

Basic Concepts of a Database System

- Database

A collection of interrelated data accessible by multiple users or multiple purposes

- Database Management System(DBMS)

Software that allows one or many persons to use and /or modify data

- Database system = Database + DBMS

Schemes and Instances

- Scheme of a database
=> structure of a database
(structural skeleton)
- Instance of a database
=> current content of the database
- Programming Language analogy
type customer = Record {}
var customer1: customer

Data Model

- A formalism for describing the logical structure of a database and operation on the database
- Programing language analogy:

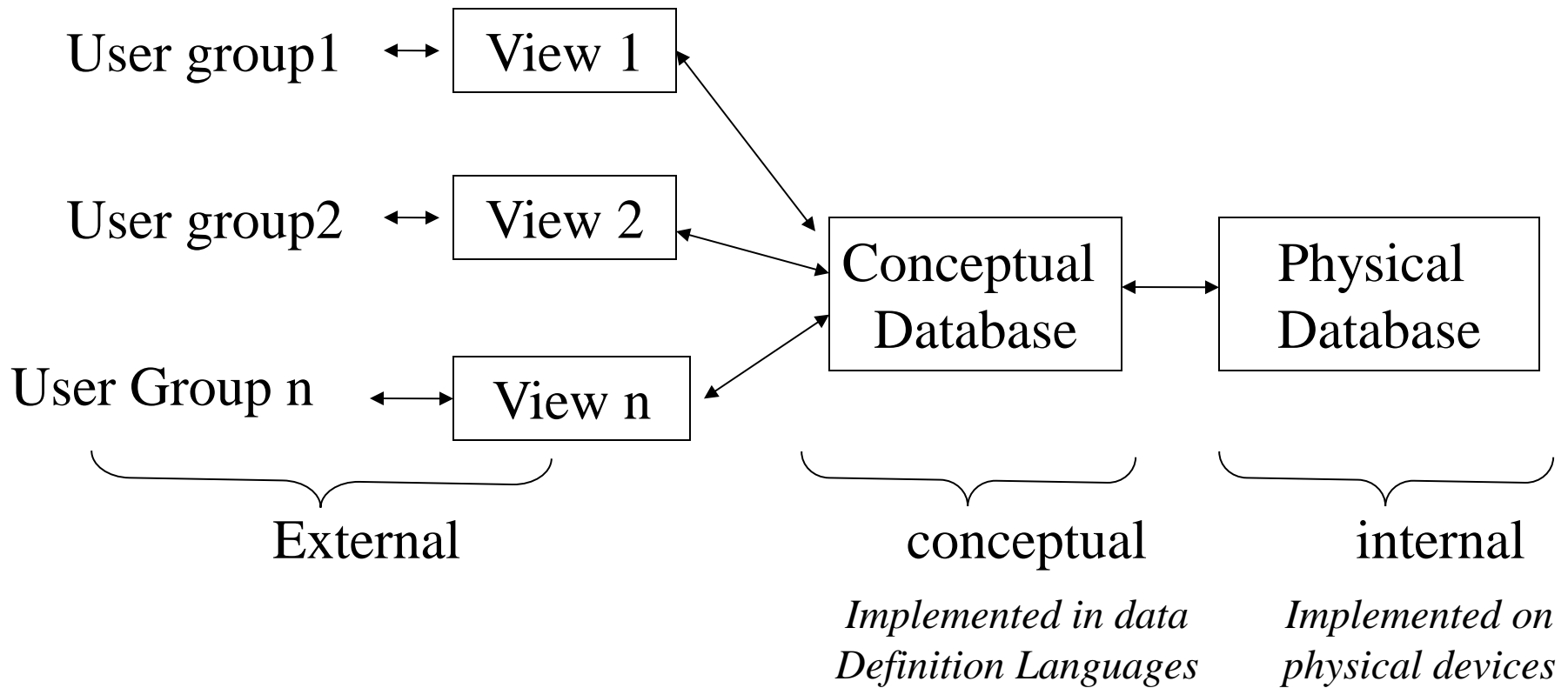
var customer1: customer;



instance scheme

PASCAL(programming Language)≡data model

Levels of Abstraction in DBMS



Database Languages

- Data Definition Language (DDL)
to describe a scheme of a database
- Data Manipulation Language(DML)
to manipulate (retrieve, insert, delete & modify) a database instance
 - non-procedural (declarative)
 - procedural
- Query Language
Interactive DML

- Host Language

Programming language in which Statements in a DML can be embedded (e.g. C)

Classification of DBMS

- From viewpoint of Data Models:
 - simple flat tables
 - Hierarchical DBMS
 - Network DBMS
 - Relational DBMS
- From a viewpoint of Control:
 - Centralized DBMS
 - Distributed DBMS (DDBMS)
 - heterogeneous DDBMS
 - homogeneous DDBMS

Important Database Properties

- Data Abstraction

(hide storage detail from user)

→ current trend : operation abstraction in object-oriented systems

- Security and Authorization

(file systems ok for all/nothing access)

But often want to grant selected field access

Grant student.advisor ACCESS(+R) to student.grade

- Control of Redundancy

- | | |
|--------------------------------|-------------------------------------|
| 1. Duplication of effort | repetition of same data in multiple |
| 2. Waste of storage space | places |
| 3. May lead to inconsistencies | |

change (photo #) one place, change everywhere?

