

Normalization

Database Development 2022
Cody Henrichsen

1

What/Why

- ▶ Make data easier to work with as a HUMAN
- ▶ Make data easier to work with in SQL
- ▶ Reduce / remove redundant data
- ▶ Smaller tables are easier to understand and link
- ▶ Naming conventions
- ▶ Direct link between tables and associated data

2

Raw Data

- ▶ Generally in a spreadsheet format
- ▶ Multiple values in a field
- ▶ Duplicated rows and/or columns
- ▶ Missing data
- ▶ Patterns? What do you mean patterns???

3

Raw sample

Seat Number	Number of Stud	Room	Class Time	Meeting Days	Instructor	Students
33	22	204	7:30-9:55	B	Hennrichsen	JJ Grant, Alan, Tyler P, ...
33	5	204	7:30-9:55	Beth	Hennrichsen	Max, Chris, Mark, Masti, Stockton
33	28	204	11:30-1:55	A	Hennrichsen	Vlad, Chandler, Logan, ...
33	22	204	7:30-9:55	A	Hennrichsen	JJ Grant, Tyler C, Tyler P, Christina, ...
33	5	204	7:30-9:55	Beth	Hennrichsen	Max, Chris, Mark, Masti, Stockton
33	28	204	11:30-1:55	B	Hennrichsen	Vlad, Max, Taylor, Zac, ...

4

1NF

- ▶ Step 1 make the data atomic
- ▶ Step 2 remove repeating columns
- ▶ Step 3 remove repeating rows (rareish)
- ▶ Great time to start fixing column names

5

1NF Sample

Section	Course #	Course name	Seat Number	Number of S	Room	Class Time	Meeting Day	Instructor	Student
AM	CSIS 1410	Computer Programming	33	22	204	7:30-9:55	B	Hennrichsen	JJ
AM	CSIS 1410	Computer Programming	33	22	204	7:30-9:55	B	Hennrichsen	Grant
AM	CSIS 1410	Computer Programming	33	22	204	7:30-9:55	B	Hennrichsen	Alan
AM	CSIS 1410	Computer Programming	33	22	204	7:30-9:55	B	Hennrichsen	Tyler P

6

2NF

- ▶ Step 1 Already in 1NF
- ▶ Step 2 Remove/Resolve Partial dependencies
 - ▶ This means split data into tables (note the plural!)
- ▶ Step 3 Identify candidate keys

7

2NF Sample

courses						
course key	Course Name	room	instructor	sections	course #	meeting

8

3NF

- ▷ Step 1 Already in 2NF
- ▷ Step 2 Resolve transitive dependencies
 - ▷ Create combo tables to handle many to many dependencies
- ▷ Each cell/field directly links to the key for the row
- ▷ All primary and foreign keys explicitly identified
 - ▷ (PK) and/or (FK) after field name in header

