO-COVID})$

## 2.6 RA 6 1.25 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor syntax error
- **0.5 pts** Major syntax error
- **0.25 pts** Inefficient
- ✓ **- 1 pts** Incomplete answer
- **1 pts** Logical error
- **2.25 pts** Incorrect

 You need to complete a natural join of DRINKER with (No\_Visit\_Bar AND No\_Covid) to get DName and Age. Currently, the result could not capture age.

2.7.

$$\begin{aligned}
 & \text{DT-bars} \leftarrow \Pi_{BNO} \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Donald Trump" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{VISIT} \\
 & \text{Every-bar} \leftarrow \Pi_{DLicNo} \left( \text{VISIT} \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{DT-bars} \right) \\
 & \text{JB-bars} \leftarrow \Pi_{BNO} \left( \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Joe Biden" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{VISIT} \right) \\
 & \text{No-bar} \leftarrow (\Pi_{DLicNo} \text{VISIT}) - \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{BNO} \\ = BNO \end{array} \right) \left( \begin{array}{l} \text{PBuyer} \left( \Pi_{BNO} \text{BNO}, \text{VISIT} \right) \\ = BNO \end{array} \right) \times_{\substack{\text{JB-bars}}} \right) \\
 & \text{Result} \leftarrow \Pi_{\text{DName, Age}} \left( \text{Every-bar} \cap \text{No-bar} \right)
 \end{aligned}$$

2.8.

$$\begin{aligned}
 & \text{No-beer-names} \leftarrow \Pi_{DLicNo} \left( \text{DRINKER} \times_{\substack{\text{DName} \\ \neq \text{BeerName}}} \text{BEER-PURCHASE} \right) \\
 & \text{Bar-Name} \leftarrow \Pi_{\text{BarName, DLicNo}} \left( \text{VISIT} \times_{\substack{\text{BNO} \\ = BNO}} \text{BAR} \right) \\
 & \text{Drinker-bar} \leftarrow \Pi_{DLicNo} \left( \text{DRINKER} \times_{\substack{\text{DName} \\ = \text{BarName}}} \text{Bar-Name} \right) \\
 & \text{Result} \leftarrow \Pi_{\text{DName}} \left( (\text{Drinker-bar} \cap \text{No-beer-names}) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{DRINKER} \right)
 \end{aligned}$$

2.9.

$$\begin{aligned}
 & \text{DT-Like} \leftarrow \Pi_{\text{BeerName}} \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Donald Trump" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{LIKES} \\
 & \text{Not-DT-Like} \leftarrow \Pi_{\text{BeerName}} \left( \text{SERVES} \right) - \Pi_{\text{BeerName}} \left( \text{DT-Like} \right) \\
 & \text{Result} \leftarrow \Pi_{\text{BarName}} \left( \left( \Pi_{BNO} \left( \text{SERVES} \times_{\substack{\text{BeerName} \\ = BeerName}} \text{Not-DT-Like} \right) \right) \times_{\substack{\text{BNO} \\ = BNO}} \text{BAR} \right)
 \end{aligned}$$

Pg. 5).

## 2.7 RA 7 2.25 / 2.25

✓ - 0 pts Correct

- 0.25 pts Minor syntax error
- 0.5 pts Major syntax error
- 1 pts Incomplete answer
- 1 pts Logical error
- 2.25 pts Incorrect

💬 Natural join VISIT with JB\_Bar and project out DLicNo, and then subtract those from Every\_bar and natural join with DRINKER to get name and age.

2.7.

$$\begin{aligned}
 & \text{DT-bars} \leftarrow \Pi_{BNO} \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Donald Trump" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{VISIT} \\
 & \text{Every-bar} \leftarrow \Pi_{DLicNo} \left( \text{VISIT} \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{DT-bars} \right) \\
 & \text{JB-bars} \leftarrow \Pi_{BNO} \left( \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Joe Biden" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{VISIT} \right) \\
 & \text{No-bar} \leftarrow (\Pi_{DLicNo} \text{VISIT}) - \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{BNO} \\ = BNO \end{array} \right) \left( \begin{array}{l} \text{PBuyer} \left( \Pi_{BNO} \text{BNO}, \text{VISIT} \right) \\ = BNO \end{array} \right) \times_{\substack{\text{JB-bars}}} \right) \\
 & \text{Result} \leftarrow \Pi_{\text{DName, Age}} \left( \text{Every-bar} \cap \text{No-bar} \right)
 \end{aligned}$$

2.8.

$$\begin{aligned}
 \text{No-beer-names} & \leftarrow \Pi_{DLicNo} \left( \text{DRINKER} \times_{\substack{\text{DName} \\ \neq \text{BeerName}}} \text{BEER-PURCHASE} \right) \\
 & \quad \text{BeerName} \\
 & \quad \text{DLicNo} = \text{DLicNo} \\
 \text{Bar-Name} & \leftarrow \Pi_{\text{BarName, DLicNo}} \left( \text{VISIT} \times_{\substack{\text{BNO} \\ = BNO}} \text{BAR} \right) \\
 \text{Drinker-bar} & \leftarrow \Pi_{DLicNo} \left( \text{DRINKER} \times_{\substack{\text{DName} \\ = \text{BarName}}} \text{Bar-Name} \right) \\
 & \quad \text{DName} \\
 & \quad \text{DLicNo} = \text{DLicNo} \\
 \text{Result} & \leftarrow \Pi_{\text{DName}} \left( (\text{Drinker-bar} \cap \text{No-beer-names}) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{DRINKER} \right)
 \end{aligned}$$

2.9.

$$\begin{aligned}
 \text{DT-Like} & \leftarrow \Pi_{\text{BeerName}} \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Donald Trump" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{LIKES} \\
 \text{Not-DT-Like} & \leftarrow \Pi_{\text{BeerName}} \left( \text{SERVES} \right) - \Pi_{\text{BeerName}} \left( \text{DT-Like} \right) \\
 \text{Result} & \leftarrow \Pi_{\text{BarName}} \left( \left( \Pi_{BNO} \left( \text{SERVES} \times_{\substack{\text{BeerName} \\ = BeerName}} \text{Not-DT-Like} \right) \right) \times_{\substack{\text{BNO} \\ = BNO}} \text{BAR} \right)
 \end{aligned}$$

Pg. 5).

**2.8 RA 8 2.25 / 2.25**

✓ - **0 pts** Correct

- **0.25 pts** Minor syntax error
- **0.5 pts** Major syntax error
- **1 pts** Incomplete answer
- **1 pts** Logical error
- **2.25 pts** Incorrect

2.7.

$$\begin{aligned}
 & \text{DT-bars} \leftarrow \Pi_{BNO} \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Donald Trump" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{VISIT} \\
 & \text{Every-bar} \leftarrow \Pi_{DLicNo} \left( \text{VISIT} \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{DT-bars} \right) \\
 & \text{JB-bars} \leftarrow \Pi_{BNO} \left( \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Joe Biden" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{VISIT} \right) \\
 & \text{No-bar} \leftarrow (\Pi_{DLicNo} \text{VISIT}) - \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{BNO} \\ = BNO \end{array} \right) \left( \begin{array}{l} \text{PBuyer} \left( \Pi_{BNO} \text{BNO}, \text{VISIT} \right) \\ = BNO \end{array} \right) \times_{\substack{\text{JB-bars}}} \right) \\
 & \text{Result} \leftarrow \Pi_{\text{DName, Age}} \left( \text{Every-bar} \cap \text{No-bar} \right)
 \end{aligned}$$

2.8.

$$\begin{aligned}
 & \text{No-beer-names} \leftarrow \Pi_{DLicNo} \left( \text{DRINKER} \times_{\substack{\text{DName} \\ \neq \text{BeerName}}} \text{BEER-PURCHASE} \right) \\
 & \text{Bar-Name} \leftarrow \Pi_{\text{BarName, DLicNo}} \left( \text{VISIT} \times_{\substack{\text{BNO} \\ = BNO}} \text{BAR} \right) \\
 & \text{Drinker-bar} \leftarrow \Pi_{DLicNo} \left( \text{DRINKER} \times_{\substack{\text{DName} \\ = \text{BarName}}} \text{Bar-Name} \right) \\
 & \text{Result} \leftarrow \Pi_{\text{DName}} \left( (\text{Drinker-bar} \cap \text{No-beer-names}) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{DRINKER} \right)
 \end{aligned}$$

2.9.

$$\begin{aligned}
 & \text{DT-Like} \leftarrow \Pi_{\text{BeerName}} \left( \Pi_{DLicNo} \left( \begin{array}{l} \text{DName} \\ = "Donald Trump" \end{array} \right) \text{DRINKER} \right) \times_{\substack{\text{DLicNo} \\ = DLicNo}} \text{LIKES} \\
 & \text{Not-DT-Like} \leftarrow \Pi_{\text{BeerName}} \left( \text{SERVES} \right) - \Pi_{\text{BeerName}} \left( \text{DT-Like} \right) \\
 & \text{Result} \leftarrow \Pi_{\text{BarName}} \left( \left( \Pi_{BNO} \left( \text{SERVES} \times_{\substack{\text{BeerName} \\ = BeerName}} \text{Not-DT-Like} \right) \right) \times_{\substack{\text{BNO} \\ = BNO}} \text{BAR} \right)
 \end{aligned}$$

Pg. 5).

