

## Function Dependencies (With Normalization):

**Assigned\_Seat** (Ticket number (TN), Carriage No(CN), Seat No. (SN), Class: (CL))

TN, CN, SN $\rightarrow$ CL

CN $\rightarrow$ CL

Primary Key: (TN, CN, SN)

Candidate Key: (TN, CN, SN)

CN $\rightarrow$ CL violates BCNF or 3NF (LHS not SK), need to be normalized:

**Assigned\_Seat** (Ticket number (TN), Carriage No(CN), Seat No. (SN))

TN, CN, SN $\rightarrow$ TN, CN, SN

Primary Key: (TN, CN, SN)

Candidate Key: (TN, CN, SN)

Foreign Key: (CN) REFERENCES Carriage\_Class (CN)

**Carriage\_Class** (Carriage No(CN), Class: (CL))

CN $\rightarrow$ CL

Primary Key: (CN)

Candidate Key: (CN)

**Train\_Station** (City(CI), Station name (SN))

CI, SN $\rightarrow$ CI, SN

Primary Key: (CI, SN)

Candidate Key: (CI, SN)

All FDs' LHS are SK, no need to normalize

**Ticket\_Schedule** (Ticket Number (TN), Departure city (DC) Departure station (DS),  
Departure time (DT), Arrival city: (AC) , Arrival station: (AS), Arrival time: (A  
T))

TN $\rightarrow$ DC, DS, DT, AC, AS, AT

Primary Key: TN

Candidate Key: TN

All FDs' LHS are SK, no need to normalize

**Train\_Trip** (Train Trip Number (TTN))

TTN→TTN

Primary Key: TTN

Candidate Key: TTN

All FDs' LHS are SK, no need to normalize

**Train\_Staff** (ID: INTEGER, Name: CHAR(20))

ID→Name

Primary Key: ID

Candidate Key: ID

All FDs' LHS are SK, no need to normalize

**Monitor** (Train Trip Number: (TTN), City(CI), Station name (SN), Staff ID (SID))

TTN, CI, SN→SID

Primary Key: (TTN, CI, SN)

Candidate Key: (TTN, CI, SN)

All FDs' LHS are SK, no need to normalize

**Train\_Trip\_Departure** (Train Trip Number (TTN), Departure city: (DC), Departure station: (DS), Departure time: (DT))

TTN, DC, DS→DT

TTN, DT→DC, DS

Primary Key: (TTN, DC, DS)

Candidate Keys: (TTN, DC, DS), (TTN, DT)

All FDs' LHS are SK, no need to normalize

**Train\_Trip\_Arrival** (Train Trip Number (TTN) , Arrival city: (AC), Arrival station: (AS), Arrival time: (AT))

TTN, AC, AS→AT

TTN, AT→AC, AS

Primary Key: (TTN, AC, AS)

Candidate Keys: (TTN, AC, AS), (TTN, AT)

All FDs' LHS are SK, no need to normalize

**Board\_Ticket** (Ticket Number (TN), Train Trip Number: (TTN))

TN→TTN

Primary Key: TN

Candidate Key: TN

All FDs' LHS are SK, no need to normalize

**Passenger** (Government ID Type(IDT), ID number(ID), First name: (FN), Last name: (LN))

$IDT, ID \rightarrow FN, LN$

Primary Key: (IDT, ID)

Candidate Key: (IDT, ID)

All FDs' LHS are SK, no need to normalize

**Passenger\_Ticket** (Ticket Number: TN, Government ID Type(IDT), ID number(ID))

$TN \rightarrow IDT, ID$

Primary Key: TN

Candidate Key: TN

All FDs' LHS are SK, no need to normalize

**One\_Ordered\_Ticket** (Ticket Number (TN), Government ID Type (IDT), ID number (ID), Order Number (ON))

$TN, IDT, ID, ON \rightarrow TN, IDT, ID, ON$

Primary Key: (TN, IDT, ID, ON)

Candidate Key: (TN, IDT, ID, ON)

All FDs' LHS are SK, no need to normalize

**User** (User ID(UID), Password (PW), Email Address (EA))

$UID \rightarrow PW, EA$

$EA \rightarrow UID, PW$

Primary Key: UID

Candidate Keys: UID, EA

All FDs' LHS are SK, no need to normalize

**Placed\_Order** (Order Number: (ON), User ID: (UID), Total Ticket Price: (TP), Total Discount: (TDIS), Total Paid: (TOTP), Payment Type: (PT))

$ON \rightarrow UID, TP, TDIS, TOTP, PT$

Primary Key: ON

Candidate Key: ON

All FDs' LHS are SK, no need to normalize

**Adult** (Government ID Type (IDT), ID number (ID), First name(FN), Last name (LN), Discount (DIS), Age, Phone Number (PN), Address (AD), Special ID Type (SIDT), Special ID Number: (SID))

