

Disciplina de Modelação de Dados em Engenharia

**Material de Apoio às Aulas
Teóricas (Português/Ingles)**

Resp. Disciplina: **Luis Camarinha Matos**

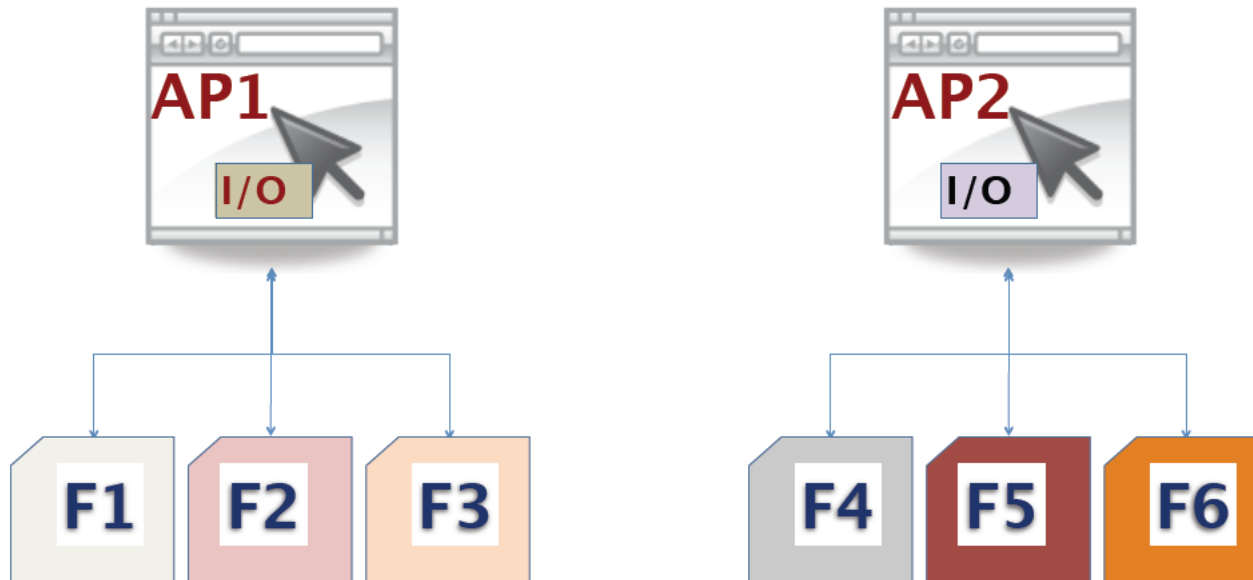
João Rosas

Yves Rybarczyk

Pedro Santana

Sistema de ficheiros

- Integridade dos dados?
- Acesso concorrente ?
- Partilha de informação?
- ...



- ✓ Dados organizados em Registos
- ✓ 'Propriedade' duma Aplicação
- ✓ Registos Fixos / Variáveis
- ✓ Consistência, acesso concorrente ...

Pre-Database Era: Stone Age of Data

- Imagine you want build an online shopping website
 - Maintain products/categories (price, picture, properties, ...)
 - Customers accounts
- File is uninterpreted, unstructured collection of information
- File operations: delete, catalog, create, rename, open, close, read, write, find, ...
- Access methods: Algorithms to implement operations along with internal file organization
- Examples: File of Customers, File of Products; Access method: implementation of a set of operations on those files

C++ file programming

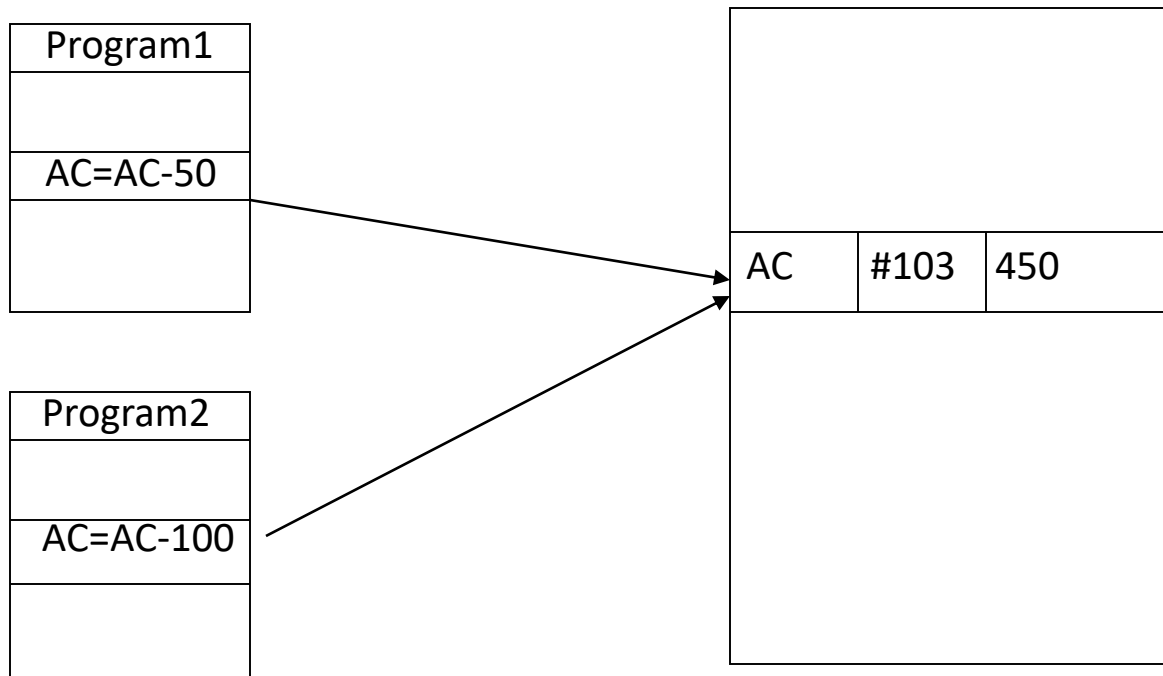
- open - open a file- specify how its opened (read/write) and type (binary/text)
- close - close an opened file
- read - read from a file
- write - write to a file
- seek - move a file pointer to somewhere in a file

File Management System Problems

- Any question (access) on the data is a small program!!
- Data redundancy
- Data is not isolated from the access implementation (different format...)
- Multiple application (concurrent program) on the same file

Concurrent Program Execution

What is the final value of the account AC?

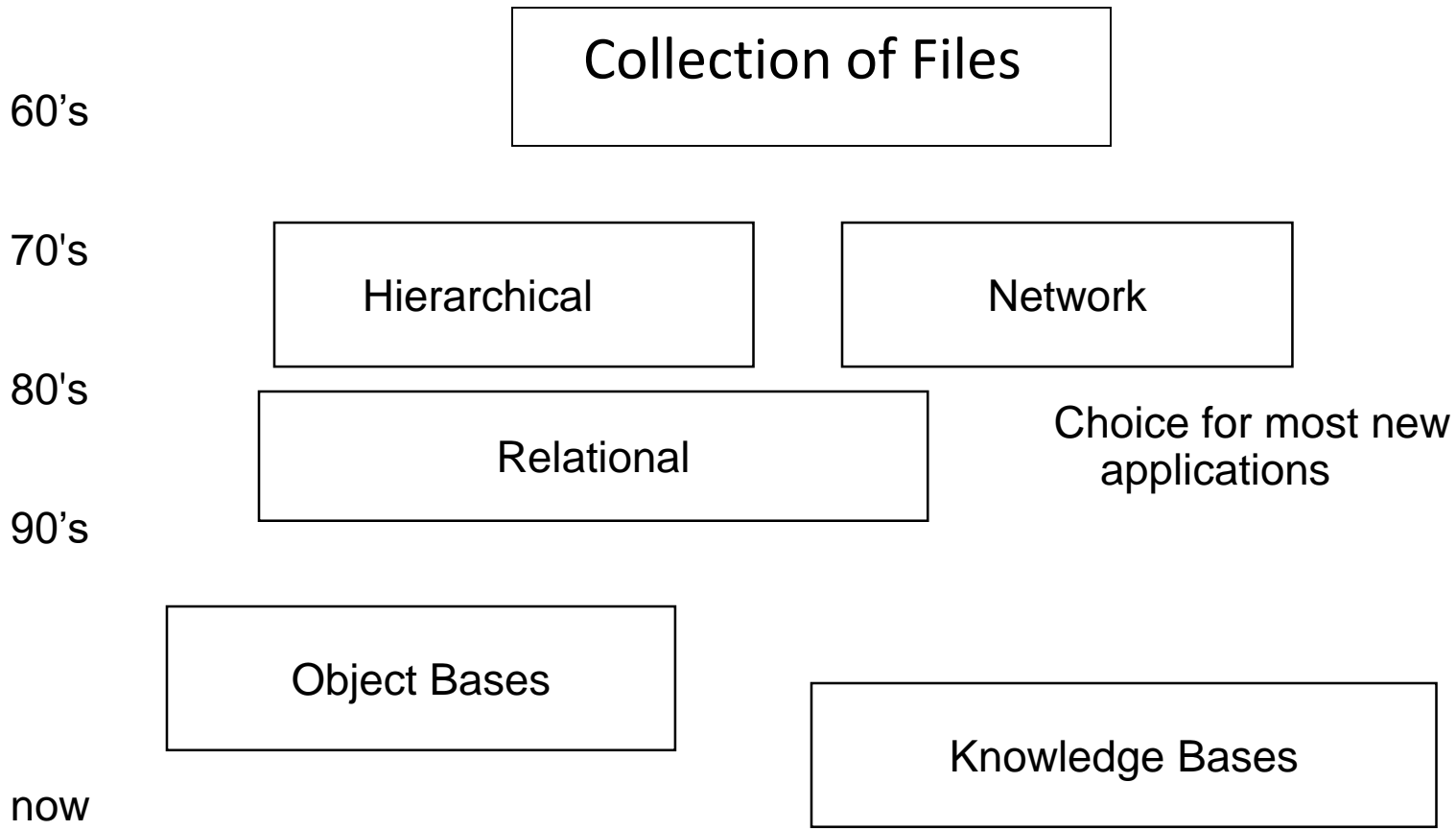


Security Problems

- Allow access to the file only to the authorized personnel
- Ability to restrict access to parts of the record
- Ability to control operation usage by different users
- Protection from unauthorized use
- Protection from the derivation of unauthorized information

Data Integrity

- A database constraint is a logical constraint about the data expressed in a logical language.
 - **STUDENT.AGE >15**
 - *If (STUDENT.CLASS ==cs43005) then (STUDENT.PRIOR_CLASS ==cs31001)*
- Database is consistent if data at each time satisfies all integrity constraints.
- Input to any application is a set of consistent data. An application output is a set of consistent data.



