Car Rental DBMS

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Project Description:

DBMS for Car Rentals: Car rentals have been used as a resource to provide a temporary vehicle to customers for temporary transportation likely for the reason they do not have access to a vehicle. Our system offers a large variety of fleet vehicles to provide options for customers to decide their preferred vehicle. Customers create an account with our company providing the necessary information. When selecting a car, customers will be able to see all the available vehicles and this would take into account the class and quality the customer is looking for. The rental period is selected by the customer and is based on a 24hr time interval. The payments made by the customer can be the full amount or a minimum fee--minimum fees equate to 10% of the total cost-- with regards to the vehicle they are renting.

Project Functions:

A customer has various attributes like account number, insurance code, license information, credit score, etc. The customer number would be considered to be the unique primary key. The attributes insurance code and credit score are required to ensure damage vehicle prevention and a trustworthy customer. When renting a vehicle, payment must be made. A transaction ID attribute would be in the BOOKINGS record and is the primary key to the nested Transactional table. Payments are made through credit card and include the payment ID, date, time, change of balance, balance, type of change. When a vehicle from the fleet is rented, each booking is linked with its own transaction ID each time it is in service and would keep track of any rental period and payment adjustments. Once the rental period of a vehicle is complete, the mileage attribute is increased and subsequently added to the car's total mileage. There are many other features that can be added to the system such as pick-up and drop off locations, comprehensive insurance coverage, insurance policy offerings, subscriptions, price adjustments from gas refills, etc.

Customer Table

Name	Customer #	Email	Address	Phone Number	License	Insurance	Credit Score	Status
Frederick James	2352345123	JJFF@bg.com	420 Float St.	888-999-1400	D6101-40706-60905	DF888833Q	850	Renting

Fleet Table

Manufacturer	Make	Model Year	Class	Car Plate	Status	Condition	Start Service Date	Total Mileage
Honda	Civic	2012	Economy	125FS2AAD	In-Service	Ok	Sept. 1, 2012	65904
Porsche	Cayenne	2019	Luxury	623KKWR2	Rentable	Good	Nov. 28, 2019	2502
Tesla	Model X	2020	Premium	42SSDW59	Rentable	New	February, 3. 2021	402

Bookings Table

Rent Code	Car Plate	Customer #	Transactional ID	Booking Status	Start Date	End Date	Mileage Accumulated
5ASI4DFA	623KKWR2	2352345123	693-264-TIF	Complete	Aug 10, 2021	Aug 12, 2021	+500
ASOG34E	125FS2AAD	2352345123	235-249-ASD	In-Use	Sept 5, 2021	Oct. 17, 2021	+0

Transaction Table

<table>
<tr><th>Transactional ID</th><th>Tables for Each ID</th><th>Status</th></tr>
<tr><td>693-264-TIF</td><td>
<table>
<tr><th>Payment ID</th><th>Date</th><th>Time</th><th>Change in Balance</th><th>Balance</th><th>Type</th></tr>
<tr><td>/////////////////////</td><td>////////////</td><td>//////////////////</td><td>/////////////////////////////</td><td>///////////////</td><td>/////////</td></tr>
</table>
</td><td>Complete</td></tr>
</table>

693-264-TIF Table (Nested)

Payment ID	Date	Time	Change in Balance	Balance	Type
2493-5506-1395	Aug 10, 2021	16:36	+$5000	$5000	Rental Charge
3767-5044-1686	Aug 10, 2021	16:36	-$2000	$3000	Credit Card Payment
8616-7092-5455	Aug 12, 2021	7:22	-$2000	$1000	Credit Card Payment
1898-1581-8710	Aug 13, 2021	0:00	+$100	$1100	Late Fees
2546-0322-7351	Aug 13, 2021	2:54	+$1100	$0	Credit Card Payment

Insurance Table

Insurance Code	Insurance Provider	Phone Number	Coverage
DF888833Q	Ecconomical CA	777-777-7777	$100,000.

