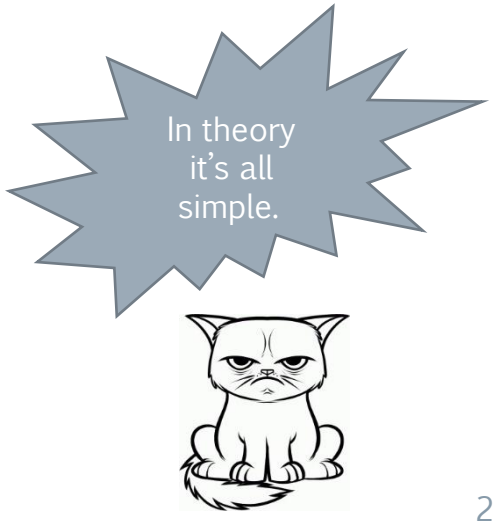
Normalisation

Relational Design Principles

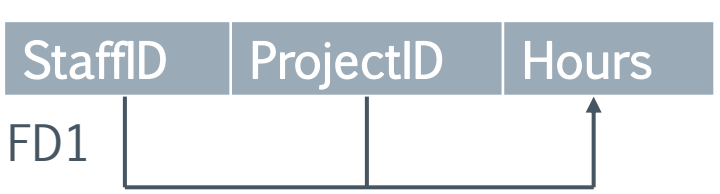
SWINBURNE UNIVERSITY OF TECHNOLOGY

Entity Relationship Design

- Steps to build a conceptual design
  1. Identify the entity types
  2. Identify and associate attributes with the entity types
  3. Identify the relationship types
  4. Determine cardinality and participation constraints
  5. Determine primary and foreign keys
  6. Validate the model



But First: Functional Dependencies



Normal Forms

desirable

First Normal Form	1NF
Second Normal Form	2NF
Third Normal Form	3NF
Boyce-Codd Normal Form	BCNF
Fourth Normal Form	4NF
Fifth Normal Form	5NF

First Normal Form

› Repeating groups:

not in 1NF (has repeating groups)

propNo	propAddress	inspDate	inspTime	comments	staffNo	sName
PG4	6 Lawrence St, Glasgow	18/10/15 22/04/16 1/10/16	10:00 09:00 12:30	Need to replace crockery In good order Damp rot in bathroom	SG37 SG14 SG14	Ann Beech David Ford David Ford
PG16	5 Novar Dr, Glasgow	22/04/16 24/10/15	13:00 14:00	Replace living room carpet Good condition	SG14 SG37	David Ford Ann Beech

Plain awful.

Example from Connolly & Begg text

First Normal Form

› Repeating groups removed:

in 1NF (has no repeating groups)

propNo	propAddress	inspDate	inspTime	comments	staffNo	sName
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	Need to replace crockery	SG37	Ann Beech
PG4	6 Lawrence St, Glasgow	22/06/16	09:00	In good order	SG14	David Ford
PG4	6 Lawrence St, Glasgow	1/10/16	12:30	Damp rot in bathroom	SG14	David Ford
PG16	5 Novar Dr, Glasgow	22/04/16	13:00	Replace living room carpet	SG14	David Ford
PG16	5 Novar Dr, Glasgow	24/10/15	14:00	Good condition	SG37	Ann Beech

Example from Connolly & Begg text

First Normal Form

› Repeating groups, variation

not in 1NF (has repeating groups)

propNo	propAddress	inspDate1	inspTime1	comments1	staffNo1	sName1
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	Need to replace crockery	SG37	Ann Beech

inspDate2	inspTime2	comments2	staffNo2	sName2
22/04/16	09:00	In good order	SG14	David Ford

inspDate3	inspTime3	comments3	staffNo3	sName3
1/10/16	12:30	Damp rot in bathroom	SG14	David Ford

I give up.

First Normal Form

› Repeating groups, simpler:

not in 1NF (has repeating groups)

propNo	propAddress	inspDate	inspTime	comment_1	comment_2	comment_3
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	Need to replace crockery	Loose tiles above bath	Replace oven
PG16	5 Novar Dr, Glasgow	22/06/16	09:00	In good order	null	null
PG23	12 Glen St, Glasgow	1/10/16	12:30	Damp rot in bathroom	Living room carpet needs clean	null

First Normal Form

› Repeating groups removed:

in 1NF (has no repeating groups)

propNo	propAddress	inspDate	inspTime	commentNo	comment
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	1	Replace oven
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	2	Loose tiles above bath
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	3	Damp rot in bathroom
PG16	5 Novar Dr, Glasgow	22/06/16	09:00	1	In good order
PG23	12 Glen St, Glasgow	1/10/16	12:30	1	Damp rot in bathroom
PG23	12 Glen St, Glasgow	1/10/16	12:30	2	Living room carpet needs clean

