



**TÉCNICO**  
LISBOA

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## Projeto BD - Parte 1

### Relatório

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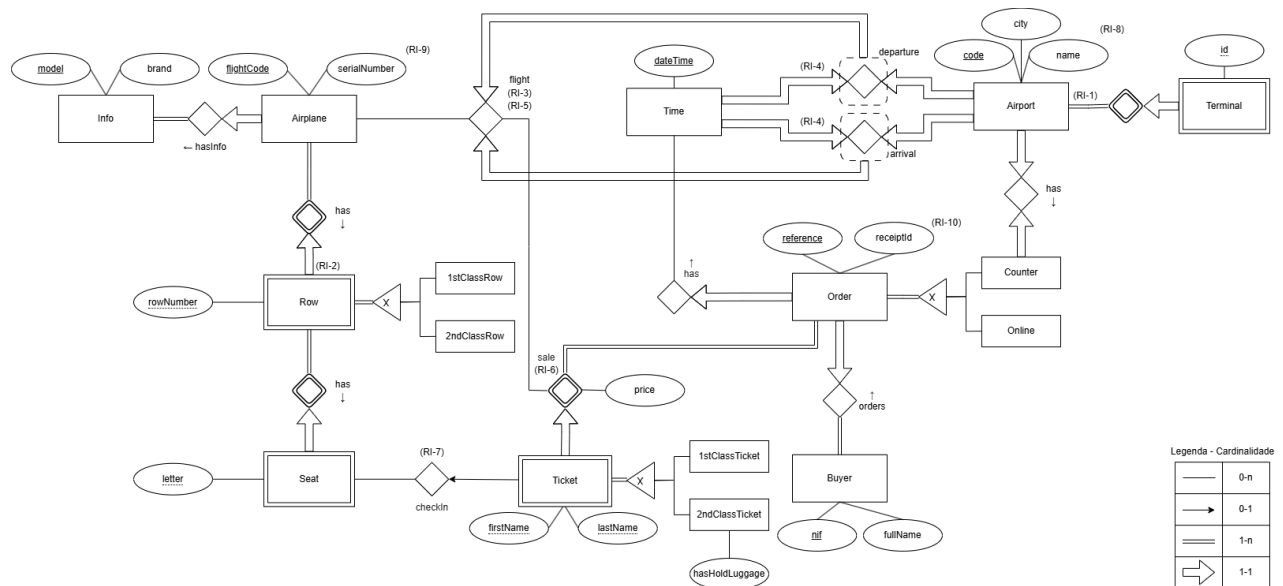
#### **Grupo 76 Lab 17**

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Bases de Dados

Ano Letivo 2024/2025, 2º Semestre, 4º Período

# 1. Modelação Entidade-Associação



### Restrições de Integridade:

RI-1 - An airport **must not** have more than **5 terminals**.

RI-2 - Seat rows **must be contiguous**, with **1stClassRows** always coming **before 2ndClassRows**, and all rows after a 2ndClassRow **must** also be a 2ndClassRow.

RI-3 - A flight **must** be operated **between two different airports**.

RI-4 - A flight's **arrival time must be later** than its **departure time**, in the same time zone.

RI-5 - The **flight duration** between the same two airports **must always be the same**.

RI-6 - No more tickets **can** be sold per class than the number of seats of that class available in the airplane assigned to the flight.

RI-7 - A seat **can only** be assigned **after check-in** is completed.

RI-8 - The **combination** of an airport's name and city **must be** unique.

RI-9 - An airplane's **serialNumber** is unique.

RI-10 - An order's **receiptId** is unique.

## 2. Conversão E-A Relacional

Airplane(flightCode, serialNumber)

- UNIQUE(serialNumber) NOT NULL

Info(model, brand)

HasInfo(flightCode, model)

- flightCode: FK(Airplane)
- model: FK(Info) NOT NULL

Row(rowNumber, flightCode, class)

- flightCode: FK(Airplane)

Seat(letter, rowNumber, flightCode)

- rowNumber, flightCode: FK(Row: rowNumber, flightCode)

Airport(code, city, name)

- UNIQUE(city, name)

Terminal(id, code)

- code: FK(Airport)

Departure(dateTime, code)

- code: FK(Airport)

Arrival(dateTime, code)

- code: FK(Airport)

Flight(flightCode, departureDateTime, departureCode, arrivalDateTime, arrivalCode)

- UNIQUE(flightCode, arrivalDateTime, arrivalCode) NOT NULL
- UNIQUE(departureCode, departureDateTime, arrivalCode, arrivalDateTime) NOT NULL
- flightCode: FK(Airplane)
- departureDateTime, departureCode: FK(Departure:dateTime, code)
- arrivalDateTime, arrivalCode: FK(Arrival:dateTime, code)

Order(reference)

Counter(reference, code, receiptId)

- reference: FK(Order)
- code: FK(Airport)
- UNIQUE(receiptId)

Online(reference, receiptId)

- reference: FK(Order)
- UNIQUE(receiptId)

Buyer(nif, fullName)

Orders(reference, nif)

