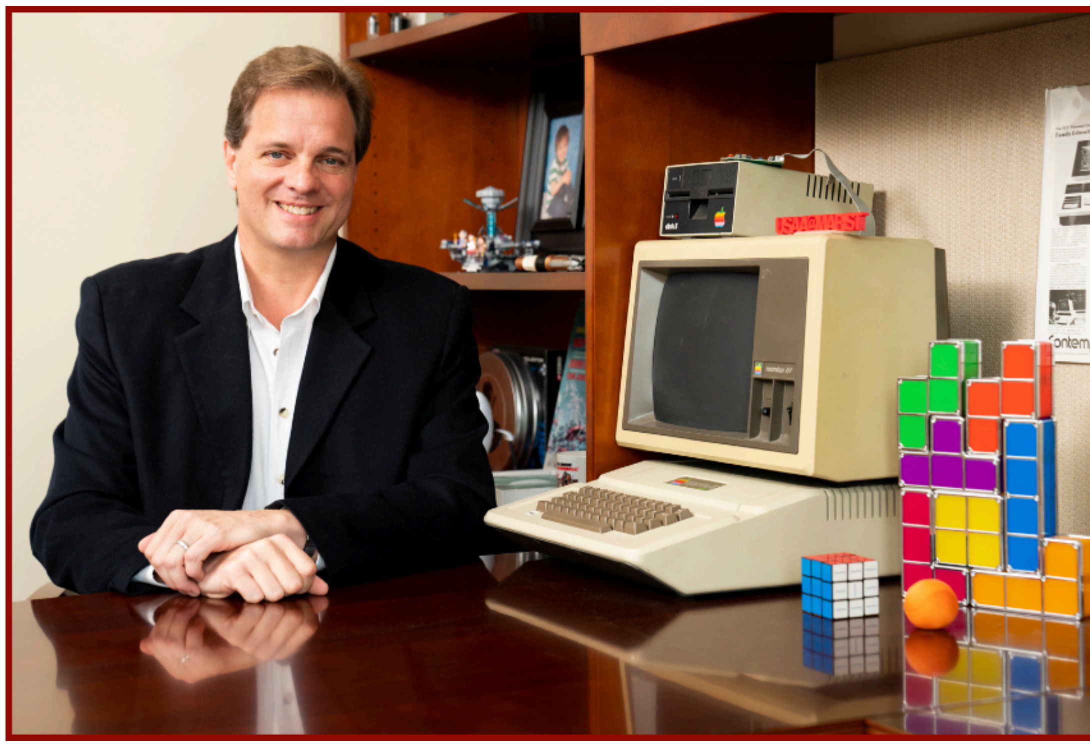
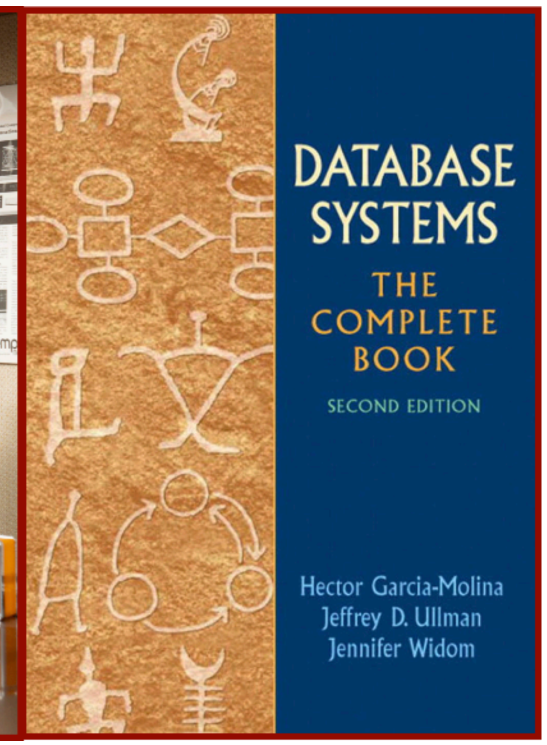
# The Relational Model

