

Welcome

login

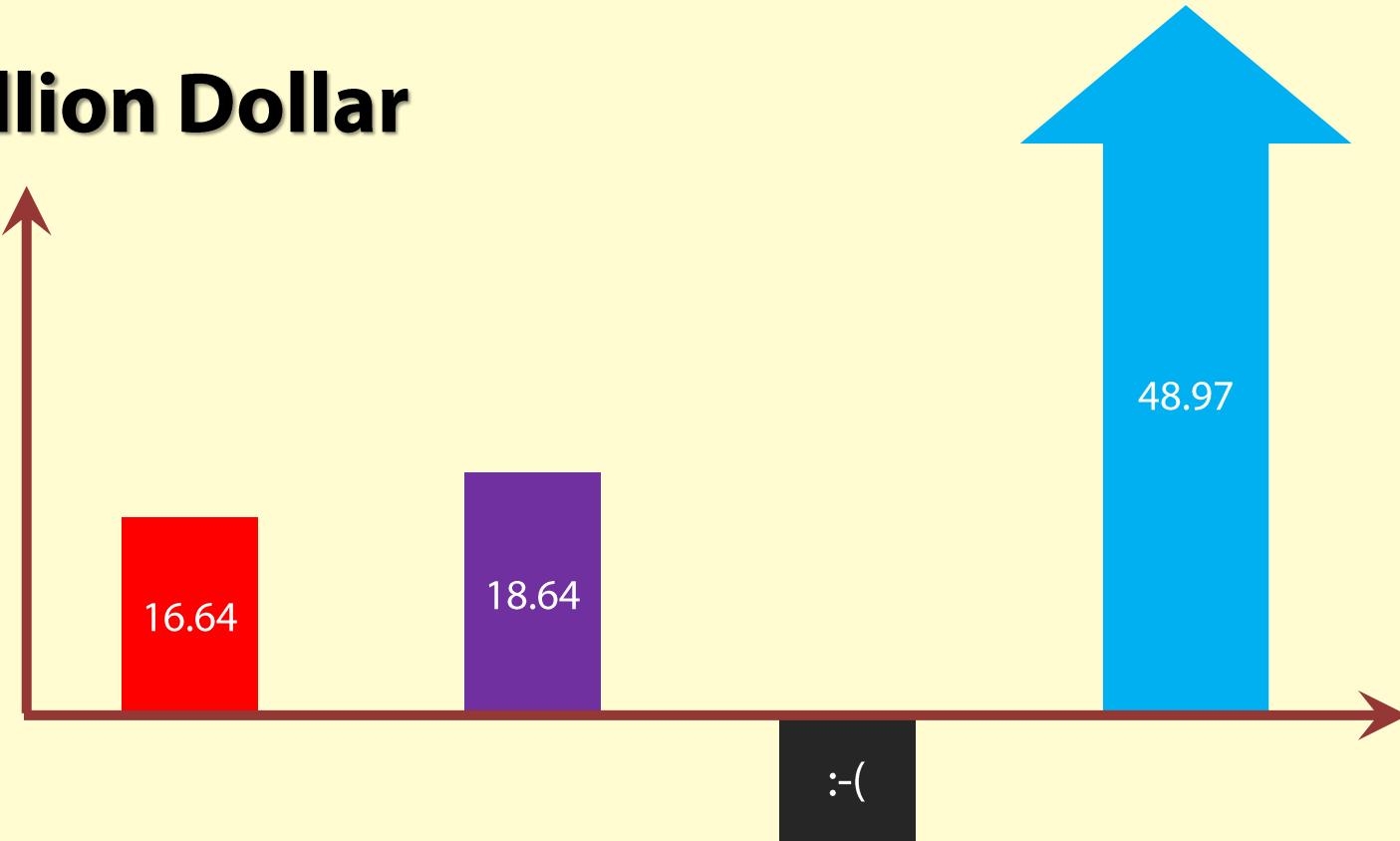
username

password

Log in

Market Value

Billion Dollar



 **Adobe**[®]

 **YAHOO!**[®]

 **GM**

 **facebook**[®]

Market Value



Relational Model



Describe
Re-define
Operate
Normalize

Relational Model



Terminology
Re-define
Operate
Normalize

Terminology

Name	Age	Gender	Y/N
Zhang Zheshen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Relation

