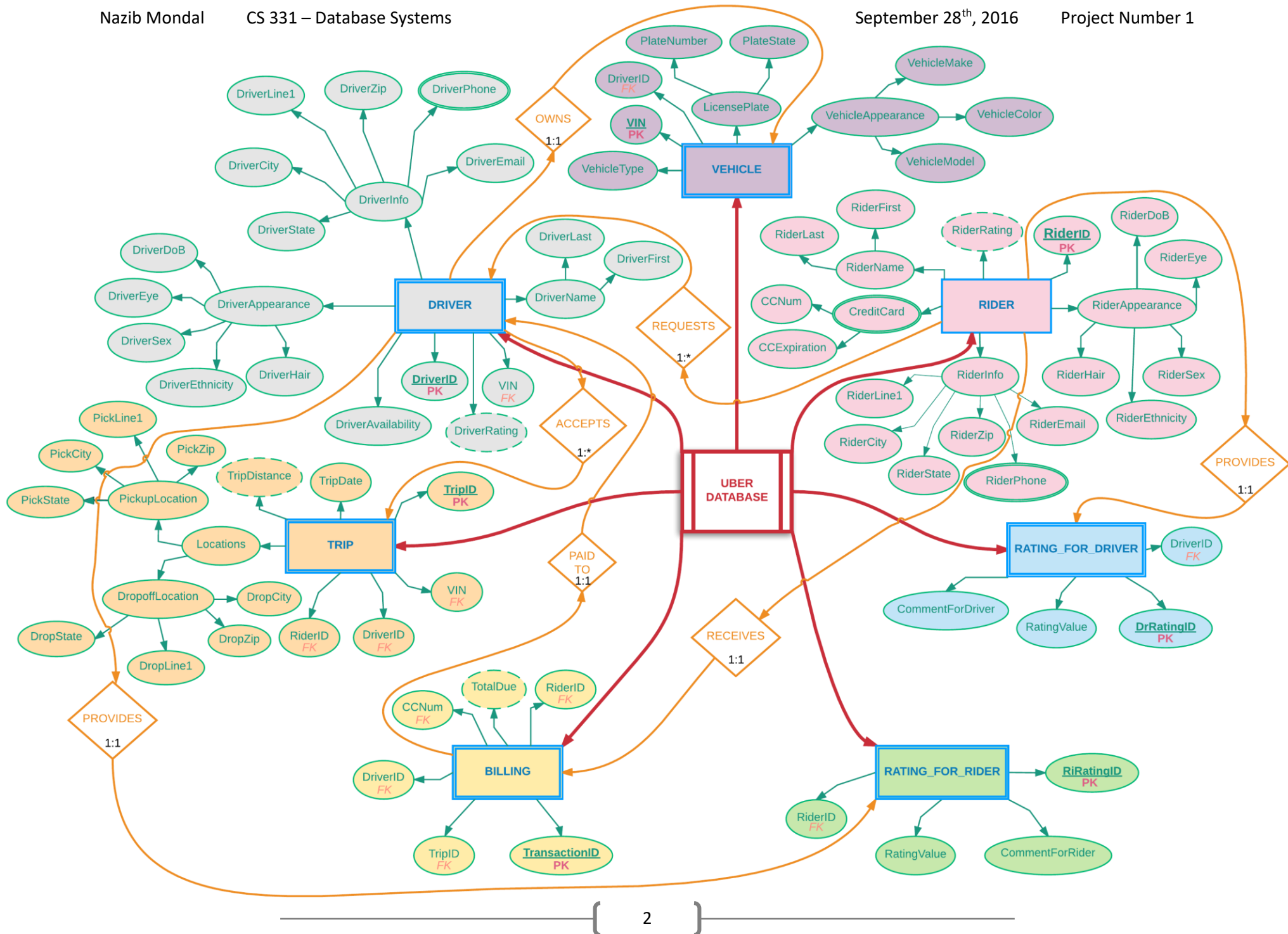Name: Nazib Mondal

ID: XXXX7217

CS 331 – Database Systems

September 28th, 2016

Project Number 1

Relational Model

1. Driver(<u>DriverID</u>, VIN, DriverFirst, DriverLast, DriverAvailability, DriverLine1, DriverCity, DriverState, DriverZip, DriverEmail, DriverDoB, DriverHair, DriverEye, DriverEthnicity, DriverSex)