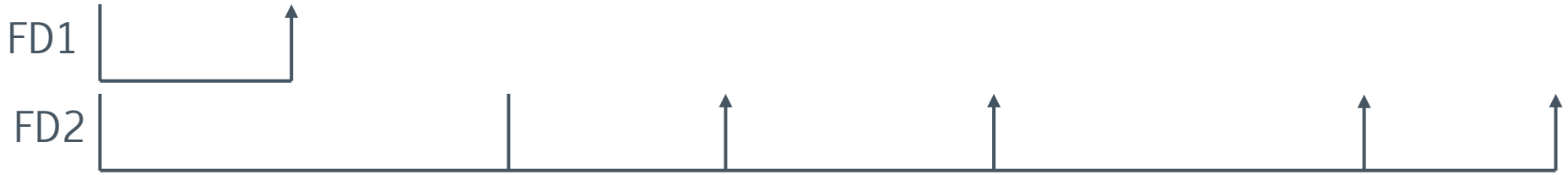
Second Normal Form

› Partial dependencies

not in 2NF (has partial dependencies)

in 1NF (has no repeating groups)

propNo	propAddress	inspDate	inspTime	comments	staffNo	sName
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	Need to replace crockery	SG37	Ann Beech
PG4	6 Lawrence St, Glasgow	22/06/16	09:00	In good order	SG14	David Ford
PG4	6 Lawrence St, Glasgow	1/10/16	12:30	Damp rot in bathroom	SG14	David Ford



Second Normal Form

› Full functional dependencies

in 2NF (has no partial dependencies)

propNo	propAddress
PG4	6 Lawrence St, Glasgow
PG16	5 Novar Dr, Glasgow

FD1

in 2NF (has no partial dependencies)

propNo	inspDate	inspTime	comments	staffNo	sName
PG4	18/10/15	10:00	Need to replace crockery	SG37	Ann Beech
PG4	22/06/16	09:00	In good order	SG14	David Ford
PG4	1/10/16	12:30	Damp rot in bathroom	SG14	David Ford
PG16	22/04/16	13:00	Replace living room carpet	SG14	David Ford
PG16	24/10/15	14:00	Good condition	SG37	Ann Beech

FD2

Third Normal Form

› Transitive dependencies

not in 3NF (has transitive dependencies)

in 2NF (has no partial dependencies)

propNo	inspDate	inspTime	comments	staffNo	sName
PG4	18/10/15	10:00	Need to replace crockery	SG37	Ann Beech
PG4	22/06/16	09:00	In good order	SG14	David Ford
PG4	1/10/16	12:30	Damp rot in bathroom	SG14	David Ford
PG16	22/04/16	13:00	Replace living room carpet	SG14	David Ford
PG16	24/10/15	14:00	Good condition	SG37	Ann Beech

Third Normal Form

› Transitive dependencies resolved

in 3NF (has no transitive dependencies)

propNo	inspDate	inspTime	comments	staffNo
PG4	18/10/15	10:00	Need to replace crockery	SG37
PG4	22/06/16	09:00	In good order	SG14
PG4	1/10/16	12:30	Damp rot in bathroom	SG14
PG16	22/04/16	13:00	Replace living room carpet	SG14
PG16	24/10/15	14:00	Good condition	SG37

in 3NF (has no transitive dependencies)

staffNo	sName
SG37	Ann Beech
SG14	David Ford

The other example…

› Can we achieve third normal form?

in 1NF (has no repeating groups)

