


Introduction to Informatics


**Jerzy Nawrocki**  
Faculty of Computing and Inf. Sci.  
Poznan University of Technology  
jerzy.nawrocki@put.poznan.pl



**Databases**

Introduction to Informatics

**Database**




= organized collection of data

Databases (2)

Introduction to Informatics

**Aim**




**Present the relational database model**

Databases (3)

Introduction to Informatics

**Agenda**



- Pre-relational era
- Relational database model
- SQL

Databases (4)

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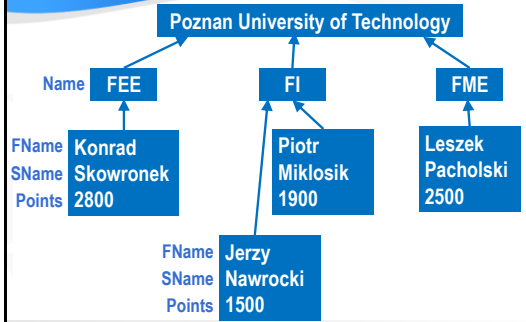
**Hierarchical model**

• How many people are employed by PUT?

Databases (5)

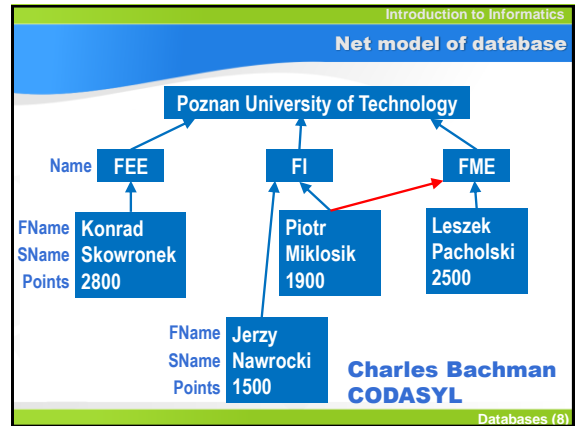
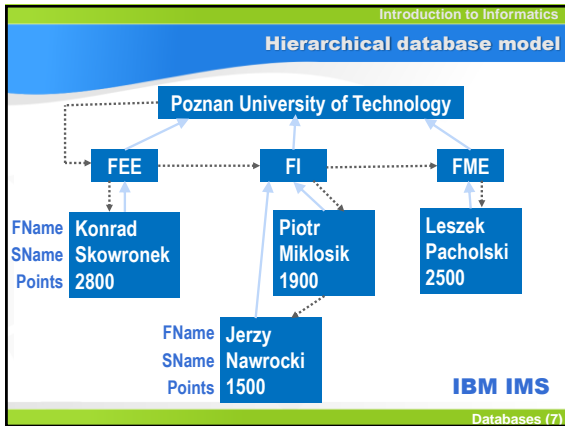
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**Hierarchical database model**



```
graph TD; PUT[Poznan University of Technology] --> FEE[FEE]; PUT --> FI[FI]; PUT --> FME[FME]; FEE --> KS[Konrad Skowronek]; FEE --> JN[Jerzy Nawrocki]; FI --> PM[Piotr Miklosik]; FME --> LP[Leszek Pacholski];
```

Databases (6)



Introduction to Informatics

### Agenda

- Pre-relational era
- **Relational database model**
- SQL

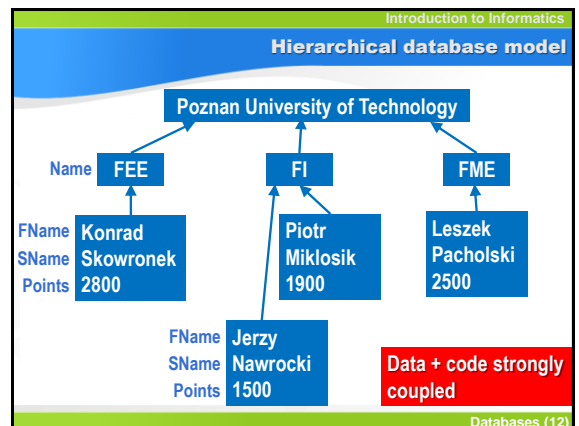
Databases (9)