   Domain Values:
   - ❖ DriverAvailability: Available, Unavailable
   - ❖ DriverState: New York, New Jersey, Connecticut, (any of the 50 States)…
   - ❖ DriverZip: 00000 – 99999 (5 Digit String)
   - ❖ DriverSex: Male, Female

   Entity Type: Weak Entity
   Primary Key: DriverID
   Foreign Key(s): VIN

2. DriverPhone(<u>DriverID</u>, <u>DriverPhoneNumber</u>)
   Composite Primary Key: DriverID, DriverPhoneNumber

3. Rider(<u>RiderID</u>, RiderFirst, RiderLast, RiderLine1, RiderCity, RiderState, RiderZip, RiderEmail, RiderDoB, RiderHair, RiderEye, RiderEthnicity, RiderSex)

   Domain Values:
   - ❖ RiderState: New York, New Jersey, (any of the 50 States)…
   - ❖ RiderZip: 00000 – 99999 (5 Digit String)
   - ❖ RiderSex: Male, Female

   Entity Type: Strong Entity
   Primary Key: RiderID
   Foreign Key(s): None

4. RiderPhone(RiderID, RiderPhoneNumber)
>   Composite Primary Key: RiderID, RiderPhoneNumber
>   Foreign Key(s): None

5. CreditCard(RiderID, CCNum, CCExpiration)
>   Domain Values:
>   ❖ CCNum: 16 Digit String
>   ❖ CCExpiration: mm/yy (4 Digit String; mm = 01 – 12, yy = 16 – 99)
>   Composite Primary Key: RiderID, CCNum, CCExpiration
>   Foreign Key(s): None

6. Vehicle(VIN, PlateNumber, PlateState, DriverID, VehicleType, VehicleMake, VehicleModel, VehicleColor)

>   Domain Values:
>   ❖ PlateNumber: (<=7 Digit Alphanumeric String)
>   ❖ PlateState: New York, New Jersey, (Any of the 50 states) …
>   ❖ VehicleType: Handicapped Accessible Van, SUV, Van, Hatchback, Car
>   ❖ VehicleMake: Toyota, Honda, Nissan, Ford, Volkswagen, (all major car Manufacturers) …
>   ❖ VehicleColor: Red, Green, Blue, Silver, Black, White, Yellow, (all major colors) …
>   Entity Type: Weak Entity
>   Primary Key: VIN
>   Foreign Key(s): DriverID

7. Trip(<u>TripID</u>, DriverID, RiderID, VIN, TripDate, PickLine1, PickCity, PickState, PickZip, DropLine1, DropCity, DropState, DropZip)

   Domain Values:
   - ❖ PickState: New York, New Jersey, Connecticut, (any of the 50 States)…
   - ❖ PickZip: 00000 – 99999 (5 Digit String)
   - ❖ DropState: New York, New Jersey, Connecticut, (any of the 50 States)…
   - ❖ DropZip: 00000 – 99999 (5 Digit String)

   Entity Type: Weak Entity
   Primary Key: TripID
   Foreign Key(s): DriverID, RiderID, VIN

8. Billing(<u>TransactionID</u>, CCNum, TripID, RiderID, DriverID)
   Domain Values:
   - ❖ CCNum: 16 Digit String

   Entity Type: Weak Entity
   Primary Key: TransactionID
   Foreign Key(s): TripID, RiderID, DriverID, CCNum

9. Rating_for_Driver(<u>DrRatingID</u>, DriverID, RatingValue, CommentForDriver)
   Domain Values:
   - ❖ RatingValue: 1 – 10 (Integer Value)

   Primary Key: DrRatingID
   Foreign Key(s): DriverID

10. Rating_for_Rider(<u>RiRatingID</u>, RiderID, RatingValue, CommentForRider)
    Domain Values:
    - ❖ RatingValue: 1 – 10 (Integer Value)

    Primary Key: RiRatingID
    Foreign Key(s): RiderID

Relational Algebra

1. Identify <u>handicapped accessible vans</u> available for a pickup <u>now</u>. Display the driver name, car color, model, manufacturer, and license plate.

