

# **Lecture 1.**

# **Introduction to**

# **Databases**

**Kuralbayev Aibek**

- Kuralbayev Aibek
- +7 701 222 5827
- aibekkuralbaev@gmail.com

# Overview

- Introduction to Databases
- Nonrelational Database Systems
- The Relational Model
- What is SQL?
- Introduction to PostgreSQL
- Tools will be used for course

A **database** is nothing more than a **set of related information**



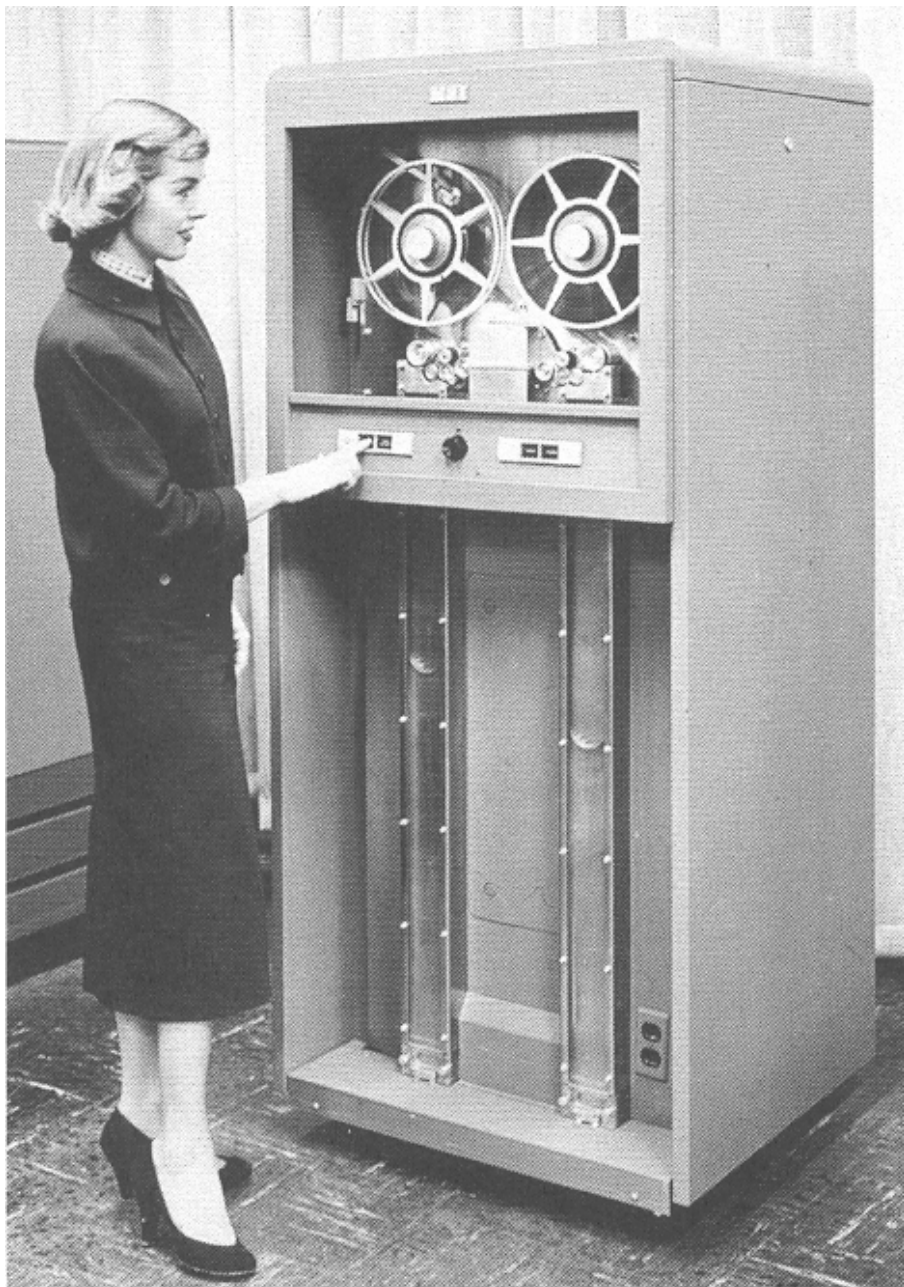
# A telephone book: **Fields**

- Name
- Phone number
- Address
- Notes

# A telephone book: **Disadvantages**

- Security
- Slow search
- Find by address impossible
- Data relevance

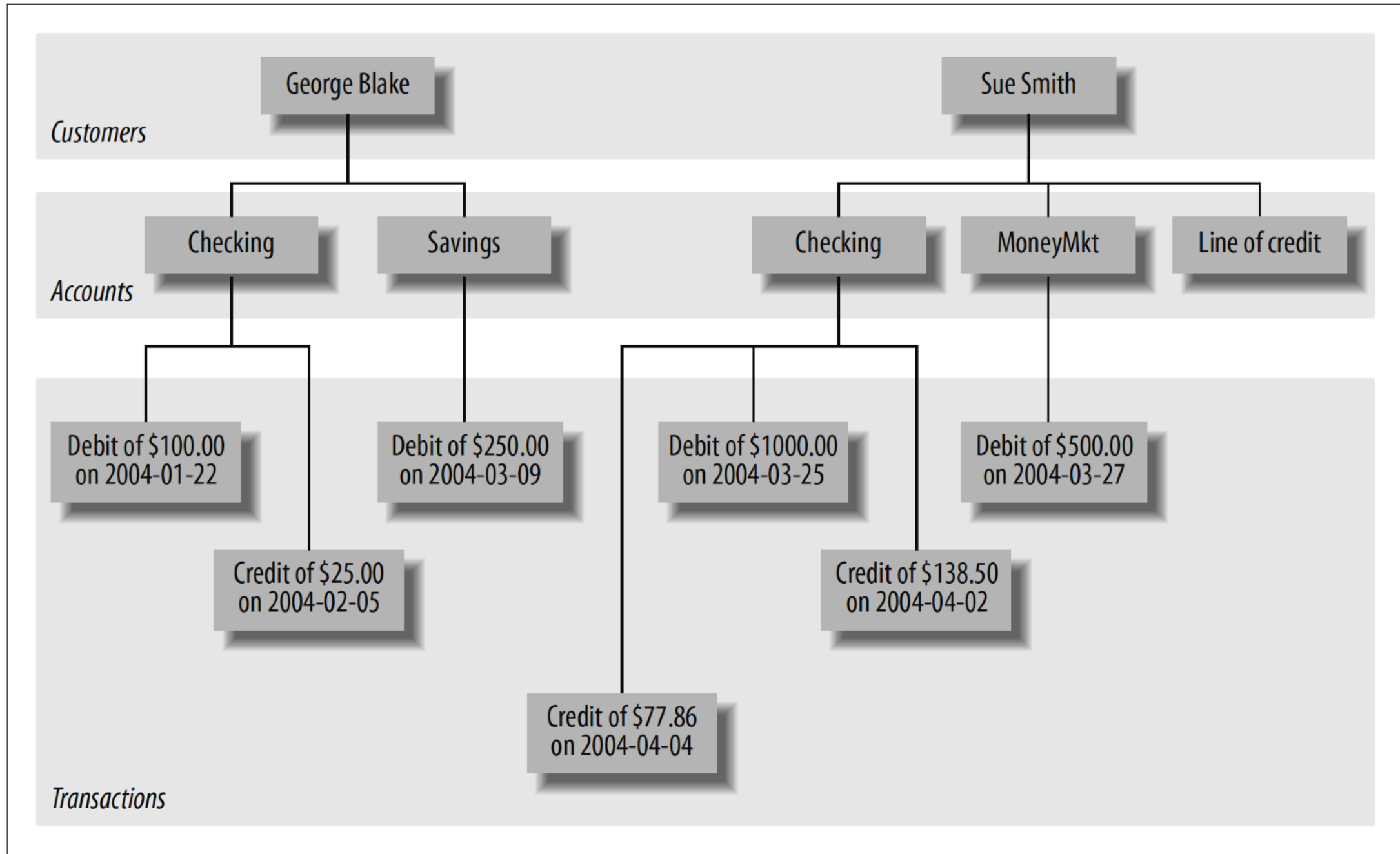
