UNTAR
Universitas Tarumanagara

Terakreditasi BAN PT A (Unggul) | QS STARS RATING SYSTEM 2019 | JABEE | CPA AUSTRALIA | ICAEW CHARTERED ACCOUNTANTS

UNTAR untuk INDONESIA

DATABASE DESIGN & MANAGEMENT

SI10317

PROGRAM STUDI SISTEM INFORMASI

UIVERRSITAS TARUMANAGARA

Pertemuan 5

Normalization: Review

Normalization

- Tujuan utama dalam membangun model data logis (logical data model) untuk sistem basis data relasional adalah untuk membuat representasi data secara akurat, hubungan antara datanya, dan batasannya.

- Untuk mencapai tujuan ini, harus mengidentifikasi setiap pasangan yang cocok dari relasi (atau tabel, atau entitas).

Normalization

- **Four most commonly used normal forms are first (1NF), second (2NF) and third (3NF) normal forms, and Boyce–Codd normal form (BCNF).**
- **Based on functional dependencies among the attributes of a relation.**
- **A relation can be normalized to a specific form to prevent possible occurrence of update anomalies.**

Data Redundancy

- Tujuan utama dari desain basis data model relasional adalah untuk mengelompokkan atribut ke dalam relasi untuk meminimalkan kerangkapan data dan mengurangi ruang penyimpanan file.

- Masalah yang terkait dengan kerangkapan data diilustrasikan dengan membandingkan relasi Staff dan Branch dengan relasi StaffBranch berikut ini.

Data Redundancy

Staff

staffNo	sName	position	salary	branchNo
SL21	John White	Manager	30000	B005
SG37	Ann Beech	Assistant	12000	B003
SG14	David Ford	Supervisor	18000	B003
SA9	Mary Howe	Assistant	9000	B007
SG5	Susan Brand	Manager	24000	B003
SL41	Julie Lee	Assistant	9000	B005

Branch

branchNo	bAddress
B005	22 Deer Rd, London
B007	16 Argyll St, Aberdeen
B003	163 Main St, Glasgow

Staff Branch

staffNo	sName	position	salary	branchNo	bAddress
SL21	John White	Manager	30000	B005	22 Deer Rd, London
SG37	Ann Beech	Assistant	12000	B003	163 Main St, Glasgow
SG14	David Ford	Supervisor	18000	B003	163 Main St, Glasgow
SA9	Mary Howe	Assistant	9000	B007	16 Argyll St, Aberdeen
SG5	Susan Brand	Manager	24000	B003	163 Main St, Glasgow
SL41	Julie Lee	Assistant	9000	B005	22 Deer Rd, London

Data Redundancy

- Relasi StaffBranch memiliki kerangkapan data: detail dari cabang (branchNo) diulang untuk setiap anggota staf

- Sebaliknya, informasi cabang hanya muncul sekali untuk setiap cabang pada Relasi Branch dan hanya branchNo yang diulang pada Relasi Staff, untuk mewakili di mana setiap anggota staf bekerja

Update Anomalies

- **Relations that contain redundant information may potentially suffer from update anomalies.**

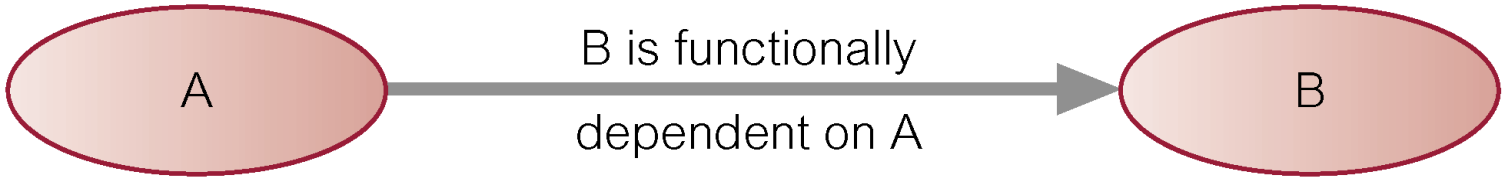
- **Types of update anomalies include:**
  - **Insertion,**
  - **Deletion,**
  - **Modification.**

Functional Dependency

- Main concept associated with normalization.
- Functional Dependency
  - Describes relationship between attributes in a relation.
  - If A and B are attributes of relation R, B is functionally dependent on A (denoted A → B), if each value of A in R is associated with exactly one value of B in R.