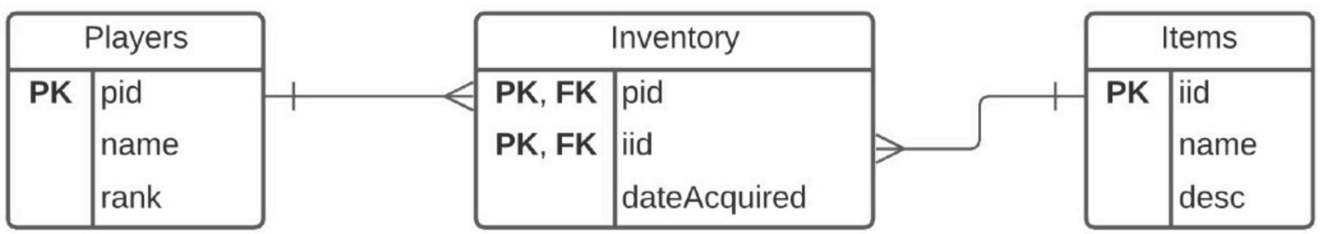





Alan G. Labouseur, Ph.D.
Alan.Labouseur@Marist.edu

# The Relational Model

Tables of rows and columns:
Our AD&D-like game




```
CAP=# select *
CAP-# from Players;
 pid |   name    |   rank
-----+-----------+---------
   1 | James     | Captain
   2 | Leonard   | Admiral
(2 rows)

CAP=# select *
CAP-# from Items;
 iid | name    | descr
-----+---------+-------
 A   | wand    | ...
 B   | gem     | ...
 C   | mace    | ...
 D   | sword   | ...
(4 rows)

CAP=# select *
CAP-# from Inventory;
 pid | iid | dateacquired
-----+-----+-------------
   1 | A   | 2020-01-23
   1 | B   | 2020-01-23
   2 | B   | 2020-01-23
   2 | C   | 2020-01-23
(4 rows)
```

# The Relational Model

## Tables of rows and columns: An e-commerce database ("CAP")

### People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
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| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
| 9 | Mr. | Alan | White | III | Pelton | 1949-06-14 |

### Products

| prodId | name | city | qtyOnHand | priceUSD |
|---|---|---|---|---|
| p01 | Heisenberg Compensator | Dallas | 47 | 67.50 |
| p02 | Universal Translator | Newark | 2399 | 5.50 |
| p03 | Commodore PET | Duluth | 1979 | 65.02 |
| p04 | LCARS module | Duluth | 3 | 47.00 |
| p05 | Remo drumhead | Dallas | 8675309 | 16.61 |
| p06 | Trapper Keeper | Dallas | 1982 | 2.00 |
| p07 | Flux Capacitor | Newark | 1007 | 1.00 |
| p08 | HAL 9000 memory core | Newark | 200 | 1.25 |
| p09 | Red Barchetta | Toronto | 1 | 379000.47 |

### Customers

| pid | paymentTerms | discountPct |
|---|---|---|
| 1 | Net 30 | 21.12 |
| 4 | Net 15 | 4.04 |
| 5 | In Advance | 5.50 |
| 7 | On Receipt | 2.00 |
| 8 | Net 30 | 10.00 |

### Agents

| pid | paymentTerms | commissionPct |
|---|---|---|
| 2 | Quarterly | 5.00 |
| 3 | Annually | 10.00 |
| 5 | Monthly | 2.00 |
| 6 | Weekly | 1.00 |

### Orders

| orderNum | dateOrdered | custId | agentId | prodId | quantityOrdered | totalUSD |
|---|---|---|---|---|---|---|
| 1011 | 2020-01-23 | 1 | 2 | p01 | 1100 | 58568.40 |
| 1012 | 2020-01-23 | 4 | 3 | p03 | 1200 | 74871.83 |
| 1015 | 2020-01-23 | 5 | 3 | p05 | 1000 | 15696.45 |
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| 1017 | 2020-02-14 | 1 | 3 | p03 | 500 | 25643.89 |
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| 1026 | 2020-05-01 | 8 | 5 | p03 | 808 | 47282.54 |

*Originally from Database Principles, Programming, and Performance by Patrick O'Neil and Elizabeth O'Neil. Modified over and over by Alan G. Labouseur.*

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## Tables of rows and columns

People

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## Tables of rows and columns

All entries in a single column are a single attribute and of a single data type.