- nif: FK(Buyer) NOT NULL
- reference: FK(Order)

Ticket(flightCode, departureDateTime, departureCode, reference, firstName, lastName, hasHoldLuggage, price)

- flightCode: FK(Airplane)
- departureDateTime, departureCode: FK(Departure:dateTime, code)
- reference: FK(Order)

CheckIn(flightCode, departureDateTime, departureCode, reference, firstName, lastName, rowNumber, letter)

- departureDateTime, departureCode, reference, firstName, lastName:  
FK(Ticket:departureDateTime, departureCode, reference, firstName, lastName)
- letter, rowNumber, flightCode: FK(Seat:letter, rowNumber, flightCode)

## Restrições de Integridade:

RI-1 - Every Info (model) must participate in the **hasInfo** association

RI-2 - Every Buyer (nif) must participate in the **orders** association

Restrições de Integridade (não passíveis de conversão):

RI-3 - Seat rows **must be contiguous**, with **1stClassRows** always coming **before 2ndClassRows**, and all rows after a 2ndClassRow **must** also be a 2ndClassRow.

RI-4 - A flight's **arrival time must be later** than its **departure time**, in the same time zone.

### 3. Álgebra Relacional

Considerando o seguinte esquema relacional:

cliente(NIF, nome, morada)  
voo(código, aeroporto\_partida, hora\_partida, aeroporto\_chegada)  
bilhete(código, assento, preço)  
    código: FK(voo)  
venda(código, assento, NIF)  
    código, assento: FK(bilhete)  
    NIF: FK(cliente)

1. “Quais os clientes que compraram bilhetes para todos os aeroportos (de chegada)?”

$$r_1 \leftarrow (\text{venda} \bowtie_{\text{venda.código}=\text{bilhete.código} \wedge \text{venda.assento}=\text{bilhete.assento}} \text{bilhete})$$
$$\bowtie_{\text{bilhete.código}=\text{voo.código}} \text{VOO}$$
$$r_2 \leftarrow \prod_{\text{NIF, aeroporto\_chegada}}(r_1)$$
$$r_3 \leftarrow \prod_{\text{aeroporto\_chegada}}(\text{VOO})$$
$$\text{res} \leftarrow r_2 \div r_3$$

2. “Qual/quais o(s) cliente(s) que gastaram mais dinheiro em bilhetes no total?”

$$\begin{aligned}
 r_1 &\leftarrow (\text{venda} \bowtie_{\text{venda.código}=\text{bilhete.código} \wedge \text{venda.assento}=\text{bilhete.assento}} \text{bilhete}) \\
 &\quad \bowtie_{\text{bilhete.código}=\text{voo.código}} \text{VOO} \\
 r_2 &\leftarrow \text{NIF } G_{\text{sum(preço)} \rightarrow \text{total\_gasto}}(r_1) \\
 r_3 &\leftarrow \text{NIF } G_{\text{max(total\_gasto)} \rightarrow \text{max\_gasto}}(r_2) \\
 \text{res} &\leftarrow r_2 \bowtie_{\text{total\_gasto}=\text{max\_gasto}} r_3
 \end{aligned}$$

3. “Para cada aeroporto, quantos clientes aterraram mas nunca levantaram desse aeroporto?”

$$\begin{aligned}
 r_1 &\leftarrow (\text{venda} \bowtie_{\text{venda.código}=\text{bilhete.código} \wedge \text{venda.assento}=\text{bilhete.assento}} \text{bilhete}) \\
 &\quad \bowtie_{\text{bilhete.código}=\text{voo.código}} \text{VOO} \\
 r_2 &\leftarrow \prod_{\text{NIF, aeroporto\_chegada}}(r_1) \\
 r_3 &\leftarrow \prod_{\text{NIF, aeroporto\_partida}}(r_1) \\
 r_4 &\leftarrow r_2 - r_3 \\
 \text{res} &\leftarrow \text{aeroporto\_chegada } G_{\text{count(NIF)} \rightarrow \text{num\_clientes}}(r_4)
 \end{aligned}$$

4. Qual a interrogação em **linguagem natural** que corresponde à seguinte expressão em álgebra relacional?

$$\begin{aligned}
 r_1 &\leftarrow \text{aeroporto\_partida } G_{\text{count()} \rightarrow \text{partidas}}(\text{VOO} \bowtie_{\text{voo.código}=\text{bilhete.código}} \text{bilhete}) \\
 r_2 &\leftarrow \text{aeroporto\_chegada } G_{\text{count()} \rightarrow \text{chegadas}}(\text{VOO} \bowtie_{\text{voo.código}=\text{bilhete.código}} \text{bilhete}) \\
 \text{res} &\leftarrow \prod_{\text{aeroporto\_partida}}(\sigma_{r_1.\text{partidas} < r_2.\text{chegadas}}(r_1 \bowtie_{r_1.\text{aeroporto\_partida}=r_2.\text{aeroporto\_chegada}} r_2))
 \end{aligned}$$

A interrogação que corresponde à expressão em álgebra relacional é a seguinte:  
 “Quais os aeroportos onde chegam mais voos do que os que partem?”