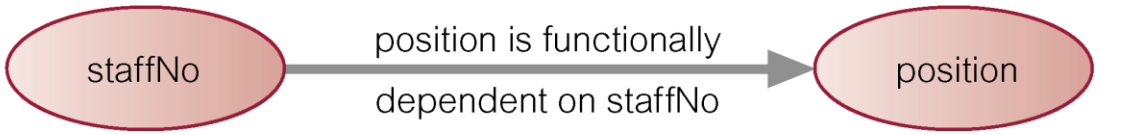
Functional Dependency

- Property of the meaning (or semantics) of the attributes in a relation.
- representation:

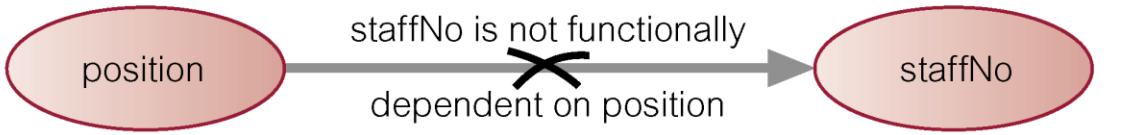


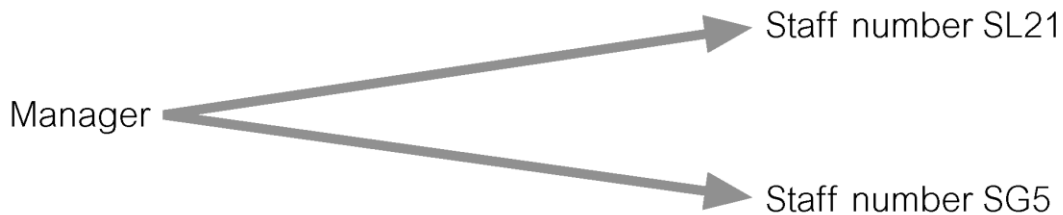
- *Determinant* of a functional dependency refers to attribute or group of attributes on left-hand side of the arrow.

Example - Functional Dependency



(a)





(b)

Functional Dependency

- Main characteristics of functional dependencies used in normalization:
  - have a 1:1 relationship between attribute(s) on left and right-hand side of a dependency;
  - hold for all time;
  - are nontrivial.

Functional Dependency

- Let A, B, and C be subsets of the attributes of relation R. Armstrong's axioms are as follows:

1. Reflexivity

   If B is a subset of A, then $A \rightarrow B$

2. Augmentation

   If $A \rightarrow B$, then $A,C \rightarrow B,C$

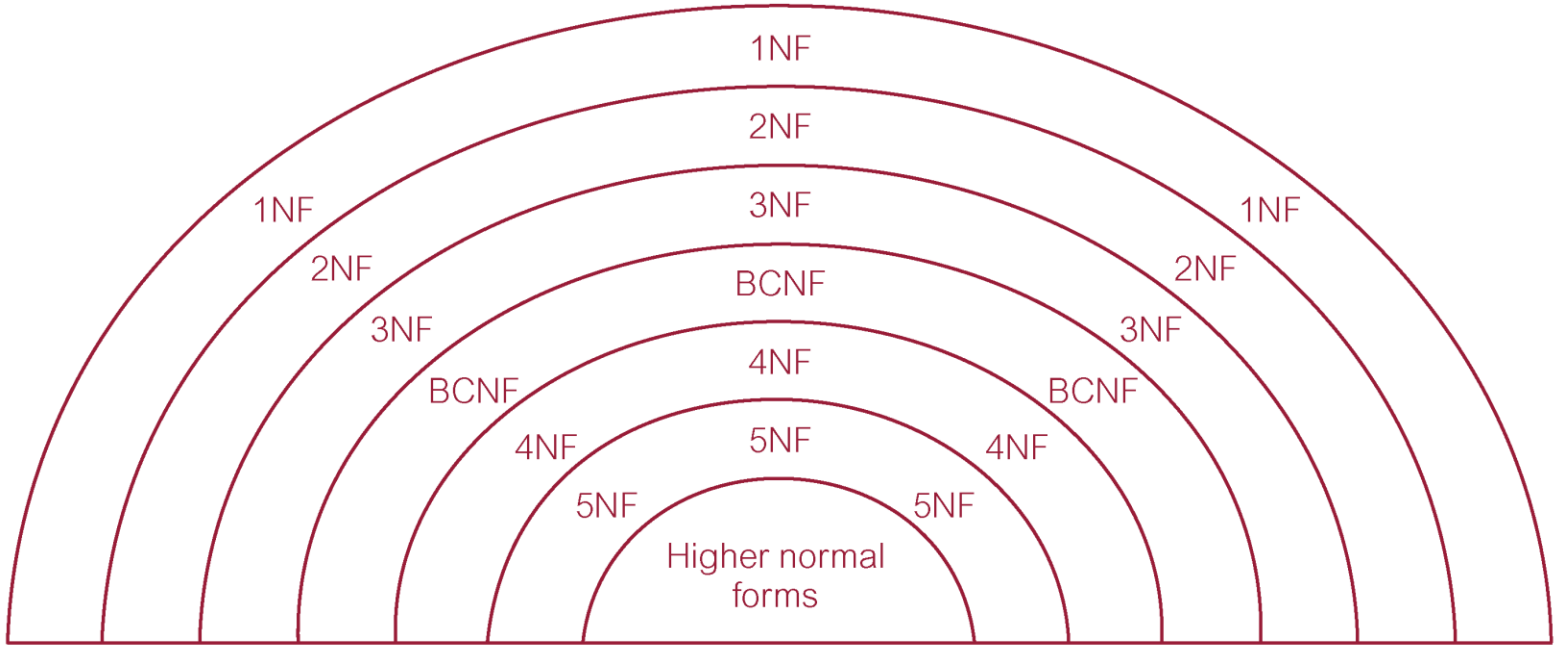
3. Transitivity

   If $A \rightarrow B$ and $B \rightarrow C$, then $A \rightarrow C$

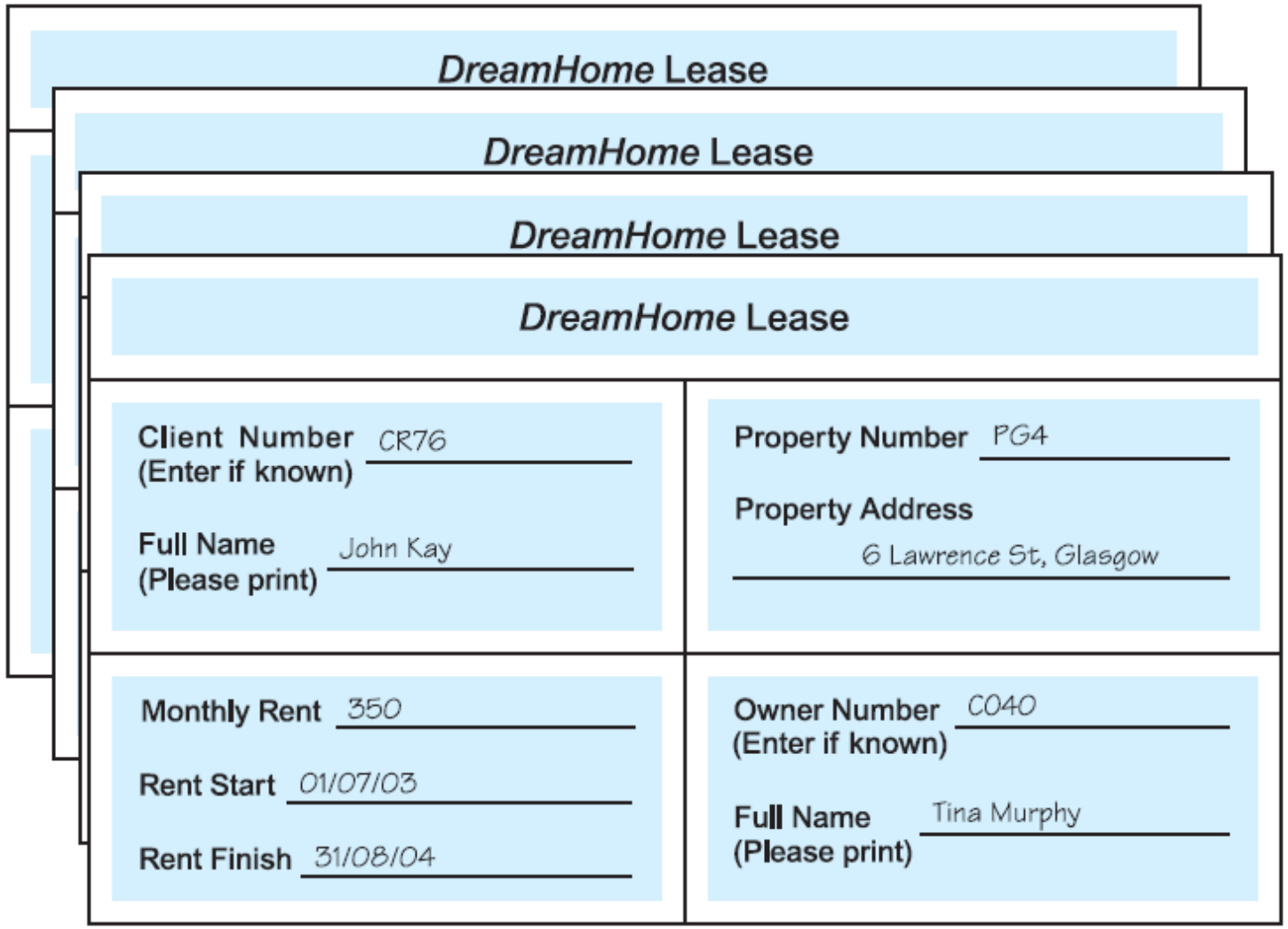
The Process of Normalization

- Teknik formal untuk menganalisis suatu relasi berdasarkan pada ketergantungan primary key dan ketergantungan fungsional di antara atribut-atributnya
- Sering dieksekusi sebagai serangkaian langkah. Setiap langkah sesuai dengan bentuk normal tertentu.
- Ketika normalisasi berlangsung, relasi menjadi semakin lebih terbatas (lebih kuat) dalam bentuk dan juga menghindari terjadinya anomali dalam pembaruan data.