<u>Rephrase</u>: Identify <u>all available hatchbacks</u> and display the driver's first and last name, the car's color, its model, its make, and its license plate number.

<u>Problem 1 Solution</u>

A $\leftarrow$ σ_{Vehicle.DriverID = Driver.DriverID $\wedge$ Vehicle.VIN = Driver.VIN} (Vehicle × Driver)

B $\leftarrow$ σ_{VehicleType = 'Hatchback' $\wedge$ DriverAvailability = 'Available'} (A)

Answer $\leftarrow$ π _{DriverFirst, DriverLast, VehicleColor, VehicleMake, VehicleModel, LicensePlateNumber} (B)

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2. Identify the number of trips by vehicle <u>last week</u>. Display two columns: license plate and number of trips. Display one row for each license plate. Don't forget to create descriptive attribute labels in your final relation.

<u>Rephrase</u>: Identify the number of trips by vehicle <u>Today</u>. Display two columns: license plate and number of trips; one row per license plate.

<u>Problem 2 Solution</u>

A $\leftarrow$ σ_{Vehicle.VIN = Trip.VIN} (Vehicle × Trip)

B $\leftarrow$ σ_{TripDate = '09/28/2016'} (A)

Answer $\leftarrow$ ρ_C(License Plate, Number of Trips) _{PlateNumber} $\mathcal{F}$ _{count.TripID} (B)

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3. Identify the number of trips by drivers <u>last week</u>. Display two columns: driver name and number of trips. Display one row for each driver. Don't forget to create descriptive attribute labels in your final relation.

<u>Rephrase</u>: Identify the number of trips by drivers <u>yesterday</u>. Display two columns: driver name and number of trips; one row per license plate.

<div style="border:1px solid black">

Problem 3 Solution

$A \leftarrow \sigma_{\text{Driver.DriverID = Trip.DriverID}} (\text{Driver} \times \text{Trip})$

$B \leftarrow \sigma_{\text{TripDate = '09/27/2016'}} (A)$

Answer $\leftarrow \rho_C(\text{Driver Name, Number of Trips})_{\text{DriverFirst, DriverLast}} \mathcal{F}_{\text{count.TripID}} (B)$

</div>

4. Identify drivers without a trip <u>last week</u>. Display the driver name and E-Mail Address.

<u>Rephrase</u>: Identify drivers without a trip <u>last month</u>. Display the driver's first and last name, as well as their E-Mail Address.

<div style="border:1px solid black">

Problem 4 Solution

$A \leftarrow \pi_{\text{DriverID}} (\text{Driver}) - \pi_{\text{DriverID}} (\sigma_{\text{TripDate >= '08/28/2016'}} (\text{Trip}))$

$B \leftarrow \sigma_{\text{A.DriverID = Driver.DriverID}} (A \times \text{Driver})$

Answer $\leftarrow \pi_{\text{DriverFirst, DriverLast, DriverEmail}} (B)$

</div>

5. Identify vehicles without trips <u>last week</u>. Display the vehicle ID, license plate, and owner.

<u>Rephrase</u>: Identify drivers without a trip <u>last year</u>. Display the VIN, the license plate number, and the driver's first and last name.

Problem 5 Solution

A $\leftarrow$ π VIN (Vehicle) - π VIN (σ TripDate >= '09/28/2015' (Trip))

B $\leftarrow$ σ A.VIN = Vehicle.VIN (A × Vehicle)

C $\leftarrow$ σ B.VIN = Driver.VIN $\wedge$ B.DriverID = Driver.DriverID (B × Driver)

Answer $\leftarrow$ π PlateNumber, DriverFirst, DriverLast (C)

---

6. Identify customers who have not requested a ride in the <u>last year</u>. Display the customer name and E-Mail Address.