Table Relations via Keys:

Customers	↔	(Customer #)	↔	Bookings
Car Fleet	↔	(Car Plate)	↔	Bookings
Bookings	↔	(Transactional ID)	↔	Transaction
Customers	↔	(Insurance Code)	↔	Insurance

A6:

LEGEND	OUTCOME
🟥	**A → B, B is not FD to A**
■	**A → B, B is FD to A**
"- - - - - - - - - - - -"	All Primary Key → Attribute, such that each attribute is FD to the Primary Key

Customer

Customer ID	First_Name	Middle_Initial	Last_Name	Phone	Email	Street	City	Postal_Code	Country	I_Code	Customer_Status	Credit_Score

FD (left-side: determinant. right-side: dependent):

Customer_ID → First_name

"- -"

First_Name → Middle_Initial

Last_Name → Phone

Email → Street

Street → City

City → Postal_Code

Country → I_Code

I_Code → Country

Customer_Status → Credit_Score

Car Fleet

Car_plate	Manufacturer	Make	Model_Year	Class	Status	Condition	Start_Service_Date	Initial_Mileage

Car_plate → Manufacturer

“- -”

Manufacturer → Make
Make → Model_Year
Model_Year → Class
Class → Status
Status → Condition
Start_Service_Date → Initial_Mileage

Insurance

I_Code	I_Provider	Phone_Number	Coverage

FD (left-side: determinant. right-side: dependent):
I_Code → I_Provider
“- -”

I_Provider → Phone_Number
I_Provider → Coverage
Phone_Number → I_Provider
Phone_Number → Coverage
Coverage → Phone_Number

Booking

Booking_ID	Booking_Status	Mileage_Accumulated	Start_Date	End_Date	Customer_ID	Car_Plate

FD (left-side: determinant. right-side: dependent):
Booking_ID → Booking_Status
“- -”

Booking_Status → Mileage_Accumulated
Start_Date → End_Date
Customer_ID → Car_Plate
Car_Plate → Customer_ID

Transactions

Payment_ID	Payment_date	Total_Amount	Payment_Type	Status	Booking_ID

FD (left-side: determinant. right-side: dependent):

Payment_ID → Payment_date

“- -”

Payment_Date → Total_Amount

Payment_Type → Status

Status → Booking_ID

Booking_ID → Status

A7:

Transitive Functional Dependency:

Transitive Functional Dependency:

{Car_Plate → Make}
{Make does not → Car_Plate }
{Make → Manufacturer, Car_Class}
Therefore:
{Car_Plate → Manufacturer, Car_Class } in a TFD relation

Car_Plate	Make	Model_Year	Status	Condition	Start_Service	Initial_Mileage
CAJA 723	Civic	2005	Requires Maintenance	Rough	2008-08-22	22000
BAMD 222	Model X	2020	Requires Maintenance	Clean	2020-04-15	253
DSXD 777	SLR	2018	Requires Maintenance	OK	2019-02-02	5
SAWW 888	Corolla	2002	Requires Maintenance	Bad	2005-12-18	255888
ABCD 888	Tacoma	2019	Requires Maintenance	Clean	2020-10-18	150

Make (PK)	Manufacturer	Car_Class
Civic	Honda	Economy
Model X	Tesla	Premium
SLR	Mercedes-Benz	Luxury
Corolla	Toyota	Economy

Compound Primary Key:

Customer #	First_Name	M	Last_Name	Phone	Email	Street	City	Postal_Code	Country	Province	I_Code	Customer_Status	Credit_Score
SSS23444D	Joe	S	Smith	416-222-1333	joe-smith@email.com	123 Street	Toronto	K2N 1T3	Canada	Ontario	AB123456C	Renting	829
GGG22234G	Bob	B	Jenkins	416-222-2333	joe-smith@email.com	123 Street	Etobicoke	E2G 1G2	Canada	Ontario	SW123456C	Renting	772
FFF19844X	Bort	K	Bot	416-222-3333	joe-smith@email.com	123 Street	Hamilton	H9S 2DG	Canada	Ontario	JJ123456C	Not Renting	612
CCC15824C	Bort	K	Ben	416-222-4333	joe-smith@email.com	123 Street	Hamilton	H9S 2DG	Canada	Ontario	BA123456C	Not Renting	612