Terminology

Name	Age	Gender	Y/N
Zhang Zheshen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Attribute

Terminology

Name	Age	Gender	Y/N
Zhang Zheshen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Tuple

Terminology

Name	Age	Gender	Y/N
Zhang Zheshen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Domain

Terminology

Name	Age	Gender	Y/N
Zhang Zhesnen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Schema

Terminology

Name	Age	Gender	Y/N
Zhang Zhesnen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N



Degree

Terminology

Name	Age	Gender	Y/N
Zhang Zhesnen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Superkey

Terminology

Name	Age	Gender	Y/N
Zhang Zhenchen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Candidate Key

Terminology

Name	Age	Gender	Y/N
Zhang Zhesnen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Primary Key

Terminology

Name	Age	Gender	Y/N
Zhang Zheshen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N

Primary Attribute

Terminology

Performance

Primary Key

IE01

Name	Order
Peng Qijia	1
Xu Chi	2
Peng Qijia	3
Yuan Quan	4
Peng Qijia	5
Zhang Zheshen	6
Qian Dongliang	7
Peng Qijia	8

Name	Age	Gender	Y/N
Zhang Zheshen	21	M	Y
Peng Qijia	21	M	Y
Xu Chi	20	M	Y
Chen Yue	19	M	Y
Dai Yibo	20	F	Y
Yang Muyang	20	M	N
Zhang Yuxuan	18	F	N
Qian Dongliang	20	M	Y
Zhu Junlin	21	M	N



Foreign Key

Relational Model



Terminology
Set Theory
Operate
Normalize

Set Theory

Cartesian Product

$$\begin{aligned} & R(A_1, A_2, \dots, A_n) \times R(B_1, B_2, \dots, B_m) \\ = & \{ (A_1, B_1), (A_1, B_2), \dots, (A_1, B_m), \\ & (A_2, B_1), (A_2, B_2), \dots, (A_2, B_m), \\ & \dots \\ & (A_n, B_1), (A_n, B_2), \dots, (A_n, B_m) \} \\ \\ = & \{ (A_i, B_j) \mid i=1,2,\dots,n \ j=1,2,\dots,m \} \end{aligned}$$

Set Theory

A **relation** is a subset of
 $D_1 \times D_2 \times \dots \times D_n$

Relational Model



Terminology
Set Theory
Operation Set
Normalize

Operation Set

Three Main Components of Relational Model

Relational Data Structure

Relational Operating Set

Relational Integrity Constraints

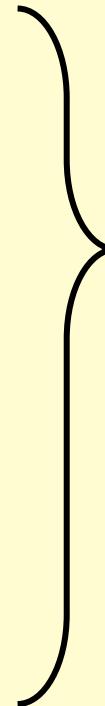
Operation Set

Query
Modify

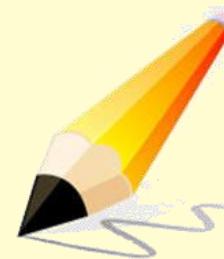


Operation Set

Union
Selection
Projection
Intersection
Difference
Natural Join
Division
Cartesian product



Insertion
Deletion
Update



Operation Set

IE01	Name	Age	Gender	Y/N
IE02	Name	Age	Gender	Y/N
	Yang Huiqiao	20	F	Y
	Xu Tianyang	21	M	N
	Pan Tao	19	M	Y
	Cao Liuxing	20	F	Y
	Yuan Quan	21	M	Y
	Zhou Liangxiao	20	M	N
	Wen Kongzi	21	M	N
	Zhu Junlin	21	M	N