<u>Rephrase</u>: Identify riders who have not requested a ride in the <u>past week</u>. Display their E-Mail Address, as well as their first and last name.

Problem 6 Solution

A $\leftarrow$ π RiderID (Rider) - π RiderID (σ TripDate >= '09/21/2016' (Trip))

B $\leftarrow$ σ A.RiderID = Rider.RiderID (A × Rider)

Answer $\leftarrow$ π RiderEmail, RiderFirst, RiderLast (B)

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7. An intoxicated passenger left his cell phone in a <u>green vehicle yesterday</u>. The driver had <u>blonde hair</u> and the drop off was <u>near City Hall</u>. Display all trips matching this description. Include the customer name, driver name, start address and destination address.

<u>Rephrase</u>: A rider left their purse in a <u>black van yesterday</u> after being dropped off <u>by the Jamaica LIRR Station</u>; the driver had <u>brown hair</u>. Display all trips matching this description and include the rider's full name, the driver's full name, and the pickup and drop-off locations of the customer.

<u>Problem 7 Solution</u>

A ← $\sigma_{\text{Vehicle.DriverID = Driver.DriverID} \wedge \text{Vehicle.VIN = Driver.VIN}}$ (Vehicle × Driver)

B ← $\sigma_{\text{A.DriverID = Trip.DriverID} \wedge \text{A.VIN = Trip.VIN}}$ (A × Trip)

C ← $\sigma_{\text{B.RiderID = Rider.RiderID}}$ (B × Rider)

D ← $\sigma_{\text{VehicleColor = 'black'} \wedge \text{TripDate = '09/27/2016'} \wedge \text{DriverHair = 'brown'} \wedge \text{DropZip = '11435'}}$ (C)

Answer ← $\pi_{\text{DriverFirst, DriverLast, RiderFirst, RiderLast, PickLine1, PickCity, PickZip, PickState}}$ (D)
$_{\text{DropLine1, DropCity, DropZip, DropState}}$

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8. A driver was involved in an accident <u>yesterday</u>. Identify all drivers using a <u>vehicle</u> with the license plate <u>New York ZYX-1234</u>. Display the driver name, address and phone.

<u>Rephrase</u>: A driver got into a fender bender <u>four days ago</u>. Identify drivers that drive an <u>SUV</u> with the license plate <u>California ABC-4321</u> and display their full name, address, and phone.

<u>Problem 8 Solution</u>

$A \leftarrow \sigma_{\text{Vehicle.DriverID = Driver.DriverID} \wedge \text{Vehicle.VIN = Driver.VIN}} (\text{Vehicle} \times \text{Driver})$

$B \leftarrow \sigma_{\text{A.DriverID = Trip.DriverID} \wedge \text{A.VIN = Trip.VIN}} (A \times \text{Trip})$

$C \leftarrow \sigma_{\text{B.DriverID = DriverPhone.DriverID}} (B \times \text{DriverPhone})$

$D \leftarrow \sigma_{\text{TripDate='09/24/2016'} \wedge \text{VehicleType='SUV'} \wedge \text{PlateState='California'} \wedge \text{PlateNumber='ABC-4321'}} (C)$

$\text{Answer} \leftarrow \pi_{\text{DriverFirst, DriverLast, DriverLine1, DriverCity, DriverState, DriverZip, DriverPhoneNumber}} (D)$

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9. A <u>red Toyota</u> was involved in a <u>hit and run accident yesterday in Brooklyn</u>. The license plate is unknown. Identify all vehicles matching this description. Display the driver name, trip date, start address and destination address.

<u>Rephrase</u>: A <u>blue Subaru</u> ran into a truck <u>last week on Inwood Street</u>. Identify vehicles that match this description and display the driver's full name, the date of the trip, pickup address and drop-off address.