Relationship Between Normal Forms



Unnormalized Form (UNF)



Unnormalized Form (UNF)

- A table that contains one or more repeating groups.
- To create an unnormalized table:
  - transform data from information source (e.g. form) into table format with columns and rows.

ClientRental

clientNo	cName	propertyNo	pAddress	rentStart	rentFinish	rent	ownerNo	oName
CR76	John Kay	PG4	6 Lawrence St, Glasgow	1-Jul-03	31-Aug-04	350	CO40	Tina Murphy
		PG16	5 Novar Dr, Glasgow	1-Sep-04	1-Sep-05	450	CO93	Tony Shaw
CR56	Aline Stewart	PG4	6 Lawrence St, Glasgow	1-Sep-02	10-June-03	350	CO40	Tina Murphy
		PG36	2 Manor Rd, Glasgow	10-Oct-03	1-Dec-04	375	CO93	Tony Shaw
		PG16	5 Novar Dr, Glasgow	1-Nov-05	10-Aug-06	450	CO93	Tony Shaw

First Normal Form (1NF)

- **A relation in which intersection of each row and column contains one and only one value.**

ClientRental

clientNo	propertyNo	cName	pAddress	rentStart	rentFinish	rent	ownerNo	oName
CR76	PG4	John Kay	6 Lawrence St, Glasgow	1-Jul-03	31-Aug-04	350	CO40	Tina Murphy
CR76	PG16	John Kay	5 Novar Dr, Glasgow	1-Sep-04	1-Sep-05	450	CO93	Tony Shaw
CR56	PG4	Aline Stewart	6 Lawrence St, Glasgow	1-Sep-02	10-Jun-03	350	CO40	Tina Murphy
CR56	PG36	Aline Stewart	2 Manor Rd, Glasgow	10-Oct-03	1-Dec-04	375	CO93	Tony Shaw
CR56	PG16	Aline Stewart	5 Novar Dr, Glasgow	1-Nov-05	10-Aug-06	450	CO93	Tony Shaw

ClientRental (clientNo, propertyNo, cName, pAddress, rentStart, rentFinish, rent, ownerNo, oName)

UNF to 1NF

- Nominate an attribute or group of attributes to act as the key for the unnormalized table.
- Identify repeating group(s) in unnormalized table which repeats for the key attribute(s).

UNF to 1NF

- Remove repeating group by:
  - entering appropriate data into the empty columns of rows containing repeating data (‘flattening’ the table).

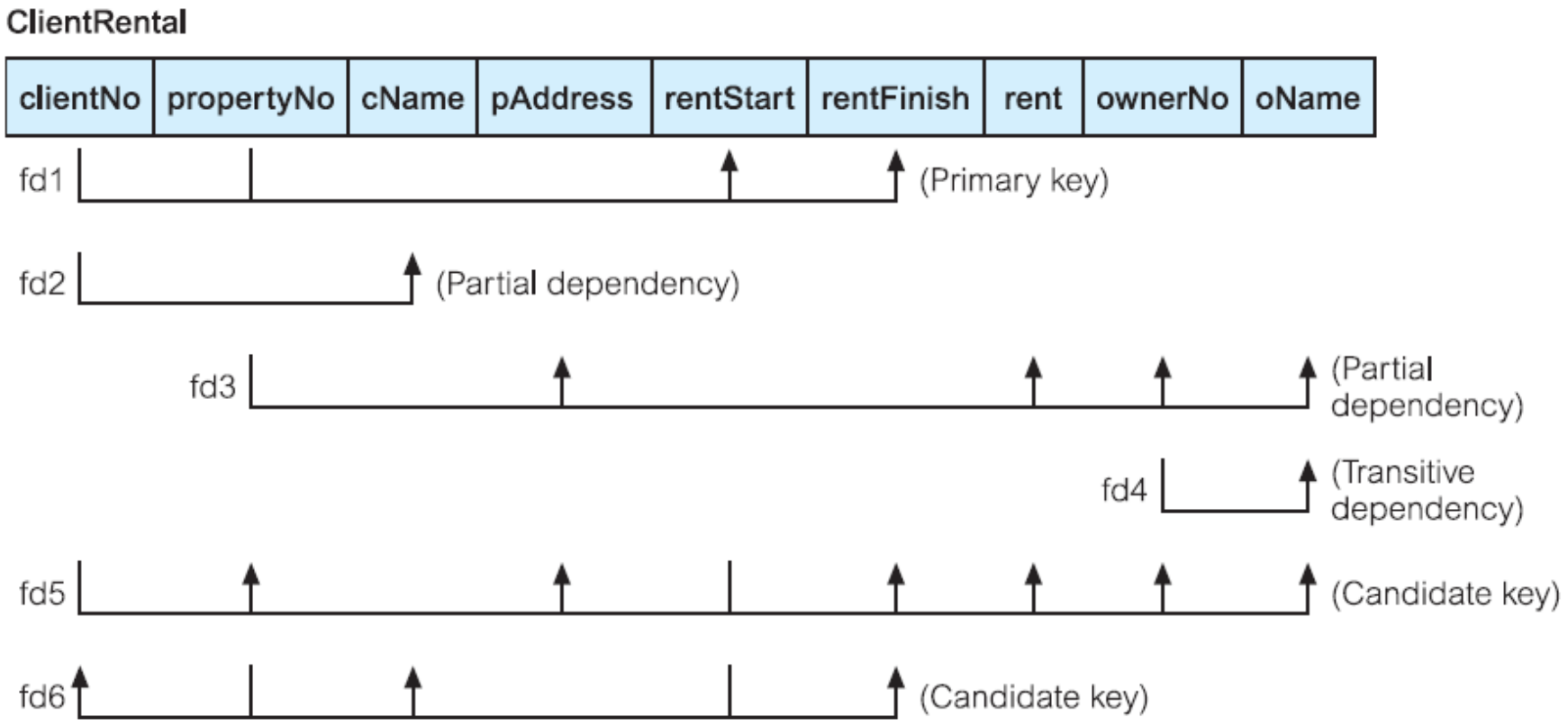
  Or by
  - placing repeating data along with copy of the original key attribute(s) into a separate relation.