**2.9 RA 9 2.25 / 2.25**

✓ - **0 pts** Correct

- **0.25 pts** Minor syntax error
- **0.5 pts** Major syntax error
- **1 pts** Incomplete answer
- **1 pts** Logical error
- **2.25 pts** Incorrect

2.10

$\text{Timonium\_Beer} \leftarrow \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Timonium" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

$\text{Towson\_Beer} \leftarrow \Pi_{\text{BNO}, \text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Towson" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

Bars  $\leftarrow$ 

$(\Pi_{\text{BNO}} \text{Towson\_Beer}) - (\Pi_{\text{BNO}} \left( \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{BeerName}} = \text{BeerName} \right) \text{BeerName} = "Towson\_Beer" \right) \times \text{Timonium\_Beer} \right))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{BAR} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{Bars} \right)$

2.11

DT-Like  $\leftarrow$ 

$(\Pi_{\text{BeerName}} \left( \text{O}_{\text{DName}} = "Donald\ Trump" \right) \text{DRINKER}) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

IT-Like  $\leftarrow$ 

$\Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{DName}} = "Ivanka\ Trump" \right) \text{DRINKER} \right) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

$\text{Result} \leftarrow \text{DT-Like} \cap \text{IT-Like}$ .

$\text{Result} \leftarrow \Pi_{\text{DName}} \left( \text{LIKES} \bowtie_{\substack{\text{DName} \\ = \text{DName}}} \text{DName} \right)$

2.12

$\text{Bar-Beer-Cnt} \leftarrow \text{BNO} \text{G}_{\text{count}} \text{BeerName} (\text{SERVES})$

$\text{Max-Bar} \leftarrow \text{BNO} \text{G}_{\text{max}} \text{count-beer} (\text{Bar-Beer-Cnt})$

$\text{Bar-Number} \leftarrow \Pi_{\text{BNO}} \left( \text{Bar-Beer-Cnt} \bowtie_{\substack{\text{count-beer} \\ = \text{max_count_beer}}} \text{Max-Bar} \right)$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{Bar-Number} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{BAR} \right)$

2.13

$\text{Drinker-Beer-Cnt} \leftarrow \text{DLICNO} \text{G}_{\text{count_beer}} \left( \text{DLICNO} \text{G}_{\text{BeerName}} (\text{LIKES}) \right)$

$\text{Min-Drinker-ID} \leftarrow \text{DLICNO} \text{G}_{\text{min}} \text{count-BeerName} (\text{Drinker-Beer-Cnt})$

$\text{Drinker-ID} \leftarrow \Pi_{\text{DLICNO}} \left( \text{Drinker-Beer-Cnt} \bowtie_{\substack{\text{count-BeerName} \\ = \text{min_count_BeerName}}} \text{Min-Drinker-ID} \right)$

$\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} \left( \text{Drinker-ID} \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{DRINKER} \right)$

6)

2.10 RA 10 **1.75 / 2.25**

- **0 pts** Correct
- **0.25 pts** Minor syntax error
- ✓ - **0.5 pts** Major syntax error
- **1 pts** Incomplete answer
- **1 pts** Logical error
- **2.25 pts** Incorrect
- **2.25 pts** Missing question (315)

 Use natural join instead of cartesian product

2.10

$\text{Timonium\_Beer} \leftarrow \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Timonium" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

$\text{Towson\_Beer} \leftarrow \Pi_{\text{BNO}, \text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Towson" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

Bars  $\leftarrow$ 

$(\Pi_{\text{BNO}} \text{Towson\_Beer}) - (\Pi_{\text{BNO}} \left( \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{BeerName}} = \text{BeerName} \right) \text{BeerName} = "Towson\_Beer" \right) \times \text{Timonium\_Beer} \right))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{BAR} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{Bars} \right)$

2.11

DT-Like  $\leftarrow$ 

$(\Pi_{\text{BeerName}} \left( \text{O}_{\text{DName}} = "Donald\ Trump" \right) \text{DRINKER}) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

IT-Like  $\leftarrow$ 

$\Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{DName}} = "Ivanka\ Trump" \right) \text{DRINKER} \right) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

$\text{Result} \leftarrow \text{DT-Like} \cap \text{IT-Like}$ .

$\text{Result} \leftarrow \Pi_{\text{DName}} \left( \text{LIKES} \bowtie_{\substack{\text{DName} \\ = \text{DName}}} \text{DName} \right)$

2.12

$\text{Bar-Beer-Cnt} \leftarrow \text{BNO} \text{G} \text{count BeerName} (\text{SERVES})$

$\text{Max-Bar} \leftarrow \text{BNO} \text{G} \text{max count-beer} (\text{Bar-Beer-Cnt})$

$\text{Bar-Number} \leftarrow \Pi_{\text{BNO}} \left( \text{Bar-Beer-Cnt} \bowtie_{\substack{\text{count-beer} \\ = \text{max_count_beer}}} \text{Max-Bar} \right)$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{Bar-Number} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{BAR} \right)$

2.13

$\text{Drinker-Beer-Cnt} \leftarrow \text{O}_{\text{DLICNO}} \text{G} \text{count_beer} (\text{DLICNO} \text{G} \text{BeerName} (\text{LIKES}))$

$\text{Min-Drinker-ID} \leftarrow \text{DLICNO} \text{G} \text{min count-BeerName} (\text{Drinker-Beer-Cnt})$

$\text{Drinker-ID} \leftarrow \Pi_{\text{DLICNO}} \left( \text{Drinker-Beer-Cnt} \bowtie_{\substack{\text{count-BeerName} \\ = \text{min_count_BeerName}}} \text{Min-Drinker-ID} \right)$

$\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} \left( \text{Drinker-ID} \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{DRINKER} \right)$

6)

2.11 RA 11 1 / 2.25

- **0 pts** Correct
- **0.25 pts** Minor syntax error
- **0.5 pts** Major syntax error
- **1 pts** One relation is incorrect

✓ - **1.25 pts** Missed a step

- **2.25 pts** Incorrect
- **2.25 pts** Missing question (315)
- **2.25 pts** Unreadable page

💬 This lists all beers that both like, regardless of if any bar serves them

2.10

$\text{Timonium\_Beer} \leftarrow \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Timonium" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

$\text{Towson\_Beer} \leftarrow \Pi_{\text{BNO}, \text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Towson" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

Bars  $\leftarrow$ 

$(\Pi_{\text{BNO}} \text{Towson\_Beer}) - (\Pi_{\text{BNO}} \left( \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{BeerName}} = \text{BeerName} \right) \text{BeerName} = "Towson\_Beer" \right) \times \text{Timonium\_Beer} \right))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{BAR} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{Bars} \right)$

2.11

DT-Like  $\leftarrow$ 

$(\Pi_{\text{BeerName}} \left( \text{O}_{\text{DName}} = "Donald\ Trump" \right) \text{DRINKER}) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

IT-Like  $\leftarrow$ 

$\Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{DName}} = "Ivanka\ Trump" \right) \text{DRINKER} \right) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

$\text{Result} \leftarrow \text{DT-Like} \cap \text{IT-Like}$ .