Introduction to Informatics

### Edgar Frank Codd

1923-08-23: Born in Portland, Dorset  
Studied math and chemistry at Oxford  
RAF pilot during II World War  
1948: IBM, New York  
1963: Ph.D., Univ. of Michigan, Ann Arbor  
1970: „A Relational Model of Data for Large Shared Data Banks”  
1981: Turing Award  
2003-04-18: Died in Williams Island, Florida (US)

Databases (10)



Introduction to Informatics

### Relational model

Faculties		
Key	Name	Dean
1	FEE	20
2	FI	22
3	FME	23

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Jerzy	Nawrocki
23	Leszek	Pacholski

Employment	
Worker	Faculty
20	1
21	2
22	2
23	3

How many workers with PUT?  
**SELECT COUNT(\*) FROM Workers;**

Databases (13)

Introduction to Informatics

### Relational model

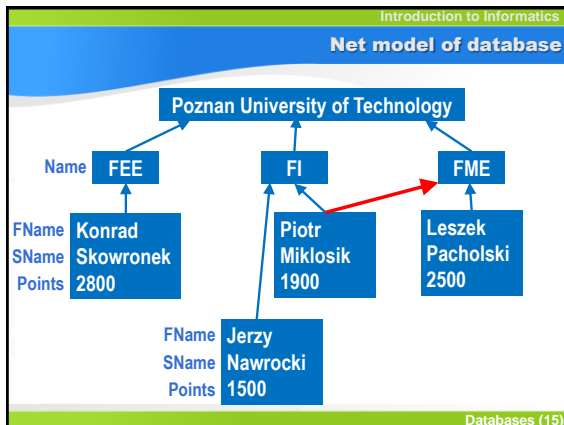
Faculties		
Key	Name	Dean
1	FEE	20
2	FI	22
3	FME	23

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Jerzy	Nawrocki
23	Leszek	Pacholski

Employment	
Worker	Faculty
20	1
21	2
22	2
23	3

How many workers with FI?  
**SELECT COUNT(\*) FROM Employment, Faculties WHERE Faculties.Name='FI' AND Faculties.Key=Employment.Faculty;**

Databases (14)



Introduction to Informatics

### Relational model

Faculties		
Key	Name	Dean
1	FEE	20
2	FI	22
3	FME	23

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Jerzy	Nawrocki
23	Leszek	Pacholski

Employment	
Worker	Faculty
20	1
21	2
22	2
23	3
21	3

How many workers with PUT?  
**SELECT COUNT(\*) FROM Workers;**

Databases (16)

Introduction to Informatics

### Relational model

Faculties		
Key	Name	Dean
1	FEE	20
2	FI	22
3	FME	23

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Jerzy	Nawrocki
23	Leszek	Pacholski

Employment	
Worker	Faculty
20	1
21	2
22	2
23	3
21	3

How many workers with FI?  
**SELECT COUNT(\*) FROM Employment, Faculties WHERE Faculties.Name='FI' AND Faculties.Key=Employment.Faculty;**

Databases (17)

Introduction to Informatics

### Formal approach

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Jerzy	Nawrocki
23	Leszek	Pacholski

Workers: Key x FName x SName  
 Key = 0, 1, 2, ...  
 FName = {"a", ..., "z", "aa", ..., "zz", ..., "A", ..., "Z", ..., "Aa", ..., "Az", ..}  
 SName = {"a", ..., "z", "aa", ..., "zz", ..., "A", ..., "Z", ..., "Aa", ..., "Az", ..}  
 Workers= { (20, "Konrad", "Skowronek"), (21, "Piotr", "Miklosik"), ..., (23, "Leszek", "Pacholski") }

Databases (18)

Introduction to Informatics

### Basic operations

Workers			
Key	FName	SName	
20	Konrad	Skowronek	
21	Piotr	Miklosik	
22	Jerzy	Nawrocki	
23	Leszek	Pacholski	

Projection (selection of columns):  
**SELECT SName FROM Workers;**

SName
Skowronek
Miklosik
Nawrocki
Pacholski

Databases (19)

