Relational Database Design

Module 1: Introduction

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Outline

- **Storage hardware**
- **Database technologies**
- **Relational model**
  - Fundamentals
  - Codd's Twelve Rules
- **Types of data models**
  - Conceptual
  - Logical
  - Physical

Development of storage hardware

- **Punch cards**

Development of storage hardware

- **Punch cards**
- **Punch tape**

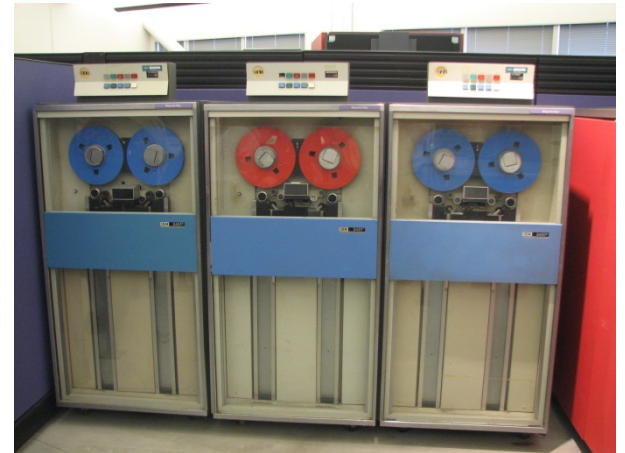http://commons.wikimedia.org/wiki/File:PaperTapes-5and8Hole.jpg

http://commons.wikimedia.org/wiki/File:Honolulu_IFSS_Teletype1964.jpg

Development of storage hardware

- **Punch cards**
- **Punch tape**
- **Magnetic tape**

http://commons.wikimedia.org/wiki/File:Quarter-Inch_Cartridges.jpg

http://commons.wikimedia.org/wiki/File:IBM_System_360_tape_drives.jpg

Development of storage hardware

- **Punch cards**
- **Punch tape**
- **Magnetic tape**
- **Spinning disc**
  - Hard disk
  - Floppy disk

http://commons.wikimedia.org/wiki/File:Hdd_od_srodka.jpg

http://commons.wikimedia.org/wiki/File:Floppy_disk_2009_G1.jpg
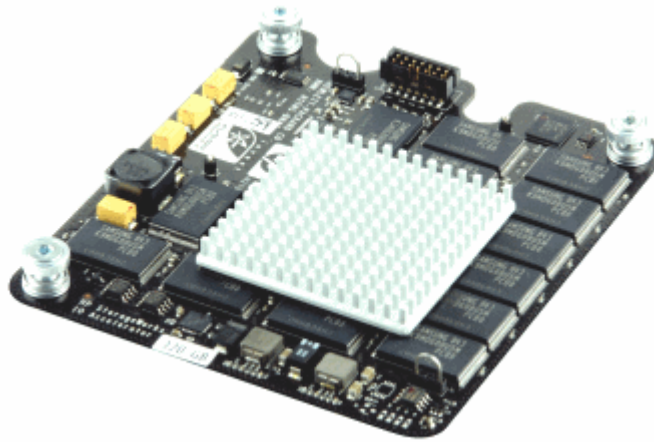
Development of storage hardware

- **Punch cards**
- **Punch tape**
- **Magnetic tape**
- **Spinning disc**
  - Hard disk
  - Floppy disk
- **Optical disc**
  - Compact disc
  - DVD
  - Blu-Ray

http://en.wikipedia.org/wiki/File:DVD-4.5-scan.png

Development of storage hardware

- **Punch cards**
- **Punch tape**
- **Magnetic tape**
- **Spinning disc**
  - Hard disk
  - Floppy disk
- **Optical disc**
  - Compact disc
  - DVD
  - Blu-Ray
- **Solid State Drive (SSD)**

http://commons.wikimedia.org/wiki/File:Hp-io-accelerator-isometric.gif

micro
4 GB

cruzer

http://commons.wikimedia.org/wiki/File:SanDisk_Cruzer_Micro.png

Database technologies

- **Database**
  - Not necessarily a relational database

Database:
"a usually large collection of data organized especially for rapid search and retrieval (as by a computer)"
(http://www.merriam-webster.com/dictionary/database)

Database technologies

- **Evolution of database technologies**
  - Sequential ("flat") files

Record type C = Customer data

```
C John Doe              19290418
A 18 Pivot Drive           Nowhereville
A PO box 39773             Somewhereelse
```