$\text{Result} \leftarrow \Pi_{\text{DName}} \left( \text{LIKES} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{DName} \right)$

2.12

$\text{Bar-Beer-Cnt} \leftarrow \text{BNO} \text{G}_{\text{count}} \text{BeerName} (\text{SERVES})$

$\text{Max-Bar} \leftarrow \text{BNO} \text{G}_{\text{max}} \text{count-beer} (\text{Bar-Beer-Cnt})$

$\text{Bar-Number} \leftarrow \Pi_{\text{BNO}} \left( \text{Bar-Beer-Cnt} \bowtie_{\substack{\text{count-beer} \\ = \text{max_count_beer}}} \text{Max-Bar} \right)$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{Bar-Number} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{BAR} \right)$

2.13

$\text{Drinker-Beer-Cnt} \leftarrow \text{O}_{\text{count_beer}} \left( \text{DLICNO} \text{G}_{\text{BeerName}} (\text{LIKES}) \right)$

$\text{Min-Drinker-ID} \leftarrow \text{DLICNO} \text{G}_{\text{min count-BeerName}} (\text{Drinker-Beer-Cnt})$

$\text{Drinker-ID} \leftarrow \Pi_{\text{DLICNO}} \left( \text{Drinker-Beer-Cnt} \bowtie_{\substack{\text{count-BeerName} \\ = \text{min_count_BeerName}}} \text{Min-Drinker-ID} \right)$

$\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} \left( \text{Drinker-ID} \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{DRINKER} \right)$

6)

**2.12 RA 12 1.75 / 2.25**

- **0 pts** Correct
- **0.25 pts** Minor syntax error
- ✓ - **0.5 pts** Major syntax error
- **1 pts** Incomplete answer
- **1 pts** Logical error
- **2.25 pts** Incorrect
- **2.25 pts** Missing question (315)

 Bar name, city, and state

2.10

$\text{Timonium\_Beer} \leftarrow \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Timonium" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

$\text{Towson\_Beer} \leftarrow \Pi_{\text{BNO}, \text{BeerName}} \left( \left( \text{O}_{\text{City}} = "Towson" \right) \text{BAR} \right) \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{SERVES}$

Bars  $\leftarrow$ 

$(\Pi_{\text{BNO}} \text{Towson\_Beer}) - (\Pi_{\text{BNO}} \left( \Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{BeerName}} = \text{BeerName} \right) \text{BeerName} = "Towson\_Beer" \right) \times \text{Timonium\_Beer} \right))$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{BAR} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{Bars} \right)$

2.11

DT-Like  $\leftarrow$ 

$(\Pi_{\text{BeerName}} \left( \text{O}_{\text{DName}} = "Donald\ Trump" \right) \text{DRINKER}) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

IT-Like  $\leftarrow$ 

$\Pi_{\text{BeerName}} \left( \left( \text{O}_{\text{DName}} = "Ivanka\ Trump" \right) \text{DRINKER} \right) \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{LIKES}$

$\text{Result} \leftarrow \text{DT-Like} \cap \text{IT-Like}$ .

$\text{Result} \leftarrow \Pi_{\text{DName}} \left( \text{LIKES} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{DName} \right)$

2.12

$\text{Bar-Beer-Cnt} \leftarrow \text{BNO} \text{G}_{\text{count}} \text{BeerName} (\text{SERVES})$

$\text{Max-Bar} \leftarrow \text{BNO} \text{G}_{\text{max}} \text{count-beer} (\text{Bar-Beer-Cnt})$

$\text{Bar-Number} \leftarrow \Pi_{\text{BNO}} \left( \text{Bar-Beer-Cnt} \bowtie_{\substack{\text{count-beer} \\ = \text{max_count_beer}}} \text{Max-Bar} \right)$

$\text{Result} \leftarrow \Pi_{\text{BarName}} \left( \text{Bar-Number} \bowtie_{\substack{\text{BNO} \\ = \text{BNO}}} \text{BAR} \right)$

2.13

$\text{Drinker-Beer-Cnt} \leftarrow \text{O}_{\text{count_beer}} \left( \text{DLICNO} \text{G}_{\text{BeerName}} (\text{LIKES}) \right)$

$\text{Min-Drinker-ID} \leftarrow \text{DLICNO} \text{G}_{\text{min count-BeerName}} (\text{Drinker-Beer-Cnt})$

$\text{Drinker-ID} \leftarrow \Pi_{\text{DLICNO}} \left( \text{Drinker-Beer-Cnt} \bowtie_{\substack{\text{count-BeerName} \\ = \text{min_count_BeerName}}} \text{Min-Drinker-ID} \right)$

$\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} \left( \text{Drinker-ID} \bowtie_{\substack{\text{DLICNO} \\ = \text{DLICNO}}} \text{DRINKER} \right)$

6)

2.13 RA 13 2.25 / 2.25

✓ - 0 pts Correct

- 0.25 pts Minor syntax error

- 0.5 pts Major syntax error

- 1 pts Incomplete answer

- 1 pts Logical error

- 2.25 pts Incorrect

- 2.25 pts Missing question (315)

- 2.25 pts Page not readable

2.14

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} LIKES \right) \\
 MP\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Mike Pence" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} LIKES \right) \\
 All\text{-Likes} &\leftarrow DT\text{-Likes} \cup MP\text{-Likes} \\
 Drinker\_DLicNo &\leftarrow \left( \Pi_{DLicNo} \text{ DRINKER} \right) - \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{BeerName1} \\ = BeerName \end{array} \left( \left( \Pi_{BeerName1} \left( \begin{array}{c} O_{BeerName1} \\ = BeerName \end{array} (All\text{-Likes}) \right) \times LIKES \right) \right) \right) \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( \text{DRINKER} \bowtie_{DLicNo = DLicNo} Drinker\_DLicNo \right).
 \end{aligned}$$

2.15

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} LIKES \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( \left( \left( \Pi_{DLicNo} \left( LIKES \div DT\text{-Likes} \right) \right) \bowtie_{DLicNo = DLicNo} \text{ DRINKER} \right) \right).
 \end{aligned}$$

2.16

$$\begin{aligned}
 COVID\text{-Beer-Purchase} &\leftarrow \Pi_{EstimateStart Date, EstimateEnd Date, DLicNo, BeerName, DateofPurchase} \left( COVID\text{-DIAGNOSIS} \bowtie_{DLicNo = DLicNo} BEER\text{-PURCHASE} \right) \\
 Result &\leftarrow \Pi_{BeerName} \left( \begin{array}{c} O_{DateofPurchase} \\ \nearrow EstimatestartDate \\ \nwarrow (DateofPurchase \\ \nearrow EstimateEndDate) \end{array} \right) COVID\text{-Beer-Purchase).
 \end{aligned}$$

2.17

$$\begin{aligned}
 DT\text{-Bar} &\leftarrow \Pi_{BNO} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} VISIT \right) \\
 Visit\text{-Count} &\leftarrow BNO \text{ COUNT DateofVisit } (DT\text{-Bar}) \\
 Result &\leftarrow \Pi_{BarName} \left( \left( \Pi_{BNO} \left( O_{Count\_DateofVisit > 1} (Visit\text{-Count}) \right) \right) \bowtie_{BNO = BNO} BAR \right).
 \end{aligned}$$

n. 2

**2.14 RA 14 2.25 / 2.25**

✓ - **0 pts** Correct

- **1 pts** Used license number instead of name Donald Trumo
- **2.25 pts** Incorrect
- **0.5 pts** Minor error
- **2.25 pts** Did not answer
- **0.5 pts** Used intersection of beers instead of union

2.14

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} LIKES \right) \\
 MP\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Mike Pence" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} LIKES \right) \\
 All\text{-Likes} &\leftarrow DT\text{-Likes} \cup MP\text{-Likes} \\
 Drinker\_DLicNo &\leftarrow \left( \Pi_{DLicNo} DRINKER \right) - \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{BeerName1} \\ = BeerName \end{array} \right) \times_{BeerName} \begin{array}{c} BeerName1 \\ = BeerName \end{array} (All\text{-Likes}) \times LIKES \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( DRINKER \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} Drinker\_DLicNo \right).
 \end{aligned}$$

2.15

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} LIKES \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( \left( \left( \Pi_{DLicNo} (LIKES \div DT\text{-Likes}) \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} DRINKER \right) \right).
 \end{aligned}$$

2.16

$$\begin{aligned}
 COVID\text{-Beer-Purchase} &\leftarrow \Pi_{EstimateStart Date, EstimateEnd Date, DLicNo, BeerName, DateofPurchase} \left( COVID\text{-DIAGNOSIS} \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} BEER\text{-PURCHASE} \right) \\
 Result &\leftarrow \Pi_{BeerName} \left( \begin{array}{c} O_{DateofPurchase} \\ \nearrow EstimatestartDate \\ \nwarrow (DateofPurchase \\ \nearrow EstimateEndDate) \end{array} COVID\text{-Beer-Purchase} \right).
 \end{aligned}$$