(Date of Birth)

situation with

| | | |
|------------------|---------|----------------|
| Rosie Donnaldson | 8/26/65 | TA |
| Rose Donnaldson | 8/26/65 | Student Record |

Controlled Redundancy may be useful.

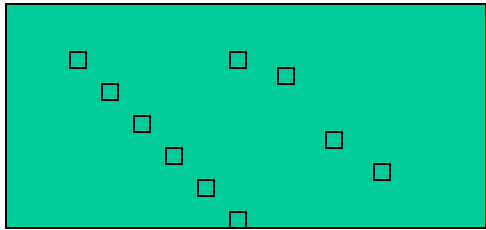
→case where difference values of field for different recs

A Brief history of Database Technology

- Flat Databases

early 1900's – The Punch card

- fixed fields for storing data
- (initially) 1 record per card

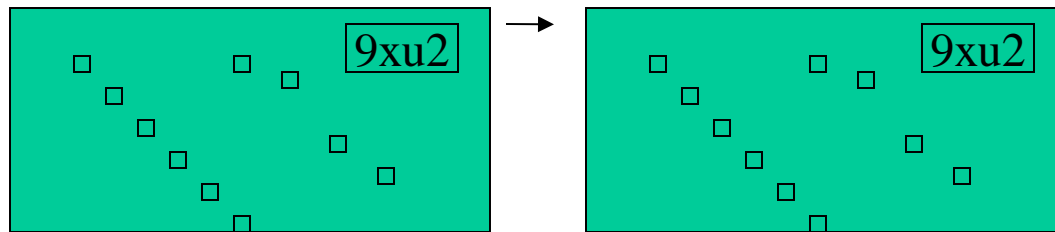


1945 – Magnetic Tape

(Punchcards on tape, but allows faster search + sorting)

Flat databases motivated by Punch cards

- The Record key – allowed flat records to continue on multiple punchcards (facilitated sorting)



(Wider records on magnetic tape)

Flat Databases are still with us

- Popular PC database programs of 70's/80's
 - Dbase (fixed field widths)
 - DB2

Flat Databases are still with us

| Records Fields Go To Exit | | | | |
|--|---------------------------|----------------|---------------|-------|
| 1:21:39 pm | | | | |
| ACCOUNT | COMPANY | ADDRESS | CITY | STATE |
| HRUNOFF | | 681 First Stre | Benicia | CA |
| ABCPLUMB | ABC Plumbing | 1858 Universit | Berkeley | CA |
| GREENTHUMB | Green Thumb Landscaping | 1248 Hearst | Berkeley | CA |
| HOME MOVIES | Home Movies Video Rentals | 2982 College A | Berkeley | CA |
| IMAGE MAKER | The Image Makers | 1988 Powell St | Emeryville | CA |
| HTK | M.T.K. Industries | 1488 61st Stre | Emeryville | CA |
| WHITNEY | Financial Planning Svcs. | 1888 Peralta B | Fremont | CA |
| LEWIS | Lewis and Associates | 468 Grand Aven | Oakland | CA |
| SHAPEUP | Shape Up Fitness Center | 2832 MacDonald | Richmond | CA |
| HRINSURANC | H & R Insurance | 1225 Van Ness | San Francisco | CA |
| JOHNSON | J. Thomas Johnson, CPA | 58 California | San Francisco | CA |
| RAPIDTYPE | RapidType Secretarial Svc | 2457 Union Str | San Francisco | CA |
| YORKPUMP | York Pump, Inc. | 632 Charcot Av | San Jose | CA |
| KELLY | Kelly and Sons Furniture | 14888 Bancroft | San Leandro | CA |
| PHOENIX | Phoenix Construction | 2125 Providenc | Eugene | OR |
| FLOORPLAN | Floor Plan Carpet Center | 2828 N.E. Oreg | Portland | OR |
| KLEIN | Carol Klein, M.D. | 1849 S.E. 48th | Portland | OR |

| | | | | |
|----------|-----------------|-----------|------|------|
| Database | MONTHLYMKTG.DAT | Rec 19/23 | File | Page |
|----------|-----------------|-----------|------|------|

View and edit fields

Flat Databases are still with us

Layout Organize Append Go To Exit

12:57 pm

Bytes remaining: 3728

| Num | Field Name | Field Type | Width | Dec | Index |
|-----|------------|------------|-------|-----|-------|
| 1 | ACCOUNT | Character | 10 | | Y |
| 2 | COMPANY | Character | 25 | | N |
| 3 | ADDRESS | Character | 25 | | N |
| 4 | CITY | Character | 20 | | N |
| 5 | STATE | Character | 2 | | N |
| 6 | ZIP | Character | 10 | | N |
| 7 | TELEPHONE | Character | 8 | | N |
| 8 | CONTACT | Character | 25 | | N |
| 9 | EQUIPMENT | Character | 100 | | N |
| 10 | FIRSTORDER | Date | 8 | | N |
| 11 | LASTORDER | Date | 8 | | N |
| 12 | CREDITOK | Logical | 1 | | N |
| 13 | YTDORDERS | Numeric | 10 | 2 | N |
| 14 | TOTORDERS | Numeric | 10 | 2 | N |
| 15 | COMMENTS | Memo | 10 | | N |