Second Normal Form (2NF)

- Based on concept of full functional dependency:
  - A and B are attributes of a relation,
  - B is fully dependent on A if B is functionally dependent on A but not on any proper subset of A.

- 2NF - A relation that is in 1NF and every non-primary-key attribute is fully functionally dependent on the primary key.

Second Normal Form (2NF)



Second Normal Form (2NF)

Client

clientNo	cName
CR76	John Kay
CR56	Aline Stewart

PropertyRentalOwner

clientNo	propertyNo	pAddress	rentStart	rentFinish	rent	ownerNo	oName
CR76	PG4	6 Lawrence St, Glasgow	1-Jul-03	31-Aug-04	350	CO40	Tina Murphy
CR76	PG16	5 Novar Dr, Glasgow	1-Sep-04	1-Sep-05	450	CO93	Tony Shaw
CR56	PG4	6 Lawrence St, Glasgow	1-Sep-02	10-Jun-03	350	CO40	Tina Murphy
CR56	PG36	2 Manor Rd, Glasgow	10-Oct-03	1-Dec-04	375	CO93	Tony Shaw
CR56	PG16	5 Novar Dr, Glasgow	1-Nov-05	10-Aug-06	450	CO93	Tony Shaw

Client (clientNo, cName)

PropertyRentalOwner (clientNo, propertyNo, pAddress, rentStart, rentFinish, rent, ownerNo, oName)

Second Normal Form (2NF)

Client

clientNo	cName
CR76	John Kay
CR56	Aline Stewart

Rental

clientNo	propertyNo	rentStart	rentFinish
CR76	PG4	1-Jul-03	31-Aug-04
CR76	PG16	1-Sep-04	1-Sep-05
CR56	PG4	1-Sep-02	10-Jun-03
CR56	PG36	10-Oct-03	1-Dec-04
CR56	PG16	1-Nov-05	10-Aug-06

PropertyOwner

propertyNo	pAddress	rent	ownerNo	oName
PG4	6 Lawrence St, Glasgow	350	CO40	Tina Murphy
PG16	5 Novar Dr, Glasgow	450	CO93	Tony Shaw
PG36	2 Manor Rd, Glasgow	375	CO93	Tony Shaw

Second Normal Form (2NF)

Client	(clientNo, cName)
Rental	(clientNo, propertyNo, rentStart, rentFinish)
PropertyOwner	(propertyNo, pAddress, rent, ownerNo, oName)

1NF to 2NF

- **Identify primary key for the 1NF relation.**
- **Identify functional dependencies in the relation.**
- **If partial dependencies exist on the primary key remove them by placing them in a new relation along with copy of their determinant.**

Third Normal Form (3NF)

- **Based on concept of transitive dependency:**
  - **A, B and C are attributes of a relation such that if A → B and B → C,**
  - **then C is transitively dependent on A through B. (Provided that A is not functionally dependent on B or C).**

- **3NF - A relation that is in 1NF and 2NF and in which no non-primary-key attribute is transitively dependent on the primary key.**

Third Normal Form (3NF)

Client

fd2	clientNo → cName	(Primary key)

Rental

fd1	clientNo, propertyNo → rentStart, rentFinish	(Primary key)
fd5′	clientNo, rentStart → propertyNo, rentFinish	(Candidate key)
fd6′	propertyNo, rentStart → clientNo, rentFinish	(Candidate key)

PropertyOwner

fd3	propertyNo → pAddress, rent, ownerNo, oName	(Primary key)
fd4	ownerNo → oName	(Transitive dependency)

Third Normal Form (3NF)

PropertyForRent

propertyNo	pAddress	rent	ownerNo
PG4	6 Lawrence St, Glasgow	350	CO40
PG16	5 Novar Dr, Glasgow	450	CO93
PG36	2 Manor Rd, Glasgow	375	CO93