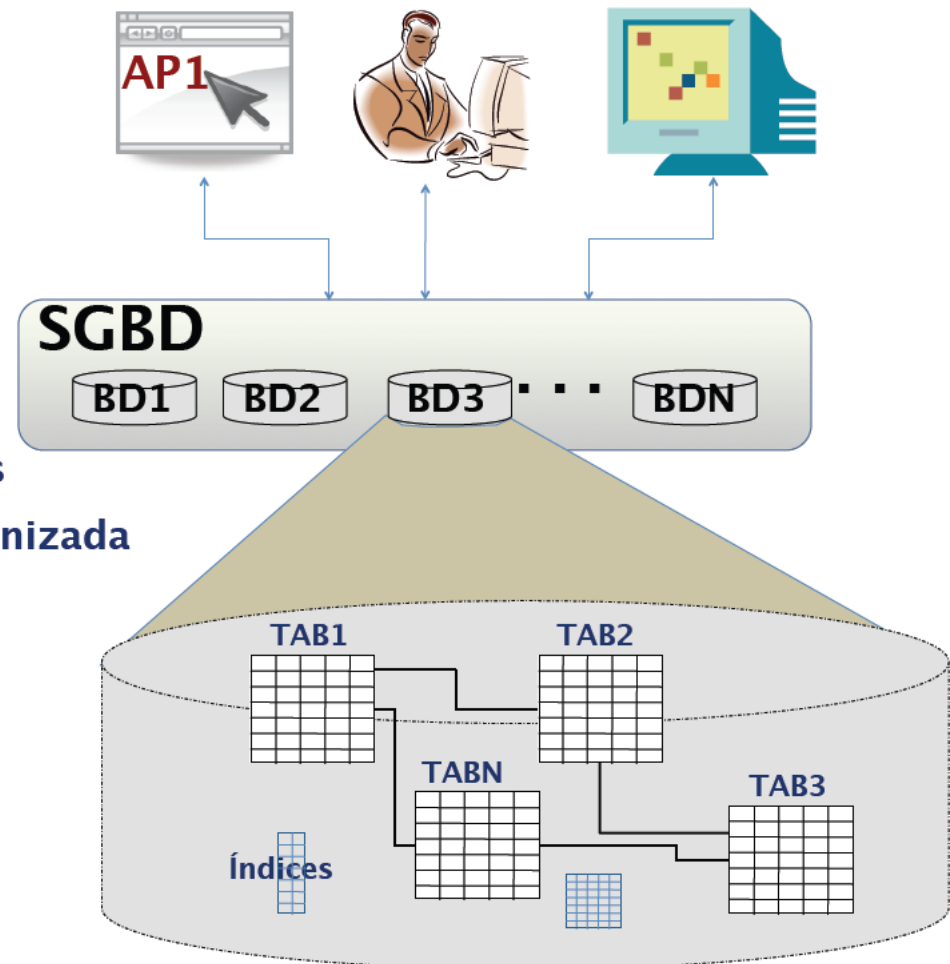
Aspectos críticos

- Redundância e Inconsistência de Dados
- Dificuldade no acesso aos Dados
- Isolamento de Dados
- Anomalias de Acesso Concorrente
- Problemas de Segurança e Privacidade
- Manutenção difícil

Sistemas de gestão de bases de dados

algumas vantagens:

- ✓ Dados Independentes
- ✓ Interface Única Padronizada
- ✓ Distribuição
- ✓ Controle de Acesso
- ✓ Integridade
- ✓ Simplicidade



Where are databases?

- You cannot avoid it and it's everywhere!
- You can say it actually makes the current society and your life work!
- Banking/Credit card /Social Security Info...
- Online shopping/booking...

Advantages of Databases

- ***Persistent Storage*** – Database not only provides persistent storage but also efficient access to large amounts of data
- ***Programming Interface*** – Database allows users to access and modify data using powerful query language. It provides flexibility in data management
- ***Transaction Management*** – Database supports a concurrent access to the data

Modern Database Applications

- Client – Server architecture
 - DBMS serves as a server and client queries are sent to servers
 - Where to locate servers
- Multimedia Applications
- Multidatabase Applications
- Data Warehouses
- It's everywhere!!

Definição para “Base de dados”

	DEFINIÇÃO	FONTE
BD	A database is an application that manages data and allows fast storage and retrieval of that data.	http://cplus.about.com/od/glossar1/g/databasedefn.ht
	A set of related files that is created and managed by a database management system (DBMS).	TechEncyclopedia
	Often abbreviated DB. A collection of information organized in such a way that a computer program can quickly select desired pieces of data.	Webopeia
	A DATABASE is a collection of information organized in such a way that a computer program can quickly select desired pieces of data. You can think of a database as an electronic filing system.	http://www.library.uq.edu.au/training/skills/what_dbase.html
	Conjunto de dados que se relacionam entre si.	Universidade Porto
	O termo base de dados está intimamente associado à noção de "uma colecção de informação".	Prof. Carlos Caldeira, Évora

Definição para “SGBD”

	DEFINIÇÃO	FONTE
SGBD	A collection of programs that enables you to store, modify, and extract information from a database. There are many different types of DBMSs, ranging from small systems that run on personal computers to huge systems that run on mainframes.	Webopeia
	A database management system (DBMS), sometimes just called a database manager, is a program that lets one or more computer users create and access data in a database. The DBMS manages user requests (and requests from other programs) so that users and other programs are free from having to understand where the data is physically located on storage media and, in a multi-user system, who else may also be accessing the data. In handling user requests, the DBMS ensures the integrity of the data (that is, making sure it continues to be accessible and is consistently organized as intended) and security (making sure only those with access privileges can access the data).	http://searchsqlserver.techtarget.com/sDefinition/0,,sid87_gci213669,00.html
	database management system' (DBMS) is computer software designed for the purpose of managing databases. Typical examples of DBMSs include Oracle, DB2, Microsoft Access, Microsoft SQL Server, Firebird, PostgreSQL, MySQL, SQLite, FileMaker and Sybase Adaptive Server Enterprise.	http://en.wikipedia.org/wiki/Database_management_system
	DBMS is a complex set of software programs that controls the organization, storage, management, and retrieval of data in a database.	http://en.wikipedia.org/wiki/Database_mana

Arquitectura por níveis

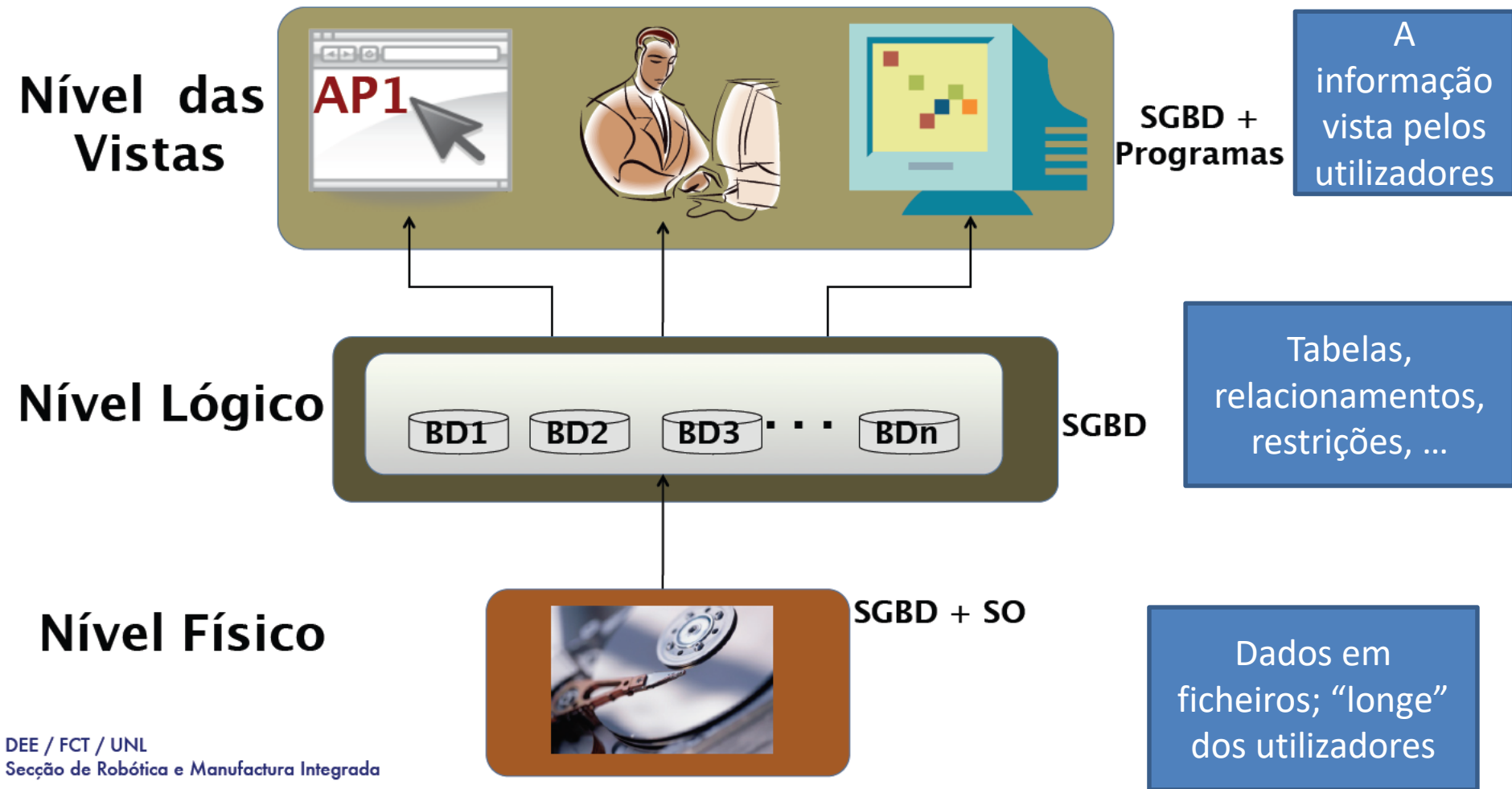
- **NÍVEL FÍSICO:** É O NÍVEL MAIS BAIXO DE ABSTRAÇÃO E DESCREVE COMO OS DADOS ESTÃO REALMENTE ARMAZENADOS;

- **NÍVEL CONCEITUAL:** DESCREVE TODOS OS DADOS QUE ESTÃO ARMAZENADOS DE FATO NO BANCO DE DADOS E AS RELAÇÕES EXISTENTES ENTRE ELAS;

- **NÍVEL DAS VISTAS:** É O NÍVEL DE ABSTRAÇÃO DO BANCO DE DADOS QUE SE ENFOCA EM ASPECTOS DE INTERESSE DE CADA USUÁRIO / APLICAÇÃO.

- O grande objetivo de um SGBD é dar aos utilizadores uma visão abstrata dos dados;
- O SGBD omite detalhes referentes à armazenagem e manutenção, uma vez que muitos dos seus usuários não são especialistas;

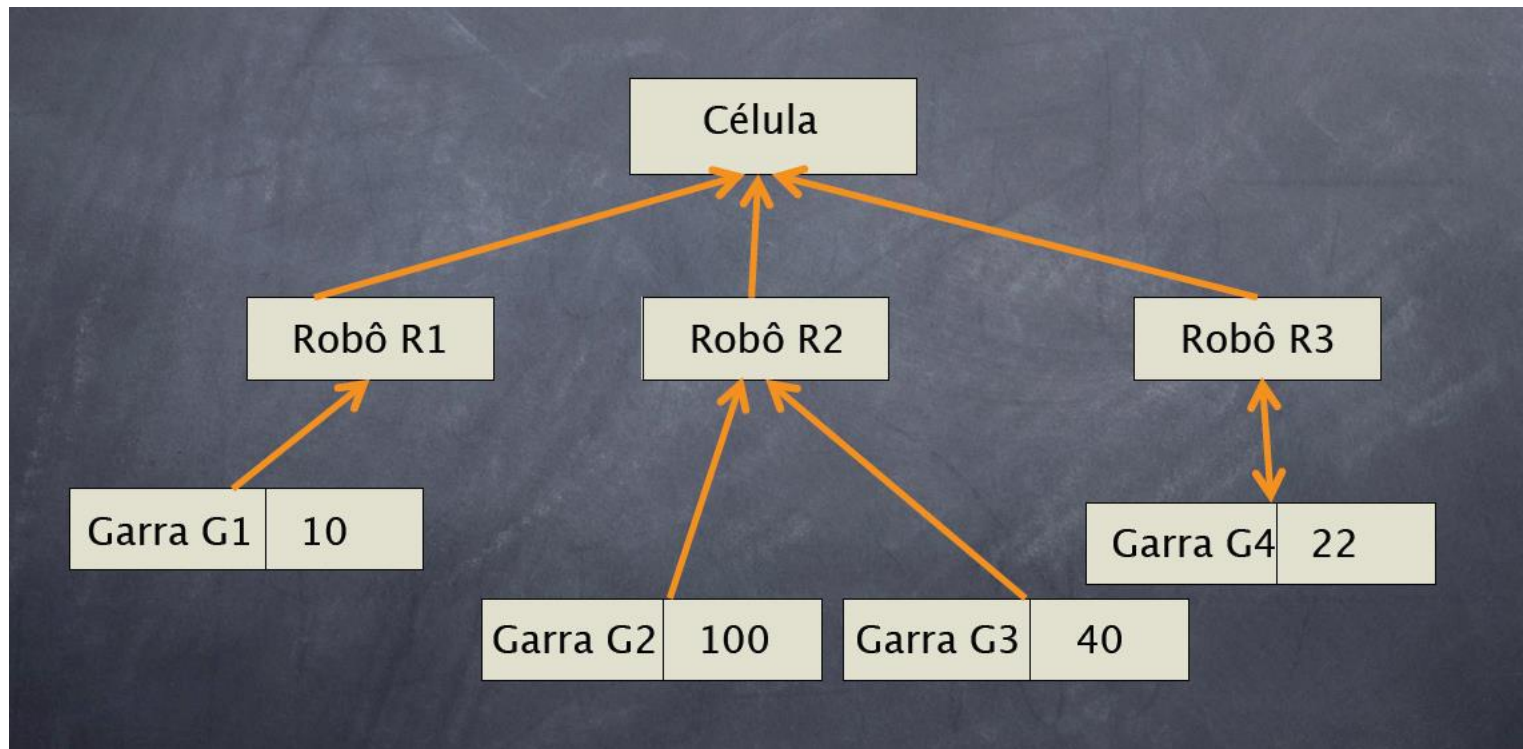
Níveis de abstracção



Tipos de modelos

- Um modelo para “descrever a estrutura (dados, relacionamentos, semântica e restrições) duma BD”
- Hierárquico, em Rede, Relacional, Entidade-Relação, Orientado por Objectos e Semi-Estruturado