2.17

$$\begin{aligned}
 DT\text{-Bar} &\leftarrow \Pi_{BNO} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} VISIT \right) \\
 Visit\text{-Count} &\leftarrow BNO \text{ Count } DateofVisit (DT\text{-Bar}) \\
 Result &\leftarrow \Pi_{BarName} \left( \left( \Pi_{BNO} \left( \begin{array}{c} O_{Count\_DateofVisit > 1} \\ \text{Visit-Count} \end{array} \right) \right) \times_{BNO} \begin{array}{c} BNO \\ = BNO \end{array} BAR \right).
 \end{aligned}$$

n. 2

**2.15 RA 15 2.25 / 2.25**

✓ - **0 pts** Correct

- **1 pts** Used license number instead of name Donald Trumo

- **2.25 pts** Incorrect

- **0.5 pts** Minor error

- **2.25 pts** Did not answer

2.14

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} LIKES \right) \\
 MP\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Mike Pence" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} LIKES \right) \\
 All\text{-Likes} &\leftarrow DT\text{-Likes} \cup MP\text{-Likes} \\
 Drinker\_DLicNo &\leftarrow \left( \Pi_{DLicNo} DRINKER \right) - \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{BeerName1} \\ = BeerName \end{array} \right) \times_{BeerName} \begin{array}{c} BeerName1 \\ = BeerName \end{array} (All\text{-Likes}) \times LIKES \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( DRINKER \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} Drinker\_DLicNo \right).
 \end{aligned}$$

2.15

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} LIKES \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( \left( \left( \Pi_{DLicNo} (LIKES \div DT\text{-Likes}) \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} DRINKER \right) \right).
 \end{aligned}$$

2.16

$$\begin{aligned}
 COVID\text{-Beer-Purchase} &\leftarrow \Pi_{EstimateStart Date, EstimateEnd Date, DLicNo, BeerName, DateofPurchase} \left( COVID\text{-DIAGNOSIS} \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} BEER\text{-PURCHASE} \right) \\
 Result &\leftarrow \Pi_{BeerName} \left( \begin{array}{c} O_{DateofPurchase} \\ \nearrow EstimatestartDate \\ \nwarrow (DateofPurchase \\ \nearrow EstimateEndDate) \end{array} COVID\text{-Beer-Purchase} \right).
 \end{aligned}$$

2.17

$$\begin{aligned}
 DT\text{-Bar} &\leftarrow \Pi_{BNO} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \right) DRINKER \right) \times_{DLicNo} \begin{array}{c} DLicNo \\ = DLicNo \end{array} VISIT \right) \\
 Visit\text{-Count} &\leftarrow BNO \text{ Count DateofVisit } (DT\text{-Bar}) \\
 Result &\leftarrow \Pi_{BarName} \left( \left( \Pi_{BNO} \left( \begin{array}{c} O_{Count\_DateofVisit > 1} \\ (Visit\text{-Count}) \end{array} \right) \right) \times_{BNO} \begin{array}{c} BNO \\ = BNO \end{array} BAR \right).
 \end{aligned}$$

n. 2

2.16 RA 16 2.25 / 2.25

✓ - 0 pts Correct

- 0.5 pts Listed Drinker name instead of beer name
- 0.25 pts Invalid operations
- 2.25 pts Incorrect
- 2.25 pts Did not answer

2.14

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} LIKES \right) \\
 MP\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Mike Pence" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} LIKES \right) \\
 All\text{-Likes} &\leftarrow DT\text{-Likes} \cup MP\text{-Likes} \\
 Drinker\_DLicNo &\leftarrow \left( \Pi_{DLicNo} \text{ DRINKER} \right) - \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{BeerName1} \\ = BeerName \end{array} \left( \left( \Pi_{BeerName1} \left( \begin{array}{c} O_{BeerName1} \\ = BeerName \end{array} (All\text{-Likes}) \right) \times LIKES \right) \right) \right) \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( \text{DRINKER} \bowtie_{DLicNo = DLicNo} Drinker\_DLicNo \right).
 \end{aligned}$$

2.15

$$\begin{aligned}
 DT\text{-Likes} &\leftarrow \Pi_{BeerName} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} LIKES \right) \\
 Result &\leftarrow \Pi_{DName, PoliticalParty} \left( \left( \left( \Pi_{DLicNo} \left( LIKES \div DT\text{-Likes} \right) \right) \bowtie_{DLicNo = DLicNo} \text{ DRINKER} \right) \right).
 \end{aligned}$$

2.16

$$\begin{aligned}
 COVID\text{-Beer-Purchase} &\leftarrow \Pi_{EstimateStart Date, EstimateEnd Date, DLicNo, BeerName, DateofPurchase} \left( COVID\text{-DIAGNOSIS} \bowtie_{DLicNo = DLicNo} BEER\text{-PURCHASE} \right) \\
 Result &\leftarrow \Pi_{BeerName} \left( \begin{array}{c} O_{DateofPurchase} \\ \nearrow EstimatestartDate \\ \nwarrow (DateofPurchase \\ \nearrow EstimateEndDate) \end{array} COVID\text{-Beer-Purchase} \right).
 \end{aligned}$$

2.17

$$\begin{aligned}
 DT\text{-Bar} &\leftarrow \Pi_{BNO} \left( \left( \Pi_{DLicNo} \left( \begin{array}{c} O_{DName} \\ = "Donald Trump" \end{array} \text{ DRINKER} \right) \right) \bowtie_{DLicNo = DLicNo} VISIT \right) \\
 Visit\text{-Count} &\leftarrow BNO \text{ COUNT DateofVisit } (DT\text{-Bar}) \\
 Result &\leftarrow \Pi_{BarName} \left( \left( \Pi_{BNO} \left( O_{Count\_DateofVisit > 1} (Visit\text{-Count}) \right) \right) \bowtie_{BNO = BNO} BAR \right).
 \end{aligned}$$

n. 2

2.17 RA 17 2.25 / 2.25

✓ - 0 pts Correct

- 2.25 pts No answer given
- 0.25 pts Minor syntax error
- 0.5 pts Major syntax error
- 0.25 pts Super Inefficient
- 1 pts Incomplete answer
- 1 pts Logical error
- 2.25 pts Incorrect

2.18

Ivanka  $\leftarrow \Pi_{DLicNo}^{\text{EstimateStartDate}, \text{EstimateEndDate}, \text{DateofVisit}, \text{BNO}} (COVID\_DIAGNOSIS \times \Pi_{DLicNo}^{\text{DName} = "Ivanka Trump"} DRINKER) \times_{DLicNo = DLicNo} VISIT)$ .

Ivanka-Bar  $\leftarrow \Pi_{BNO, \text{DateofVisit}}^{\text{O}(DateofVisit} \rightarrow \text{EstimateStartDate}) \text{ Ivanka)}.$   
 $(DateofVisit < \text{EstimateEndDate})$

Same-Day  $\leftarrow \Pi_{DLicNo}^{\text{BNO}} (Ivanka \times_{(DateofVisit = DateofVisit)} VISIT).$   
 $(BNO = BNO)$

Result  $\leftarrow \Pi_{DName, \text{Phone}}^{\text{DLicNo}} (\text{Same-Day} \times_{DLicNo = DLicNo} DRINKER)$ .

2.19

COVID-Bar-Visits  $\leftarrow \Pi_{BNO, \text{DateofVisit}, \text{DLicNo}}^{\text{DLicNo1} \wedge \text{DLicNo1} = \text{DLicNo}} ((P_{DLicNo1} (COVID\_DIAGNOSIS)) \times VISIT)$   
 $(\text{EstimateStartDate} < \text{DateofVisit})$   
 $(\text{EstimateEndDate} > \text{DateofVisit})$ .

Same-Day-Drinker  $\leftarrow \Pi_{DLicNo}^{\text{COVID-Bar-Visits} \times_{(BNO = BNO) \wedge (DateofVisit = DateofVisit) \wedge (DLicNo = DLicNo)} VISIT}$ .

Result  $\leftarrow \Pi_{DName, \text{Phone}}^{\text{DLicNo}} (\text{Same-Day-Drinker} \times_{DLicNo = DLicNo} DRINKER)$ .

2.20.

COVID-info  $\leftarrow \Pi_{DLicNo, BNO, \text{EstimateStartDate}, \text{EstimateEndDate}}^{\text{DLicNo1} \wedge \text{DLicNo1} = \text{DLicNo}} ((P_{DLicNo1} (COVID\_DIAGNOSIS) \times VISIT))$   
 $(\text{EstimateStartDate} < \text{DateofVisit})$   
 $(\text{EstimateEndDate} > \text{DateofVisit})$

Result  $\leftarrow \Pi_{BarName, DName, \text{EstimateStartDate}, \text{EstimateEndDate}}^{\text{DRINKER} \times_{DLicNo = DLicNo} COVID\_info \times_{BNO = BNO} BAR}$ .