Owner

ownerNo	oName
CO40	Tina Murphy
CO93	Tony Shaw

PropertyForRent (propertyNo, pAddress, rent, ownerNo)
Owner (ownerNo, oName)

Third Normal Form (3NF)

PropertyForRent

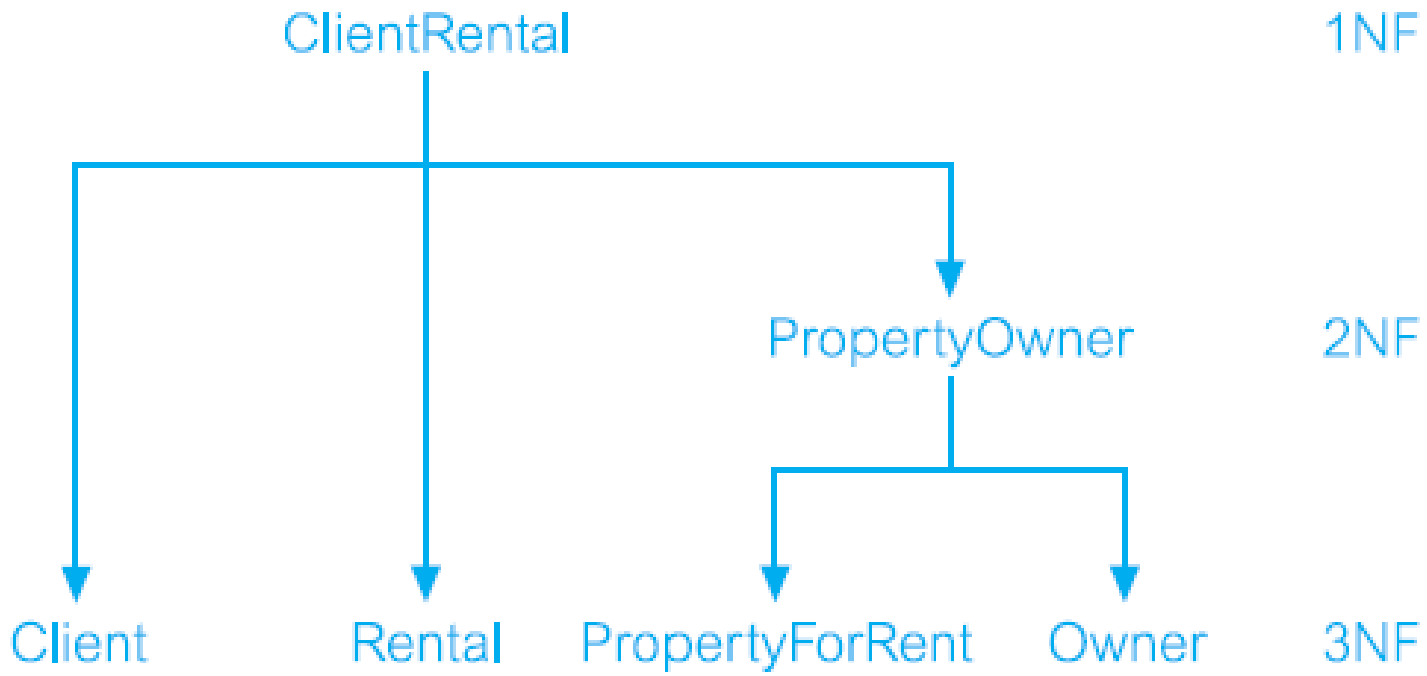
propertyNo	pAddress	rent	ownerNo
PG4	6 Lawrence St, Glasgow	350	CO40
PG16	5 Novar Dr, Glasgow	450	CO93
PG36	2 Manor Rd, Glasgow	375	CO93

Owner

ownerNo	oName
CO40	Tina Murphy
CO93	Tony Shaw

Client (clientNo, cName)
Rental (clientNo, propertyNo, rentStart, rentFinish)
PropertyForRent (propertyNo, pAddress, rent, ownerNo)
Owner (ownerNo, oName)

Third Normal Form (3NF)



Third Normal Form (3NF)

Client

clientNo	cName
CR76	John Kay
CR56	Aline Stewart

Rental

clientNo	propertyNo	rentStart	rentFinish
CR76	PG4	1-Jul-03	31-Aug-04
CR76	PG16	1-Sep-04	1-Sep-05
CR56	PG4	1-Sep-02	10-Jun-03
CR56	PG36	10-Oct-03	1-Dec-04
CR56	PG16	1-Nov-05	10-Aug-06

PropertyForRent

propertyNo	pAddress	rent	ownerNo
PG4	6 Lawrence St, Glasgow	350	CO40
PG16	5 Novar Dr, Glasgow	450	CO93
PG36	2 Manor Rd, Glasgow	375	CO93