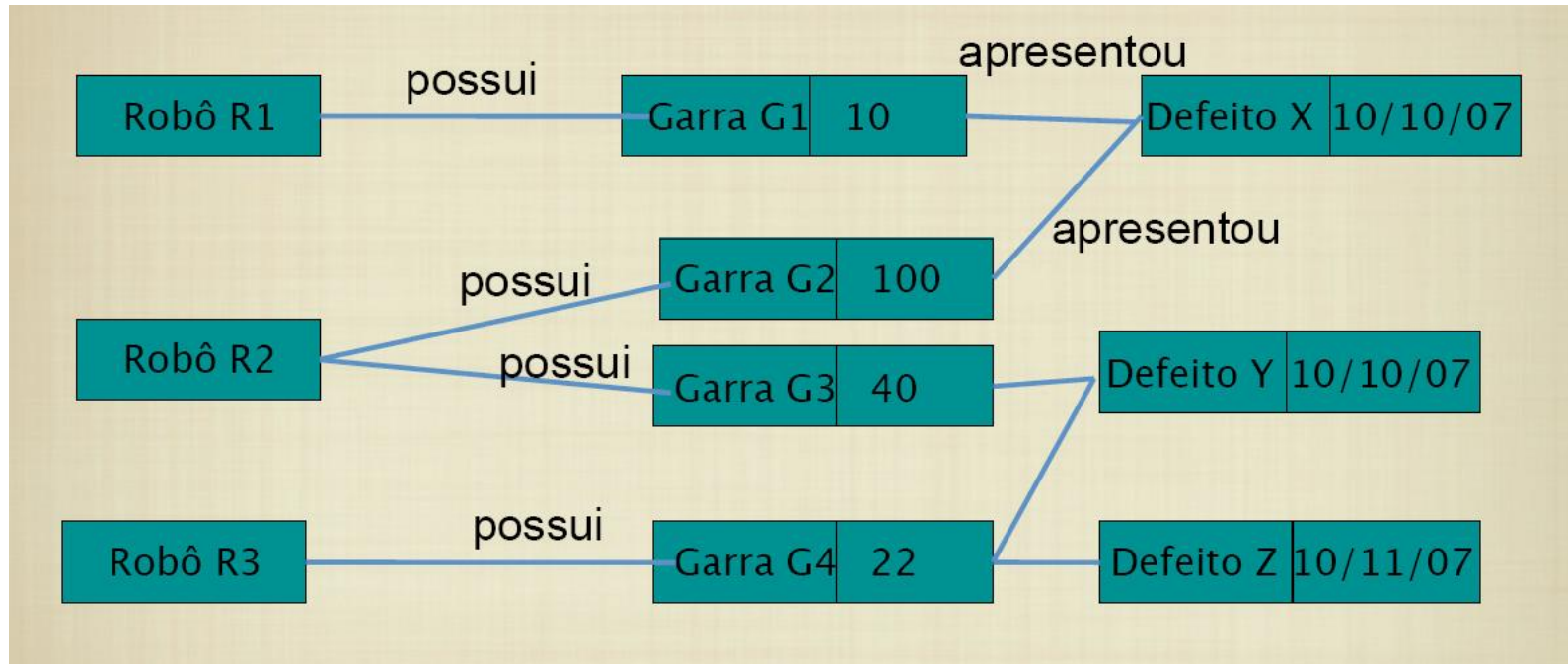
Modelo Hierárquico



Modelo Hierárquico

- Árvore, Relação Pai ==> Filho (1:1; 1:M), acíclico
- Problemas
 - Complexidade Implementação
 - Manipulação dos dados: difícil
 - Falta de Padrões
 - Dependência Estrutural (+ novas apps é difícil)

Modelo em rede




Modelo em rede

- Grafo orientado
- Nodos e Arestas
- Registos interligados através de referências (links)
- Problemas
 - Complexidade do sistema
 - Dificuldade : projecto e manutenção dos dados
 - Dependência estrutural

Modelo Relacional

- **TED CODD: 1970, IBM**
- **RELAÇÃO: BASE DE TUDO**
- **RELAÇÃO == TABELA**
- **TABELA: LINHAS (TUPLOS / REGISTOS) E COLUNAS (ATRIBUTOS)**



Tipo Robô	Numero_de_Serie	Fabricante	Ano de Fabricação
Pintor_Teto	0X-345545-87970-23B	SIEMENS	2005
Empilhadeira_Paletes	OOB-353635-34234234-XXY	BOSCH	2006
Detector_Presença	XBDC-DGSDE-00001-2008	TOYOTA	2008

Oracle (porquê este?)

- DBMS.
- Obrigatório pagar só quando usado comercialmente 😊
- É complexo... pois, mas a vida não é simples!
- As grandes empresas (ou todas) exigem GARANTIA, FIABILIDADE, ROBUSTEZ, ... e “alguém” que os indemnize se houverem problemas no sistema imputáveis aos fornecedores.
- Valorizar o (vosso) curriculum (“managers” vs informáticos)

Site da "Amazon"

Amazon.com Books: New & used books, textbooks, children's books, biographies & more - Mozilla Firefox

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http://www.amazon.com/books-used-books-textbooks/b/ref=sa_menu_bo0?ie=UTF8&node=283155

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Books

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Best Books of the Month

Find our editors' picks for the [best books of February](#)—including our Spotlight selection, *West of Here* by Jonathan Evison, and more new releases not to miss this month.

▶ [See all the best books of the month](#)

Spring Reading

Spring is just around the corner, and our [Spring Reading Store](#) features the biggest books of the season, including Jean M. Auel's long-awaited return, *The Land of Painted Caves*.

▶ [See more spring new releases](#)

Amazon Omnivoracious


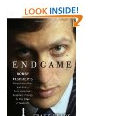

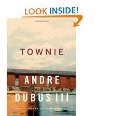
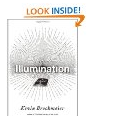


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Fall Under the Spell

A perfect brew of history, romance, and magic, *A Discovery of Witches* follows the adventures of a centuries-old vampire, a spellbound witch, and the mysterious manuscript that draws them together.



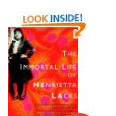
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Editors' Picks: Our Best Books of February

 West of Here ▶ Jonathan Evison Hardcover \$24.95 \$14.25	 Endgame: Bobby Fischer's Remarkable... ▶ Frank Brady Hardcover \$25.99 \$15.59	 A Discovery of Witches: A Novel ▶ Deborah E. Harkness Hardcover \$28.95 \$14.77	 Townie: A Memoir ▶ Andre Dubus III Hardcover \$25.95 \$14.27	 The Illumination: A Novel ▶ Kevin Brockmeier Hardcover \$24.95 \$14.97	 Sex and the River Styx ▶ Edward Hoagland Hardcover \$27.50 \$16.33	 The Evolution of Bruno Littlemore ▶ Benjamin Hale Hardcover \$25.99 \$13.35
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Featured Categories

 West of Here ▶ Jonathan Evison Hardcover \$24.95 \$14.25	 The Cat in the Hat ▶ Dr. Seuss Hardcover \$3.99 \$2.49	 The Land of Painted Caves ▶ Jean M. Auel Hardcover \$27.95 \$14.95
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Page 1 of 2

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Concluido

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- RIM BlackBerry Curve 8330 From: \$74.95
- RIM BlackBerry Storm 9530 From: \$75.76
- RIM BlackBerry Curve 8330 (Sprint) From: \$5.75

Trends on eBay Updated daily

- dave duerson
- elton john tickets
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- queens of the stone age
- florence and the machine

Concluído

Instalação Oracle (1)

Oracle Database 11g Release 2 Installer - Installing database - Step 1 of 9

Configure Security Updates

Provide your email address to be informed of security issues, install the product and initiate configuration manager. [View details.](#)

Email:

Easier for you if you use your My Oracle Support email address/username.

I wish to receive security updates via My Oracle Support.

My Oracle Support Password:

Deixar estes campos em branco

Auxílio < Anterior Seguinte > Terminar Cancelar

Instalação Oracle (1.1)

Oracle Database 11g Release 2 Installer - Installing database - Step 1 of 9

Configure Security Updates


Provide your email address to be informed of security issues, install the product and initiate configuration manager. [View details.](#)

Email:
Easier for you if you use your My Oracle Support email address/username.

I wish to receive security updates via My Oracle Support.

My Oracle Support Password:

Email Address Not Specified

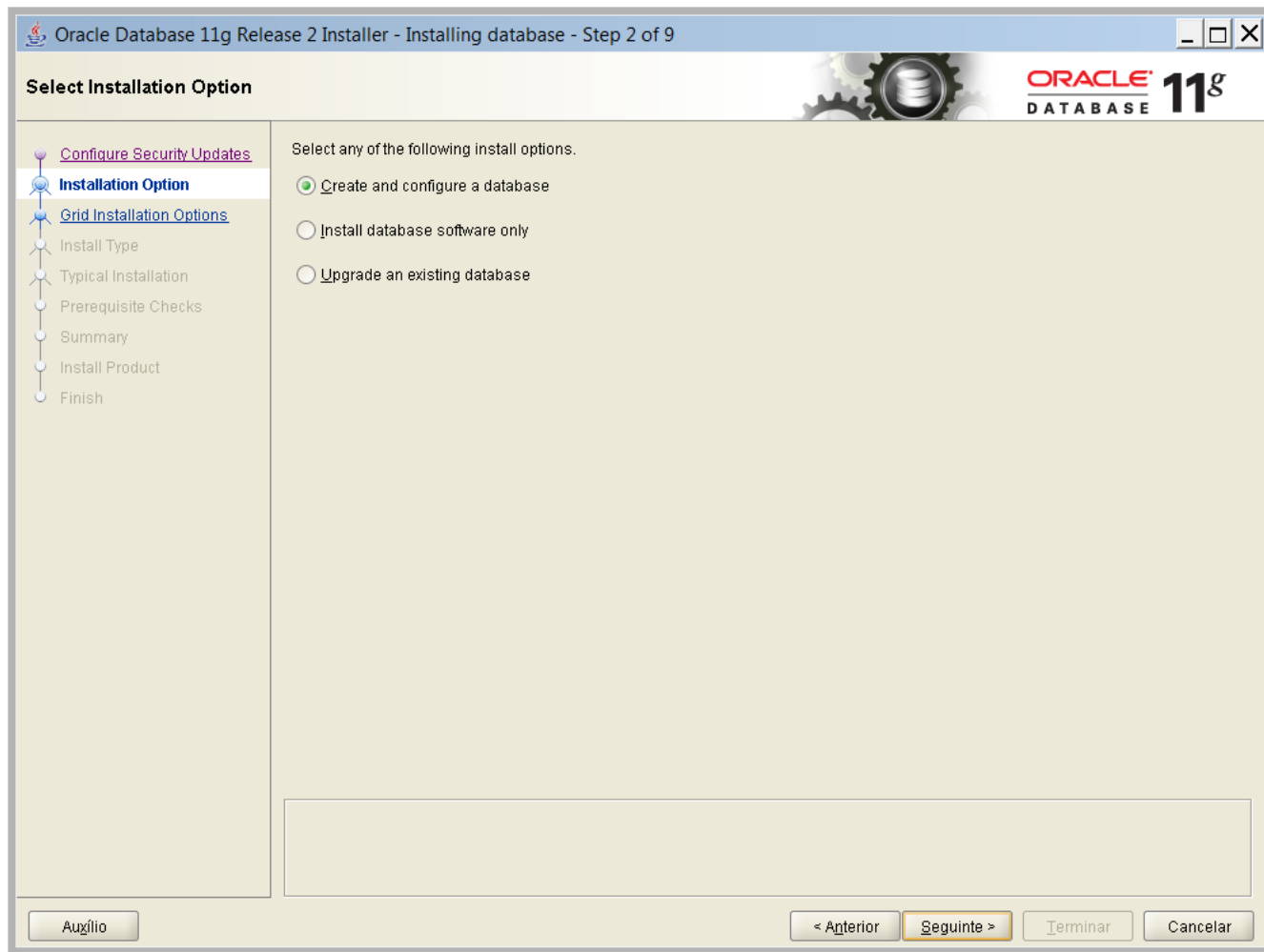
 You have not provided an email address.

