

# tut09

## Redundancy is Bad

accountNo	balance	customer	branch	address	assets
A-101	500	1313131	Downtown	Brooklyn	9000000
A-102	400	1313131	Perryridge	Horseneck	1700000
A-113	600	9876543	Round Hill	Horseneck	8000000
A-201	900	9876543	Brighton	Brooklyn	7100000
A-215	700	1111111	Mianus	Horseneck	400000
A-222	700	1111111	Redwood	Palo Alto	2100000
A-305	350	1234567	Round Hill	Horseneck	8000000
...	...	...	...	...	...

what if we want to

- change balance of A-113
- add new account
- delete account
- update branch address

## Functional Dependency

$X \rightarrow Y$

can be read as:

- Y functionally depends on X
- X determines Y
- if we know X then we know Y

### Rules

reflectivity:  $X \rightarrow X$

augmentation:  $X \rightarrow Y \quad \Rightarrow \quad XZ \rightarrow YZ$

transitivity:  $X \rightarrow Y, Y \rightarrow Z \Rightarrow X \rightarrow Z$   
 additivity:  $X \rightarrow Y, X \rightarrow Z \Rightarrow X \rightarrow YZ$   
 projectivity:  $X \rightarrow YZ \Rightarrow X \rightarrow Y, X \rightarrow Z$   
 pseudotransitivity:  $X \rightarrow Y, YZ \rightarrow W \Rightarrow XZ \rightarrow W$

## Closure

$X^+$  largest set of attributes that can be derived from  $X$  using  $F$

where

$X$  set of attributes

$F$  set of functional dependencies

## Super Key

set of attributes that uniquely identifies a tuple in a table  
 any set  $X$ , such that  $X^+ = R$

## Candidate Key

a.k.a primary key

minimal superkey

any set  $X$ , such that  $X^+ = R$  and there is no  $Y$  subset of  $X$  such that  $Y^+ = R$

## Boyce-Codd Normal Form (BCNF)

for all functional dependencies  $X \rightarrow Y$

either

- $X \rightarrow Y$  is trivial
- $X$  is a superkey

## Third Normal Form (3NF)

for all functional dependencies  $X \rightarrow Y$

either

- $X \rightarrow Y$  is trivial
- $X$  is a superkey
- $Y$  is single attribute of a candidate key