Owner

ownerNo	oName
CO40	Tina Murphy
CO93	Tony Shaw

2NF to 3NF

- **Identify the primary key in the 2NF relation.**
- **Identify functional dependencies in the relation.**
- **If transitive dependencies exist on the primary key remove them by placing them in a new relation along with copy of their determinant.**

General Definitions of 2NF and 3NF

- **Second normal form (2NF)**
  - **A relation that is in 1NF and every non-primary-key attribute is fully functionally dependent on *any candidate key*.**

- **Third normal form (3NF)**
  - **A relation that is in 1NF and 2NF and in which no non-primary-key attribute is transitively dependent on *any candidate key*.**

Review of Normalization (UNF to

DreamHome
Property Inspection Report

DreamHome
Property Inspection Report

Property Number PG4

Property Address 6 Lawrence St, Glasgow

Inspection Date	Inspection Time	Comments	Staff no	Staff Name	Car Registration
18-Oct-00	10.00	Need to replace crockery	SG37	Ann Beech	M231 JGR
22-Apr-01	09.00	In good order	SG14	David Ford	M533 HDR
1-Oct-01	12.00	Damp rot in bathroom	SG14	David Ford	N721 HFR

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Review of Normalization (UNF to BCNF)

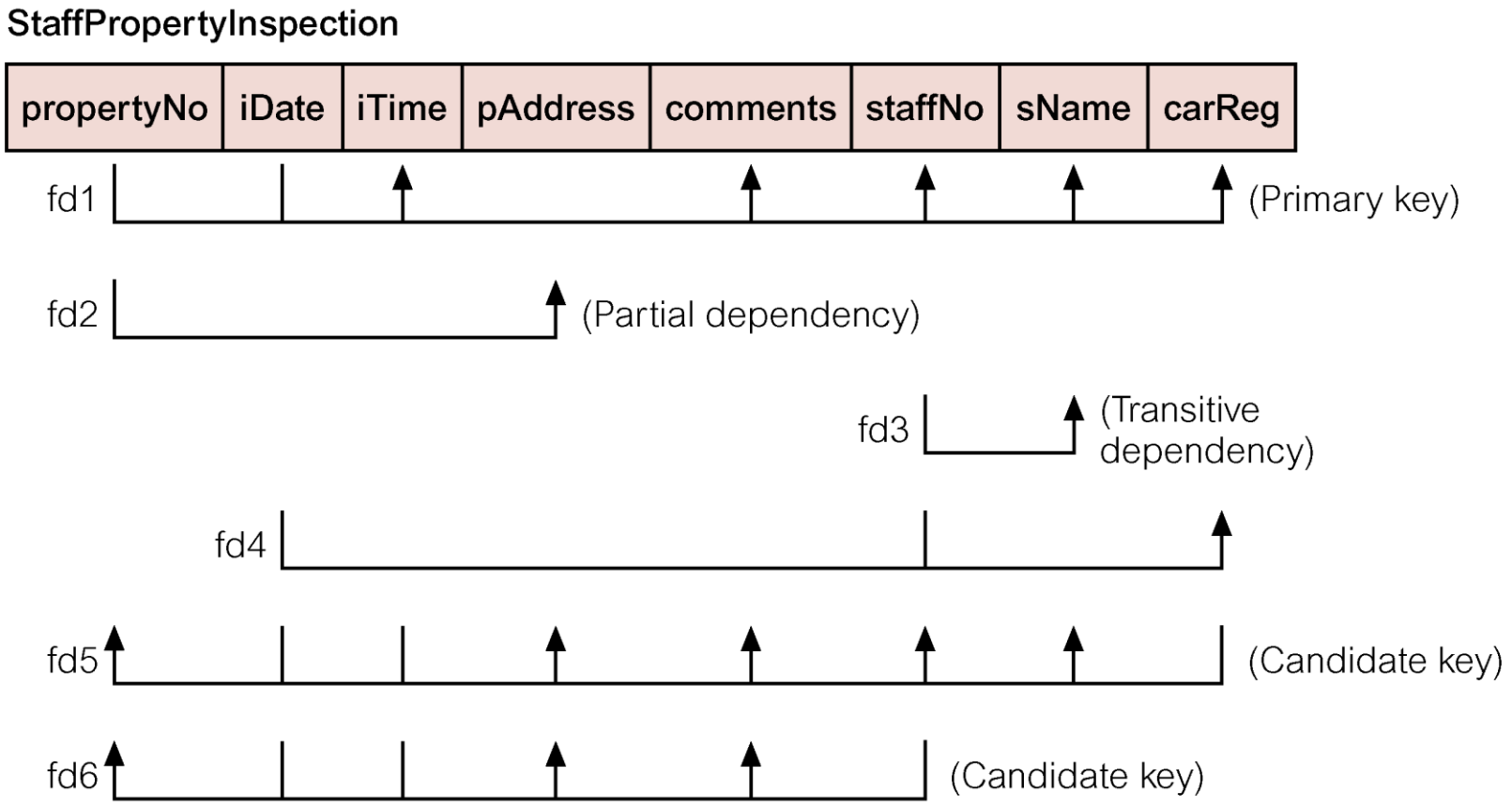
StaffPropertyInspection