Operation Set

IE01	Name	Age	Gender	Y/N
IErs	Name	Age	Gender	Y/N
	Zhang Zheshen	21	M	Y
	Peng Qijia	21	M	Y
	Xu Chi	20	M	Y
	Chen Yue	19	M	Y
	Dai Yibo	20	F	Y
	Yang Muyang	20	M	N
	Zhang Yuxuan	18	F	N
	Qian Dongliang	20	M	Y
	Zhu Junlin	21	M	N
	Yang Huiqiao	20	F	Y
	Xu Tianyang	21	M	N
	Pan Tao	19	M	Y
	Cao Liuxing	20	F	Y
	Yuan Quan	21	M	Y
	Zhou Liangxiao	20	M	N
	Wen Kongzi	21	M	N
Total Students				
	Wen Kongzi	21	M	N

Union

$$IErs = IE01 \cup IE02$$

Operation Set

IErs	Name	Age	Gender	Y/N
Tour	Name	Age	Gender	Y/N
	Zhang Zheshen	21	M	Y
	Peng Qijia	21	M	Y
	Xu Chi	20	M	Y
	Dai Yibo	20	F	Y
	Qian Dongliang	20	M	Y
	Yang Huiqiao	20	F	Y
	Cao Liuxing	20	F	Y
	Yuan Quan	21	M	Y

Cao Liuxing	20	-	-	-
	Yuan Quan	21	M	Y
	Zhou Liangxiao	20	M	N
	Wen Kongzi	21	M	N

Selection

$Tour = \sigma_{Y/N=Y \wedge Age \geq 20}(IErs)$

Operation Set

Tour	Name	Age	Gender	Y/N
	Zhang Zheshen	21	M	Y
	Peng Qijia	21	M	Y
	Xu Chi	20	M	Y
	Dai Yibo	20	F	Y
	Qian Dongliang	20	M	Y
	Yang Huiqiao	20	F	Y
	Cao Liuxing	20	F	Y
	Yuan Quan	21	M	Y

Projection

$$[Gender?] = \prod_{Gender} (Tour)$$

Gender
M
F

Operation Set



Burger	Name	Size
	Zhang Zheshen	Big
	Peng Qijia	Big
	Xu Chi	Small
	Yuan Quan	Big
	Qian Dongliang	Small

Coke	Name	Size
	Yuan Quan	Small
	Peng Qijia	Big
	Qian Dongliang	Small

Operation Set

Burger	Name	Size
	Zhang Zheshen	Big
	Peng Qijia	Big
	Xu Chi	Small
	Yuan Quan	Big
	Qian Dongliang	Small

Coke	Name	Size
	Yuan Quan	Small
	Peng Qijia	Big
	Qian Dongliang	Small

Indifference

$Combo = Burger \cap Coke$

Neither	Name
	Yang Huiqiao
	Dai Yibo
	Cao Liuxing
	Yuan Quan

$$[Neither] = \Pi_{Name}(Tour) - \Pi_{Name}(Burger) \cup \Pi_{Name}(Coke)$$

$$Combo = \Pi_{Name}(Burger) \cap \Pi_{Name}(Coke)$$

Operation Set

Name	P.Order	D+.Order	Type	Duration
Peng Qijia	1	1	Peking Opera	7
Peng Qijia	1	2	Dance	5
Peng Qijia	1	3	Song	4
Peng Qijia	1	4	Dance	5
Peng Qijia	1	5	Dance	5
Peng Qijia	1	6	Song	4
Peng Qijia	1	7	Joke	3
Peng Qijia	1	8	Joke	3
Xu Chi	2	1	Peking Opera	7
Xu Chi	2	2	Dance	5
Xu Chi	2	3	Song	4
Xu Chi	2	4	Dance	5
Xu Chi	2	5	Dance	5
Xu Chi	2	6	Song	4
Xu Chi	2	7	Joke	3
Xu Chi	2	8	Joke	3

Detail	Order	Type	Duration
...
...
Peng Qijia	8	1	Peking Opera
Peng Qijia	9	2	Dance
Peng Qijia	10	3	Song
Peng Qijia	11	4	Dance
Peng Qijia	12	5	Dance
Peng Qijia	13	6	Song
Peng Qijia	14	7	Joke
Peng Qijia	15	8	Joke

Cartesian product

$$[\geq 5] = \prod_{Name} (\sigma_{Dur \geq 5} (\sigma_{P.O=D+.O} (P \times D+)))$$