P9.8

2.18 RA 18 2.25 / 2.25

✓ - 0 pts Correct

- 1 pts Didn't check that visitor visited same bar on same day as ivanka
- 0.5 pts Used a relation as a variable
- 1 pts Logical Error
- 2.25 pts didn't answer

2.18

Ivanka  $\leftarrow \Pi_{DLicNo}^{\text{EstimateStartDate}, \text{EstimateEndDate}, \text{DateofVisit}, \text{BNO}} (COVID\_DIAGNOSIS \times \Pi_{DLicNo}^{\text{DName} = "Ivanka Trump"} DRINKER) \times_{DLicNo = DLicNo} VISIT)$ .

Ivanka-Bar  $\leftarrow \Pi_{BNO, \text{DateofVisit}}^{\text{O}(DateofVisit} \rightarrow \text{EstimateStartDate}) \text{ Ivanka)}.$   
 $(DateofVisit < \text{EstimateEndDate})$

Same-Day  $\leftarrow \Pi_{DLicNo}^{\text{BNO}} (Ivanka \times_{(DateofVisit = DateofVisit)} VISIT).$   
 $(BNO = BNO)$

Result  $\leftarrow \Pi_{DName, \text{Phone}}^{\text{DLicNo}} (\text{Same-Day} \times_{DLicNo = DLicNo} DRINKER)$ .

2.19

COVID-Bar-Visits  $\leftarrow \Pi_{BNO, \text{DateofVisit}, \text{DLicNo}}^{\text{DLicNo1} \wedge \text{DLicNo1} = \text{DLicNo}} ((P_{DLicNo1} (COVID\_DIAGNOSIS)) \times VISIT)$   
 $(\text{EstimateStartDate} < \text{DateofVisit})$   
 $(\text{EstimateEndDate} > \text{DateofVisit})$ .

Same-Day-Drinker  $\leftarrow \Pi_{DLicNo}^{\text{COVID-Bar-Visits} \times_{(BNO = BNO) \wedge (DateofVisit = DateofVisit) \wedge (DLicNo = DLicNo)} VISIT}$ .

Result  $\leftarrow \Pi_{DName, \text{Phone}}^{\text{DLicNo}} (\text{Same-Day-Drinker} \times_{DLicNo = DLicNo} DRINKER)$ .

2.20.

COVID-info  $\leftarrow \Pi_{DLicNo, BNO, \text{EstimateStartDate}, \text{EstimateEndDate}}^{\text{DLicNo1} \wedge \text{DLicNo1} = \text{DLicNo}} ((P_{DLicNo1} (COVID\_DIAGNOSIS) \times VISIT))$   
 $(\text{EstimateStartDate} < \text{DateofVisit})$   
 $(\text{EstimateEndDate} > \text{DateofVisit})$

Result  $\leftarrow \Pi_{BarName, DName, \text{EstimateStartDate}, \text{EstimateEndDate}}^{\text{DRINKER} \times_{DLicNo = DLicNo} COVID\_info \times_{BNO = BNO} BAR}$ .

P9.8

**2.19 RA 19 2.25 / 2.25**

✓ - **0 pts** Correct

- **1 pts** Didn't check that people in final result visited same bar as covid people

- **1 pts** Logical error

- **2.25 pts** No answer

2.18

Ivanka  $\leftarrow \Pi_{DLicNo}^{\text{EstimateStartDate}, \text{EstimateEndDate}, \text{DateofVisit}, \text{BNO}} (COVID\_DIAGNOSIS \times \Pi_{DLicNo}^{\text{DName} = "Ivanka Trump"} DRINKER) \times_{DLicNo = DLicNo} VISIT)$ .

Ivanka-Bar  $\leftarrow \Pi_{BNO, \text{DateofVisit}}^{\text{O}(DateofVisit} \rightarrow \text{EstimateStartDate}) \text{ Ivanka)}.$   
 $(DateofVisit < \text{EstimateEndDate})$

Same-Day  $\leftarrow \Pi_{DLicNo}^{\text{BNO}} (Ivanka \times_{(DateofVisit = DateofVisit)} VISIT).$   
 $(BNO = BNO)$

Result  $\leftarrow \Pi_{DName, \text{Phone}}^{\text{DLicNo}} (\text{Same-Day} \times_{DLicNo = DLicNo} DRINKER)$ .

2.19

COVID-Bar-Visits  $\leftarrow \Pi_{BNO, \text{DateofVisit}, \text{DLicNo}}^{\text{DLicNo1} \wedge \text{DLicNo1} = \text{DLicNo}} ((P_{DLicNo1} (COVID\_DIAGNOSIS)) \times VISIT)$   
 $(\text{EstimateStartDate} < \text{DateofVisit})$   
 $(\text{EstimateEndDate} > \text{DateofVisit})$ .

Same-Day-Drinker  $\leftarrow \Pi_{DLicNo}^{\text{COVID-Bar-Visits} \times_{(BNO = BNO) \wedge (DateofVisit = DateofVisit) \wedge (DLicNo = DLicNo)} VISIT}$ .

Result  $\leftarrow \Pi_{DName, \text{Phone}}^{\text{DLicNo}} (\text{Same-Day-Drinker} \times_{DLicNo = DLicNo} DRINKER)$ .

2.20.

COVID-info  $\leftarrow \Pi_{DLicNo, BNO, \text{EstimateStartDate}, \text{EstimateEndDate}}^{\text{DLicNo1} \wedge \text{DLicNo1} = \text{DLicNo}} ((P_{DLicNo1} (COVID\_DIAGNOSIS) \times VISIT))$   
 $(\text{EstimateStartDate} < \text{DateofVisit})$   
 $(\text{EstimateEndDate} > \text{DateofVisit})$

Result  $\leftarrow \Pi_{BarName, DName, \text{EstimateStartDate}, \text{EstimateEndDate}}^{\text{DRINKER} \times_{DLicNo = DLicNo} COVID\_info \times_{BNO = BNO} BAR}$ .

P9.8

2.20 RA 20 2.25 / 2.25

✓ - 0 pts Correct

- 2.25 pts No answer given

- 1 pts Didn't natural join with DRINKER

- 1 pts Didn't check if dates in range

- 2 pts Incorrect

- 0.5 pts Minor error

2.21

$\text{JB\_info} \leftarrow \text{VISIT} \ \text{IXI} \ \text{DLicNo} = \text{DLicNo} \ (\Pi_{\text{DLicNo}} (\Theta_{\text{DName}} = "Joe Biden" \ \text{DRINKER}))$   
 $\text{JB\_Bar\_Cnt} \leftarrow \text{BNO} \ G \ \text{Count DateofVisit} \ (\text{VISIT})$   
 $\text{People\_Bar\_Cnt} \leftarrow \text{DLicNo}, \ G \ \text{Count DateofVisit} \ (\text{VISIT})$   
 $\text{people} \leftarrow \Pi_{\text{DLicNo}} (\text{people\_Bar\_Cnt} \ \text{IXI} \ \text{BNO} = \text{BNO} \ \wedge \ \text{Count\_DateofVisit} = \text{Count\_DateofVisit} \ \text{People\_Bar\_Cnt})$   
 $\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} (\text{people} \ \text{IXI} \ \text{DLicNo} = \text{DLicNo} \ \text{DRINKER})$

2.22

$\text{Diagnosis\_and\_vaccine} \leftarrow \text{COVID\_VACCINE} \ \text{IXI} \ \text{DLicNo} = \text{DLicNo} \ \text{COVID\_DIAGNOSIS}$   
 $\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}, \text{PoliticalParty}} (\text{DRINKER} \ \text{IXI} \ \text{DLicNo} ((\Theta_{\text{EstimatestartDate}} = \text{DLicNo}) \rightarrow \text{DateofVaccine} \ \text{Diagnosis\_and\_vaccine}))$

2.23

$\text{Batbar\_BarNo} \leftarrow \Pi_{\text{BNO}} (\Theta_{\text{BarName}} = "BatBar" \ \text{BAR})$   
 $\text{Batbar\_Serves} \leftarrow \Pi_{\text{BarName}} (\text{Batbar\_BarNo} \ \text{IXI} \ \text{BNO} = \text{BNO} \ \text{SERVES})$   
 $\text{Beer\_at\_Bar} \leftarrow (\Pi_{\text{BNO}} (\text{Batbar\_BarNo})) \ \text{IXI} \ \text{BNO} = \text{BNO} \ \text{BEER\_PURCHASE}$   
 $\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} ((\text{Beer\_at\_Bar} \ \dot{\cup} \ \text{Batbar\_Serves}) \ \text{IXI} \ \text{DLicNo} = \text{DLicNo} \ \text{DRINKER})$

Part 2-2.