Showing Partial Dependency

Compound Key: {Customer#, Phone}
Partial Dependency: {Phone → Street}

Phone	Street
416-222-1333	123 Street
416-222-2333	123 Street
416-222-3333	123 Street
416-222-4333	123 Street

(2NF) Functional Dependencies:

Insurance

- {I_Code → I_Provider, Phone_Number, Coverage}

Customer Table

- {Customer_ID→ First_Name, M, Last_Name, Phone, Email, Street, City, Postal, Country, Province, I_Code, Customer, Credit_Score}
- {Phone → Street }

Car Fleet

- {Car_Plate → Manufacturer, Make, Model_Year, Car_Class, Status, Condition, Start_Service, Initial_Mileage}

Booking

- {Booking_ID → Booking_Status, Mileage_Accumulated, Start_Date, End_Date, Customer_ID, Car_Plate}

Transactions

- {Booking_ID → Billing_Date, Payment_Date, Total_Amount, Paid_Amount, Status}

First Normal Form: 1NF

- A table must not contain **composite** (with sub-values), **Multi-valued** (with different values), and **repeated group of attributes**
- Rules:
  - Each attribute must have an **Atomic Value (one value)**
  - Each attribute must have **value with the same type**
  - Each attribute has a **unique name**

Insurance

Candidate Keys: {I_Code}

I_Code	I_Provider	Phone_Number	Coverage
AB123456C	Aviva	416-222-3333	10000
SW123456C	Get a Life	416-332-3433	20000
JJ123456C	Dont Die	255-299-3231	30000
BA123456C	Dont Die	255-212-3131	50000

Customer Table

Candidate Keys: {Customer #, Phone, Email, I_Code}

Customer #	First_Name	M	Last_Name	Phone	Email	Street	City	Postal_Code	Country	Province	I_Code	Customer_Status	Credit_Score
SSS23444D	Joe	S	Smith	416-222-1333	joe-smith@email.com	123 Street	Toronto	K2N 1T3	Canada	Ontario	AB123456C	Renting	829
GGG22234G	Bob	B	Jenkins	416-222-2333	joe-smith@email.com	123 Street	Etobicoke	E2G 1G2	Canada	Ontario	SW123456C	Renting	772
FFF19844X	Bort	K	Bot	416-222-3333	joe-smith@email.com	123 Street	Hamilton	H9S 2DG	Canada	Ontario	JJ123456C	Not Renting	612
CCC15824C	Bort	K	Ben	416-222-4333	joe-smith@email.com	123 Street	Hamilton	H9S 2DG	Canada	Ontario	BA123456C	Not Renting	612

Car Fleet

Candidate Keys: {Car_Plate}

Car_Plate	Manufacturer	Make	Model_Year	Car_Class	Status	Condition	Start_Service	Initial_Mileage
CAJA 723	Honda	Civic	2005	Economy	Requires Maintenance	Rough	2008-08-22	22000
BAMD 222	Tesla	Model X	2020	Premium	Requires Maintenance	Clean	2020-04-15	253
DSXD 777	Mercedes-Benz	SLR	2018	Luxury	Requires Maintenance	OK	2019-02-02	5
SAWW 888	Toyota	Corolla	2002	Economy	Requires Maintenance	Bad	2005-12-18	255888
ABCD 888	Toyota	Tacoma	2019	Economy	Requires Maintenance	Clean	2020-10-18	150

Booking

Candidate Keys: {Booking_ID}

Booking_ID	Booking_Status	Mileage_Accumulated	Start_Date	End_Date	Customer_ID	Car_Plate
23452	Complete	1000	2021-07-15	2021-07-18	FFF19844X	CAJA 723
82727	In-Progress	0	2021-10-10	2021-11-18	SSS23444D	SAWW 888
99823	In-Progress	0	2021-10-15	2021-10-23	GGG22234G	DSXD 777