Operation Set

Detail	Order	Type	Duration	Type	Time
	1	Peking Opera		Peking Opera	7
	2	Dance		Dance	5
	3	Song		Song	4
	4	Dance		Joke	3
	5	Dance		Dance	5
	6	Song		Song	4
	7	Joke		Joke	3
	8	Joke		Joke	3

Natural Join

$[Detail+] = Detail \bowtie Duration$

Operation Set

Performance	Party	Name	Order	Type	Duration	Duration
Peking Opera 1	Peking Opera	Peng	1	Peking Opera	Peking Opera	7
		Xu Chi	2	Dance	5	5
		Peng Qijia	3	Song	5	4
		Yuan Quan	4	Dance	3	5
		Peng Qijia	5	Dance	4	4
		Zhang Zheshen	6	Song	4	3
		Qian Dongliang	7	Joke	2	3
		Peng Qijia	8	Joke	3	

Division

$$[All] = \prod_{Name, Type} (Party) \div \prod_{Type} (Party)$$

Operation Set

Party	Name	Order	Type	Duration
	Peng Qijia	1	Peking Opera	7
	Xu Chi	2	Dance	5
	Peng Qijia	3	Song	5
	Yuan Quan	4	Dance	3
	Peng Qijia	5	Dance	4
	Zhang Zheshen	6	Song	4
	Qian Dongliang	7	Joke	2
	Peng Qijia	8	Joke	3

**Insertion
Deletion
Update**

Operation Set

Party	Name	Order	Type	Duration
	Peng Qijia	1	Peking Opera	7
	Xu Chi	2	Dance	5
	Peng Qijia	3	Song	5
	Yuan Quan	4	Dance	3
	Peng Qijia	5	Dance	4
	Zhang Zheshen	6	Song	4
	Qian Dongliang	7	Joke	2
	Peng Qijia	8	Joke	3

Domain Integrity

Entity Domain Integrity
Entity Integrity
Referential Integrity
User-defined Integrity

Relational Model



Terminology
Set Theory
Operation Set
Normal Form

Normal Form

elgg_user_entities

guid	name
51	Chen Yue
52	Xu Chi
56	Zhang Zheshan
61	Dai Yibo
65	Peng Qiqi
66	Yang Guiqiao
69	Vanya

elgg_entities

auid	subtype	owner_guid
80	4	51
84	1	52
88	4	61
90	9	52

elgg_entity_subtypes

id	type	subtype
1	object	file
2	object	plugin
3	object	widget
4	object	blog
5	object	thewire
6	object	question
7	object	answer
8	object	page_top
9	object	messages

elgg_objects_entity

guid	title	description
80	My First Blog	<p> This is my first blog </p>
84	UAM Proposal.docx	<p> UAM Proposal.docx </p>
88	A Nice Day	<p> I'm feeling good! </p>
90	Greeting	<p> Nice to meet you! </p>

Normal Form

entity_guid	owner_guid	owner_name	type	subtype	title	description
80	51	Chen Yue	object	blog	My First Blog	<p> This is my first blog </p>
84	52	Xu Chi	object	file	UAM Proposal.docx	<p> UAM Proposal.docx </p>
88	61	Dai Yibo	object	blog	A Nice Day	<p> I'm feeling good! </p>
90	52	Xu Chi	object	messages	Greeting	<p> Nice to meet you! </p>

Normal Form

Problems

Functional Dependency

Relation R.

Attribute sets X & Y is in R.

X determines Y

Y is dependent on X.