<u>Problem 9 Solution</u>

$A \leftarrow \sigma_{\text{Vehicle.DriverID = Driver.DriverID} \wedge \text{Vehicle.VIN = Driver.VIN}} (\text{Vehicle} \times \text{Driver})$

$B \leftarrow \sigma_{\text{A.DriverID = Trip.DriverID} \wedge \text{A.VIN = Trip.VIN}} (A \times \text{Trip})$

$C \leftarrow \sigma_{\text{VehicleColor = 'blue'} \wedge \text{VehicleMake = 'subaru'} \wedge \text{TripDate = '09/27/2016'} \wedge \text{PickZip = '11435'} \vee \text{DropZip = '11435'}} (B)$

$\text{Answer} \leftarrow \pi_{\text{DriverFirst, DriverLast, TripDate, PickLine1, PickCity, PickZip, PickState, DropLine1, DropCity, DropZip, DropState}} (C)$

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10. A bonus will be awarded to the driver with the highest average rating in the last year. Display three columns: driver name, number of trips, and average rating.

Rephrase: This month's "Driver of the Month" needs to be awarded, display the driver's name, number of trips, and their average rating.

> ## Problem 10 Solution
>
> $A \leftarrow \sigma_{\text{Driver.DriverID = Trip.DriverID} \wedge \text{Driver.VIN = Trip.VIN}} (\text{Driver} \times \text{Trip})$
>
> $A \leftarrow \sigma_{\text{A.DriverID = Rating\_for\_Driver.DriverID}} (A \times \text{Rating\_for\_Driver})$
>
> $C \leftarrow \sigma_{\text{TripDate = '08/28/2016'}} (B)$
>
> $\text{Answer} \leftarrow \pi_{\text{DriverFirst, DriverLast,}} (\mathcal{F}_{\text{count.TripID}}), (\mathcal{F}_{\text{average.RatingValue}}) (C)$

11. Identify customers with credit cards expiring this month. Display the customer name, E-Mail address, credit card number, and expiration date.

Rephrase: Identify customers with credit cards that will expire this year, and display their name, E-Mail address, credit card number and expiration date.

> ## Problem 11 Solution
>
> $A \leftarrow \sigma_{\text{Rider.RiderID = CreditCard.RiderID}} (\text{Rider} \times \text{CreditCard})$
>
> $B \leftarrow \sigma_{\text{this\_year => CCExpiration.year}} (A)$
>
> $\text{Answer} \leftarrow \pi_{\text{RiderFIrst, RiderLast, RiderEmail, CCNum, CCExpiration}} (D)$

12. Identify Uber's best customers <u>this year</u>. Display the customer name and attribute(s) which identify the best customer. Explain the method used to identify the best customer.

Problem 12 Solution

A $\leftarrow \sigma_{\text{Billing.RiderID=Trip.RiderID} \land \text{Billing.TripID=Trip.TripID} \land \text{Billing.DriverID=Trip.DriverID}}(\text{Billing} \times \text{Trip})$

B $\leftarrow \sigma_{\text{A.RiderID = Rider.RiderID}}(\text{A} \times \text{Rider})$

C $\leftarrow \sigma_{\text{B.RiderID = CreditCard.RiderID}}(\text{B} \times \text{CreditCard})$

D $\leftarrow \sigma_{\text{C.RiderID = Rating\_for\_Rider.RiderID}}(\text{C} \times \text{Rating\_for\_Rider})$

E $\leftarrow \sigma_{\text{TripDate = '09/28/2015'}}(\text{D})$

Answer $\leftarrow \pi_{\text{DriverFirst, DriverLast,}} (\mathcal{F}_{\text{max.TotalDue}}),(\mathcal{F}_{\text{count.TripID}}),(\mathcal{F}_{\text{average.RatingValue}})(\text{C})$

To put it simply (my apologies for the mess – I don't think I expressed it as I meant to) – we find the customer who has taken the most trips, has the highest rating, and has spent the most on the company's services and validate them as the "best customer" of that year.