IDT, ID→FN, LN, DIS, Age, PN, AD, SIDT, SID

Age, SIDT→DIS

Primary Key: (IDT, ID)

Candidate Keys: (IDT, ID), (FN, LN, PN), (FN, LN, AD)

Age, SIDT→DIS violates BCNF or 3NF (LHS not SK), need to be normalized:

**Adult** (Government ID Type (IDT), ID number (ID), First name(FN), Last name (LN), Age, Phone Number (PN), Address (AD), Special ID Type (SIDT), Special ID Number: (SID))

IDT, ID→FN, LN, Age, PN, AD, SIDT, SID

Primary Key: (IDT, ID)

Candidate Keys: (IDT, ID), (FN, LN, PN), (FN, LN, AD)

Foreign Key: (Age, SIDT) REFERENCES Adults\_Discount (Age, SIDT)

**Adults\_Discount** (Age, Special ID Type (SIDT), Discount: (DIS))

Age, SIDT→DIS

Primary Key: (Age, SIDT)

Candidate Key: (Age, SIDT)

**Guarded\_Child** (Chile ID Type (CIDT), Child ID number (CID), Child Discount (DIS), First name (FN), Last name (LN), Age, Adult ID Type(AIDT), Adult ID number (AID))

CIDT, CID→DIS, Age, FN, LN, AIDT, AID

Age→DIS

Primary Key: (CIDT, CID)

Candidate Key: (CIDT, CID)

Age→DIS violates BCNF or 3NF (LHS not SK), need to be normalized:

**Guarded\_Child** (Chile ID Type (CIDT), Child ID number (CID), First name (FN), Last name (LN), Child\_Age (Age), Adult ID Type(AIDT), Adult ID number (AID))

CIDT, CID→Age, FN, LN, AIDT, AID

Primary Key: (CIDT, CID)

Candidate Key: (CIDT, CID)

Foreign Key: (Child\_Age) REFERENCES Children\_Discount (Child\_Age)

**Children\_Discount** (Child\_Age (Age), Discount: (DIS))

Age→DIS

Primary Key: Age

Candidate Key: Age

## Populate tables

Table User

User	Password	Email Address
a1	111	a1@ubc.ca
a2	222	a2@ubc.ca
a3	333	a3@ubc.ca
a4	444	a4@ubc.ca
a5	555	a5@ubc.ca

Table Placed Order

User ID	Order Num	Ticket Price	Discount	Total Paid	Payment Type
a1	1	100	10	90	Counter
a2	2	100	0	100	Credit
a3	3	200	0	200	Credit
a4	4	100	0	100	Points
a5	5	300	30	270	Credit

Table Adult

IDT	ID	First Name	Last Name	Age
Driver Licence	29387412	Lucy	Du	21
Passport	E23432233	Michael	Ding	34
Driver Licence	34452343	Kevin	Hu	36
Health Card	30452323	Andy	Liu	70
Government ID Card	39349203849302821	Edmond	Zhang	25

Phone	Address	Special ID Type	Special ID Number
7788854445	2205 Lower Mall	Student	40401212
7784561234	1385 West Mall	Null	

7784445569	7713 East Mall	Employee	44554412
7789874561	4511 Wesbrook Mall	Null	
7785461230	1200 Chancellor Boulevard	Null	

Table Adults Discount

Age	Special ID Type	Discount
22	Student	0.9
30	Null	0
68	Null	0.8
35	Employee	0.7
22	Null	0

Table Child

IDT	ID	First Name	Last Name	Age	Adult ID	Adult
Passport	E24432323	Gloria	Liu	3	Health Card	30452323
Health Card	3432123	Anderson	Hu	7	Driver Licence	34452343
Passport	E45353123	Kath	Liu	13	Health Card	30452323
HealthCard	5655421	Mike	Zhang	15	Government ID Card	393492038 49302821
HealthCard	4532312	Steven	Du	2	Driver Licence	29387412

Table Children Discount

Age	Discount
2	1
3	1
7	0.5

13	0.7
15	0.7

Table One\_Ordered\_Ticket

Ticket Number	Government ID Type	ID Number	Order Number
123456	Driver Licence	29387412	222120
423421	Driver Licence	29387412	222120
537839	Passport	E23432233	222121
256542	Driver Licence	34452343	222122
246488	Health Card	3432123	222122
678564	Passport	E24432323	222120

Table Passenger\_Ticket

Ticket Number	Government ID Type	ID Number
123456	Driver Licence	29387412
423421	Driver Licence	29387412
537839	Passport	E23432233
256542	Driver Licence	34452343
246488	Health Card	3432123
678564	Passport	E24432323