Do you wish to remain uninformed of critical security issues in your configuration?

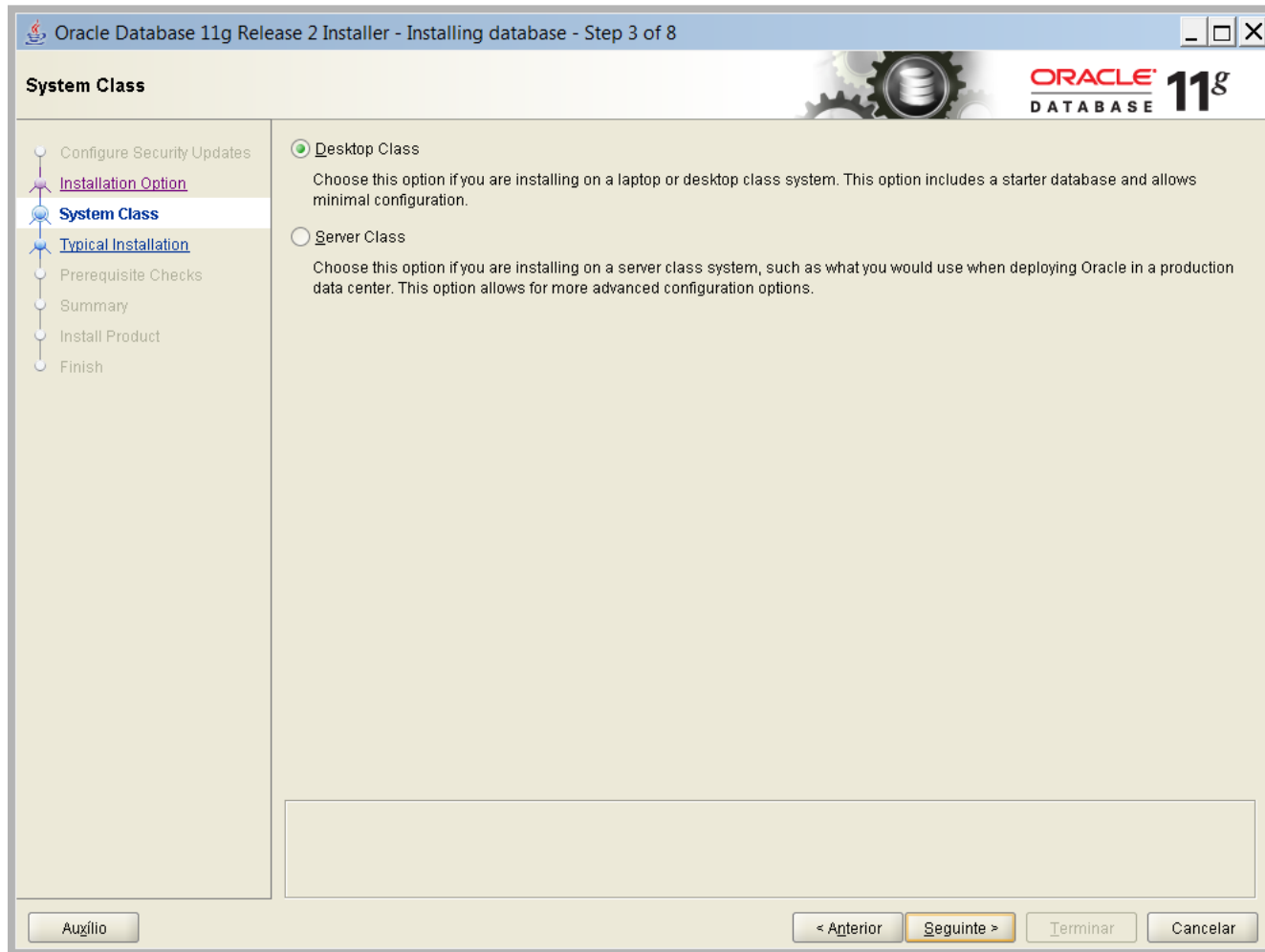
Yes No

Auxílio < Anterior Seguinte > Terminar Cancelar

Instalação Oracle (2)



Instalação Oracle (3)



Instalação Oracle (4)

Oracle Database 11g Release 2 Installer - Installing database - Step 4 of 8

Typical Install Configuration

Perform full Database installation with basic configuration.

Oracle base: Browse

Software location: Browse

Database file location: Browse

Database edition: **Personal Edition (3,27GB)**

Character Set:

Global database name:

Administrative password:

Confirm Password:

mde2011

Mensagens:

Administrative password:[INS-30011] The ADMIN password entered does not conform to the Oracle recommended standards.

Auxílio < Anterior Seguinte > Terminar Cancelar

Instalação Oracle (4.1)

The screenshot displays the Oracle Database 11g Release 2 Installer window, titled "Oracle Database 11g Release 2 Installer - Installing database - Step 4 of 8". The main window is titled "Typical Install Configuration" and shows the following configuration options:

- Oracle base: C:\app\jrosas
- Software location: C:\app\jrosas\product11.2.0\dbhome_1
- Database file location: C:\app\jrosas\oradata
- Database edition: Personal Edition (3,27GB)
- Character Set: Default (WE8MSWIN1252)

A warning dialog box is overlaid on the main window, titled "Oracle Database 11g Release 2 Installer". The dialog contains the following text:

[INS-30011] The ADMIN password entered does not conform to the Oracle recommended standards.
Are you sure you want to continue ?

The "Yes" button in the dialog is circled in red. The "No" button is highlighted with a yellow border. The "Details" button is also visible.

At the bottom of the main window, there are navigation buttons: "Ajúlio", "< Anterior", "Seguinte >", "Terminar", and "Cancelar".

Caso Oracle não esteja a funcionar

- NÃO RE-INSTALAR!
- NÃO DESINSTALAR!
- NÃO FORMATAR DISCO!
- (NÃO DESESPERAR!!!)
- Normalmente é apenas necessário fazer o “net-configuration”.
- Pedir ajuda (aos docentes da disciplina).
- Incentivar entreajuda.

Caso PC/Portátil muito lento

- Ir ao “Control Panel”
- “Administrative tools”
- “Services”
- Fazer “disable” dos serviços relacionados com o “Oracle”.
- (Atenção), reverter a operação anterior para voltar a usar o ORACLE.

Desinstalar Oracle

- Operação complexa.
- Seguir estes paços:
 - Apagar base-de-dados
 - Apagar “listener”
 - Ir à “console” e executar o “deinstall” dentro da directoria do Oracle.

Introdução ao SQL

- SQL – Structured Query Language (SQL) is the language used to manipulate relational databases. SQL is tied very closely with the relational model.

SQL Statements

- The following is an alphabetical list of SQL statements that can be issued against an Oracle database. These commands are available to any user of the Oracle database. These are the most commonly used:
- **ALTER** - Change an existing table, view or index definition
- **AUDIT** - Track the changes made to a table
- **COMMENT** - Add a comment to a table or column in a table
- **COMMIT** - Make all recent changes permanent
- **CREATE** - Create new database objects such as tables or views
- **DELETE** - Delete rows from a database table
- **DROP** - Drop a database object such as a table, view or index
- **GRANT** - Allow another user to access database objects such as tables or views
- **INSERT** - Insert new data into a database table
- **No AUDIT** - Turn off the auditing function
- **REVOKE** - Disallow a user access to database objects such as tables and views
- **ROLLBACK** - Undo any recent changes to the database
- **SELECT** - Retrieve data from a database table
- **UPDATE** - Change the values of some data items in a database table

Create statement

- Para criar uma tabela com o registo dos alunos, utiliza-se o operador “CREATE TABLE”:
- CREATE TABLE employee
- (fname VARCHAR2(8),
- minit VARCHAR2(2),
- lname VARCHAR2(8),
- ssn VARCHAR2(9) NOT NULL,
- bdate DATE,
- address VARCHAR2(27),
- sex VARCHAR2(1),
- salary NUMBER(7) NOT NULL,
- superssn VARCHAR2(9),
- dno NUMBER(1) NOT NULL
-);

Inserir registros

- To insert a new employee:

```
INSERT INTO employee
```

```
VALUES ('BUD', 'T', 'WILLIAMS', '132451122',  
        '24-JAN-54', '987 Western Way, Plano, TX',  
        'M', 42000, NULL, 5);
```


Obter informação

- To retrieve a list of all employees with salary greater than 30000 from the employees table, the following SQL statement might be issued (Note that all SQL statements end with a semicolon):

```
SELECT fname, lname, salary FROM employee  
WHERE salary > 30000;
```

Alterar registros numa tabela

- To give each employee in department 5 a 4 percent raise, the following SQL statement might be issued:

```
UPDATE employee  
SET salary = salary * 1.04  
WHERE dno = 5;
```

Apagar um registro

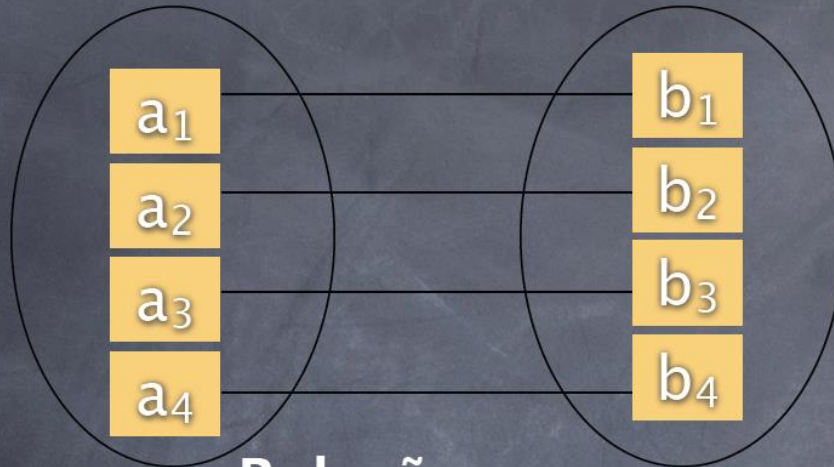
- To delete an employee record from the database, the following SQL statement might be issued:

```
DELETE FROM employee  
WHERE empid = 101 ;
```

Diagramas de Entidades e Relacionamentos (DER)

- Peter Chen: 1976
- Espelha o Mundo Real : Entidades e Relações
- **Entidade**
 - substantivo,
 - objecto / algo único: atributos (propriedades)
 - Ex: Alunos (número, curso, ano, ...), Profs (nome, curso, disciplinas,...) , Robôs, Sistemas Domóticos, etc.
 - Agrupamentos: entidades com algo em comum
- **Relação:**
 - verbo, acção,
 - associa entidades
 - Também podem ter atributos
 - Ex: Prof pertence ao DEE

Diagramas de Entidades e Relacionamentos (DER)

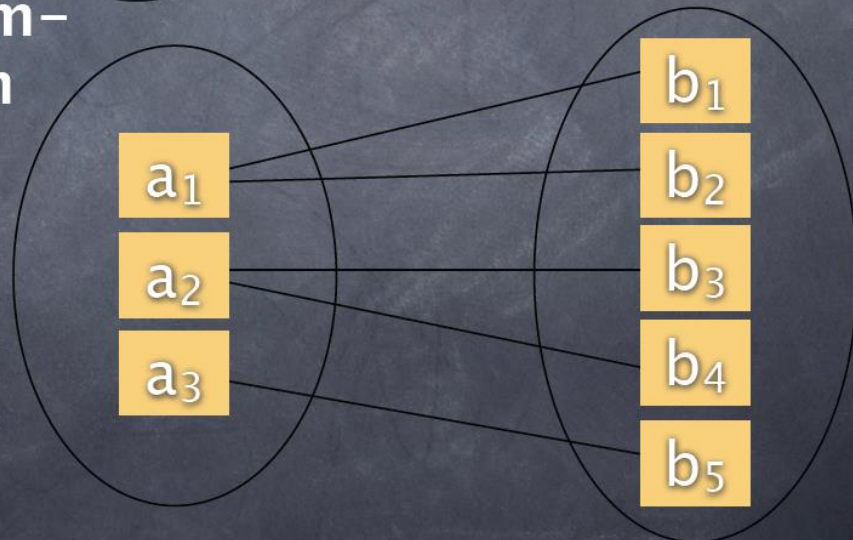


Relação um-
para-um

Relação muitos-
para-um

Relação muitos-
para-muitos

Relação um-
para-muitos



Entidade “produtos”