# Magnetic tapes



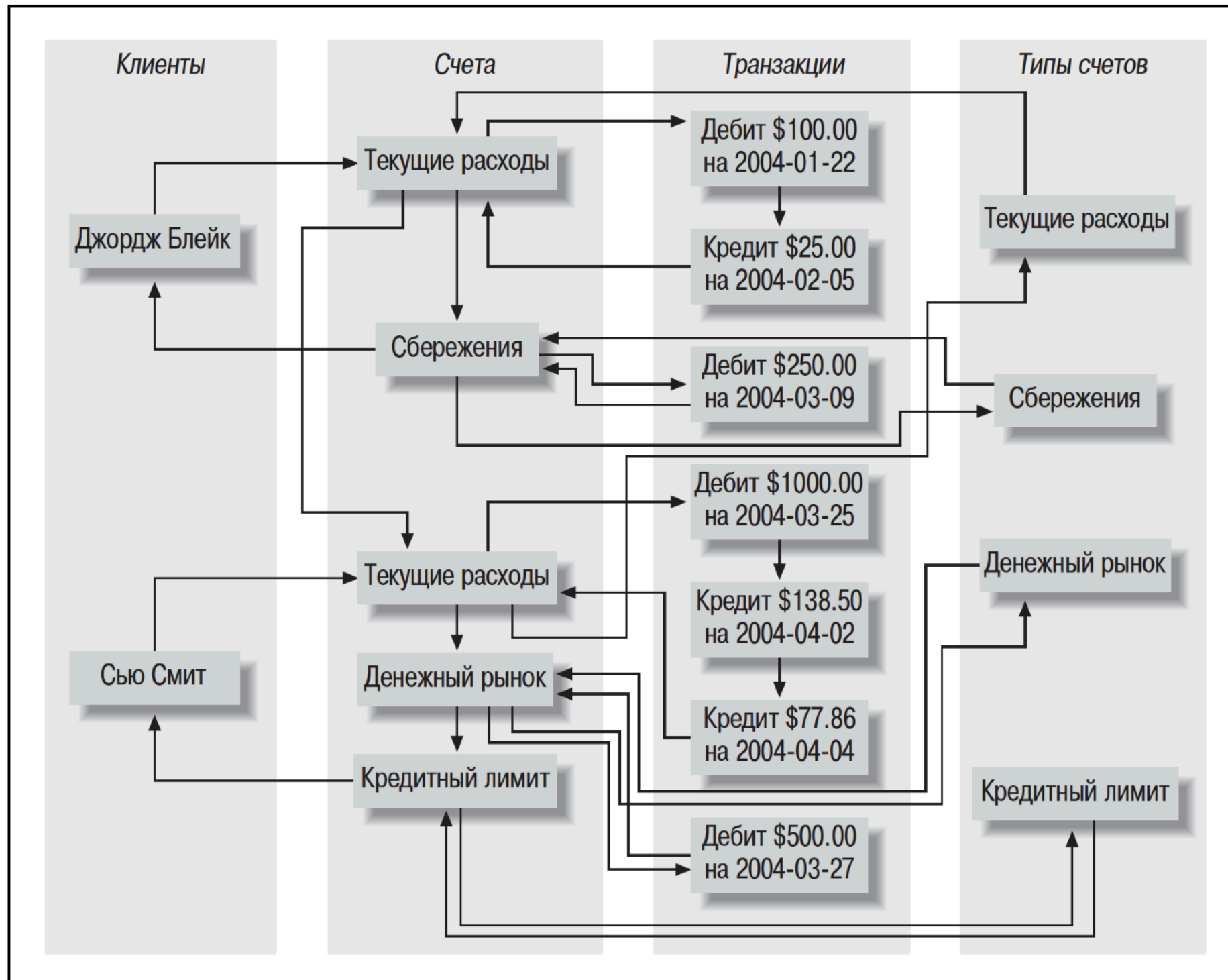
# **Nonrelational Database Systems**



# Hierarchical Database System



# Network Database System



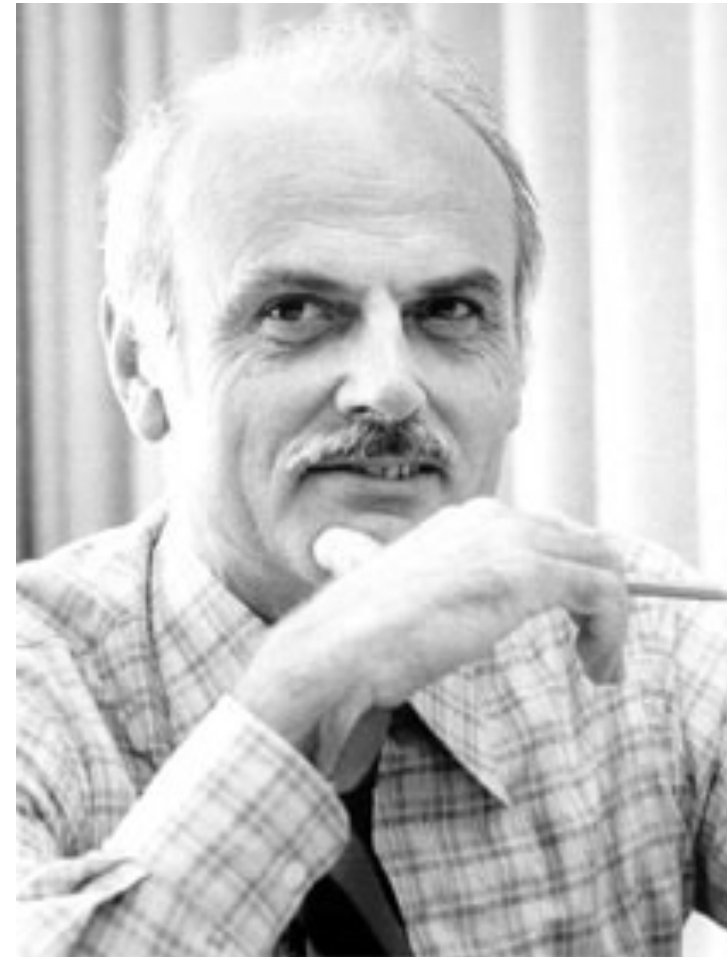
# Nonrelational Database Systems

- Active Directory (Microsoft)
- Directory Server (Netscape)
- XML (Extensible Markup Language)

# The Relational Model

# The Relational Model

- Dr. E. F. Codd
- 1970
- «A Relational Model of Data for Large Shared Data Banks»



# The Relational Model

- Data can be represented as sets of **tables**.
- Rather than using pointers to navigate between related entities, **redundant data** is used to link records in different tables.