Transactions

Candidate Keys: {Booking_ID}

Booking_ID	Billing_Date	Payment_Date	Total_Amount	Paid_Amount	Status
23452	2021-10-10 09:26:50.12	2021-10-11 16:55:23.06	2500	2500	Complete
82727	2021-10-15 23:11:11.11	2021-10-17 12:25:51.42	9000	9000	Complete

Second Normal Form: 2NF

- The data must be in **1NF**, and the relation must not contain any **Partial Functional Dependency**
- Rules:
    - Be in 1NF
    - No Partial Dependency

Insurance

Candidate Keys: {I_Code}

I_Code	I_Provider	Phone_Number	Coverage
AB123456C	Aviva	416-222-3333	10000
SW123456C	Get a Life	416-332-3433	20000
JJ123456C	Dont Die	255-299-3231	30000
BA123456C	Dont Die	255-212-3131	50000

Customer Table

Candidate Keys: {Customer #, Phone, Email, I_Code}
Compound Key: {Customer #, Phone}
Partial Dependency:

- {Phone → Street}

Customer #	First_Name	M	Last_Name	Phone	Email	City	Postal_Code	Country	Province	I_Code	Customer_Status	Credit_Score
SSS23444D	Joe	S	Smith	416-222-3333	joe-smith@email.com	Toronto	K2N 1T3	Canada	Ontario	AB123456C	Renting	829
GGG22234G	Bob	B	Jenkins	416-222-3333	joe-smith@email.com	Etobicoke	E2G 1G2	Canada	Ontario	SW123456C	Renting	772
FFF19844X	Bort	K	Bot	416-222-3333	joe-smith@email.com	Hamilton	H9S 2DG	Canada	Ontario	JJ123456C	Not Renting	612
CCC15824C	Bort	K	Ben	416-222-3333	joe-smith@email.com	Hamilton	H9S 2DG	Canada	Ontario	BA123456C	Not Renting	612

Phone	Street
416-222-1333	123 Street
416-222-2333	123 Street
416-222-3333	123 Street
416-222-4333	123 Street

Car Fleet

Candidate Keys: {Car_Plate}

Car_Plate	Manufacturer	Make	Model_Year	Car_Class	Status	Condition	Start_Service	Initial_Mileage
CAJA 723	Honda	Civic	2005	Economy	Requires Maintenance	Rough	2008-08-22	22000
BAMD 222	Tesla	Model X	2020	Premium	Requires Maintenance	Clean	2020-04-15	253
DSXD 777	Mercedes-Benz	SLR	2018	Luxury	Requires Maintenance	OK	2019-02-02	5
SAWW 888	Toyota	Corolla	2002	Economy	Requires Maintenance	Bad	2005-12-18	255888
ABCD 888	Toyota	Tacoma	2019	Economy	Requires Maintenance	Clean	2020-10-18	150

Booking

Candidate Keys: {Booking_ID}

Booking_ID	Booking_Status	Mileage_Accumulated	Start_Date	End_Date	Customer_ID	Car_Plate
23452	Complete	1000	2021-07-15	2021-07-18	FFF19844X	CAJA 723
82727	In-Progress	0	2021-10-10	2021-11-18	SSS23444D	SAWW 888
99823	In-Progress	0	2021-10-15	2021-10-23	GGG22234G	DSXD 777

Transactions

Candidate Keys: {Booking_ID}

Booking_ID	Billing_Date	Payment_Date	Total_Amount	Paid_Amount	Status
23452	2021-10-10 09:26:50.12	2021-10-11 16:55:23.06	2500	2500	Complete
82727	2021-10-15 23:11:11.11	2021-10-17 12:25:51.42	9000	9000	Complete

Third Normal Form: 3NF + BCNF

- **Transitive Dependency:**
  - An attribute not depending on the **PK** but on the **Non-prime Attribute**

- The data must be in **2NF,** and the relation must not contain any **Transitive Functional Dependency**
- Rules:
  - Be in **2NF**
  - No **Transitive Dependency**

Insurance

Transitive Dependency:

- {Phone_Number -> I_Provider}

I_Code	Coverage	Phone_Number
AB123456C	10000	416-222-3333
SW123456C	20000	416-332-3433
JJ123456C	30000	255-299-3231
BA123456C	50000	255-212-3131