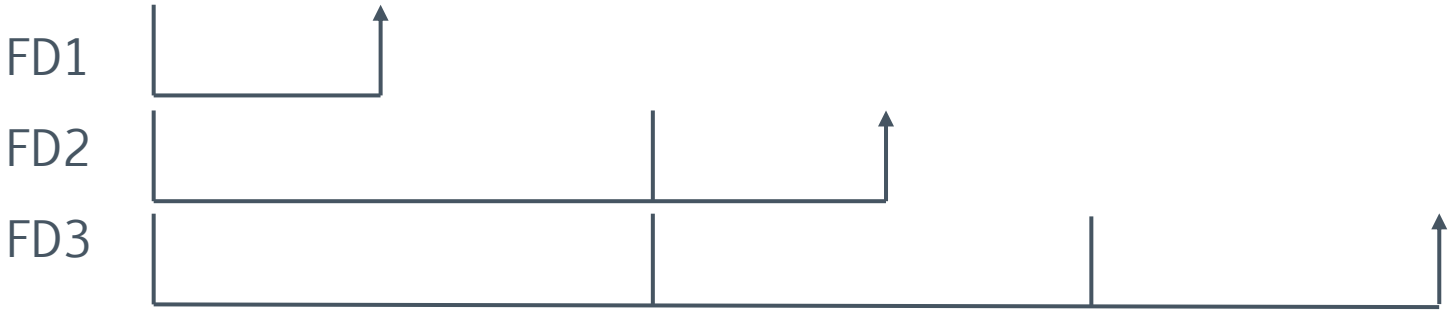
propNo	propAddress	inspDate	inspTime	commentNo	comment
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	1	Replace oven
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	2	Loose tiles above bath
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	3	Damp rot in bathroom
PG16	5 Novar Dr, Glasgow	22/06/16	09:00	1	In good order
PG23	12 Glen St, Glasgow	1/10/16	12:30	1	Damp rot in bathroom
PG23	12 Glen St, Glasgow	1/10/16	12:30	2	Living room carpet needs clean

Solution: Second Normal Form

› Analysing for partial dependencies

in 1NF (has no repeating groups)

propNo	propAddress	inspDate	inspTime	commentNo	comment
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	1	Replace oven
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	2	Loose tiles above bath
PG4	6 Lawrence St, Glasgow	18/10/15	10:00	3	Damp rot in bathroom
PG16	5 Novar Dr, Glasgow	22/06/16	09:00	1	In good order



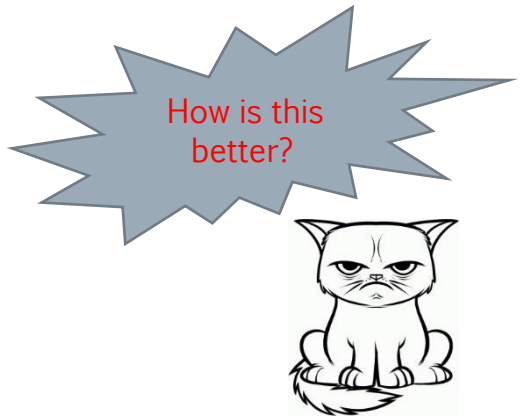
Solution: Second (and Third) Normal Form

› Creating separate tables

propNo	propAddress
PG4	6 Lawrence St, Glasgow
PG16	5 Novar Dr, Glasgow

propNo	inspDate	inspTime
PG4	18/10/15	10:00
PG16	22/06/16	09:00

propNo	inspDate	commentNo	comment
PG4	18/10/15	1	Replace oven
PG4	18/10/15	2	Loose tiles above bath
PG4	18/10/15	3	Damp rot in bathroom
PG16	22/06/16	1	In good order



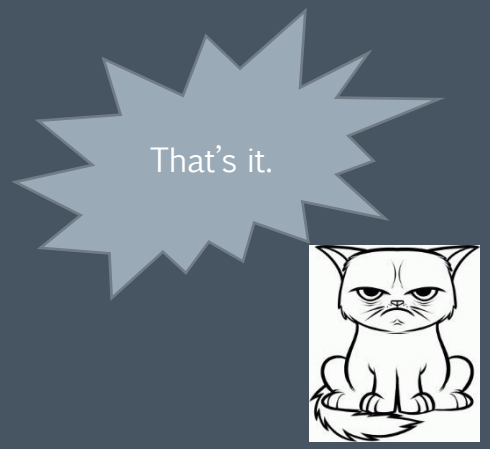
Surrogate Keys

› Replacing Composite Keys

inspID	propNo	inspDate	inspTime
1	PG4	18/10/15	10:00
2	PG16	22/06/16	09:00

inspID	propNo	inspDate	commentNo	comment
1	PG4	18/10/15	1	Replace oven
1	PG4	18/10/15	2	Loose tiles above bath
1	PG4	18/10/15	3	Damp rot in bathroom
2	PG16	22/06/16	1	In good order

Summary



- Normalisation is a way of ensuring that each relation schema within the database schema is functional and redundancy-free.
- If a relation is in 1NF, it has no repeating groups.
- If a relation is in 2NF, it is in 1NF and has no partial dependencies.
- If a relation is in 3NF, it is in 2NF and has no transitive dependencies.
- The normalising process works by separating entities into tables. Sometimes this is undesirable and people decide to denormalise.
- Surrogate keys are widely used when no obvious attributes lend themselves as keys – especially with composite keys.