Introduction to Informatics

### Basic operations

Workers			
Key	FName	SName	
20	Konrad	Skowronek	
21	Piotr	Miklosik	
22	Konrad	Nawrocki	
23	Leszek	Pacholski	

Selection (selection of rows):  
**SELECT \* FROM Workers  
 WHERE FName='Konrad';**

Key	FName	SName
20	Konrad	Skowronek
22	Konrad	Nawrocki

Databases (20)

Introduction to Informatics

### Basic operations

Workers			
Key	FName	SName	
20	Konrad	Skowronek	
21	Piotr	Miklosik	
22	Konrad	Nawrocki	
23	Leszek	Pacholski	

Selection with projection:  
**SELECT SName FROM Workers  
 WHERE FName='Konrad';**

SName
Skowronek
Nawrocki

Databases (21)

Introduction to Informatics

### Relational model

Faculties			Workers		
Key	Name	Dean	Key	FName	SName
1	FEE	20	20	Konrad	Skowronek
2	FI	22	21	Piotr	Miklosik
3	FME	23	22	Jerzy	Nawrocki
			23	Leszek	Pacholski

Join (merging 2 or more tables):  
**SELECT Name, SName  
 FROM Faculties, Workers  
 WHERE Dean=Workers.Key;**

Name	SName
FEE	Skowronek
FI	Nawrocki
FME	Pacholski

Databases (22)

Introduction to Informatics

### Agenda



- Pre-relational era
- Relational database model
- SQL

Databases (23)

Introduction to Informatics

### Creating a table

Workers			
Key	FName	SName	

**CREATE TABLE Workers  
 ( Key SERIAL,  
 FName VARCHAR(40),  
 SName VARCHAR(40)  
 );**

Basic data types:  
 SERIAL  
 VARCHAR (n)  
 CHAR (n)  
 INTEGER  
 NUMERIC (n.f)

Databases (24)

Introduction to Informatics

### Inserting data

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Jerzy	Nawrocki
23	Leszek	Pacholski

```

INSERT INTO Workers
VALUES ( 'Konrad', 'Skowronek');

INSERT INTO Workers
VALUES ( 'Piotr', 'Miklosik');

INSERT INTO Workers
VALUES ( 'Jerzy', 'Nawrocki');

INSERT INTO Workers
VALUES ( 'Leszek', 'Pacholski');
    
```

```

CREATE TABLE Workers
( Key SERIAL,
  FName VARCHAR(40),
  SName VARCHAR(40)
);
    
```

Databases (25)

Introduction to Informatics

### Ordering data

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

```

SELECT SName, FName
FROM Workers
WHERE FName='Konrad'
ORDER BY SName ASC;
    
```

Key	FName	SName
20	Konrad	Nawrocki
22	Konrad	Skowronek

Databases (26)

Introduction to Informatics

### Ordering data

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

```

SELECT SName, FName
FROM Workers
WHERE FName='Konrad'
ORDER BY SName DESC;
    
```

Key	FName	SName
20	Konrad	Skowronek
22	Konrad	Nawrocki

Databases (27)

Introduction to Informatics

### Homework

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

```

SELECT SName, FName
FROM Workers
WHERE FName='Konrad'
ORDER BY SName;
    
```

What will be the result?

Databases (28)

Introduction to Informatics

### Distinct items

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

First names of the workers?

```

SELECT FName
FROM Workers
ORDER BY FName ASC;
    
```

FName
Konrad
Konrad
Leszek
Piotr

Databases (29)

Introduction to Informatics

### Distinct items

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

First names of the workers?

```

SELECT DISTINCT FName
FROM Workers
ORDER BY FName ASC;
    
```

FName
Konrad
Leszek
Piotr

Databases (30)

Introduction to Informatics

If you don't like column name ...

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

First names of the workers?

```
SELECT DISTINCT FName
FROM Workers
ORDER BY FName ASC;
```

FName
Konrad
Leszek
Piotr

Databases (31)

Introduction to Informatics

If you don't like column name ...