- Entidade produtos: codigo, designacao, validade, preco

PRODUTO

- codigo
- designacao
- validade
- preco

Codigo

Designacao

Preço

Validade

```
CREATE TABLE Produto
```

```
(  
  codigo          VARCHAR2 (12) ,  
  designacao      VARCHAR2 (30) ,  
  validade        DATE ,  
  preco           NUMBER (10,2)  
)
```

```
;
```

Entidade “produto” - instâncias

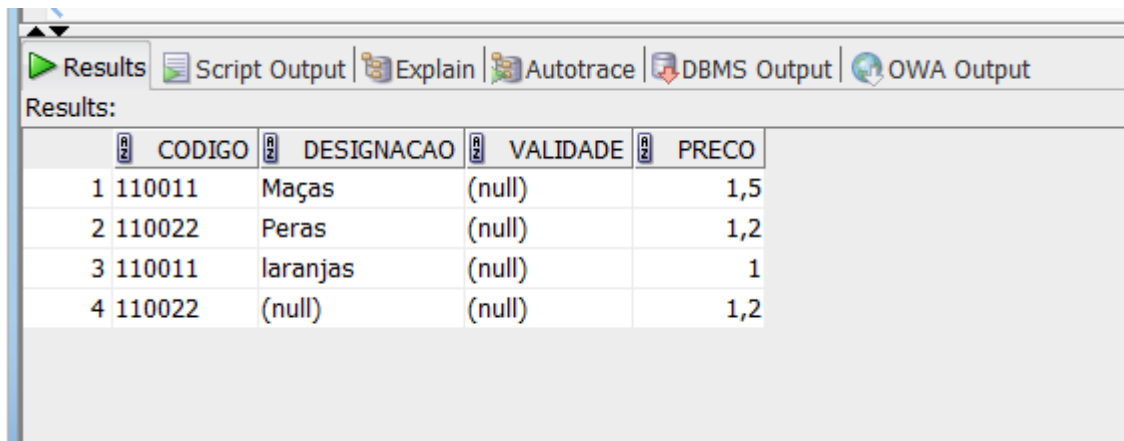
- Algumas instâncias:

Insert into produto(codigo, designacao, preco) values('110011','Maças',1.5);

Insert into produto(codigo, designacao, preco) values('110022','Peras',1.2);

Insert into produto(codigo, designacao, preco) values('110011','laranjas',1.0);

Insert into produto(codigo, preco) values('110022',1.2);



The screenshot shows a database query results window with a table containing 4 rows. The table has columns for CODIGO, DESIGNACAO, VALIDADE, and PRECO. The data is as follows:

	CODIGO	DESIGNACAO	VALIDADE	PRECO
1	110011	Maças	(null)	1,5
2	110022	Peras	(null)	1,2
3	110011	laranjas	(null)	1
4	110022	(null)	(null)	1,2

Entidade “produto” - problemas

1	110011	Maças	(null)	1,5
2	110022	Peras	(null)	1,2
3	110011	laranjas	(null)	1
4	110022	(null)	(null)	1,2

Produtos repetidos?

Como Identificar univocamente cada produto?

Produto sem designação?

Chaves primárias (e 'not NULL')

Entidade

Produto	
P *	codigo VARCHAR2 (12)
*	designacao VARCHAR2 (30)
	validade DATE
	preco NUMBER (10,2)
↳ Produto PK (codigo)	

Tabela

```
CREATE TABLE Produto
(
  codigo VARCHAR2 (12) NOT NULL ,
  designacao VARCHAR2 (30) NOT NULL ,
  validade DATE ,
  preco NUMBER (10,2),

  CONSTRAINT "Produto PK" PRIMARY KEY ( codigo )
)
;
```

Produtos: inserindo informação

```
Insert into produto(codigo, designacao, preco) values('110011','Maças',1.5);
Insert into produto(codigo, designacao, preco) values('110022','Peras',1.2);
Insert into produto(codigo, designacao, preco) values('110011','laranjas',1.0);
Insert into produto(codigo, preco) values('110022',1.2);
```

1 rows inserted
1 rows inserted

Error starting at line 3 in command:

```
Insert into produto(codigo, designacao, preco) values('110011','laranjas',1.0)
```

Error report:

SQL Error: ORA-00001: restrição exclusiva (SYSTEM.Produto PK) violada
00001. 00000 - "unique constraint (%s.%s) violated"

*Cause: An UPDATE or INSERT statement attempted to insert a duplicate key.
For Trusted Oracle configured in DBMS MAC mode, you may see
this message if a duplicate entry exists at a different level.

*Action: Either remove the unique restriction or do not insert the key.

Error starting at line 4 in command:

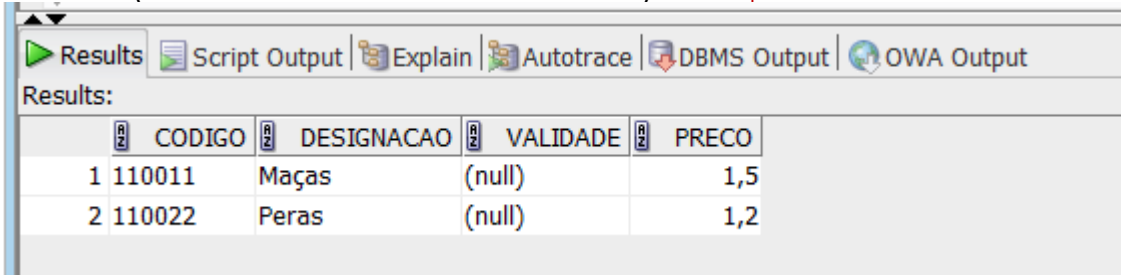
```
Insert into produto(codigo, preco) values('110022',1.2)
```

Error report:

SQL Error: ORA-01400: não é possível inserir NULL em ("SYSTEM"."PRODUTO"."DESIGNACAO")
01400. 00000 - "cannot insert NULL into (%s.%s.%s)"

*Cause:

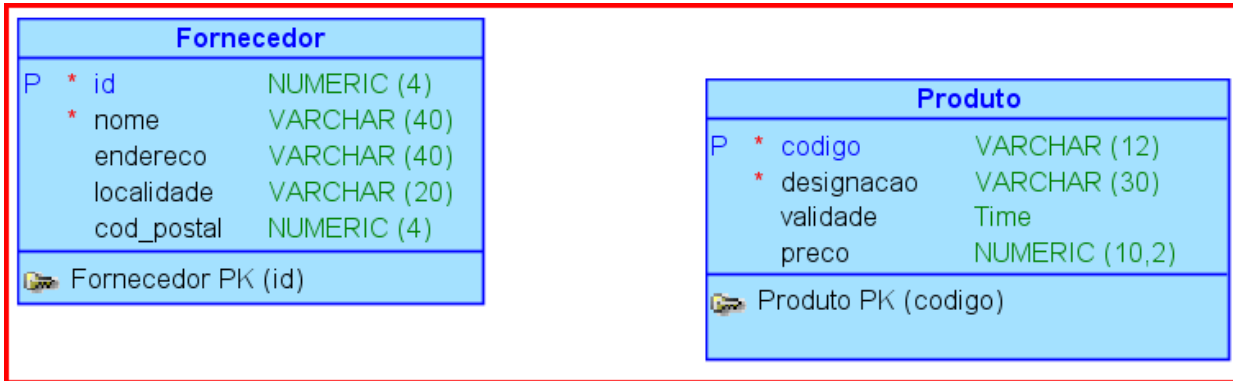
*Action:



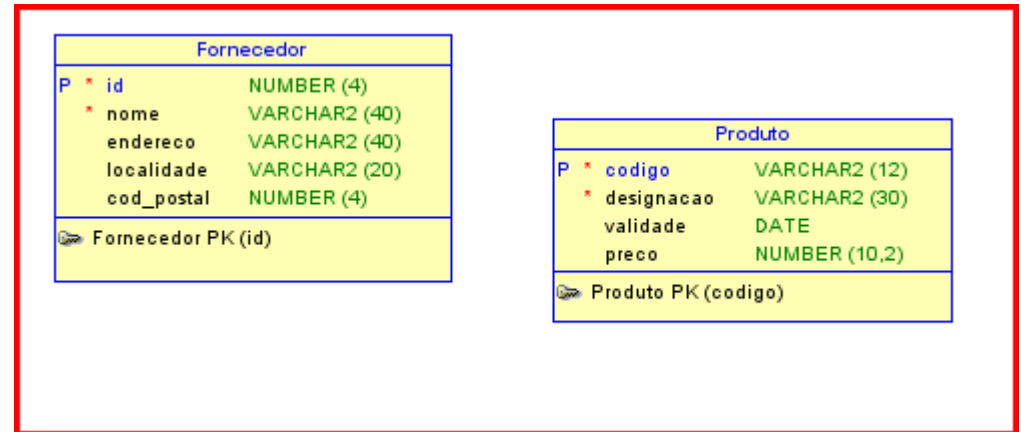
	CODIGO	DESIGNACAO	VALIDADE	PRECO
1	110011	Maças	(null)	1,5
2	110022	Peras	(null)	1,2

Entidade: Fornecedores

Modelo Lógico

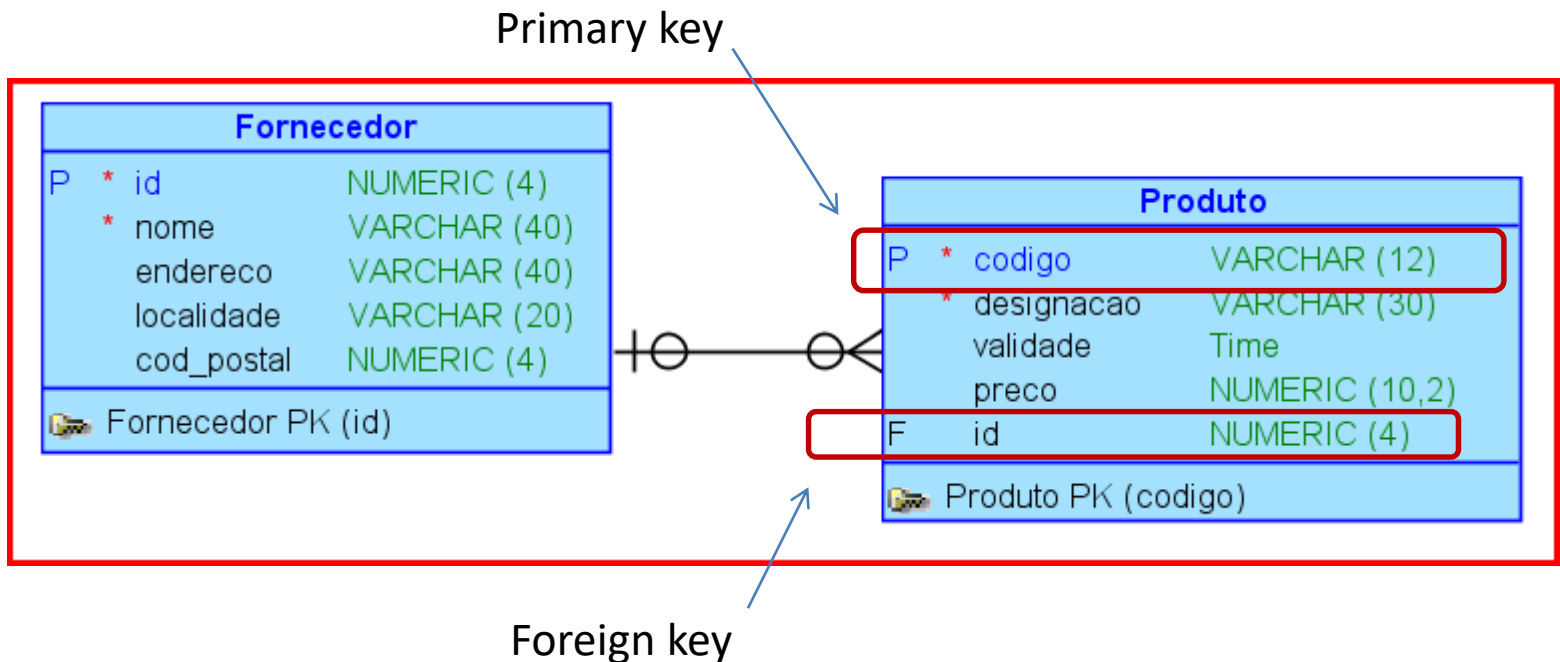
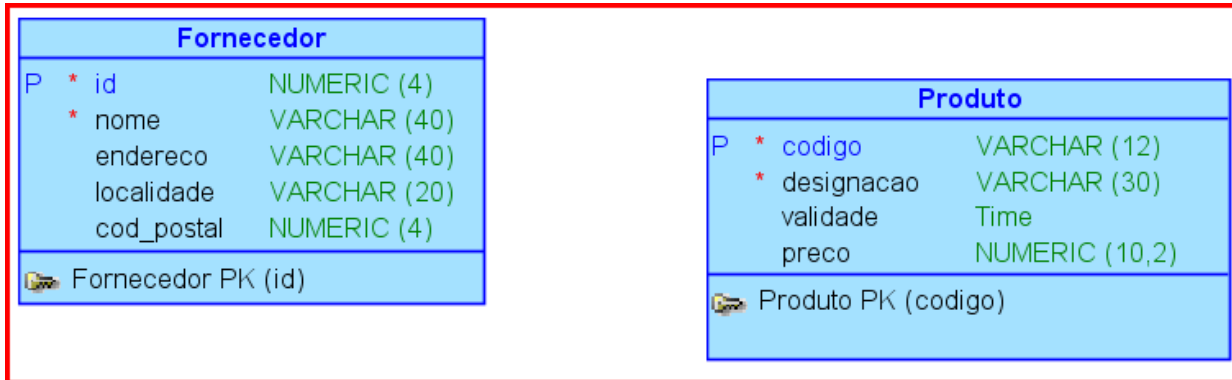