People

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| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
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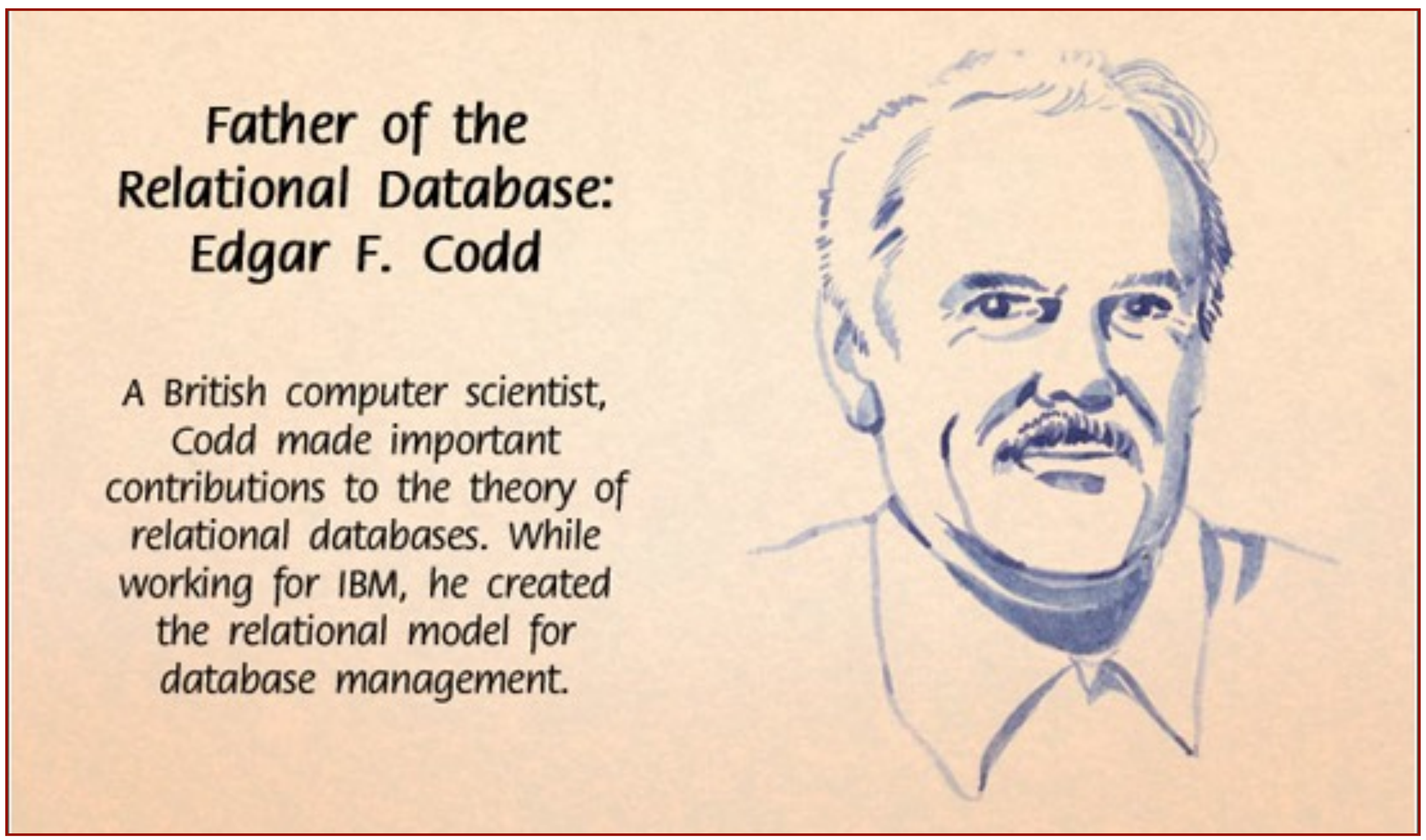
Integer Text Date

# Relational Rules

From Codd Himself.