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

First names of the workers?

```
SELECT DISTINCT FName
AS "First name"
FROM Workers
ORDER BY FName ASC;
```

First name
Konrad
Leszek
Piotr

Databases (32)

Introduction to Informatics

Patterns

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

SELECT FName, SName  
FROM Workers  
WHERE SName LIKE '%ki';

FName	SName
Konrad	Nawrocki
Leszek	Pacholski

Databases (33)

Introduction to Informatics

Patterns

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

SELECT FName, SName  
FROM Workers  
WHERE SName LIKE '\_a%';

FName	SName
Konrad	Nawrocki
Leszek	Pacholski

Databases (34)

Introduction to Informatics

Storing results in a table

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

First names of the workers

```
SELECT DISTINCT FName
FROM Workers
ORDER BY FName ASC;
```

WorkNams	
FName	
Konrad	
Leszek	
Piotr	

Databases (35)

Introduction to Informatics

Storing results in a table

Workers		
Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

First names of the workers

```
CREATE TABLE WorkNams
( Key SERIAL,
Name VARCHAR(40),
);
```

```
INSERT INTO WorkNams (Name)
SELECT DISTINCT FName
FROM Workers
ORDER BY FName ASC;
```

WorkNams	
Key	Name
1	Konrad
2	Leszek
3	Piotr

Databases (36)

Introduction to Informatics

### Updating data

Workers

Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

Jerzy, not Konrad

```
UPDATE Workers
SET FName= 'Jerzy'
WHERE SName= 'Nawrocki';
```

Databases (37)

Introduction to Informatics

### Updating data

Workers

Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Jerzy	Nawrocki
23	Leszek	Pacholski

Jerzy, not Konrad

```
UPDATE Workers
SET FName= 'Jerzy'
WHERE SName= 'Nawrocki';
```

Databases (38)

Introduction to Informatics

### Deleting data

Workers

Key	FName	SName
20	Konrad	Skowronek
21	Piotr	Miklosik
22	Konrad	Nawrocki
23	Leszek	Pacholski

```
DELETE FROM Workers
WHERE SName= '%ro%';
```

Key	FName	SName
21	Piotr	Miklosik
23	Leszek	Pacholski

Databases (39)

Introduction to Informatics

### Aggregation functions

Workers

Key	Hours	SName
20	170	Skowronek
21	90	Miklosik
22	140	Nawrocki
23	160	Pacholski

```
SELECT COUNT(SName)
FROM Workers;
```

count
4

Databases (40)

Introduction to Informatics

### Aggregation functions

Workers

Key	Hours	SName
20	170	Skowronek
21	90	Miklosik
22	140	Nawrocki
23	160	Pacholski

```
SELECT COUNT(*)
FROM Workers;
```

count
4

Databases (41)

Introduction to Informatics

### Aggregation functions

Workers

Key	Hours	SName
20	170	Skowronek
21	90	Miklosik
22	140	Nawrocki
23	160	Pacholski

```
SELECT MIN(Hours)
FROM Workers;
```

min
90

Databases (42)

Introduction to Informatics

### Aggregation functions

Key	Hours	SName
20	170	Skowronek
21	90	Miklosik
22	140	Nawrocki
23	160	Pacholski

```
SELECT MAX(Hours)
FROM Workers;
```

max
-----
170

Databases (43)

Introduction to Informatics

### Aggregation functions

Key	Hours	SName
20	170	Skowronek
21	90	Miklosik
22	140	Nawrocki
23	160	Pacholski

```
SELECT SUM(Hours)
FROM Workers;
```

sum
-----
560

Databases (44)

Introduction to Informatics

### Aggregation functions

Key	Hours	SName
20	170	Skowronek
21	90	Miklosik
22	140	Nawrocki
23	160	Pacholski

```
SELECT AVG(Hours)
FROM Workers;
```

avg
-----
140

Databases (45)

Introduction to Informatics

### Nested queries

Key	Hours	SName
20	170	Skowronek
21	90	Miklosik
22	140	Nawrocki
23	160	Pacholski

```
SELECT * FROM Workers
WHERE Hours > (SELECT AVG(Hours) FROM Workers);
```

Key	Hours	SName
20	170	Skowronek
23	160	Pacholski

Databases (46)