Modelo Físico/Relacional

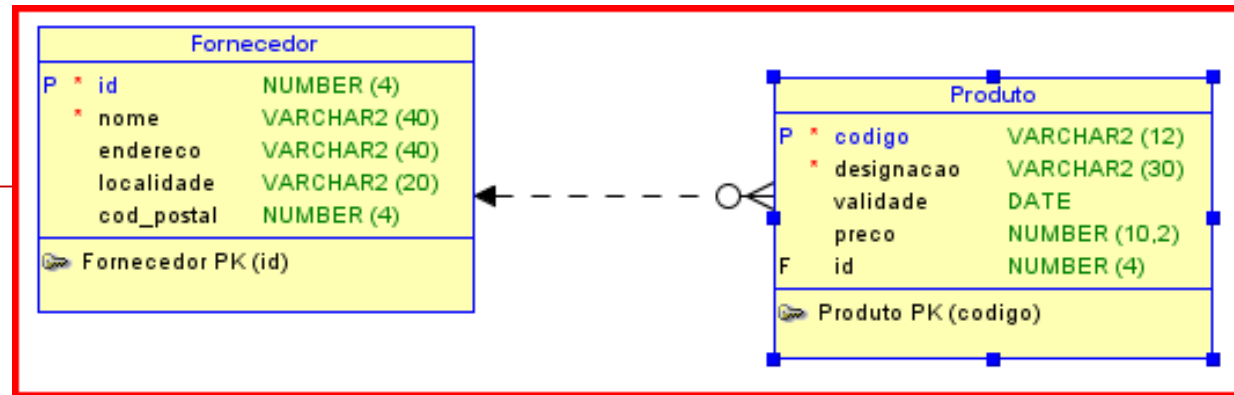


Como indicar que um fornecedor fornece N produtos?

Relacionamento 1:N



SQL para relacionamento 1:N



```
CREATE TABLE Fornecedor (
  id NUMBER (4) NOT NULL ,
  nome VARCHAR2 (40) NOT NULL ,
  endereco VARCHAR2 (40) ,
  localidade VARCHAR2 (20) ,
  cod_postal NUMBER (4),
  CONSTRAINT "Fornecedor PK" PRIMARY KEY ( id ) ;
);
```

```
CREATE TABLE Produto (
  codigo VARCHAR2 (12) NOT NULL ,
  designacao VARCHAR2 (30) NOT NULL ,
  validade DATE ,
  preco NUMBER (10,2) ,
  id NUMBER (4),
  CONSTRAINT "Produto PK" PRIMARY KEY ( codigo ) ,
  CONSTRAINT Relation_2 FOREIGN KEY(id) REFERENCES Fornecedor(id) ON DELETE SET NULL
)
;
```

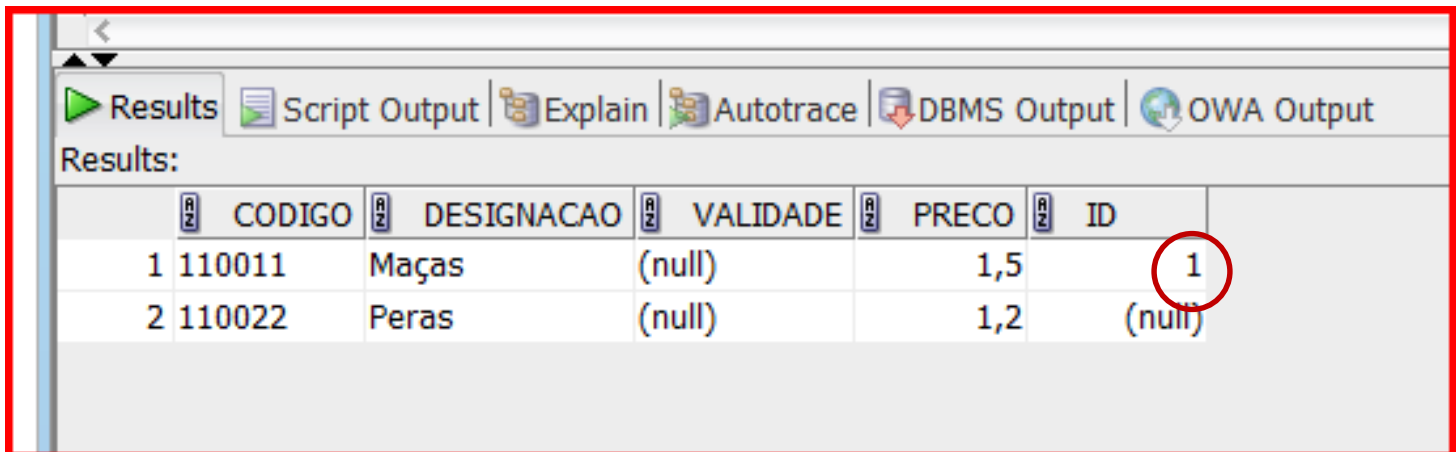
Informação sobre fornecedores

```
Insert into fornecedor(id, nome, localidade)  
values(1, 'Cavaco', 'Lisboa');
```

Update produto

```
Set id =1 where codigo=110011;
```

```
Select * from produto;
```



Results

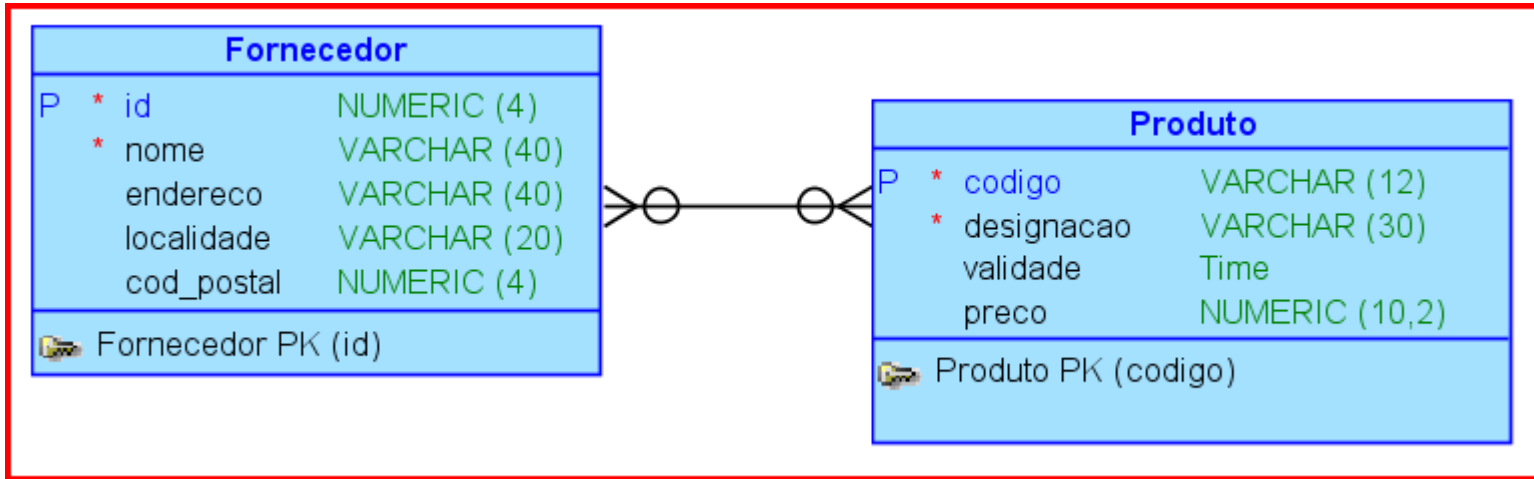
	CODIGO	DESIGNACAO	VALIDADE	PRECO	ID
1	110011	Maças	(null)	1,5	1
2	110022	Peras	(null)	1,2	(null)

Problema

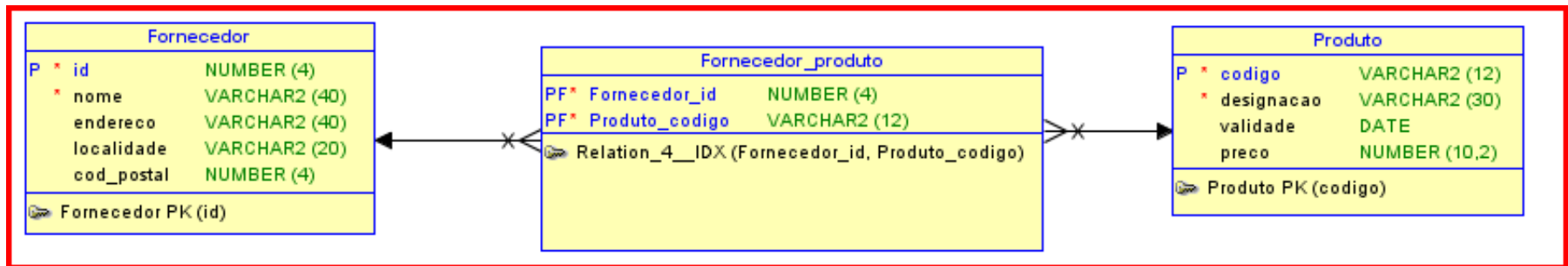
- Como modelar o facto de que um produto pode ter vários fornecedores distintos?
- Certamente também, um fornecedor fornece mais que um produto distinto!