# The Relational Model

Клиент

<i>cust_id</i>	<i>fname</i>	<i>lname</i>
1	Джордж	Блейк
2	Сью	Смит

Счет

<i>account_id</i>	<i>product_cd</i>	<i>cust_id</i>	<i>balance</i>
103	CHK	1	\$75.00
104	SAV	1	\$250.00
105	CHK	2	\$783.64
106	MM	2	\$500.00
107	LOC	2	0

Тип счета

<i>product_cd</i>	<i>name</i>
CHK	Текущие расходы
SAV	Сбережения
MM	Денежный рынок
LOC	Кредитный лимит

Транзакция

<i>txn_id</i>	<i>txn_type_cd</i>	<i>account_id</i>	<i>amount</i>	<i>date</i>
978	DBT	103	\$100.00	2004-01-22
979	CDT	103	\$25.00	2004-02-05
980	DBT	104	\$250.00	2004-03-09
981	DBT	105	\$1000.00	2004-03-25
982	CDT	105	\$138.50	2004-04-02
983	CDT	105	\$77.86	2004-04-04
984	DBT	106	\$500.00	2004-03-27

# The Relational Model

Primary key: Customer - cust\_id

Foreign key: Account - cust\_id



# Transactions of George Blake's checking account

```
SELECT t.txn_id, t.txn_type_cd, t.txn_date, t.amount
FROM individual i
  INNER JOIN account a ON i.cust_id = a.cust_id
  INNER JOIN product p ON p.product_cd = a.product_cd
  INNER JOIN transaction t ON t.account_id = a.account_id
WHERE i.fname = 'George' AND i.lname = 'Blake'
  AND p.name = 'checking account';
```

txn_id	txn_type_cd	txn_date	amount
11	DBT	2008-01-05 00:00:00	100.00

1 row in set (0.00 sec)

# Definitions

- Entity (Сущность)
- Column (Столбец)
- Row (Строка)
- Table (Таблица)
- Result set (Результирующий набор)
- Primary key (Первичный ключ)
- Foreign key (Внешний ключ)

# SQL (Structured Query Language)

# Names

- DSL / Alpha
- SQUARE
- SEQUEL
- SQL

# SQL Statement Classes

- SQL schema statements
- SQL data statements
- SQL transaction statements

# SQL schema statements

```
CREATE TABLE corporation  
  (corp_id SMALLINT,  
   name VARCHAR(30),  
   CONSTRAINT pk_corporation PRIMARY KEY (corp_id)  
  );
```

# SQL data statements

```
INSERT INTO corporation (corp_id, name)  
VALUES (27, 'Acme Paper Corporation');
```

# SQL transaction statements

```
BEGIN;
```

```
UPDATE accounts SET balance = balance - 100.00
```

```
WHERE name = 'Alice';
```

```
-- etc etc
```

```
ROLLBACK;
```

```
COMMIT;
```



# Retrieve inserted row

```
SELECT name FROM corporation
WHERE corp_id = 27;
```

```
+ - - - - - - - - - - - - +
| name                               |
+ - - - - - - - - - - - - +
| Acme Paper Corporation           |
+ - - - - - - - - - - - - +
```

# **SQL: A Nonprocedural Language**

# SQL integration toolkits

Language	Toolkit
Java	JDBC (Java Database Connectivity; JavaSoft)
C++	Rogue Wave SourcePro DB (third-party tool to connect to Oracle, SQL Server, MySQL, Informix, DB2, Sybase, and PostgreSQL databases)
C/C++	Pro*C (Oracle), MySQL C API (open source), and DB2 Call Level Interface (IBM)
C#	ADO.NET (Microsoft)
Perl	Perl DBI
Python	Python DB
Visual Basic	ADO.NET (Microsoft)

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# DBMS (Database Management System)

- MySQL
- MS SQL Server (Microsoft)
- Oracle DB (Oracle)
- DB2 Universal Database (IBM)
- PostgreSQL (PostgreSQL GDG)

# Why PostgreSQL?

PostgreSQL is an **enterprise-class** relational database management system, on par with the very best proprietary database systems