9

3NF Sample

customer_id	customer_name	customer_type	customer_address	customer_city	customer_state	customer_zip	customer_phone	customer_email	customer_fax	customer_website	customer_notes
1	ABC Corp	Corporate	123 Main St	Anytown	CA	90210	(555) 123-4567	john.doe@abc.com	(555) 123-4568	http://www.abc.com	ABC Corp is a large company with many branches.
2	DEF Inc	Corporate	456 Main St	Anytown	CA	90210	(555) 234-5678	jane.smith@def.com	(555) 234-5679	http://www.def.com	DEF Inc is a medium-sized company.
3	GHI LLC	Corporate	789 Main St	Anytown	CA	90210	(555) 345-6789	bob.jones@ghi.com	(555) 345-6790	http://www.ghi.com	GHI LLC is a small company.
4	JKL Corp	Corporate	101 Main St	Anytown	CA	90210	(555) 456-7890	alice.brown@jkl.com	(555) 456-7891	http://www.jkl.com	JKL Corp is a large company with many branches.
5	MNO Inc	Corporate	111 Main St	Anytown	CA	90210	(555) 567-8901	charlie.davis@mno.com	(555) 567-8902	http://www.mno.com	MNO Inc is a medium-sized company.
6	PQR LLC	Corporate	121 Main St	Anytown	CA	90210	(555) 678-9012	diana.evans@pqr.com	(555) 678-9013	http://www.pqr.com	PQR LLC is a small company.
7	STU Corp	Corporate	131 Main St	Anytown	CA	90210	(555) 789-0123	frank.garcia@stu.com	(555) 789-0124	http://www.stu.com	STU Corp is a large company with many branches.
8	VWX Inc	Corporate	141 Main St	Anytown	CA	90210	(555) 890-1234	grace.harris@vwx.com	(555) 890-1235	http://www.vwx.com	VWX Inc is a medium-sized company.
9	YZA LLC	Corporate	151 Main St	Anytown	CA	90210	(555) 901-2345	henry.kim@yza.com	(555) 901-2346	http://www.yza.com	YZA LLC is a small company.
10	BCD Corp	Corporate	161 Main St	Anytown	CA	90210	(555) 012-3456	ivy.lee@bcd.com	(555) 012-3457	http://www.bcd.com	BCD Corp is a large company with many branches.
11	EFG Inc	Corporate	171 Main St	Anytown	CA	90210	(555) 123-4567	jacob.miller@efg.com	(555) 123-4568	http://www.efg.com	EFG Inc is a medium-sized company.
12	HIJ LLC	Corporate	181 Main St	Anytown	CA	90210	(555) 234-5678	karen.nelson@hij.com	(555) 234-5679	http://www.hij.com	HIJ LLC is a small company.
13	KLM Corp	Corporate	191 Main St	Anytown	CA	90210	(555) 345-6789	leo.olson@klm.com	(555) 345-6790	http://www.klm.com	KLM Corp is a large company with many branches.
14	NOP Inc	Corporate	201 Main St	Anytown	CA	90210	(555) 456-7890	mia.patel@nop.com	(555) 456-7891	http://www.nop.com	NOP Inc is a medium-sized company.
15	QRS LLC	Corporate	211 Main St	Anytown	CA	90210	(555) 567-8901	noah.ramirez@qrs.com	(555) 567-8902	http://www.qrs.com	QRS LLC is a small company.
16	TUV Corp	Corporate	221 Main St	Anytown	CA	90210	(555) 678-9012	olivia.sanchez@tuv.com	(555) 678-9013	http://www.tuv.com	TUV Corp is a large company with many branches.
17	WXY Inc	Corporate	231 Main St	Anytown	CA	90210	(555) 789-0123	peter.taylor@wxy.com	(555) 789-0124	http://www.wxy.com	WXY Inc is a medium-sized company.
18	ZAB LLC	Corporate	241 Main St	Anytown	CA	90210	(555) 890-1234	quinn.thompson@zab.com	(555) 890-1235	http://www.zab.com	ZAB LLC is a small company.
19	CCD Corp	Corporate	251 Main St	Anytown	CA	90210	(555) 901-2345	ryan.walker@ccd.com	(555) 901-2346	http://www.ccd.com	CCD Corp is a large company with many branches.
20	EEF Inc	Corporate	261 Main St	Anytown	CA	90210	(555) 012-3456	sarah.young@eef.com	(555) 012-3457	http://www.eef.com	EEF Inc is a medium-sized company.
21	GGH LLC	Corporate	271 Main St	Anytown	CA	90210	(555) 123-4567	steve.zimmerman@ggh.com	(555) 123-4568	http://www.ggh.com	GGH LLC is a small company.
22	HHI Corp	Corporate	281 Main St	Anytown	CA	90210	(555) 234-5678	timothy.lopez@hhi.com	(555) 234-5679	http://www.hhi.com	HHI Corp is a large company with many branches.