2.1.  $\{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{PoliticalParty} = d.\text{PoliticalParty} \wedge \exists a \in \text{DRINKER} (a.\text{DName} = "Ivanka Trump") \wedge \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo}) \wedge \exists c \in \text{VISIT} (c.\text{BNO} = b.\text{BNO} \wedge c.\text{DateofVisit} = b.\text{DateofVisit} \wedge c.\text{DLicNo} = d.\text{DLicNo}) \}) \}$

Pg. 9)

## 2.21 RA 21 1 / 2.25

- **0 pts** Correct
  - **2.25 pts** Not 415 / 615
  - **0.3 pts** Minor syntax error (misspelling, etc)
  - **0.5 pts** Major Syntax Error (putting one relation when obviously intended another, etc.)
  - **1 pts** Operation uses incorrect attributes or attributes not found
  - **1 pts** Unsuccessfully get the # of times Joe Biden visited bars
- ✓ - **1.25 pts** Improper use of divide operation
- **0.5 pts** Projecting incorrect output
  - **2.25 pts** Makes no progress towards solution
  - **0.75 pts** Database assumptions (Hardcoded, will not always work depending on database composition, etc)
  - **0 pts** Inefficient
  - **2.25 pts** Missing answer (not sure if 315 / 415)

💬 RHS Line 4 meant JB\_Bar\_Cnt? not deducted because of logic error in line:

Also - the line 4 join will actually get anyone who has gone to any bar the same number of times as Joe Biden. The Divide operation would work better in this spot.

2.21

$\text{JB\_info} \leftarrow \text{VISIT} \ \text{IX} \ \Pi_{\text{DLicNo}} (\Theta_{\text{DName}} = "Joe Biden" \text{ DRINKER})$   
 $\text{JB\_Bar\_Cnt} \leftarrow \text{BNO} \text{ G}_{\text{Count DateofVisit}} (\text{VISIT})$   
 $\text{People\_Bar\_Cnt} \leftarrow \text{DLicNo, BNO, G}_{\text{Count DateofVisit}} (\text{VISIT})$   
 $\text{people} \leftarrow \text{DLicNo. ( people\_Bar\_Cnt IX)} \ \begin{matrix} \text{BNO=BNO} \\ \text{Count\_DateofVisit} \\ =\text{Count\_DateofVisit} \end{matrix} \text{ People\_Bar\_cnt)$   
 $\text{Result} \leftarrow \text{DName, ( people IX)} \ \begin{matrix} \text{Age} \\ \text{DLicNo} \\ =\text{DLicNo} \end{matrix} \text{ DRINKER}$

2.22

$\text{Diagnosis\_and\_vaccine} \leftarrow \text{COVID\_VACCINE} \ \text{IX} \ \Pi_{\text{DLicNo}} \text{ COVID\_DIAGNOSIS}$   
 $\text{Result} \leftarrow \text{DName, ( DRINKER IX)} \ \begin{matrix} \text{Age} \\ \text{PoliticalParty} \\ \text{DLicNo} \\ =\text{DLicNo} \end{matrix} \ \begin{matrix} \text{((O EstimatestartDate} \\ \text{DateofVaccine) } \\ \text{Diagnosis\_and\_vaccine}) \end{matrix}$

2.23

$\text{Batbar\_BarNo} \leftarrow \Pi_{\text{BNO}} (\Theta_{\text{BarName}} = "BatBar" \text{ BAR})$   
 $\text{Batbar\_Serves} \leftarrow \Pi_{\text{BNO}} (\text{BarName} (\text{Batbar\_BarNo IX})) \ \begin{matrix} \text{BNO} \\ =\text{BNO} \end{matrix} \text{ SERVES}$   
 $\text{Beer\_at\_Bar} \leftarrow (\Pi_{\text{BNO}} (\text{Batbar\_BarNo})) \ \text{IX} \ \begin{matrix} \text{BNO} \\ =\text{BNO} \end{matrix} \text{ BEER\_PURCHASE}$   
 $\text{Result} \leftarrow \Pi_{\text{DName, Age}} ((\text{Beer\_at\_Bar} \ \Delta \ \text{Batbar\_Serves}) \ \text{IX} \ \begin{matrix} \text{DLicNo} \\ =\text{DLicNo} \end{matrix} \text{ DRINKER})$

Part 2-2.

2.1.  $\{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{PoliticalParty} = d.\text{PoliticalParty} \wedge \exists a \in \text{DRINKER} (a.\text{DName} = "Ivanka Trump") \wedge \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo}) \wedge \exists c \in \text{VISIT} (c.\text{BNO} = b.\text{BNO} \wedge c.\text{DateofVisit} = b.\text{DateofVisit} \wedge c.\text{DLicNo} = d.\text{DLicNo}) \}) \}$

Pg. 9)

**2.22 RA 22 1.75 / 2.25**

- **0 pts** Correct
- **2.25 pts** Not 415 / 615
- **0.25 pts** Minor syntax error

✓ - **0.5 pts** Major syntax error

- **0.25 pts** Inefficient
- **1 pts** Incomplete answer
- **1 pts** Logical error

- **2.25 pts** Incorrect

 Date of vaccine < DateOfDiagnosis

2.21

$\text{JB\_info} \leftarrow \text{VISIT} \ \text{IX} \ \Pi_{\text{DLicNo}} (\Theta_{\text{DName}} = "Joe Biden" \text{ DRINKER})$   
 $\text{JB\_Bar\_Cnt} \leftarrow \text{BNO} \text{ G}_{\text{Count DateofVisit}} (\text{VISIT})$   
 $\text{People\_Bar\_Cnt} \leftarrow \text{DLicNo, BNO, G}_{\text{Count DateofVisit}} (\text{VISIT})$   
 $\text{people} \leftarrow \Pi_{\text{DLicNo}} (\text{people\_Bar\_Cnt IX} \ \begin{matrix} \text{BNO} = \text{BNO} \\ \text{Count\_DateofVisit} \\ = \text{Count\_DateofVisit} \end{matrix} \text{ People\_Bar\_Cnt})$   
 $\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} (\text{people IX} \ \begin{matrix} \text{DLicNo} \\ = \text{DLicNo} \end{matrix} \text{ DRINKER})$

2.22

$\text{Diagnosis\_and\_vaccine} \leftarrow \text{COVID\_VACCINE} \ \text{IX} \ \Pi_{\text{DLicNo}} (\Theta_{\text{DName}}, \text{Age}, \text{PoliticalParty} \ \text{DRINKER} \ \text{IX} \ \begin{matrix} \text{DLicNo} \\ = \text{DLicNo} \end{matrix} \text{ COVID\_DIAGNOSIS})$   
 $\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}, \text{PoliticalParty}} (\text{DRINKER IX} \ \begin{matrix} \text{DLicNo} \\ = \text{DLicNo} \end{matrix} (\Theta_{\text{EstimatestartDate}} \rightarrow \text{DateofVaccine}) \ \text{Diagnosis\_and\_vaccine})$

2.23

$\text{Batbar\_BarNo} \leftarrow \Pi_{\text{BNO}} (\Theta_{\text{BarName}} = "BatBar" \text{ BAR})$   
 $\text{Batbar\_Serves} \leftarrow \Pi_{\text{Bname}} (\text{Batbar\_BarNo IX} \ \begin{matrix} \text{BNO} \\ = \text{BNO} \end{matrix} \text{ SERVES})$   
 $\text{Beer\_at\_Bar} \leftarrow (\Pi_{\text{Bname}} (\text{Batbar\_BarNo})) \ \text{IX} \ \begin{matrix} \text{BNO} \\ = \text{BNO} \end{matrix} \text{ BEER\_PURCHASE}$   
 $\text{Result} \leftarrow \Pi_{\text{DName}, \text{Age}} ((\text{Beer\_at\_Bar} \ \Delta \ \text{Batbar\_Serves}) \ \text{IX} \ \begin{matrix} \text{DLicNo} \\ = \text{DLicNo} \end{matrix} \text{ DRINKER})$

Part 2-2.