Phone_Number	I_Provider (FK)
416-222-3333	Aviva
416-332-3433	Get a Life
255-299-3231	Dont Die
255-212-3131	Dont Die

Customer Table

Partial Dependency:

- {Phone} → {Street}

Transitive Dependency:

- {Postal_Code} -> {City, Country, Province}

Customer #	First_Name	M	Last_Name	Phone	Email	I_Code	Customer_Status	Credit_Score	Postal_Code (FK)
SSS23444D	Joe	S	Smith	416-222-1333	joe-smith@email.com	AB123456C	Renting	829	K2N 1T3
GGG22234G	Bob	B	Jenkins	416-222-2333	joe-smith@email.com	SW123456C	Renting	772	E2G 1G2
FFF19844X	Bort	K	Bot	416-222-3333	joe-smith@email.com	JJ123456C	Not Renting	612	H9S 2DG
CCC15824C	Bort	K	Ben	416-222-4333	joe-smith@email.com	BA123456C	Not Renting	612	H9S 2DG

Assumption:

Phone	Street
416-222-1333	123 Street
416-222-2333	123 Street
416-222-3333	123 Street
416-222-4333	123 Street

Postal_Code (PK)	City	Country	Province
K2N 1T3	Toronto	Canada	Ontario
E2G 1G2	Etobicoke	Canada	Ontario
H9S 2DG	Hamilton	Canada	Ontario

Car Fleet

Transitive Dependency:

- {Make -> Manufacturer, Model_Year }

Car_Plate	Start_Service	Initial_Mileage	Make (FK)	Condition	Model_Year	Status
CAJA 723	2008-08-22	22000	Civic	Rough	2005	Requires Maintenance
BAMD 222	2020-04-15	253	Model X	Clean	2020	Requires Maintenance
DSXD 777	2019-02-02	5	SLR	OK	2018	Requires Maintenance
SAWW 888	2005-12-18	255888	Corolla	Bad	2002	Requires Maintenance
ABCD 888	2020-10-18	150	Tacoma	Clean	2019	Requires Maintenance

Make (PK)	Manufacturer	Car_Class
Civic	Honda	Economy
Model X	Tesla	Premium
SLR	Mercedes-Benz	Luxury
Corolla	Toyota	Economy
Tacoma	Toyota	Economy

Booking

Booking_ID	Customer_ID	Car_Plate	Booking_Status	Start_Date	End_Date	Mileage_Accumulated
23452	FFF19844X	CAJA 723	Complete	2021-07-15	2021-07-18	1000
82727	SSS23444D	SAWW 888	In-Progress	2021-10-10	2021-11-18	0
99823	GGG22234G	DSXD 777	In-Progress	2021-10-15	2021-10-23	0

Transactions

Booking_ID	Billing_Date	Payment_Date	Total_Amount	Paid_Amount	Status
23452	2021-10-10 09:26:50.12	2021-10-11 16:55:23.06	2500	2500	Complete
82727	2021-10-15 23:11:11.11	2021-10-17 12:25:51.42	9000	9000	Complete

Customer | Bernstein's Algorithm for 3NF

Customer ID	First_Name	Middle_Initial	Last_Name	Phone	Email	Street	City	Postal_Code	Country	Province	I_Code	Customer_Status	Credit_Score

R(CID, F, M, L, P, E, S, C, PC, CT, PR,IC,CUS, CRS)

Step 1:

Determining Functional Dependencies:

FD = {

CID, P → F,M,L,E,S,PR,IC,CUS,CRS,P,PC

P → S

PC → C,CT,PR

}

Step 2a:

Break RHS and find redundancies

FD = {

CIDP → F, CIDP → M, CIDP → L, CIDP → E, CIDP → E, CIDP → S, CIDP → PR, CIDP → IC, CIDP → CUS, CID → P, CID → PC

P → S

PC → C, PC → CT, PC → PR

}

CIDP → F: CIDP+ = {CID, M ,L,E,S,PR,IC,CUS,CRS,P,PC} we do not get F, so not redundant