23	IIJ Inc	Corporate	291 Main St	Anytown	CA	90210	(555) 345-6789	tracy.martinez@iij.com	(555) 345-6790	http://www.iij.com	IIJ Inc is a medium-sized company.
24	JJK LLC	Corporate	301 Main St	Anytown	CA	90210	(555) 456-7890	tyler.morgan@jjk.com	(555) 456-7891	http://www.jjk.com	JJK LLC is a small company.
25	KKL Corp	Corporate	311 Main St	Anytown	CA	90210	(555) 567-8901	uma.nelson@kkk.com	(555) 567-8902	http://www.kkk.com	KKL Corp is a large company with many branches.
26	LLM Inc	Corporate	321 Main St	Anytown	CA	90210	(555) 678-9012	victor.olson@llm.com	(555) 678-9013	http://www.llm.com	LLM Inc is a medium-sized company.
27	MMN LLC	Corporate	331 Main St	Anytown	CA	90210	(555) 789-0123	wendy.patel@mmn.com	(555) 789-0124	http://www.mmn.com	MMN LLC is a small company.
28	NNP Corp	Corporate	341 Main St	Anytown	CA	90210	(555) 890-1234	xavier.ramirez@nnp.com	(555) 890-1235	http://www.nnp.com	NNP Corp is a large company with many branches.
29	OOQ Inc	Corporate	351 Main St	Anytown	CA	90210	(555) 901-2345	yara.sanchez@ooq.com	(555) 901-2346	http://www.ooq.com	OOQ Inc is a medium-sized company.
30	PPR LLC	Corporate	361 Main St	Anytown	CA	90210	(555) 012-3456	zachary.taylor@ppr.com	(555) 012-3457	http://www.ppr.com	PPR LLC is a small company.
31	QQS Corp	Corporate	371 Main St	Anytown	CA	90210	(555) 123-4567	zoe.thompson@qqq.com	(555) 123-4568	http://www.qqq.com	QQS Corp is a large company with many branches.
32	RRT Inc	Corporate	381 Main St	Anytown	CA	90210	(555) 234-5678	adam.walker@rrt.com	(555) 234-5679	http://www.rrt.com	RRT Inc is a medium-sized company.
33	SSU LLC	Corporate	391 Main St	Anytown	CA	90210	(555) 345-6789	alex.young@ssu.com	(555) 345-6790	http://www.ssu.com	SSU LLC is a small company.
34	TTV Corp	Corporate	401 Main St	Anytown	CA	90210	(555) 456-7890	amy.zimmerman@ttv.com	(555) 456-7891	http://www.ttv.com	TTV Corp is a large company with many branches.
35	UUW Inc	Corporate	411 Main St	Anytown	CA	90210	(555) 567-8901	ben.lopez@uuu.com	(555) 567-8902	http://www.uuu.com	UUW Inc is a medium-sized company.
36	VVX LLC	Corporate	421 Main St	Anytown	CA	90210	(555) 678-9012	bella.martinez@vvv.com	(555) 678-9013	http://www.vvv.com	VVX LLC is a small company.
37	WWY Corp	Corporate	431 Main St	Anytown	CA	90210	(555) 789-0123	carlos.nelson@www.com	(555) 789-0124	http://www.www.com	WWY Corp is a large company with many branches.
38	XXZ Inc	Corporate	441 Main St	Anytown	CA	90210	(555) 890-1234	diana.olson@xxz.com	(555) 890-1235	http://www.xxz.com	XXZ Inc is a medium-sized company.
39	YYA LLC	Corporate	451 Main St	Anytown	CA	90210	(555) 901-2345	edward.patel@yyy.com	(555) 901-2346	http://www.yyy.com	YYA LLC is a small company.
40	ZZB Corp	Corporate	461 Main St	Anytown	CA	90210	(555) 012-3456	frank.ramirez@zzz.com	(555) 012-3457	http://www.zzz.com	ZZB Corp is a large company with many branches.
41	AAA Inc	Corporate	471 Main St	Anytown	CA	90210	(555) 123-4567	grace.sanchez@aaa.com	(555) 123-4568	http://www.aaa.com	AAA Inc is a medium-sized company.
42	BBB LLC	Corporate	481 Main St	Anytown	CA	90210	(555) 234-5678	henry.taylor@bbb.com	(555) 234-5679	http://www.bbb.com	BBB LLC is a small company.
43	CCC Corp	Corporate	491 Main St	Anytown	CA	90210	(555) 345-6789	ivy.thompson@ccc.com	(555) 345-6790	http://www.ccc.com	CCC Corp is a large company with many branches.
44	DDD Inc	Corporate	501 Main St	Anytown	CA	90210	(555) 456-7890	jacob.walker@ddd.com	(555) 456-7891	http://www.ddd.com	DDD Inc is a medium-sized company.
45	EEE LLC	Corporate	511 Main St	Anytown	CA	90210	(555) 567-8901	karen.young@eee.com	(555) 567-8902	http://www.eee.com	EEE LLC is a small company.
46	FFF Corp	Corporate	521 Main St	Anytown	CA	90210	(555) 678-9012	leo.zimmerman@fff.com	(555) 678-9013	http://www.fff.com	FFF Corp is a large company with many branches.