2.1.  $\{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{PoliticalParty} = d.\text{PoliticalParty} \wedge \exists a \in \text{DRINKER} (a.\text{DName} = "Ivanka Trump") \wedge \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo}) \wedge \exists c \in \text{VISIT} (c.\text{BNO} = b.\text{BNO} \wedge c.\text{DateofVisit} = b.\text{DateofVisit} \wedge c.\text{DLicNo} = d.\text{DLicNo}) \}) \}$

Pg. 9)

2.23 RA 23 2.25 / 2.25

✓ - 0 pts Correct!

- 1.5 pts Didn't use division
- 0.5 pts Used a relation as a variable
- 0.5 pts Minor error
- 2.25 pts No answer

2.21

$\text{JB\_info} \leftarrow \text{VISIT} \ \text{IX} \ \Pi_{\text{DLicNo}} (\Theta_{\text{DName}} = "Joe Biden" \text{ DRINKER})$   
 $\text{JB\_Bar\_Cnt} \leftarrow \text{BNO} \text{ G}_{\text{Count DateofVisit}} (\text{VISIT})$   
 $\text{People\_Bar\_Cnt} \leftarrow \text{DLicNo, BNO, G}_{\text{Count DateofVisit}} (\text{VISIT})$   
 $\text{people} \leftarrow \text{DLicNo. ( people\_Bar\_Cnt IX)} \ \begin{matrix} \text{BNO=BNO} \\ \text{Count\_DateofVisit} \\ =\text{Count\_DateofVisit} \end{matrix} \text{ People\_Bar\_cnt)$   
 $\text{Result} \leftarrow \text{DName, ( people IX)} \ \begin{matrix} \text{Age} \\ \text{DLicNo} \\ =\text{DLicNo} \end{matrix} \text{ DRINKER}$

2.22

$\text{Diagnosis\_and\_vaccine} \leftarrow \text{COVID\_VACCINE} \ \text{IX} \ \Pi_{\text{DLicNo}} (\Theta_{\text{DName}} = "Joe Biden" \text{ COVID\_DIAGNOSIS})$   
 $\text{Result} \leftarrow \text{DName, ( DRINKER IX)} \ \begin{matrix} \text{Age} \\ \text{PoliticalParty} \\ \text{DLicNo} \\ =\text{DLicNo} \end{matrix} \ \begin{matrix} \text{((O EstimatestartDate} \\ \text{DateofVaccine) } \\ \text{Diagnosis\_and\_vaccine}) \end{matrix}$

2.23

$\text{Batbar\_BarNo} \leftarrow \text{BNO} \ \Theta_{\text{BarName}} = "BatBar" \text{ BAR}$   
 $\text{Batbar\_Serves} \leftarrow \text{BNO} \ \Theta_{\text{BarName}} (\text{Batbar\_BarNo IX}) \ \begin{matrix} \text{BNO} \\ =\text{BNO} \end{matrix} \text{ SERVES}$   
 $\text{Beer\_at\_Bar} \leftarrow (\Pi_{\text{BNO}} (\text{Batbar\_BarNo})) \ \text{IX} \ \begin{matrix} \text{BNO} \\ =\text{BNO} \end{matrix} \text{ BEER\_PURCHASE}$   
 $\text{Result} \leftarrow \text{DName, ( Beer\_at\_Bar} \ \Theta_{\text{Age}} \text{ Batbar\_Serves) IX} \ \begin{matrix} \text{DName} \\ \text{Age} \\ \text{DLicNo} \\ =\text{DLicNo} \end{matrix} \text{ DRINKER}$

Part 2-2.

2.1 { t |  $\exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{PoliticalParty} = d.\text{PoliticalParty} \wedge$   
 $\exists a \in \text{DRINKER} (a.\text{DName} = "Ivanka Trump" \wedge$   
 $\exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo} \wedge$   
 $\exists c \in \text{VISIT} (c.\text{BNO} = b.\text{BNO} \wedge c.\text{DateofVisit} = b.\text{DateofVisit} \wedge c.\text{DLicNo} = d.\text{DLicNo})$  } } )

Pg. 9)

3.1 RC 1 2.25 / 2.25

✓ - 0 pts Correct

- 2.25 pts Not 315 / 415

- 1 pts Logic Error

- 0.25 pts Minor syntax error

- 0.5 pts Major syntax error

- 1 pts Unsafe

- 2.25 pts Incorrect

- 0.5 pts Hardcoded values

- 0 pts Specifies in Relational Algebra format

2.2.

$$\{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BState} = "MD" \wedge d.\text{BCity} \neq "Baltimore" \wedge \exists a \in \text{SERVES} (a.\text{BNO} = d.\text{BNO} \wedge a.\text{BeerName} \neq "Bud Lite") ) \}$$

2.3.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge d.\text{Age} < 30 \wedge \\ & \exists v \in \text{VISITED} (d.\text{DLicNo} = v.\text{DLicNo} \wedge \\ & \exists b \in \text{BAR} (b.\text{BNO} = v.\text{BNO} \wedge b.\text{BCity} = "Georgetown" \wedge \\ & \exists l \in \text{LIKES} (l.\text{DLicNo} = d.\text{DLicNo} \wedge l.\text{BeerName} = "Bud Lite" \wedge \\ & \forall a \in \text{LIKES} (a.\text{DLicNo} = d.\text{DLicNo} \wedge a.\text{BeerName} = "MillerLite")))) \} \end{aligned}$$

2.4.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{Age} = d.\text{Age} \wedge \\ & \exists c \in \text{VISIT} (c.\text{DLicNo} = d.\text{DLicNo} \wedge \\ & \exists a \in \text{DRINKER} (a.\text{DName} = "Donald Trump" \wedge \\ & \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo} \wedge b.\text{BNO} = c.\text{BNO}))) \} \end{aligned}$$

2.9.

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge \\ & \exists s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \exists b \in \text{DRINKER} (b.\text{DName} = "Donald Trump" \wedge \\ & \forall l \in \text{LIKES} (l.\text{DLicNo} = b.\text{DLicNo} \wedge s.\text{BeerName} \neq l.\text{BeerName}))) \} \end{aligned}$$

2.10

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BCity} = "Towson" \wedge \\ & \forall s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \forall a \in \text{BAR} (a.\text{BCity} = "Timonium" \wedge \\ & \forall b \in \text{SERVES} (b.\text{BNO} = a.\text{BNO} \wedge s.\text{BeerName} \neq b.\text{BeerName}))) \} \end{aligned}$$

### 3.2 RC 2 0 / 2.25

- **0 pts** Correct
  - **2.25 pts** Not 315 / 415
  - **1 pts** Logic Error
  - **0.25 pts** Minor syntax error
  - **0.5 pts** Major syntax error
  - **1 pts** Unsafe
- ✓ - **2.25 pts** Incorrect
- **0.5 pts** Hardcoded values
  - **0 pts** Specifies in Relational Algebra format
- 💬 Gets bars that serve any beer that isn't bud lite

2.2.

$$\{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BState} = "MD" \wedge d.\text{BCity} \neq "Baltimore" \wedge \exists a \in \text{SERVES} (a.\text{BNO} = d.\text{BNO} \wedge a.\text{BeerName} \neq "Bud Lite") ) \}$$

2.3.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge d.\text{Age} < 30 \wedge \\ & \exists v \in \text{VISITED} (d.\text{DLicNo} = v.\text{DLicNo} \wedge \\ & \exists b \in \text{BAR} (b.\text{BNO} = v.\text{BNO} \wedge b.\text{BCity} = "Georgetown" \wedge \\ & \exists l \in \text{LIKES} (l.\text{DLicNo} = d.\text{DLicNo} \wedge l.\text{BeerName} = "Bud Lite" \wedge \\ & \forall a \in \text{LIKES} (a.\text{DLicNo} = d.\text{DLicNo} \wedge a.\text{BeerName} = "MillerLite")))) \} \end{aligned}$$

2.4.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{Age} = d.\text{Age} \wedge \\ & \exists c \in \text{VISIT} (c.\text{DLicNo} = d.\text{DLicNo} \wedge \\ & \exists a \in \text{DRINKER} (a.\text{DName} = "Donald Trump" \wedge \\ & \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo} \wedge b.\text{BNO} = c.\text{BNO}))) \} \end{aligned}$$

2.9.

