Relational Data Model
(Chapter 3.1)

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What are Database Systems?
(Review from Chapter 1)

Database systems are software that provide

- abstract data models,

- easy-to-use queries

- good query evaluation performance.

Example Database System

- MLPQ
- MySQL
- Oracle

Data Abstraction
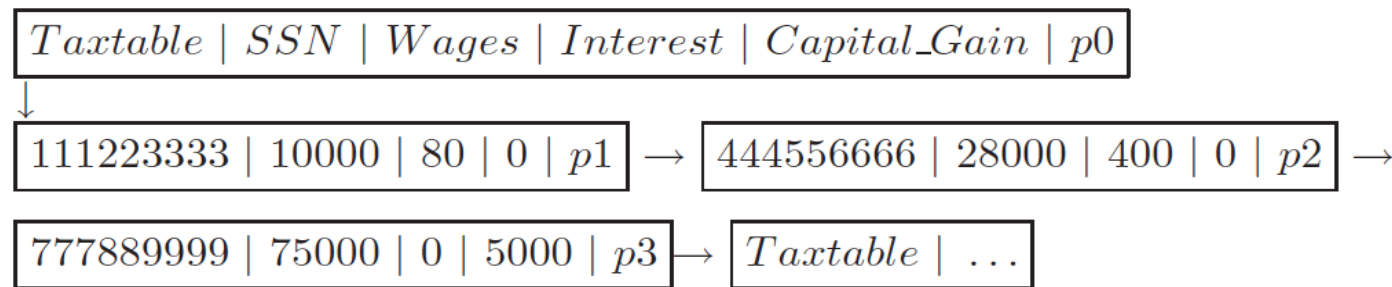## (Review from Chapter 1)

Data Abstraction Features:

- Hides some parts of the data that are unimportant.
- Makes queries easier.

Data Abstraction Increases over Time

- 1960s – Hierarchical Databases and Network Databases

    Tables represented as linked lists, queries used pointers to search for data.

    $$Taxtable \mid SSN \mid Wages \mid Interest \mid Capital\_Gain \mid p0$$
    $$\downarrow$$
    $$111223333 \mid 10000 \mid 80 \mid 0 \mid p1 \;\rightarrow\; 444556666 \mid 28000 \mid 400 \mid 0 \mid p2 \;\rightarrow$$
    $$777889999 \mid 75000 \mid 0 \mid 5000 \mid p3 \;\mapsto\; Taxtable \mid \ldots$$

- 1970 – Relational Databases introduced by Edgar F. Codd at IBM research

    IBM, which already marketed Hierarchical Databases, did not embrace the idea. Many experts thought that Relational Databases will never be practical because they require more computer memory than other databases. Larry Ellison, founder of Oracle, saw an opportunity to develop commercial Relational Databases.

- 1980s – Oracle first to market Relational Databases

- 2000s – practical Geographic Information Systems

Data Models
(Review from Chapter 1)

Some examples of different types of data:

- Tax records

- Maps

- Photos

- Music

- Genomes

Data Models
(Review from Chapter 1)

Some examples of different types of data:

- Tax records
- Maps
- Photos
- Music
- Genomes

Out of the above, what type of data can relational databases handle? _____

Different Types of Databases
(Review from Chapter 1)

- Tax records - Relational Databases

- Maps – Geographic Information Systems

- Photos – Image Databases

- Music – Music Databases

- Genomes – Genome Databases

- Out of the above, what type of data can relational databases handle? Tax records data only.

Basic Database Terms

- Relation: Each table is a separate relation.

- Attribute: The heading of each row is an attribute.

- Scheme: Relation name followed by set of attributes in parentheses.

- Tuple: Each row of the table.

Primary Keys

Primary Key Features:

- Unique set of attributes for each tuple

- Declared when creating a relation

- Checked for uniqueness at insertion of new records

- Indexed for fast retrieval

Basic Database Terms

Taxrecord

SSN	Wages	Interest	Capital_Gain
111223333	10000	80	0
444556666	28000	400	0
777889999	75000	0	5000

Examples:

- Relation: Taxrecord

- Attributes: Wages.

- Scheme: Taxrecord(SSN, Wages, Interest, Capital_Gain)

- Tuple: (111223333, 10000, 80, 0)

- Primary key: SSN

Basic Database Terms

Package

Number	Origin	Destination	Weight
101	Omaha	Chicago	12.6
102	Omaha	Atlanta	27.3
103	Omaha	Boston	37.5
104	Omaha	Atlanta	18.7
105	Omaha	Chicago	22.4

Find an example of each:
- Relation: _____
- Attributes: _____
- Scheme: _____
- Tuple: _____
- Primary key: _____

Candidate Keys

Candidate Key Features:

- Unique for each record.

- Potential primary keys.

Relational Data Model

Planet

Name	Mass	Period
Mercury	0.06	0.24
Venus	0.82	0.62
Earth	1.00	1.00
Mars	0.11	1.88
Jupiter	317.80	11.86
Saturn	95.2	29.46
Uranus	14.6	84.01
Neptune	17.2	164.8

Find all the candidate keys: _____

Foreign Keys

Foreign Key Features:

- A field in one relation that is a primary key in another relation.

- Foreign keys may be declared and checked at insertions/deletions.

Hospital Database

Patient

Name	ID	CM	KG
Anderson	100	200	130
Brown	111	150	50
Davis	222	190	90
Edwards	333	160	90
Ford	345	165	100
Hardy	454	175	70
Johnson	567	170	50
Smith	755	180	120

Doctor

Name	ID	Age	Specialty
Cheney	987	50	pediatry
Hardy	454	53	osteopathology
McBride	377	36	radiology
Miller	300	60	neurology
Moss	244	30	neurology
Nelson	400	76	cardiology
Oltman	181	56	urology
Paine	266	45	cardiology
Pepper	555	42	cardiology
Snow	500	65	radiology

Visit

PID	DID	Month	Day	Year
100	181	5	20	2008
100	555	6	30	2009
111	987	8	20	2009
111	987	5	28	2010
222	266	9	12	2007
222	400	5	20	2008
222	555	5	20	2008
333	987	6	23	2009
345	300	5	16	2009
454	244	6	10	2010
567	377	2	20	2010
567	454	5	28	2010
755	987	6	23	2009

Find for each relation a primary key:

_____

Find a foreign key:_____

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222	555	5	20	2008
333	987	6	23	2009
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454	244	6	10	2010
567	377	2	20	2010
567	454	5	28	2010
755	987	6	23	2009

Find for each relation a primary key:

ID in Patient,   ID in Doctor,

(PID, DID, Month, Day, Year) in Visit

Find a foreign key: PID in Visit