

## Question 1

Assumptions:

1. Assume one manual form contains all parts a customer orderers at the given date and time.

All data laid out as below. The original from (paper form) is in UNF, since it has repeating groups (partNumber, name, type, cageCode, quantityOrdered, unitPrice). After laying out all data below, this table is in 1NF. Composite PK (customerNumber, date, time, partNumber) can be used to identify a unique record.

PK customerNumber	customerName	customerType	PK date	PK time	employee	PK partNumber	name	type	cageCode	quantityOrdered	unitPrice
HG54587	Jeff Peterson	Consumer	7/1/2024	10:30am	D.Harrison	10654	Float Control	Plumbing	G413	4	12
HG54587	Jeff Peterson	Consumer	7/1/2024	10:30am	D.Harrison	10456	Modulator	Electrical	H433	3	7
HG54587	Jeff Peterson	Consumer	7/1/2024	10:30am	D.Harrison	10776	Hose Assembly	Plumbing	G413	7	9
HG54587	Jeff Peterson	Consumer	7/1/2024	10:30am	D.Harrison	10657	Float Assembly	Plumbing	G413	5	10

1NF

Functional Dependencies:  
partNumber → (name, type, cageCode, unitPrice)  
customerNumber → (customerName, customerType)  
(customerNumber, date, time) → employee  
(customerNumber, date, time, partNumber) → quantityOrdered

There are partial dependencies as spotted in the FDs. Thus to qualify 2NF, I created more tables to ensure no table contains partial dependencies.

customer		
PK customerNumber	customerName	customerType
HG54587	Jeff Peterson	Consumer

part				
PK partNumber	name	type	cageCode	unitPrice
10654	Float Control	Plumbing	G413	12
10456	Modulator	Electrical	H433	7
10776	Hose Assembly	Plumbing	G413	9
10657	Float Assembly	Plumbing	G413	10

service_record			
PK customerName	PK date	PK time	employee
Jeff Peterson	7/1/2024	10:30am	D.Harrison

order_quantity				
PK partNumber	PK customerNumber	PK date	PK time	quantityOrdered
10654	HG54587	7/1/2024	10:30am	4
10456	HG54587	7/1/2024	10:30am	3
10776	HG54587	7/1/2024	10:30am	7
10657	HG54587	7/1/2024	10:30am	5

2NF & 3NF

Now all non-key attributes depend on the whole key. This is in 2NF.

Note that there are no transitive dependencies in the tables, thus the tables are already in 3NF. Below are tables with relationships marked.

customer		
PK customerNumber	customerName	customerType
HG54587	Jeff Peterson	Consumer

service_record			
PK customerName	PK date	PK time	employee
Jeff Peterson	7/1/2024	10:30am	D.Harrison

PK partNumber	PK customerNumber	PK date	PK time	quantityOrdered
10654	HG54587	7/1/2024	10:30am	4
10456	HG54587	7/1/2024	10:30am	3
10776	HG54587	7/1/2024	10:30am	7
10657	HG54587	7/1/2024	10:30am	5

3NF with relationships marked

PK partNumber	name	type	cageCode	unitPrice
10654	Float Control	Plumbing	G413	12
10456	Modulator	Electrical	H433	7
10776	Hose Assembly	Plumbing	G413	9
10657	Float Assembly	Plumbing	G413	10

## Question 2

Assumptions:

1. Each therapist has their unique staffNo.
2. Each patient has their unique patNo.
3. A patient can have multiple appointments on a same day, but not two at the same time.
4. A therapist can have multiple appointments on a same day, but only at one branch.

staffNo	therapistName	patNo	patName	appointment date	time	branchNo
S1011	Fred Smith	P100	Lily White	9/12/2022	10:00	M15
S1011	Fred Smith	P105	Jill Baker	9/12/2022	12:00	M15
S1024	Heidi Pierce	P108	Andy McKee	9/12/2022	10:00	Q10
S1024	Heidi Pierce	P108	Andy McKee	9/14/2022	14:00	Q10
S1032	Richard Levin	P105	Jill Baker	9/14/2022	16:30	M15
S1032	Richard Levin	P110	Jimmy Winter	9/15/2022	18:00	B13

The given table laid out all information. This is not in normal form (not 1NF) since there are two values of different type in the column appointment that are date and time.

To normalize table to 1NF, I separated appointment into two columns date, and time. Now the table holds atomic values, and that primary key (composite key) is defined.