Database: Database AUGUST Field 1/15

Enter the field name. Insert/Delete field: Ctrl-N/Ctrl-U

Field names begin with a letter and may contain letters, digits and underscores

Flat Databases are still with us

Layout Fields Words Go To Exit 1:02:53 pm
[.....1.....2.....3.....5.....6.....7.....]

Customer Inquiry and Update

| | | | |
|-------------|--|--------------|---|
| Account ID | XXXXXXXXXX | | |
| Company | XXXXXXXXXXXXXXXXXXXXXXXXXXXX | | |
| Address | XXXXXXXXXXXXXXXXXXXXXXXXXXXX | | |
| City | XXXXXXXXXXXXXXXXXXXX | State | XX ZIP 99999#9999 |
| Telephone | 999-9999 | Contact Name | XXXXXXXXXXXXXXXXXXXXXXXXXXXX |
| Equipment | XX | | |
| First Order | MM/DD/YY | Y-T-D Orders | 9,999,999.99 OK to Extend |
| Most Recent | MM/DD/YY | Total Orders | 9,999,999.99 Credit Terms ? <input checked="" type="checkbox"/> |

Notes

XX
XX
XX
XX

Form C:\dbase4\NJCUST3 Row:2 Col:1 File: Njcust Ins
Add field:F5 Select:F6 Move:F7 Copy:F8 Size:Shift-F7

Flat Databases are still with us

| Records Fields Go To Exit | | | | |
|--|---------------------------|----------------|---------------|-------|
| 1:21:39 pm | | | | |
| ACCOUNT | COMPANY | ADDRESS | CITY | STATE |
| HRUNOFF | | 681 First Stre | Benicia | CA |
| ABCPLUMB | ABC Plumbing | 1858 Universit | Berkeley | CA |
| GREENTHUMB | Green Thumb Landscaping | 1248 Hearst | Berkeley | CA |
| HOME MOVIES | Home Movies Video Rentals | 2982 College A | Berkeley | CA |
| IMAGE MAKER | The Image Makers | 1988 Powell St | Emeryville | CA |
| HTK | M.T.K. Industries | 1488 61st Stre | Emeryville | CA |
| WHITNEY | Financial Planning Svcs. | 1888 Peralta B | Fremont | CA |
| LEWIS | Lewis and Associates | 468 Grand Aven | Oakland | CA |
| SHAPEUP | Shape Up Fitness Center | 2832 MacDonald | Richmond | CA |
| HRINSURANC | H & R Insurance | 1225 Van Ness | San Francisco | CA |
| JOHNSON | J. Thomas Johnson, CPA | 58 California | San Francisco | CA |
| RAPIDTYPE | RapidType Secretarial Svc | 2457 Union Str | San Francisco | CA |
| YORKPUMP | York Pump, Inc. | 632 Charcot Av | San Jose | CA |
| KELLY | Kelly and Sons Furniture | 14888 Bancroft | San Leandro | CA |
| PHOENIX | Phoenix Construction | 2125 Providenc | Eugene | OR |
| FLOORPLAN | Floor Plan Carpet Center | 2828 N.E. Oreg | Portland | OR |
| KLEIN | Carol Klein, M.D. | 1849 S.E. 48th | Portland | OR |

| | | | | |
|----------|-----------------|-----------|------|------|
| Database | MONTHLYMKTG.DAT | Rec 19/23 | File | Page |
|----------|-----------------|-----------|------|------|

View and edit fields

Flat Databases – where else?

...

Flat Databases – where else?

| Name | SSN | HW1 | HW2 | HW3 | FP | FE |
|-------|------|-----|-----|-----|----|----|
| ... | | 99 | 83 | 58 | 22 | 92 |
| | | 78 | 84 | 92 | 33 | 91 |
| | | | | | | |

- **AWK/GAWK/Perl**
 - Variable field widths
 - separated by tab character (or equiv.)

Advantages:

easy to code(simple data model)
efficient to index + access (data all in one place)
deletion/insertion easy (if fixed width)
→ fewer dependencies

Disadvantages:

- consistency management
- Redundancy

History (continued)

- 1970 Relational Data Model
 Ted Codd, IBM research fellow
 square
 Sequel(SQL) } relational
 QBE } languages
 Quel

 System R – IBM } Relational
 INGRES - Berkeley } Research projects

History (continued)

- 1964 – GE Integrated Data Store (IDS)

Bachman, Network. Data Model

- 1965 – IBM Information Management System(IMS)

Hierarchical Data Mode

- Late 60's – SABRE (IBM + American Airline)

First large distributed database with intense concurrency and transaction control needs