propertyNo	pAddress	iDate	iTime	comments	staffNo	sName	carReg
PG4	6 Lawrence St, Glasgow	18-Oct-00 22-Apr-01 1-Oct-01	10.00 09.00 12.00	Need to replace crockery In good order Damp rot in bathroom	SG37 SG14 SG14	Ann Beech David Ford David Ford	M231 JGR M533 HDR N721 HFR
PG16	5 Novar Dr, Glasgow	22-Apr-01 24-Oct-01	13.00 14.00	Replace living room carpet Good condition	SG14 SG37	David Ford Ann Beech	M533 HDR N721 HFR

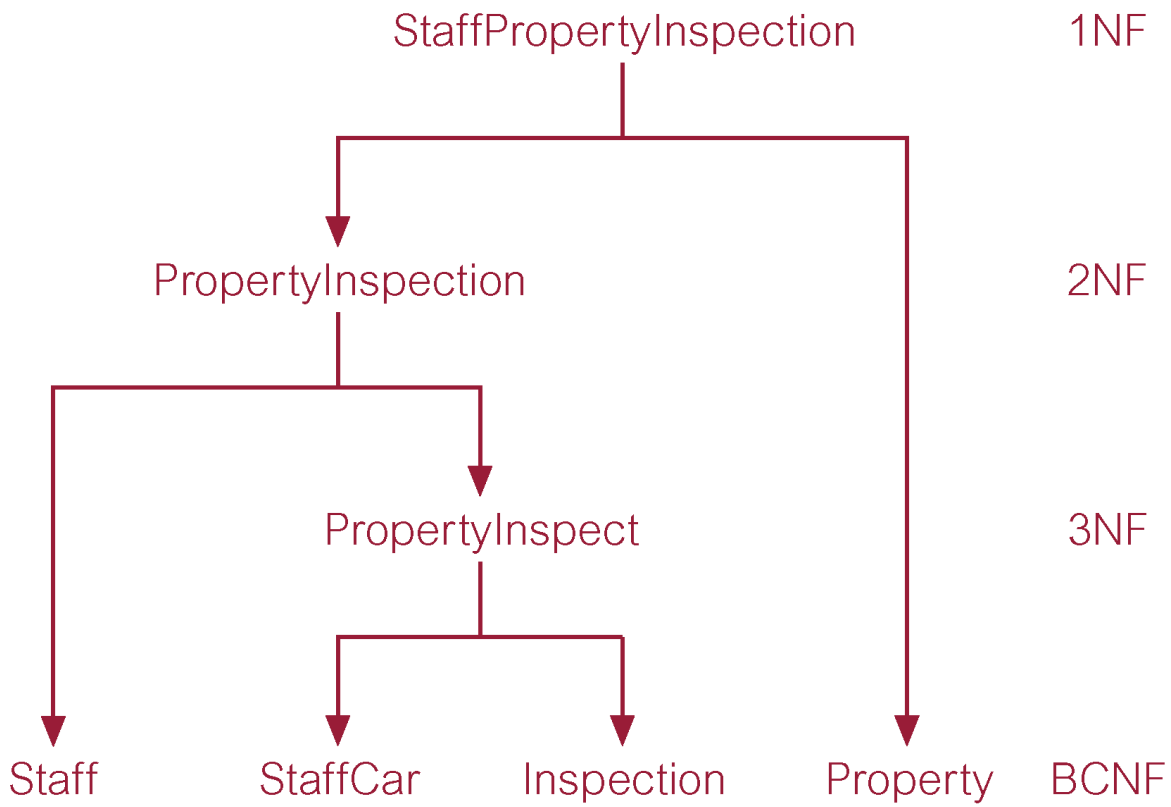
StaffPropertyInspection

propertyNo	iDate	iTime	pAddress	comments	staffNo	sName	carReg
PG4	18-Oct-00	10.00	6 Lawrence St, Glasgow	Need to replace crockery	SG37	Ann Beech	M231 JGR
PG4	22-Apr-01	09.00	6 Lawrence St, Glasgow	In good order	SG14	David Ford	M533 HDR
PG4	1-Oct-01	12.00	6 Lawrence St, Glasgow	Damp rot in bathroom	SG14	David Ford	N721 HFR
PG16	22-Apr-01	13.00	5 Novar Dr, Glasgow	Replace living room carpet	SG14	David Ford	M533 HDR
PG16	24-Oct-01	14.00	5 Novar Dr, Glasgow	Good condition	SG37	Ann Beech	N721 HFR

Review of Normalization (UNF to BCNF)



Review of Normalization (UNF to BCNF)



Thank You

Reference: Database Systems A Practical Approach to Design, Implementation, and Management Fourth Edition.

Thomas M. Connolly and Carolyn E. Begg

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