1NF

PK staffNo	therapistName	PK patNo	patName	PK date	PK time	branchNo
S1011	Fred Smith	P100	Lily White	9/12/2022	10:00	M15
S1011	Fred Smith	P105	Jill Baker	9/12/2022	12:00	M15
S1024	Heidi Pierce	P108	Andy McKee	9/12/2022	10:00	Q10
S1024	Heidi Pierce	P108	Andy McKee	9/14/2022	14:00	Q10
S1032	Richard Levin	P105	Jill Baker	9/14/2022	16:30	M15
S1032	Richard Levin	P110	Jimmy Winter	9/15/2022	18:00	B13

Composite key: (patNo, appointmentDate, appointmentTime) and (staffNo, appointmentDate, appointmentTime)

Functional Dependencies:  
• staffNo → therapistName  
• patNo → patName  
• (staffNo, tdate) → branchNo (one branch per therapist per day)  
• (patNo, date, time) → staffNo, branchNo  
• (staffNo, date, time) → patNo

To normalize to 2NF, I removed the following partial dependencies:  
therapistName depends on staffNo.  
patName depends on patNo.  
branchNo depends on (staffNo, appointmentDate).

therapist	
PK staffNo	therapistName
S1011	Fred Smith
S1024	Heidi Pierce
S1032	Richar Levin

patient	
PK patNo	patName
P100	Lily White
P105	Jill Baker
P108	Andy McKee
P110	Jimmy Winter

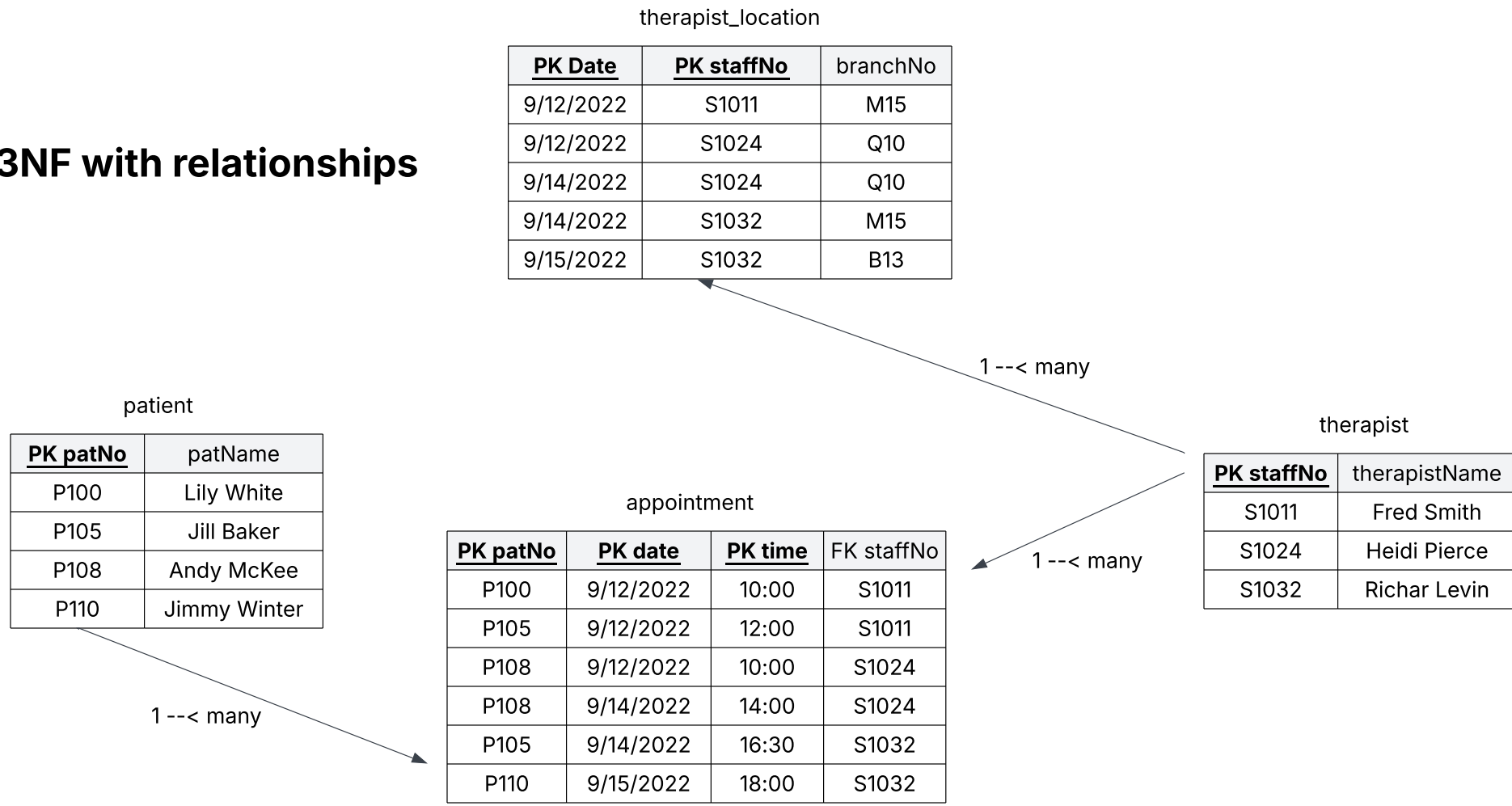
therapist_location		
PK staffNo	PK Date	branchNo
S1011	9/12/2022	M15
S1024	9/12/2022	Q10
S1024	9/14/2022	Q10
S1032	9/14/2022	M15
S1032	9/15/2022	B13

PK patNo	PK date	PK time	staffNo
P100	9/12/2022	10:00	S1011
P105	9/12/2022	12:00	S1011
P108	9/12/2022	10:00	S1024
P108	9/14/2022	14:00	S1024
P105	9/14/2022	16:30	S1032
P110	9/15/2022	18:00	S1032

2NF & 3NF

This is in 2NF because all non-key attributes depend on the whole key.  
Note that there are no transitive dependencies, thus the tables are already in 3NF.