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge \\ & \exists s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \exists b \in \text{DRINKER} (b.\text{DName} = "Donald Trump" \wedge \\ & \forall l \in \text{LIKES} (l.\text{DLicNo} = b.\text{DLicNo} \wedge s.\text{BeerName} \neq l.\text{BeerName}))) \} \end{aligned}$$

2.10

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BCity} = "Towson" \wedge \\ & \forall s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \forall a \in \text{BAR} (a.\text{BCity} = "Timonium" \wedge \\ & \forall b \in \text{SERVES} (b.\text{BNO} = a.\text{BNO} \wedge s.\text{BeerName} \neq b.\text{BeerName}))) \} \end{aligned}$$

### 3.3 RC 3 2.25 / 2.25

✓ - 0 pts Correct

- 2.25 pts Not 315 / 415

- 1 pts Logic Error

- 0.25 pts Minor syntax error

- 0.5 pts Major syntax error

- 1 pts Unsafe

- 2.5 pts Incorrect

- 0.5 pts Hardcoded values

- 0 pts Specifies in Relational Algebra format

2.2.

$$\{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BState} = "MD" \wedge d.\text{BCity} \neq "Baltimore" \wedge \exists a \in \text{SERVES} (a.\text{BNO} = d.\text{BNO} \wedge a.\text{BeerName} \neq "Bud Lite") ) \}$$

2.3.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge d.\text{Age} < 30 \wedge \\ & \exists v \in \text{VISITED} (d.\text{DLicNo} = v.\text{DLicNo} \wedge \\ & \exists b \in \text{BAR} (b.\text{BNO} = v.\text{BNO} \wedge b.\text{BCity} = "Georgetown" \wedge \\ & \exists l \in \text{LIKES} (l.\text{DLicNo} = d.\text{DLicNo} \wedge l.\text{BeerName} = "Bud Lite" \wedge \\ & \forall a \in \text{LIKES} (a.\text{DLicNo} = d.\text{DLicNo} \wedge a.\text{BeerName} = "MillerLite")))) \} \end{aligned}$$

2.4.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{Age} = d.\text{Age} \wedge \\ & \exists c \in \text{VISIT} (c.\text{DLicNo} = d.\text{DLicNo} \wedge \\ & \exists a \in \text{DRINKER} (a.\text{DName} = "Donald Trump" \wedge \\ & \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo} \wedge b.\text{BNO} = c.\text{BNO}))) \} \end{aligned}$$

2.9.

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge \\ & \exists s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \exists b \in \text{DRINKER} (b.\text{DName} = "Donald Trump" \wedge \\ & \forall l \in \text{LIKES} (l.\text{DLicNo} = b.\text{DLicNo} \wedge s.\text{BeerName} \neq l.\text{BeerName}))) \} \end{aligned}$$

2.10

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BCity} = "Towson" \wedge \\ & \forall s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \forall a \in \text{BAR} (a.\text{BCity} = "Timonium" \wedge \\ & \forall b \in \text{SERVES} (b.\text{BNO} = a.\text{BNO} \wedge s.\text{BeerName} \neq b.\text{BeerName}))) \} \end{aligned}$$

### 3.4 RC 4 2.25 / 2.25

✓ - 0 pts Correct

- 2.25 pts Not 315 / 415

- 1 pts Logic Error

- 0.25 pts Minor syntax error

- 0.5 pts Major syntax error

- 1 pts Unsafe

- 2.25 pts Incorrect

- 0.5 pts Hardcoded values

- 0 pts Specifies in Relational Algebra format

2.2.

$$\{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BState} = "MD" \wedge d.\text{BCity} \neq "Baltimore" \wedge \exists a \in \text{SERVES} (a.\text{BNO} = d.\text{BNO} \wedge a.\text{BeerName} \neq "Bud Lite") ) \}$$

2.3.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge d.\text{Age} < 30 \wedge \\ & \exists v \in \text{VISITED} (d.\text{DLicNo} = v.\text{DLicNo} \wedge \\ & \exists b \in \text{BAR} (b.\text{BNO} = v.\text{BNO} \wedge b.\text{BCity} = "Georgetown" \wedge \\ & \exists l \in \text{LIKES} (l.\text{DLicNo} = d.\text{DLicNo} \wedge l.\text{BeerName} = "Bud Lite" \wedge \\ & \forall a \in \text{LIKES} (a.\text{DLicNo} = d.\text{DLicNo} \wedge a.\text{BeerName} = "MillerLite")))) \} \end{aligned}$$

2.4.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{Age} = d.\text{Age} \wedge \\ & \exists c \in \text{VISIT} (c.\text{DLicNo} = d.\text{DLicNo} \wedge \\ & \exists a \in \text{DRINKER} (a.\text{DName} = "Donald Trump" \wedge \\ & \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo} \wedge b.\text{BNO} = c.\text{BNO}))) \} \end{aligned}$$

2.9.

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge \\ & \exists s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \exists b \in \text{DRINKER} (b.\text{DName} = "Donald Trump" \wedge \\ & \forall l \in \text{LIKES} (l.\text{DLicNo} = b.\text{DLicNo} \wedge s.\text{BeerName} \neq l.\text{BeerName}))) \} \end{aligned}$$

2.10

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BCity} = "Towson" \wedge \\ & \forall s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \forall a \in \text{BAR} (a.\text{BCity} = "Timonium" \wedge \\ & \forall b \in \text{SERVES} (b.\text{BNO} = a.\text{BNO} \wedge s.\text{BeerName} \neq b.\text{BeerName}))) \} \end{aligned}$$

3.5 RC 9 2.25 / 2.25

✓ - 0 pts Correct

- 2.25 pts Not 315 / 415

- 1 pts Logic Error

- 0.25 pts Minor syntax error

- 0.5 pts Major syntax error

- 1 pts Unsafe

- 2.25 pts Incorrect

- 0.5 pts Hardcoded values

- 0 pts Specifies in Relational Algebra format

2.2.

$$\{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BState} = "MD" \wedge d.\text{BCity} \neq "Baltimore" \wedge \exists a \in \text{SERVES} (a.\text{BNO} = d.\text{BNO} \wedge a.\text{BeerName} \neq "Bud Lite") ) \}$$

2.3.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge d.\text{Age} < 30 \wedge \\ & \exists v \in \text{VISITED} (d.\text{DLicNo} = v.\text{DLicNo} \wedge \\ & \exists b \in \text{BAR} (b.\text{BNO} = v.\text{BNO} \wedge b.\text{BCity} = "Georgetown" \wedge \\ & \exists l \in \text{LIKES} (l.\text{DLicNo} = d.\text{DLicNo} \wedge l.\text{BeerName} = "Bud Lite" \wedge \\ & \forall a \in \text{LIKES} (a.\text{DLicNo} = d.\text{DLicNo} \wedge a.\text{BeerName} = "MillerLite")))) \} \end{aligned}$$

2.4.

$$\begin{aligned} & \{ t | \exists d \in \text{DRINKER} (t.\text{DName} = d.\text{DName} \wedge t.\text{Age} = d.\text{Age} \wedge \\ & \exists c \in \text{VISIT} (c.\text{DLicNo} = d.\text{DLicNo} \wedge \\ & \exists a \in \text{DRINKER} (a.\text{DName} = "Donald Trump" \wedge \\ & \exists b \in \text{VISIT} (b.\text{DLicNo} = a.\text{DLicNo} \wedge b.\text{BNO} = c.\text{BNO}))) \} \end{aligned}$$

2.9.

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge \\ & \exists s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \exists b \in \text{DRINKER} (b.\text{DName} = "Donald Trump" \wedge \\ & \forall l \in \text{LIKES} (l.\text{DLicNo} = b.\text{DLicNo} \wedge s.\text{BeerName} \neq l.\text{BeerName}))) \} \end{aligned}$$

2.10

$$\begin{aligned} & \{ t | \exists d \in \text{BAR} (t.\text{BarName} = d.\text{BarName} \wedge d.\text{BCity} = "Towson" \wedge \\ & \forall s \in \text{SERVES} (s.\text{BNO} = d.\text{BNO} \wedge \\ & \forall a \in \text{BAR} (a.\text{BCity} = "Timonium" \wedge \\ & \forall b \in \text{SERVES} (b.\text{BNO} = a.\text{BNO} \wedge s.\text{BeerName} \neq b.\text{BeerName}))) \} \end{aligned}$$

### 3.6 RC 10 2.25 / 2.25

✓ - 0 pts Correct

- 2.25 pts Not 315 / 415

- 1 pts Logic Error

- 0.25 pts Minor syntax error

- 0.5 pts Major syntax error

- 1 pts Unsafe

- 2.25 pts Incorrect

- 0.5 pts Hardcoded values

- 0 pts Specifies in Relational Algebra format