CIDP → M: CIDP+ = {CID, F, L,E, S,PR,IC,CUS,CRS,P,PC} we do not get M, so not redundant

CIDP → L: CIDP+ = {CID, F, M, ,E, S,PR,IC,CUS,CRS,P,PC} we do not get L, so not redundant

CIDP → E: CIDP+ = {CID, F,M,L,S,PR,IC,CUS,CRS,P,PC} we do not get E, so not redundant

CIDP → S: CIDP+ = {CID, F,M,L,E,PR,IC,CUS,CRS,P,PC} we do not get S, so not redundant

CIDP → PR: CIDP+ = {CID, F,M,L,E,S,PR,IC,CUS,CRS,P,PC} we get PR, so redundant

CIDP → IC: CIDP+ = {CID, F,M,L,E,S,PR,CUS,CRS,P,PC} we do not get IC, so not redundant

CIDP → CUS: CIDP+ = {CID, F,M,L,E,S,PR,IC,CRS,P,PC} we do not get CUS, so not redundant

CIDP → P: CIDP+ = {CID, F,M,L,E,S,PR,IC,CUS,CRS,PC} we do not get P, so not redundant

CIDP → PC: CIDP+ = {CID, F,M,L,E,S,PR,IC,CUS,CRS,P} we do not get PC, so not redundant

P → S: P+ {P} we do not get S, so not redundant

PC → C: PC+ = {CT,PR} → we do not get C, so not redundant

PC → CT: PC+ = {C,PR} → we do not get CT, so not redundant

PC → PR: PC+ = {C,CT,PR} → we do not get PR, so not redundant

Redundancies:

Therefore,

CIDP → PR
PC → PR
CIDP → PC
Remove CIDP → PR

So after removing redundancies,

FD = {
CID, P → F,M,L,E,S,IC,CUS,CRS,P,PC
P → S
PC → C,CT,PR
}

Step 2b:

Find & Remove Partial Dependencies:

Since P→ S, remove it from FD of CIDP → {}

New FDs = {
CID → F,M,L,E,IC,CUS,CRS,P,PC
P → S
PC → C,CT,PR
}

Step 3:

Find Keys:

CID + = { CID, F, M, L, P, E, S, C, PC, CT, PR,IC,CUS, CRS } this is the key!

Step 4:

Make Tables:

FD = {
CID → F,M,L,E,IC,CUS,CRS,P,PC
P → S
PC → C,CT,PR
}

Per Functional Dependencies:

CID → F,M,L,E,IC,CUS,CRS,P,PC :	→	R1(CID, F, M, L, E, IC, CUS, CRS, P, PC)
P → S	→	R2(P, S)
PC → C,CT,PR	→	R3(PC,C,CT,PR)

BCNF:

- **A relation is in BCNF if and only if every nontrivial, left irreducible FD has a candidate key as its determinant**

R(CID, F, M, L, P, E, S, C, PC, CT, PR,IC,CUS, CRS)

FD = {

CID, P → F,M,L,E,S,PR,IC,CUS,CRS,P,PC

P → S

PC → C,CT,PR

}

CID+ = {CID, F, M, L, E, IC, CUS, CRS, P, PC} is a key so R1 is in **BCNF** with respect to CID → F,M,L,E,IC,CUS,CRS,P,PC

Already in BCNF

P+ = {P, S} is a key so R2 is in **BCNF** with respect to P → S

Already in BCNF

PC+ = {C, CT, PR} is a key so R3 is in **BCNF** with respect to PC → C, CT, PR

Already in BCNF

Final BCNF Schema for R is:

R1(CID, F, M, L, E, IC, CUS, CRS, P, PC)

R2(P, S)

R3(PC,C,CT,PR)

Car Fleet

Car_plate	Manufacturer	Make	Model_Year	Class	Status	Condition	Start_Service_Date	Initial_Mileage

R(MAN, M, MY, CL, S, C, SSD, IM)

Step 1:
Determining Functional Dependencies:

FD = {
CP → M, MAN, MY ,CL, S, C, SSD, IM
M → MAN, CL
}

Step 2a:
Break RHS and find redundancies

FD = {
CP → M, CP → MAN, CP → MY , CP → CL, CP→ S, CP → C, CP → SSD, CP → IM
M → MAN, M → CL
}

CP → M : CP+ = {MAN, MY ,CL, S, C, SSD, IM} we do not get M, so not redundant
CP → MAN: CP+ = {M, MAN, MY ,CL, S, C, SSD, IM} we do get MAN, so it is redundant
CP → MY: CP+ = {M, MAN ,CL, S, C, SSD, IM} we do not get MY, so not redundant
CP → CL: CP+ = {M, MAN, MY, CL, S, C, SSD, IM} we do get CL, so it is redundant
CP → S: CP + = {M, MAN, MY ,CL, C, SSD, IM} we do not get S, so not redundant
CP → C: CP + = {M, MAN, MY ,CL, S, SSD, IM} we do not get C, so not redundant
CP → SSD: CP+ = {M, MAN, MY ,CL, S, C, IM} we do not get SSD, so not redundant
CP → IM: CP+ = {M, MAN, MY ,CL, S, C, SSD} we do not get IM, so not redundant

M → MAN: M+ = {CL}, we do not get MAN, so not redundant
M → CL: M+ = {MAN}, we do not get CL, so not redundant

Redundancies:
Therefore,

CP → MAN, CL
M → MAN, CL
CP → M
Remove CP → MAN, CL

So after removing redundancies,

FD = {
CP → M, MY, S, C, SSD, IM
M → MAN, CL
}

Step 2b:
Find & Remove Partial Dependencies:

There are no Partial Dependencies

Step 3:
Find Keys:

CP+ { M, MAN, MY ,CL, S, C, SSD, IM } this is the key!

Step 4:
Make Tables:

FD = {
CP → M, MY, S, C, SSD, IM
M → MAN, CL
}

Per Functional Dependencies:

CP → M, MY, S, C, SSD, IM	→	R1(CP,M,MY,S,C,SSD,IM)
M → MAN, CL	→	R2(M,MAN,CL)

*** Table is in BCNF and 3NF Form**

BCNF:

- **A relation is in BCNF if and only if every nontrivial, left irreducible FD has a candidate key as its determinant**

R(MAN, M, MY, CL, S, C, SSD, IM)
FD = {
CP → M, MAN, MY ,CL, S, C, SSD, IM
M → MAN, CL
}

CP+ = {M, MY, S, C, SSD, IM} is a key to R1 and is in **BCNF** with respect to CP → M, MY, S, C, SSD, IM
Already in BCNF

M+ = {MAN, CL} is a key to R2 and is in **BCNF** with respect to M → MAN, CL
Already in BCNF

Final BCNF Schema for R is:
R1(CP,M,MY,S,C,SSD,IM)
R2(M,MAN,CL)

Insurance

I_Code	I_Provider	Phone_Number	Coverage

R(IP, PN, C)

Determining Functional Dependencies:

FD = {

IC → IP, PN, C

}

Booking

Booking_ID	Booking_Status	Mileage_Accumulated	Start_Date	End_Date	Customer_ID	Car_Plate

R(BS, MA, SD, ED, CID, CP)

Determining Functional Dependencies:

FD = {

BID → BS, MA, SD, ED, CID, CP

}

Transactions

Payment_ID	Payment_date	Total_Amount	Payment_Type	Status	Booking_ID

R(PD, TA, PT, S, BID)

Determining Functional Dependencies:

FD = {

PID → PD, TA, PT, S, BID

}

CPS 510 - Assignment 10 - Group 12

Relational Algebra:

Query #1: **/* Shows Economy Class Cars */**

```
SELECT Car_Plate,Manufacturer, Make, Model_Year, Car_Class
FROM CarFleet
WHERE Car_Class = 'Economy'
ORDER BY Model_Year asc;
```

```
τ Model_Year asc
π Car_Plate, Manufacturer, Make, Model_Year, Car_Class (
        σ (Car_Class = 'Economy)'
        (CarFleet))
```