Table Passenger

Government ID Type	ID Number	First Name	Last Name
Driver Licence	29387412	Lucy	Du
Passport	E23432233	Michael	Ding
Driver Licence	34452343	Kevin	Hu
Health Card	30452323	Andy	Liu
Government ID Card	39349203849302821	Edmond	Zhang
Passport	E24432323	Gloria	Liu

Health Card	3432123	Anderson	Hu
Passport	E45353123	Kath	Liu
HealthCard	5655421	Mike	Zhang
HealthCard	4532312	Steven	Du

Table Board\_Ticket

Ticket Number	Train Trip Number
123456	V320
423421	V321
537839	T341
256542	T342
246488	T342
678564	V320

Train Trip Departure

Train Trip Number	Departure City	Departure Station	Departure Time
V320	Vancouver	Pacific Central Station	9:00 on Feb 4
V320	Edmonton	Edmonton Train Station	12:10 on Feb 5
V320	Toronto	Toronto Pearson International Airport	9:10 on Feb 7
V321	Toronto	Toronto Union Station	12:00 on Feb 8
V321	Toronto	Toronto Pearson International Airport	13:30 on Feb 8
V321	Edmonton	Edmonton Train Station	23:10 on Feb 10
T342	Toronto	Toronto Pearson International Airport	10:30 on Feb 4



T342	Toronto	Toronto Union Station	12:00 on Feb 4
T341	Ottawa	Ottawa Central Station	11:30 on Feb 3
T341	Toronto	Toronto Union Station	20:40 on Feb 3

Train Trip Arrival

Train Trip Number	Arrival City	Arrival Station	Arrival Time
V320	Edmonton	Edmonton Train Station	12:00 on Feb 5
V320	Toronto	Toronto Pearson International Airport	9:00 on Feb 7
V320	Toronto	Toronto Union Station	10:20 on Feb 7
V321	Toronto	Toronto Pearson International Airport	13:20 on Feb 8
V321	Edmonton	Edmonton Train Station	23:00 on Feb 10
V321	Vancouver	Pacific Central Station	15:00 on Feb 11
T342	Toronto	Toronto Union Station	11:50 on Feb 4
T342	Ottawa	Ottawa Central Station	20:30 on Feb 4
T341	Toronto	Toronto Union Station	20:30 on Feb 3
T341	Toronto	Toronto Pearson International Airport	21:50 on Feb 3

Table Assigned\_Seat

Ticket_Number	Carriage_No	Seat_No
123456	1	22

423421	1	23
537839	5	19
256542	2	31
246488	2	10
678564	6	10

Table Carriage\_Class

Carriage_No	Class
1	Business
2	Economy Plus
3	Economy Plus
4	Economy
5	Economy
6	Economy

Table Train\_Station

City	Station
Vancouver	Pacific Central Station
Toronto	Toronto Union Station
Toronto	Toronto Pearson International Airport
Edmonton	Edmonton Train Station
Ottawa	Ottawa Central Station

Table Ticket\_Schedule

Ticket_No	De_City	De_Station	De_Time	Ar_City	Ar_Station	Ar_Time
123456	Vancouver	Pacific Central Station	9:00 on Feb 4	Toronto	Toronto Union Station	10:20 on Feb 7
423421	Toronto	Toronto Pearson International Air	13:30 on Feb 8	Edmonton	Edmonton Train Station	23:00 on Feb 10

		port				
537839	Ottawa	Ottawa Central Station	11:30 on Feb 3	Toronto	Toronto Union Station	21:50 on Feb 3
256542	Toronto	Toronto Pearson International Airport	10:30 on Feb 4	Ottawa	Ottawa Central Station	20:30 on Feb 4
246488	Toronto	Toronto Union Station	12:00 on Feb 4	Ottawa	Ottawa Central Station	20:30 on Feb 4
678564	Vancouver	Pacific Central Station	9:00 on Feb 4	Toronto	Toronto Union Station	10:20 on Feb 7

Table Train\_Trip

Train_Trip_Number
V320
V321
T342
T341
T121

Table Train\_Staff

ID	Name
1000	Isha Mehta
2547	Alex Deacon
3357	Angela Machado
4768	Armin Talaie
5134	Jason Nguyen

Table Monitor

Train Trip Number	City	Station_Name	Staff_ID
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V320	Vancouver	Pacific Central Station	1000
V321	Toronto	Toronto Union Station	2547
T342	Toronto	Toronto Union Station	2547
T342	Ottawa	Ottawa Central Station	5134
T112	Montreal	Montreal Train Station	3357