iii. Normalization

↳ 1NF, 2NF, 3NF, BCNF (3.5NF) ..... more!

1NF

↳ No multivalued attributes

People

name	email	phone
Mike	Mike@	{416 .... 647 ....}

cannot happen!

name	email	phone
Mike	Mike@	416
Mike	Mike@	647

✓ in 1NF

"prime part of a key"

2NF

- We are 1NF
- Any non-prime attrs. depend on the proper subset of any CK.

"not part of a key"

R:

Prof_id	subject	Prof_age
111 *	Math	38 *
111 *	Physics *	38 *
222 *	Bio	38 *
333 *	Physics *	40 *
333 *	Chem	40 *

CK: {Prof_id, subject}

Non-Prime Attr: Prof_age

not part of CK so we need to decompose!

↳ atributes are in an "atomic" state.

R1:

Employees:

- emplD → postal, name
- Postal → prov, city, region

non-prime attributes

emplD	name	postal	prov	city	~~district~~ region
1001	Mike	L4S	ont.	Richmond Hill	York
1002	Ilir	M9A	ont	Toronto	Toronto
1003	Naaz	L6S	ont	Mississauga	Peel
1004	Mike	L8S	ont	Hamilton	Halton

Superkey

emplD, {emplD, name}, {emplD, ...}, ~~{name, postal code}~~

Q: in this case yes, in general like not

Candidate keys

emplD

Non-prime attributes: everything except emplD

Employee1:

emplD → postal
emplD → name

emplD	name	postal
1001	Mike	L4S
1002	Ilir	M9A
1003	Naaz	L6S
1004	Mike	L8S

Employee2:

postal → city
postal → prov
postal → region

postal	city	prov	region
L4S	R. Hill	ONT	York
M9A	Toronto	ONT	Toronto
L6S	Miss..	ONT	Peel
L8S	Hamilton	ONT	Halton

- 3NF upholds 2 properties!
  - Lossless Join & Dependency Preservation.

Task I

Consider a relation R with a set of attributes $\alpha = \{A, B, C, D, E, F\}$ and the set of Functional Dependencies $\mathcal{F} = \{ A \to BC,\ B \to E,\ C \to BD,\ D \to A,\ E \to F,\ F \to BE\}$

(a) Compute the closure of each attribute. (using Armstrong's axioms)

(b) Find all candidate keys (i.e., minimal keys) of relation R.

FDs
A → BC
B → E
C → BD
D → A
E → F
F → BE

(a)

$A^+ = \{ABCEDF\}$ ✓ CK!

$B^+ = \{BEF\}$ X Not a CK!

$C^+ = \{ABCDEF\}$ ✓ CK!

$D^+ = \{ABCDEF\}$ ✓ CK!

$E^+ = \{FBE\}$ X Not a CK!

$F^+ = \{BEF\}$ X Not a CK!