Relacionamento N:M

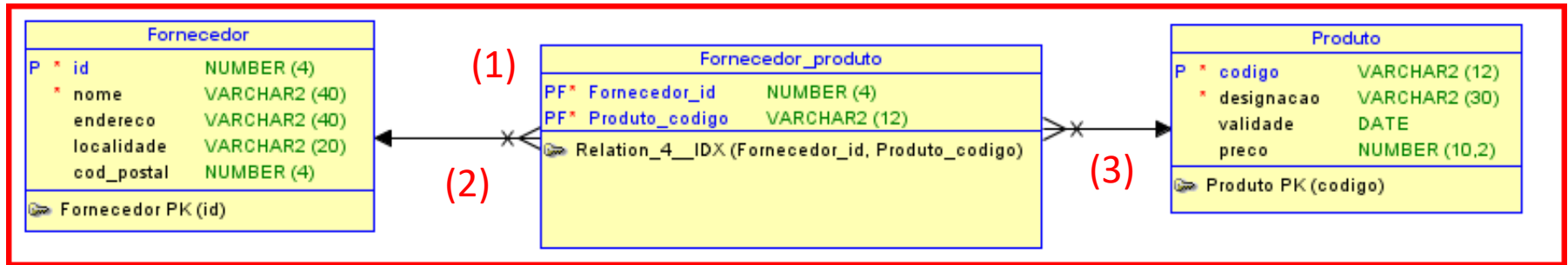
Modelo Lógico



Modelo Relacional/Físico



Relacionamento N:M



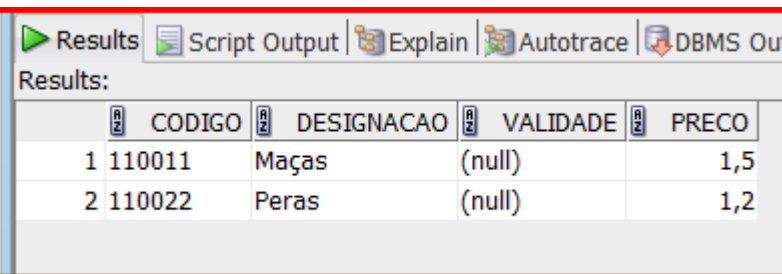
```
CREATE TABLE Fornecedor_produto
```

```
(  
  Fornecedor_id NUMBER (4) NOT NULL ,  
  Produto_codigo VARCHAR2 (12) NOT NULL,
```

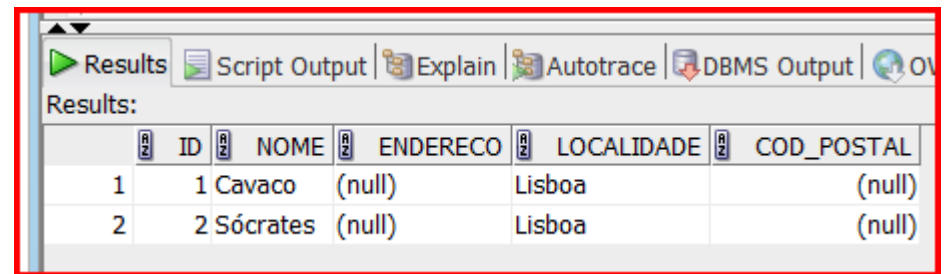
- (1) CONSTRAINT Relation_4__IDX PRIMARY KEY (Fornecedor_id, Produto_codigo),
 - (2) CONSTRAINT FK_ASS_4 FOREIGN KEY(Fornecedor_id) REFERENCES Fornecedor(id) ON DELETE CASCADE,
 - (3) CONSTRAINT FK_ASS_5 FOREIGN KEY(Produto_codigo) REFERENCES Produto(codigo) ON DELETE CASCADE
- ```
)
;
```

# Algumas instancias

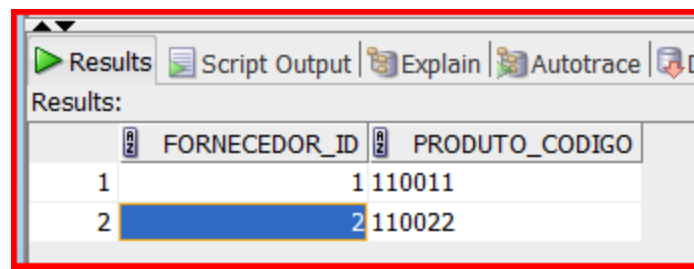
- Insert into fornecedor(id, nome, localidade) values(2, 'Sócrates', 'Lisboa');
- Insert into fornecedor\_produto values(1,110011);
- Insert into fornecedor\_produto values(2,110022);
- Select \* from produto;
- Select \* from fornecedor;
- Select \* from fornecedor\_produto;



|   | CODIGO | DESIGNACAO | VALIDADE | PRECO |
|---|--------|------------|----------|-------|
| 1 | 110011 | Maças      | (null)   | 1,5   |
| 2 | 110022 | Peras      | (null)   | 1,2   |

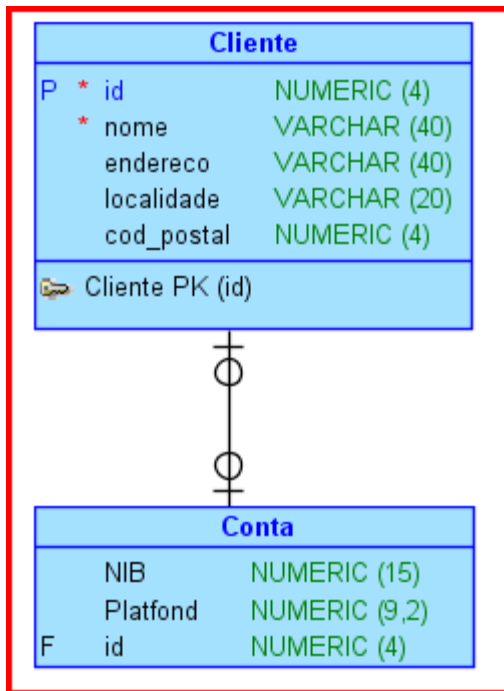


|   | ID | NOME     | ENDERECO | LOCALIDADE | COD_POSTAL |
|---|----|----------|----------|------------|------------|
| 1 | 1  | Cavaco   | (null)   | Lisboa     | (null)     |
| 2 | 2  | Sócrates | (null)   | Lisboa     | (null)     |



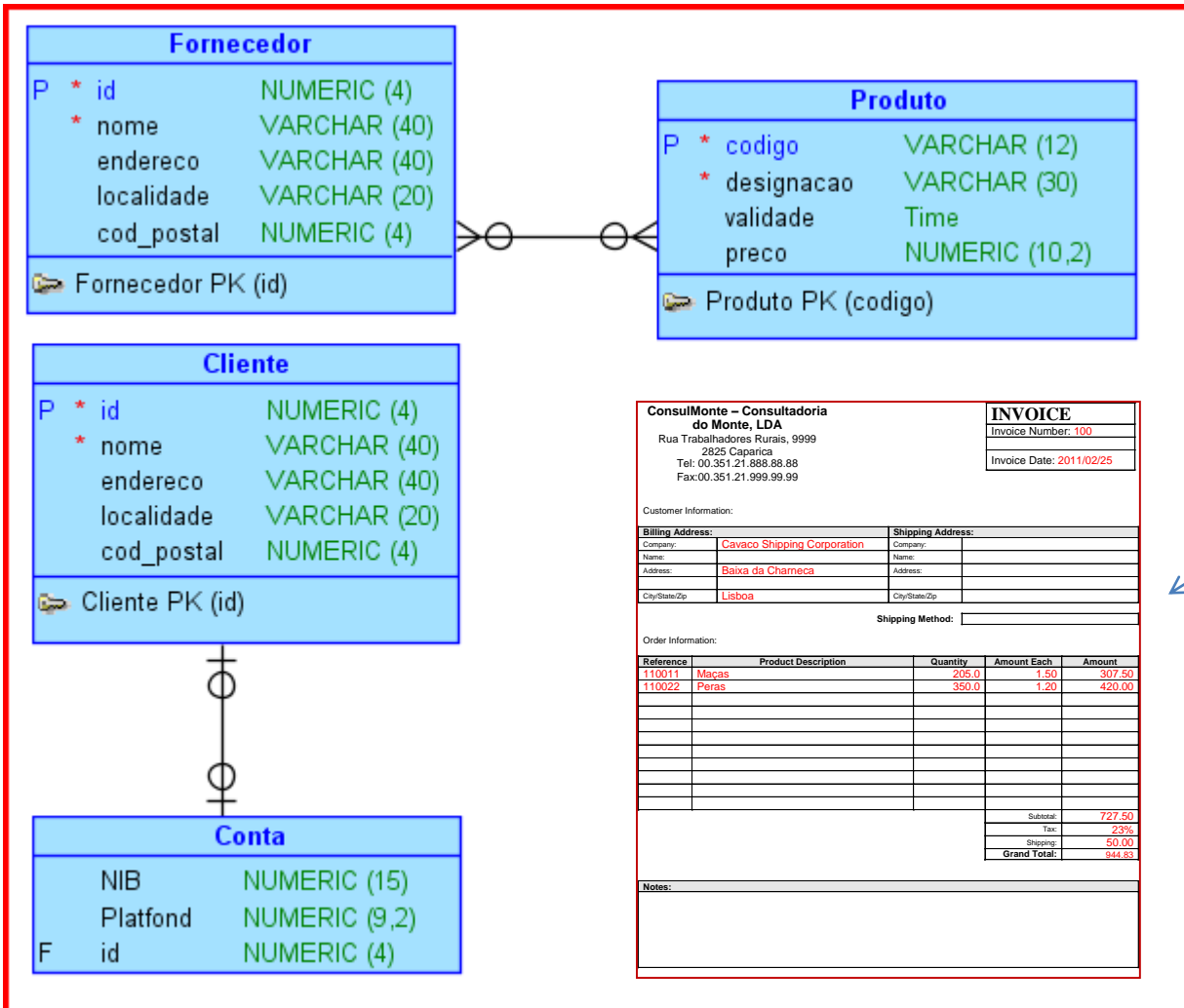
|   | FORNECEDOR_ID | PRODUTO_CODIGO |
|---|---------------|----------------|
| 1 | 1             | 110011         |
| 2 | 2             | 110022         |

# Relacionamento 1:1

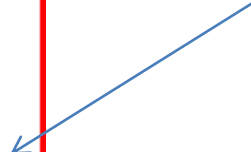


- Um cliente tem exactamente um NIB e um platfond na sua conta
- Cada conta refere-se a apenas um cliente
- Neste caso, a chave estrangeira coloca-se na entidade com “**participação total**”, ou o mais próximo disso.

# O modelo até agora



FALTA ISTO!



| ConsulMonte – Consultadoria do Monte, LDA |                     | INVOICE                  |                     |               |
|-------------------------------------------|---------------------|--------------------------|---------------------|---------------|
| Rua Trabalhadores Rurais, 9999            |                     | Invoice Number: 100      |                     |               |
| 2825 Caparica                             |                     | Invoice Date: 2011/02/25 |                     |               |
| Tel: 00.351.21.888.88.88                  |                     |                          |                     |               |
| Fax: 00.351.21.999.99.99                  |                     |                          |                     |               |
| Customer Information:                     |                     |                          |                     |               |
| Billing Address:                          |                     | Shipping Address:        |                     |               |
| Company: Cavaco Shipping Corporation      | Company:            |                          |                     |               |
| Name:                                     | Name:               |                          |                     |               |
| Address: Baixa da Charneca                | Address:            |                          |                     |               |
| City/State/Zip: Lisboa                    | City/State/Zip:     |                          |                     |               |
| Shipping Method:                          |                     |                          |                     |               |
| Order Information:                        |                     |                          |                     |               |
| Reference                                 | Product Description | Quantity                 | Amount Each         | Amount        |
| 110011                                    | Macas               | 205.0                    | 1.50                | 307.50        |
| 110022                                    | Peras               | 350.0                    | 1.20                | 420.00        |
|                                           |                     |                          |                     |               |
|                                           |                     |                          |                     |               |
|                                           |                     |                          |                     |               |
|                                           |                     |                          |                     |               |
|                                           |                     |                          |                     |               |
|                                           |                     |                          |                     |               |
|                                           |                     |                          | Subtotal:           | 727.50        |
|                                           |                     |                          | Tax:                | 23%           |
|                                           |                     |                          | Shipping:           | 50.00         |
|                                           |                     |                          | <b>Grand Total:</b> | <b>944.00</b> |
| Notes:                                    |                     |                          |                     |               |

# Factura a cliente

## ConsulMonte – Consultadoria do Monte, LDA

Rua Trabalhadores Rurais, 9999  
 2825 Caparica  
 Tel: 00.351.21.888.88.88  
 Fax:00.351.21.999.99.99

|                                 |
|---------------------------------|
| <b>INVOICE</b>                  |
| Invoice Number: <b>100</b>      |
|                                 |
| Invoice Date: <b>2011/02/25</b> |

Identificação da factura

### Customer Information:

| Billing Address: |                                    | Shipping Address: |  |
|------------------|------------------------------------|-------------------|--|
| Company:         | <b>Cavaco Shipping Corporation</b> | Company:          |  |
| Name:            |                                    | Name:             |  |
| Address:         | <b>Baixa da Charneca</b>           | Address:          |  |
|                  |                                    |                   |  |
| City/State/Zip   | <b>Lisboa</b>                      | City/State/Zip    |  |

Identificação da factura  
 (Só deve conter um cliente)  
 (e apenas clientes já definidos)

Shipping Method:

### Order Information:

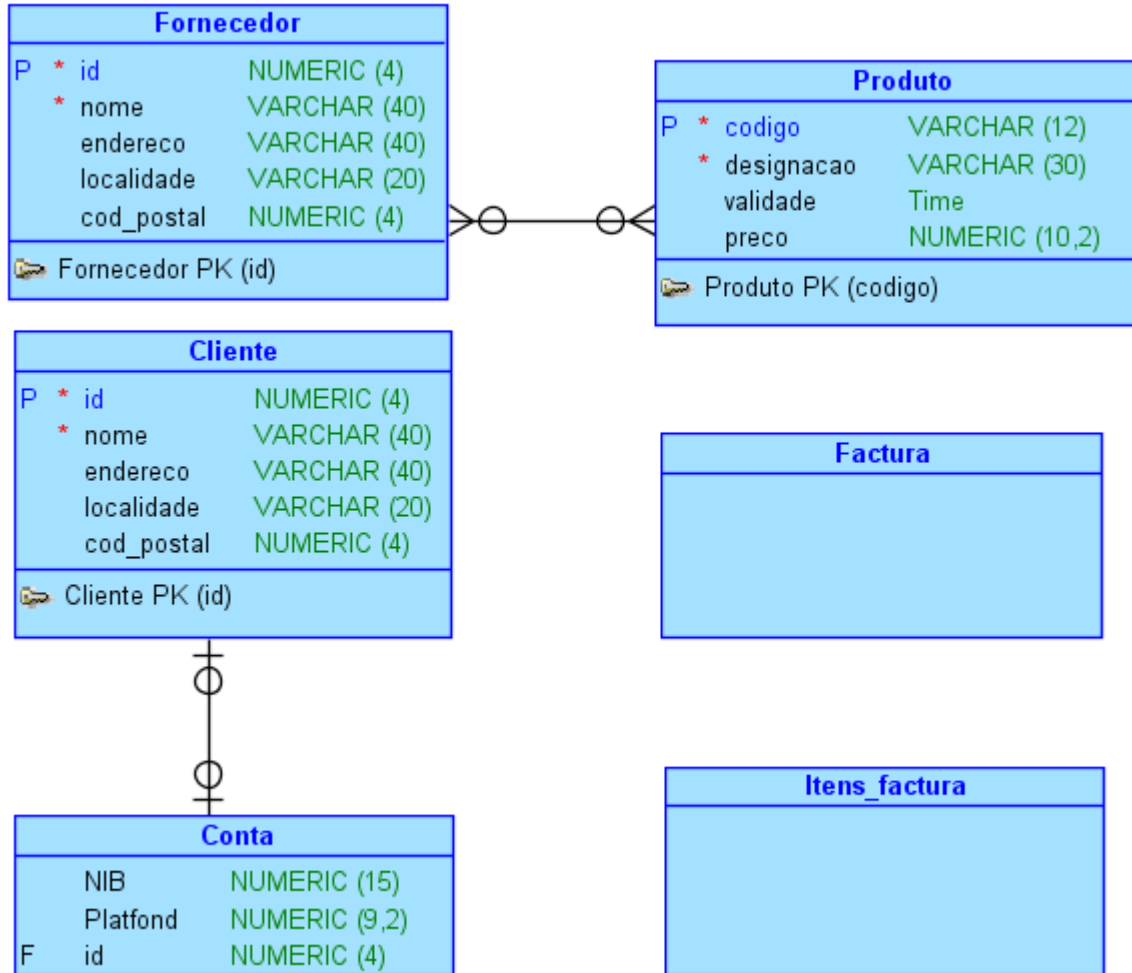
| Reference     | Product Description | Quantity     | Amount Each         | Amount        |
|---------------|---------------------|--------------|---------------------|---------------|
| <b>110011</b> | <b>Maças</b>        | <b>205.0</b> | <b>1.50</b>         | <b>307.50</b> |
| <b>110022</b> | <b>Peras</b>        | <b>350.0</b> | <b>1.20</b>         | <b>420.00</b> |
|               |                     |              |                     |               |
|               |                     |              |                     |               |
|               |                     |              |                     |               |
|               |                     |              |                     |               |
|               |                     |              |                     |               |
|               |                     |              |                     |               |
|               |                     |              |                     |               |
|               |                     |              | Subtotal:           | <b>727.50</b> |
|               |                     |              | Tax:                | <b>23%</b>    |
|               |                     |              | Shipping:           | <b>50.00</b>  |
|               |                     |              | <b>Grand Total:</b> | <b>944.83</b> |

Detalhes da factura  
 (só deve conter itens existentes na bd como produtos para venda)

Onde é que ficam os totais?

| Notes: |
|--------|
|        |

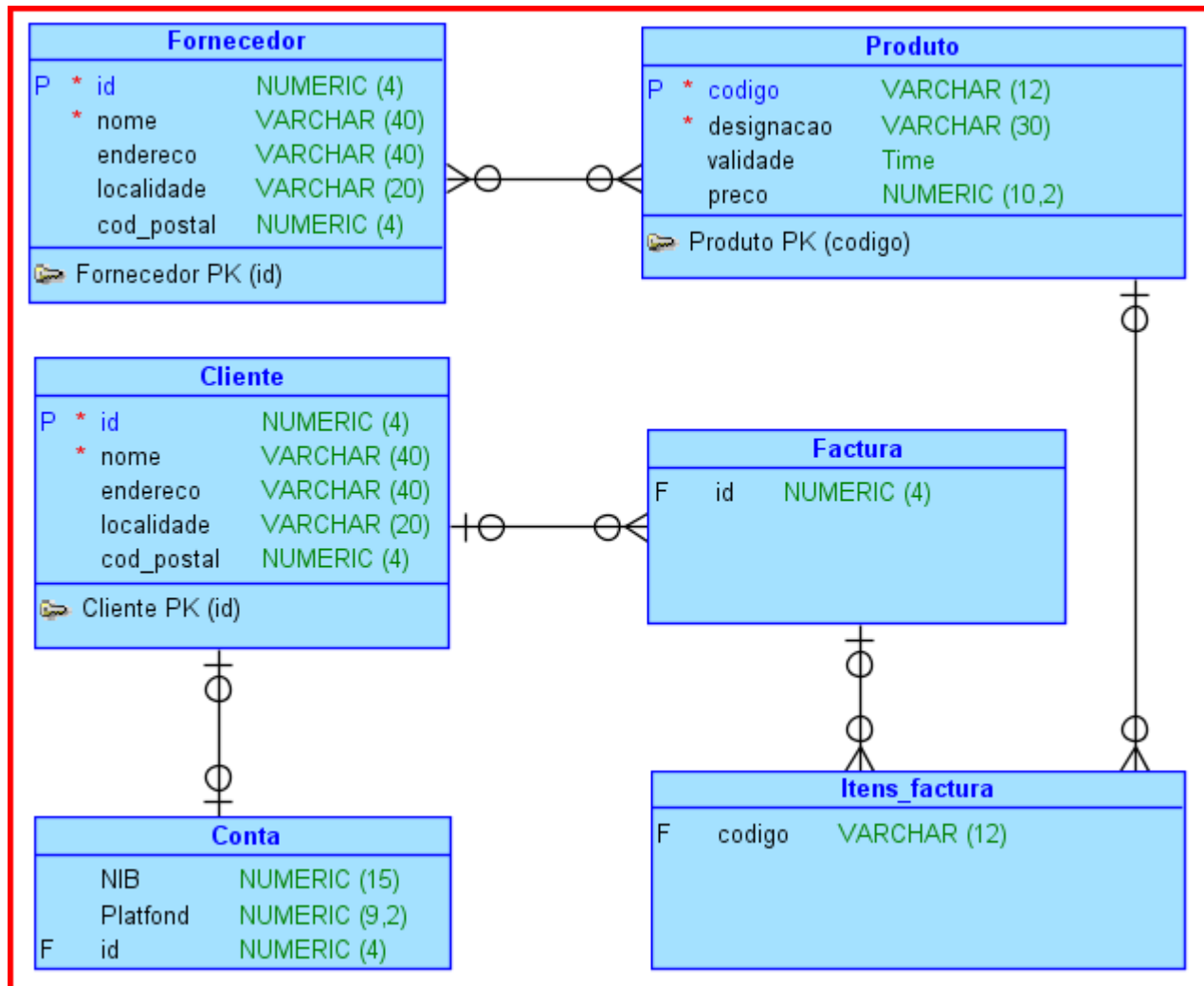
# Modelo proposto



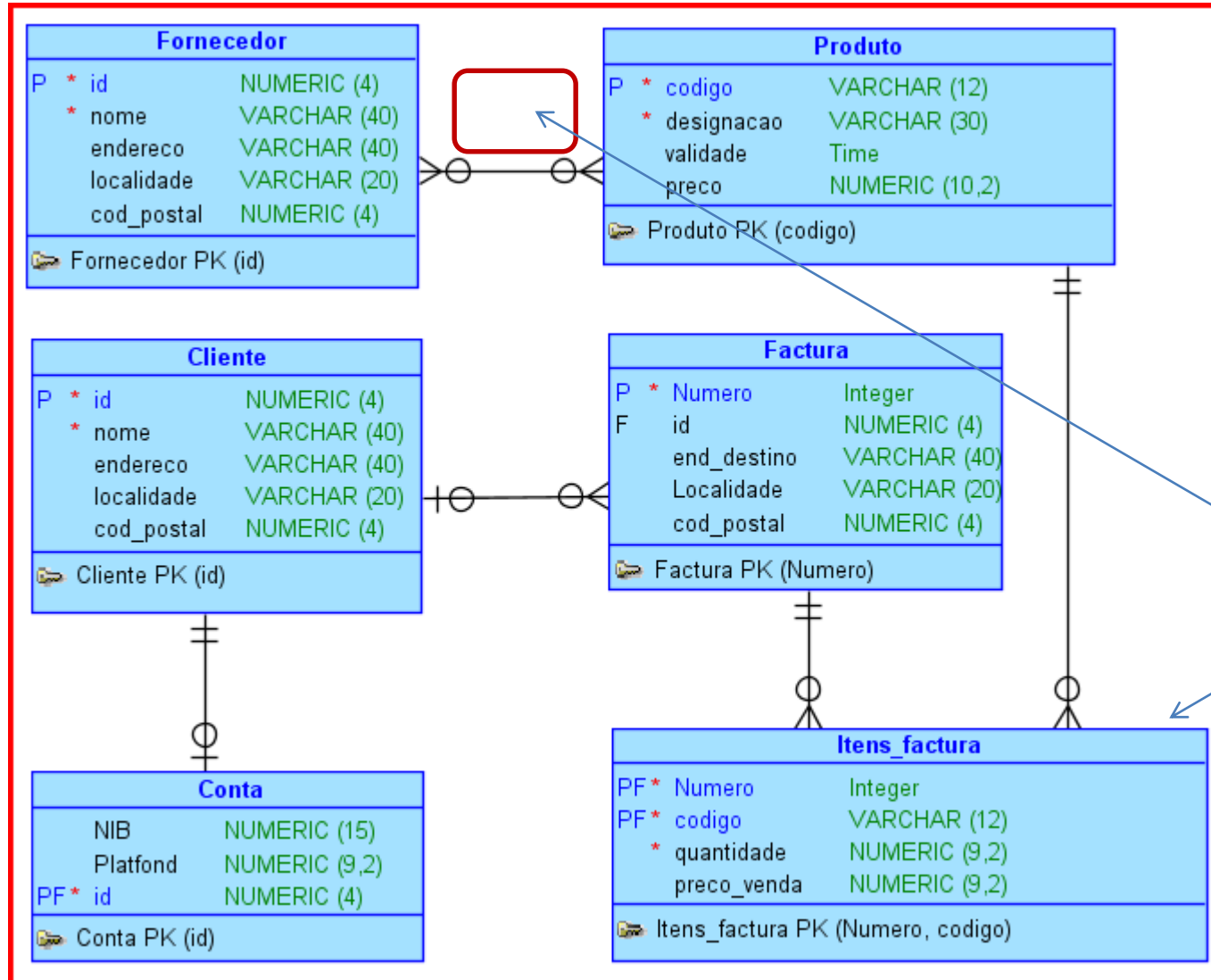
- Que informação colocar em cada entidade?
- Que tipos de relacionamentos?
- Entidades fortes/fracas?

FAZER!

# O Modelo com relacionamentos



# O Modelo completo



Entidades fracas



# O Modelo físico