47	GGG Inc	Corporate	531 Main St	Anytown	CA	90210	(555) 789-0123	mia.lopez@ggg.com	(555) 789-0124	http://www.ggg.com	GGG Inc is a medium-sized company.
48	HHH LLC	Corporate	541 Main St	Anytown	CA	90210	(555) 890-1234	noah.martinez@hhh.com	(555) 890-1235	http://www.hhh.com	HHH LLC is a small company.
49	III Corp	Corporate	551 Main St	Anytown	CA	90210	(555) 901-2345	olivia.nelson@iii.com	(555) 901-2346	http://www.iii.com	III Corp is a large company with many branches.
50	JJJ Inc	Corporate	561 Main St	Anytown	CA	90210	(555) 012-3456	peter.olson@jjj.com	(555) 012-3457	http://www.jjj.com	JJJ Inc is a medium-sized company.
51	KKK LLC	Corporate	571 Main St	Anytown	CA	90210	(555) 123-4567	quinn.patel@kkk.com	(555) 123-4568	http://www.kkk.com	KKK LLC is a small company.
52	LLL Corp	Corporate	581 Main St	Anytown	CA	90210	(555) 234-5678	ryan.ramirez@lll.com	(555) 234-5679	http://www.lll.com	LLL Corp is a large company with many branches.
53	MMM Inc	Corporate	591 Main St	Anytown	CA	90210	(555) 345-6789	sarah.sanchez@mmm.com	(555) 345-6790	http://www.mmm.com	MMM Inc is a medium-sized company.
54	NNN LLC	Corporate	601 Main St	Anytown	CA	90210	(555) 456-7890	steve.taylor@nnn.com	(555) 456-7891	http://www.nnn.com	NNN LLC is a small company.
55	OOO Corp	Corporate	611 Main St	Anytown	CA	90210	(555) 567-8901	timothy.thompson@ooo.com	(555) 567-8902	http://www.ooo.com	OOO Corp is a large company with many branches.
56	PPP Inc	Corporate	621 Main St	Anytown	CA	90210	(555) 678-9012	tracy.walker@ppp.com	(555) 678-9013	http://www.ppp.com	PPP Inc is a medium-sized company.
57	QQQ LLC	Corporate	631 Main St	Anytown	CA	90210	(555) 789-0123	tyler.young@qqq.com	(555) 789-0124	http://www.qqq.com	QQQ LLC is a small company.
58	RRR Corp	Corporate	641 Main St	Anytown	CA	90210	(555) 890-1234	uma.zimmerman@rrr.com	(555) 890-1235	http://www.rrr.com	RRR Corp is a large company with many branches.
59	SSS Inc	Corporate	651 Main St	Anytown	CA	90210	(555) 901-2345	victor.lopez@sss.com	(555) 901-2346	http://www.sss.com	SSS Inc is a medium-sized company.
60	TTT LLC	Corporate	661 Main St	Anytown	CA	90210	(555) 012-3456	wendy.martinez@ttt.com	(555) 012-3457	http://www.ttt.com	TTT LLC is a small company.
61	UUU Corp	Corporate	671 Main St	Anytown	CA	90210	(555) 123-4567	xavier.nelson@uuu.com	(555) 123-4568	http://www.uuu.com	UUU Corp is a large company with many branches.
62	VVV Inc	Corporate	681 Main St	Anytown	CA	90210	(555) 234-5678	yara.olson@vvv.com	(555) 234-5679	http://www.vvv.com	VVV Inc is a medium-sized company.
63	WWW LLC	Corporate	691 Main St	Anytown	CA	90210	(555) 345-6789	zachary.patel@www.com	(555) 345-6790	http://www.www.com	WWW LLC is a small company.
64	XXX Corp	Corporate	701 Main St	Anytown	CA	90210	(555) 456-7890	adam.ramirez@xxx.com	(555) 456-7891	http://www.xxx.com	XXX Corp is a large company with many branches.
65	YYY Inc	Corporate	711 Main St	Anytown	CA	90210	(555) 567-8901	alex.sanchez@yyy.com	(555) 567-8902	http://www.yyy.com	YYY Inc is a medium-sized company.
66	ZZZ LLC	Corporate	721 Main St	Anytown	CA	90210	(555) 678-9012	bella.taylor@zzz.com	(555) 678-9013	http://www.zzz.com	ZZZ LLC is a small company.
67	AAA Corp	Corporate	731 Main St	Anytown	CA	90210	(555) 789-0123	ben.thompson@aaa.com	(555) 789-0124	http://www.aaa.com	AAA Corp is a large company with many branches.
68	BBB Inc	Corporate	741 Main St	Anytown	CA	90210	(555) 890-1234	carlos.walker@bbb.com	(555) 890-1235	http://www.bbb.com	BBB Inc is a medium-sized company.
69	CCC LLC	Corporate	751 Main St	Anytown	CA	90210	(555) 901-2345	diana.young@ccc.com	(555) 901-2346	http://www.ccc.com	CCC LLC is a small company.