3NF with relationships



## Question 3

Assumptions:

1. Each event has exactly one location.
2. Each row records the total hours worked for one employee under one contract.

eNo	contractNo	hours	eName	eventNo	eventLoc
1135	C1024	16	Smith J	H25	Queens
1057	C1024	24	Hocine D	H25	Queens
1068	C1025	28	White T	H4	Yonkers
1135	C1025	15	Smith J	H4	Yonkers
1135	C1026	10	Smith J	H25	Queens

The given table laid out all data, and is not in normal form. This table it stores atomic values, but is missing a primary key or composite.

PK eNo	PK contractNo	hours	eName	eventNo	eventLoc
1135	C1024	16	Smith J	H25	Queens
1057	C1024	24	Hocine D	H25	Queens
1068	C1025	28	White T	H4	Yonkers
1135	C1025	15	Smith J	H4	Yonkers
1135	C1026	10	Smith J	H25	Queens

I identified the primary key (eNo, contractNo) and included this information in the table. Now this table stores atomic values and has primary key, thus it qualifies to be 1NF. Not that this primary key choice can also be confirmed with FDs. Using an unique (eNo, contractNo) pair, we are able to locate a unique row.

Functional Dependencies:  
• eNo → eName  
• contractNo → eventNo  
• eventNo → eventLoc  
• (eNo, contractNo) → hours  
• contractNo → eventLoc (by transitivity as shown above)

1NF

To remove partial dependencies, I try to resolve:  
• Attributes depending only on eNo: eName  
• Attributes depending only on contractNo: eventNo, eventLoc  
I created three separate tables to ensure that they are in 2NF (no partial dependencies).

employee	
PK eNo	eName
1135	Smith J
1057	Hocine D
1068	White T

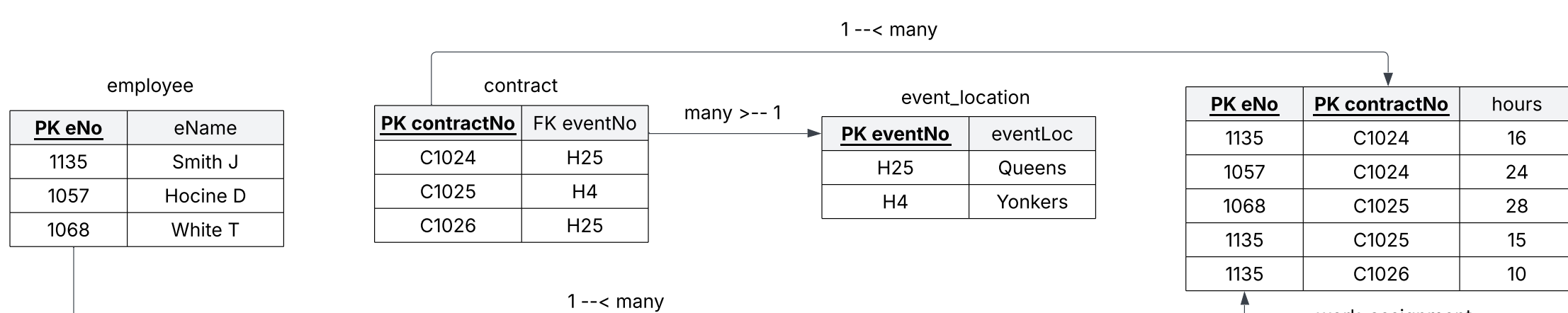
contract_info		
PK contractNo	eventNo	eventLoc
C1024	H25	Queens
C1025	H4	Yonkers
C1026	H25	Queens

work_assignment		
PK eNo	PK contractNo	hours
1135	C1024	16
1057	C1024	24
1068	C1025	28
1135	C1025	15
1135	C1026	10

2NF

Every non-key attribute is fully functionally dependent on the entire key of that relation (no dependency on just eNo or just contractNo inside work\_assignment; single-attribute keys in employee and contract\_info vacuously satisfy 2NF).

In contract\_info, eventNo → eventLoc (transitive via contractNo). Thus to normalize to 3NF, I split this table into two tables: event\_Location with (eventNo, eventLoc) and contract with (contractNo, eventNo). This ensures all transitive dependencies are removed.



3NF