Record type A = Address

Database technologies

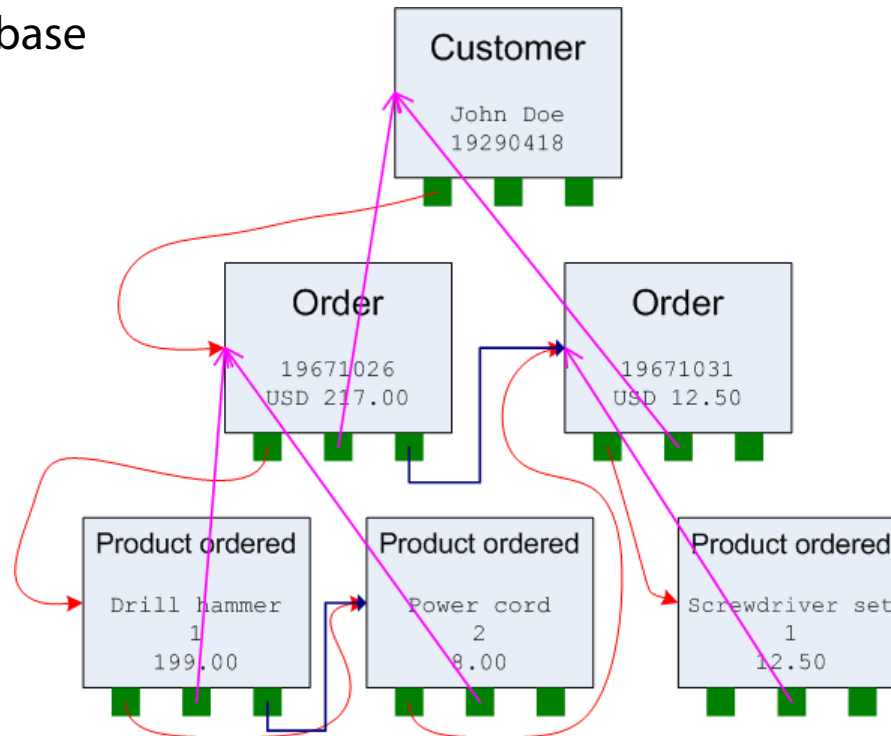- **Evolution of database technologies**
  - Sequential ("flat") files

```
C John Doe            19290418
A 18 Pivot Drive           Nowhereville
A PO box 39773             Somewhereelse
O 19671026 USD 217.00
P Drill hammer      1    199.00
P Power cord        2      8.00
O 19671031 USD  12.50
P Screwdriver set  1     12.50
...
```

Record type O = Order information

Record type P = Product ordered

Database technologies

- **Evolution of database technologies**
  - Sequential ("flat") files
  - Hierarchical database

Database technologies

- **Evolution of database technologies**
  - Sequential ("flat") files
  - Hierarchical database
  - Network database
  - Relational database
  - Object database
  - XML database
  - "Big data"
  - ?????

The Relational Model

- **Based on mathematics**
  - Set theory
  - First-order predicate logic

Column (attribute)

Table (relation)

Row (tuple)

Primary key

Data value

CustomerID	FirstName	LastName	Birthdate
XY001	John	Doe	April 18, 1929
BR092	Mary	Green	March 4, 1980
PD500	Francesca	de la Gillebert	September 12, 1959
WI308	John	Green	March 4, 1980

The Relational Model

- **Based on mathematics**
  - Set theory
  - First-order predicate logic

- **Relationships between elements based on data values (primary key)**
  - NOT on storage order
  - NOT with pointers to physical location

- **Rules for relational databases describe behavior**
  - Actual implementation can be chosen by vendor

The Relational Model

- **Codd's twelve rules**
  - 0: Foundation Rule
  - 1: Information Rule
  - 2: Guaranteed Access Rule
  - 3: Systematic Treatment of Null Values
  - 4: Dynamic On-line Catalog Based on the Relational Model
  - 5: Comprehensive Data Sublanguage Rule
  - 6: View Updating Rule
  - 7: High-level Insert, Update, and Delete
  - 8: Physical Data Independence
  - 9: Logical Data Independence
  - 10: Integrity Independence
  - 11: Distribution Independence
  - 12: Nonsubversion Rule

Data modeling

- **Conceptual data model**
    - All information in the organization
    - Not necessarily stored in computers

- **Logical data model**
    - For storing in computers
    - For a specific database technology
    - Implementation independent

- **Physical data model**
    - Optimized for specific vendor
    - Based on logical model

Summary

- **Storage hardware**
- **Database technologies**
- **Relational model**
  - Fundamentals
  - Codd's Twelve Rules
- **Types of data models**
  - Conceptual
  - Logical
  - Physical

References

- **Further reading:**
  - http://en.wikipedia.org/wiki/History_of_computing_hardware
  - http://royal.pingdom.com/2008/04/08/the-history-of-computer-data-storage-in-pictures/
  - http://en.wikipedia.org/wiki/Database_management_system
  - http://www.seas.upenn.edu/~zives/03f/cis550/codd.pdf (Codd's groundbreaking article from 1970)
  - http://en.wikipedia.org/wiki/Relational_model
  - http://en.wikipedia.org/wiki/Codd's_12_rules
  - http://pbdj.sys-con.com/node/106944 ("Why Have Conceptual, Logical, and Physical Data Modeling?")