70	DDD Corp	Corporate	761 Main St	Anytown	CA	90210	(555) 012-3456	edward.zimmerman@ddd.com	(555) 012-3457	http://www.ddd.com	DDD Corp is a large company with many branches.
71	EEE Inc	Corporate	771 Main St	Anytown	CA	90210	(555) 123-4567	frank.lopez@eee.com	(555) 123-4568	http://www.eee.com	EEE Inc is a medium-sized company.
72	FFF LLC	Corporate	781 Main St	Anytown	CA	90210	(555) 234-5678	grace.martinez@fff.com	(555) 234-5679	http://www.fff.com	FFF LLC is a small company.
73	GGG Corp	Corporate	791 Main St	Anytown	CA	90210	(555) 345-6789	henry.nelson@ggg.com	(555) 345-6790	http://www.ggg.com	GGG Corp is a large company with many branches.
74	HHH Inc	Corporate	801 Main St	Anytown	CA	90210	(555) 456-7890	ivy.olson@hhh.com	(555) 456-7891	http://www.hhh.com	HHH Inc is a medium-sized company.
75	III LLC	Corporate	811 Main St	Anytown	CA	90210	(555) 567-8901	jacob.patel@iii.com	(555) 567-8902	http://www.iii.com	III LLC is a small company.
76	JJJ Corp	Corporate	821 Main St	Anytown	CA	90210	(555) 678-9012	karen.ramirez@jjj.com	(555) 678-9013	http://www.jjj.com	JJJ Corp is a large company with many branches.
77	KKK Inc	Corporate	831 Main St	Anytown	CA	90210	(555) 789-0123	leo.sanchez@kkk.com	(555) 789-0124	http://www.kkk.com	KKK Inc is a medium-sized company.
78	LLL LLC	Corporate	841 Main St	Anytown	CA	90210	(555) 890-1234	mia.taylor@lll.com	(555) 890-1235	http://www.lll.com	LLL LLC is a small company.
79	MMM Corp	Corporate	851 Main St	Anytown	CA	90210	(555) 901-2345	noah.thompson@mmm.com	(555) 901-2346	http://www.mmm.com	MMM Corp is a large company with many branches.
80	NNN Inc	Corporate	861 Main St	Anytown	CA	90210	(555) 012-3456	olivia.walker@nnn.com	(555) 012-3457	http://www.nnn.com	NNN Inc is a medium-sized company.
81	OOO LLC	Corporate	871 Main St	Anytown	CA	90210	(555) 123-4567	peter.young@ooo.com	(555) 123-4568	http://www.ooo.com	OOO LLC is a small company.
82	PPP Corp	Corporate	881 Main St	Anytown	CA	90210	(555) 234-5678	quinn.zimmerman@ppp.com	(555) 234-5679	http://www.ppp.com	PPP Corp is a large company with many branches.
83	QQQ Inc	Corporate	891 Main St	Anytown	CA	90210	(555) 345-6789	ryan.lopez@qqq.com	(555) 345-6790	http://www.qqq.com	QQQ Inc is a medium-sized company.
84	RRR LLC	Corporate	901 Main St	Anytown	CA	90210	(555) 456-7890	sarah.martinez@rrr.com	(555) 456-7891	http://www.rrr.com	RRR LLC is a small company.
85	SSS Corp	Corporate	911 Main St	Anytown	CA	90210	(555) 567-8901	steve.nelson@sss.com	(555) 567-8902	http://www.sss.com	SSS Corp is a large company with many branches.
86	TTT Inc	Corporate	921 Main St	Anytown	CA	90210	(555) 678-9012	timothy.olson@ttt.com	(555) 678-9013	http://www.ttt.com	TTT Inc is a medium-sized company.
87	UUU LLC	Corporate	931 Main St	Anytown	CA	90210	(555) 789-0123	tracy.patel@uuu.com	(555) 789-0124	http://www.uuu.com	UUU LLC is a small company.
88	VVV Corp	Corporate	941 Main St	Anytown	CA	90210	(555) 890-1234	tyler.ramirez@vvv.com	(555) 890-1235	http://www.vvv.com	VVV Corp is a large company with many branches.
89	WWW Inc	Corporate	951 Main St	Anytown	CA	90210	(555) 901-2345	uma.sanchez@www.com	(555) 901-2346	http://www.www.com	WWW Inc is a medium-sized company.
90	XXX LLC	Corporate	961 Main St	Anytown	CA	90210	(555) 012-3456	victor.taylor@xxx.com	(555) 012-3457	http://www.xxx.com	XXX LLC is a small company.
91	YYY Corp	Corporate	971 Main St	Anytown	CA	90210	(555) 123-4567	wendy.thompson@yyy.com	(555) 123-4568	http://www.yyy.com	YYY Corp is a large company with many branches.
92	ZZZ Inc	Corporate	981 Main St	Anytown	CA	90210	(555) 234-5678	xavier.walker@zzz.com	(555) 234-5679	http://www.zzz.com	ZZZ Inc is a medium-sized company.
93	AAA LLC	Corporate	991 Main St	Anytown	CA	90210	(555) 345-6789	yara.young@aaa.com			