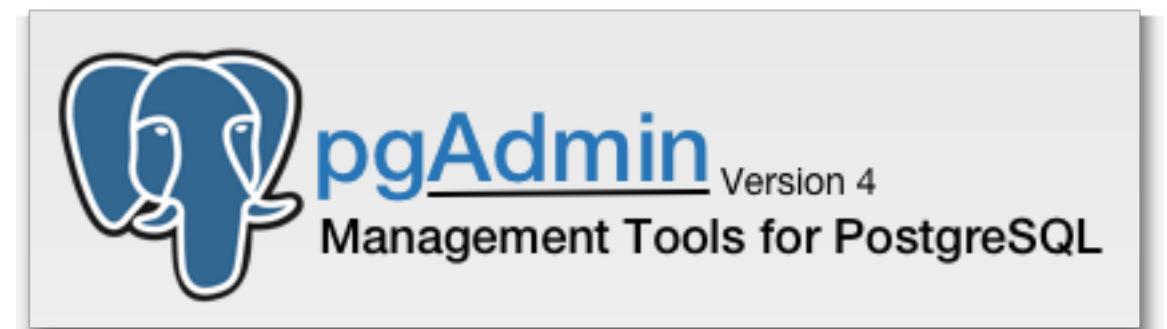
PostgreSQL

# Why PostgreSQL?

- Open source (Large community)
- Cross platform
- Fast
- Stored procedures and functions in numerous programming languages (C, SQL, Python, JS, Ruby etc.)
- Large number of data types and define your own
- NoSQL

# Management Tools

- psql
- pgAdmin
- phpPgAdmin
- Adminer



# psql

```
# aibekkuralbaev @ MacBook-Pro-Aibek in ~ [16:41:42]
$ psql
psql (9.6.4)
Type "help" for help.

aibekkuralbaev=# SELECT datname FROM pg_database;
      datname
-----
aibekkuralbaev
template1
template0
pillowzdb
mydb
exercises
(6 rows)

aibekkuralbaev=#
```



# pgAdmin

pgAdmin 4 File Object Tools Help

Browser

- Servers (1)
  - myserver
    - Databases (4)
      - aibekkuralbaev
        - Casts
        - Catalogs
        - Event Triggers
        - Extensions
        - Foreign Data Wrappers
        - Languages
        - Schemas (1)
          - public
            - Collations
            - Domains
            - FTS Configurations
            - FTS Dictionaries
            - FTS Parsers
            - FTS Templates
            - Foreign Tables
            - Functions
            - Materialized Views
            - 1..3 Sequences
            - Tables (122)
            - Trigger Functions
            - Types
            - Views
      - exercises
      - mydb
      - pillowzdb
    - Login/Group Roles
    - Tablespaces

Dashboard Properties SQL Statistics Dependencies Dependents

Server sessions

Transactions per second

Tuples in

Tuples out

Block I/O

Server activity

Sessions Locks Prepared Transactions Configuration

			PID	Database	User	Application	Client	Backend start	State	Wait Event	Blocking PIDs
✖	■	▶	2459	aibekkuralbaev	aibekkuralbaev	psql		2018-01-07 16:36:09 +06	idle		
✖	■	▶	2482	aibekkuralbaev	aibekkuralbaev	psql		2018-01-07 16:37:43 +06	idle		
✖	■	▶	2499	aibekkuralbaev	aibekkuralbaev	psql		2018-01-07 16:37:57 +06	idle		
✖	■	▶	2521	aibekkuralbaev	aibekkuralbaev	psql		2018-01-07 16:38:48 +06	idle		
✖	■	▶	2539	aibekkuralbaev	aibekkuralbaev	psql		2018-01-07 16:39:18 +06	idle		
✖	■	▶	2583	aibekkuralbaev	aibekkuralbaev	psql		2018-01-07 16:41:13 +06	idle		
✖	■	▶	2600	aibekkuralbaev	aibekkuralbaev	psql		2018-01-07 16:41:14 +06	idle		

# Where to Get PostgreSQL

- <https://www.postgresql.org/download/>
- <https://www.pgadmin.org/download/>