Query #2: **/* Show Insurance Table in Order of Coverage to a certain threshold */**

```
SELECT I_Code, I_Provider, Phone_Number, Coverage
FROM Insurance
WHERE Coverage >= 30000
ORDER BY Coverage desc;
```

```
τ Coverage desc
π I_Code, I_Provider, Phone_Number, Coverage (
        σ (Coverage ≥ 30000)
        (Insurance))
```

Query #3: **/* Join Bookings and Transactions: See which Bookings have been paid */**

```
Select Booking.Booking_ID, Booking.Car_Plate, Transactions.Payment_Date,
Transactions.Status AS Transaction_Status
From Booking
INNER JOIN Transactions
ON Booking.Booking_ID = Transactions.Booking_ID
WHERE Transactions.Status = 'Paid'
ORDER BY Transactions.Payment_Date asc;
```

```
τ Transaction.Payment_Date asc ρ
Transaction_Status←Transaction.Status
π Booking.Booking_ID, Booking.Car_Plate, Transaction.Payment_Date, Transaction.Status (
        σ (Transaction.Status = 'Paid') ( Booking ⋈ Booking.Booking_ID =
Transaction.Booking_ID)
        (Transaction))
```

Query #4: **/* Unionize People not Renting + Renting */**

```
SELECT Customer.Customer_ID, Customer.First_Name, Customer.Last_Name
FROM Customer
WHERE Customer_Status = 'Renting'
UNION
SELECT Customer.Customer_ID, Customer.First_Name, Customer.Last_Name
FROM Customer
WHERE Customer_Status = 'Not Renting';
```

```
π Customer.Customer_ID, Customer.First_Name, Customer.Last_Name (
        σ (Customer_Status = 'Renting)' Customer  ∪
        π Customer.Customer_ID, Customer.First_Name, Customer.Last_Name (
                σ (Customer_Status = 'Not Renting')
                (Customer)))
```

Query #5: **/* Show Customers currently Renting */**

```
Select Customer_ID, First_Name, Middle_Initial, Last_Name, Customer_Status
FROM Customer
WHERE Customer_Status = 'Renting';
```

```
π Customer_ID, First_Name, Middle_Initial, Last_Name, Customer_Status (
        σ (Customer_Status = 'Renting')
        (Customer))
```

Query #6: **/* Show Completed Bookings */**

```
Select Booking_ID, Customer_ID, Car_Plate, Booking_Status
FROM Booking
WHERE Booking_Status = 'Complete';
```

```
π Booking_ID, Customer_ID, Car_Plate, Booking_Status (
        σ (Booking_Status = 'Complete')
        (Booking))
```

Query#7: **/* Join Customers and Insurance: See each Customer's Insurance */**

```
Select Customer.First_Name, Customer.Last_Name, Insurance.I_Provider, Insurance.Coverage
From Customer
INNER JOIN Insurance
ON Customer.I_Code = Insurance.I_Code
ORDER BY Customer.Last_Name asc;
```

```
τ Customer.Last_Name asc
π Customer.First_Name, Customer.Last_Name, Insurance.I_Provider, Insurance.Coverage
        ( Customer ⋈ Customer.I_Code = Insurance.I_Code
        (Insurance) )
```

Query#8: **/* Join Bookings and CarFleet: See which cars are currently being Rented */**

```
Select Booking.Customer_ID, CarFleet.Manufacturer, CarFleet.Make, CarFleet.Car_Class,
Booking.Booking_Status
From Booking
INNER JOIN CarFleet
ON Booking.Car_Plate = CarFleet.Car_Plate
WHERE Booking_Status = 'In-Progress'
ORDER BY CarFleet.Car_Class asc;
```

```
τ CarFleet.Car_Class asc
π Booking.Customer_ID, CarFleet.Manufacturer, CarFleet.Make, CarFleet.Car_Class,
Booking.Booking_Status (
        σ (Booking_Status = 'In-Progress') ( Booking ⋈ Booking.Car_Plate = CarFleet.Car_Plate
        (CarFleet) ))
```