X → Y

Normal Form

owner_guid → owner_name

entity_guid	owner_guid	owner_name	type	subtype	title	description
80	51	Chen Yue	object	blog	My First Blog	<p> This is my first blog </p>
84	52	Xu Chi	object	file	UAM Proposal.docx	<p> UAM Proposal.docx </p>
88	61	Dai Yibo	object	blog	A Nice Day	<p> I'm feeling good! </p>
90	52	Xu Chi	object	messages	Greeting	<p> Nice to meet you! </p>

Normal Form

entity_guid	owner_guid	owner_name	type	subtype	title		description
80	51	Chen Yue	object	blog	My First Blog		<p> This is my first blog </p>
84	52	Xu Chi	object	file	UAM Proposal.docx		<p> UAM Proposal.docx </p>
88	61	Dai Yibo	object	blog	A Nice Day		<p> I'm feeling good! </p>
90	52	Xu Chi	object	messages	Greeting		<p> Nice to meet you! </p>
84	52	Xu Chi	object	file	UAM Proposal.docx		<p> UAM Proposal.docx </p>
88	61	Dai Yibo	object	blog	A Nice Day		<p> I'm feeling good! </p>
90	52	Xu Chi	object	messages	Greeting		<p> Nice to meet you! </p>

Normal Form

How to evaluate a
database?

Normal Form

Normal Form

First normal form (1NF)

Definition:

The domains of all attributes of it are atomic .

Normal Form

Second normal form (2NF)

Definition:

- It is in 1NF.
- No *partial functional dependency*.

Normal Form

entity_guid	owner_guid	owner_name	type	subtype	title	description
80	51	Chen Yue	object	blog	My First Blog	<p> This is my first blog </p>
84	52	Xu Chi	object	file	UAM Proposal.docx	<p> UAM Proposal.docx </p>
88	61	Dai Yibo	object	blog	A Nice Day	<p> I'm feeling good! </p>
90	52	Xu Chi	object	messages	Greeting	<p> Nice to meet you! </p>

Normal Form

guid	name	entity_guid	owner_uid	type	subtype	title	description
51	Chen Yue	80	51	object	blog	My First Blog	<p> This is my first blog </p>
52	Xu Chi	84	52	object	file	UAM Proposal.	<p> UAM Proposal.docx </p>
56	Zhang Zheshen					docx	
61	Dai Yibo	88	61	object	blog	A Nice Day	<p> I'm feeling good! </p>
65	Peng Qijia						
66	Yang Huiqiao	90	52	object	messages	Greeting	<p> Nice to meet you! </p>
69	Vaina						

Normal Form

Third normal form (3NF)

Definition:

- It is in 2NF.
- No *transitive functional dependencies* between non-key attributes.

Normal Form

entity_guid	owner_guid	type	subtype	title	description
80	51	object	blog	My First Blog	<p> This is my first blog </p>
84	52	object	file	UAM Proposal.docx	<p> UAM Proposal.docx </p>
88	61	object	blog	A Nice Day	<p> I'm feeling good! </p>
90	52	object	messages	Greeting	<p> Nice to meet you! </p>

Normal Form

type	subtype
object	file
object	plugin
object	widget
object	blog
object	thewire
object	question
object	answer
object	page_top
object	messages

entity_guid	owner_g uid	subtype	title	description
80	51	blog	My First Blog	<p> This is my first blog </p>
84	52	file	UAM Proposal.docx	<p> UAM Proposal.docx </p>
88	61	blog	A Nice Day	<p> I'm feeling good! </p>
90	52	messages	Greeting	<p> Nice to meet you! </p>

Normal Form

Other normal forms

- Boyce-Codd normal form (BCNF)(1974)
- Forth normal form (4NF)(1977)
- Fifth normal form (5NF) (1979)
- Domain/key normal form (DKNF) (1981)
- Sixth normal form (6NF) (2002)

$$5\text{NF} \subseteq 4\text{NF} \subseteq \text{BCNF} \subseteq 3\text{NF} \subseteq 2\text{NF} \subseteq 1\text{NF}$$

Normal Form

elgg_entity_subtypes

In elgg

id	type	subtype
1	object	file
2	object	plugin
3	object	widget
4	object	blog
5	object	thewire
6	object	question
7	object	answer
8	object	page_top
9	object	messages

Created by us

type	subtype
object	file
object	plugin
object	widget
object	blog
object	thewire
object	question
object	answer
object	page_top
object	messages

Not in 3NF

Reference

Papers and books and Wikipedia here

Acknowledgement

Dr. Benjamin Koo

Yang Liqian

Liu Yifan

Pan Tao

Relational Model



Thank you