These rules allow us to achieve excellence in database design across time and space.



# Relational Rules

## 1. The **First Normal Form** Rule

There can be *no multi-valued attributes* or values with internal structure at any intersection of a row and a column in a table.

In older terms: *no repeating groups* or *no repeating fields*.

Put another way, all values at the intersection or a row and a column must be **atomic**, meaning that they cannot be subdivided.

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```
People
pid  name    profession                       skills
---  ------  -------------------------------  --------------------------------
007  Sean    spy                              pronounces "S" like "Sh", charm
008  Roger   secret agent (on who's side?)    humour, stealth
009  Pierce  stiff-assed Brit                 wit, hair
```

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```

This is a violation of the 1NF rule.

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Put another way, all values at the intersection or a row and a column must be **atomic**, meaning that they cannot be subdivided.

```
People
```

| pid | name | profession | skill1 | skill2 |
|---|---|---|---|---|
| 007 | Sean | spy | pronounces "S" like "Sh" | charm |
| 008 | Roger | secret agent (on who's side?) | humour | stealth |
| 009 | Pierce | stiff-assed Brit | wit | hair |

A slight restructuring of table removes the 1NF violation (but this is still bad design).

# Relational Rules

## 2. The **Access Rows by Content Only** Rule

We can only ask for ("query") data by **what's there**, never by **where it is**.

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We **can** ask, "What is the name of pid 007?"
We **cannot** ask, "What is the name in the first row?"

People

| pid | name | profession | skill1 | skill2 |
| --- | --- | --- | --- | --- |
| 007 | Sean | spy | pronounces "S" like "Sh" | charm |
| 008 | Roger | secret agent (on who's side?) | humour | stealth |
| 009 | Pierce | stiff-assed Brit | wit | hair |

Tables are sets. The elements of a set have no intrinsic order.
{a, b, c} = {b, a, c} = {c, a, b}

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| 008 | Roger | secret agent (on who's side?) | humour | stealth |
| 009 | Pierce | stiff-upper-lip Brit | wit | hair |

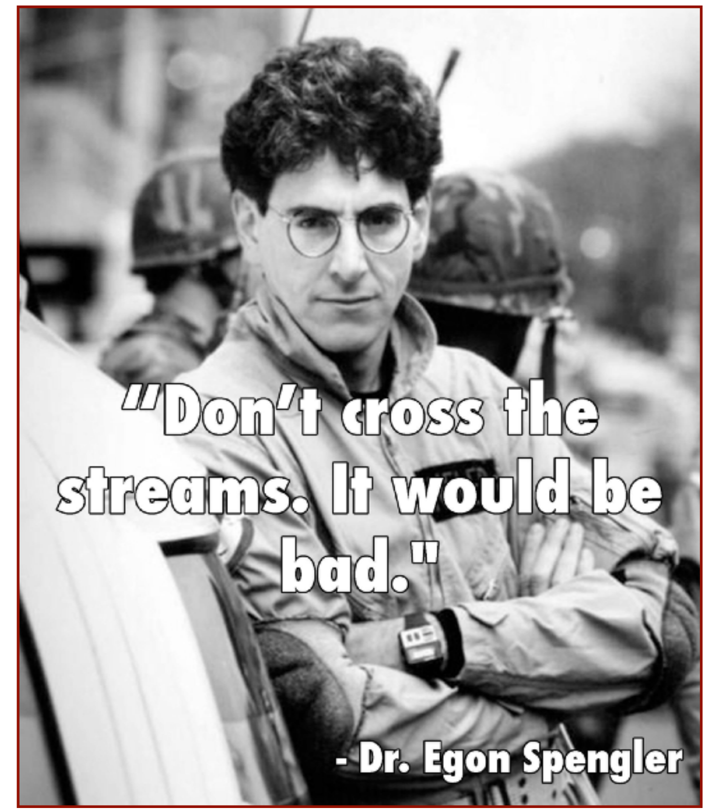
Tables are sets. The elements of a set have no intrinsic order.
{a, b, c} = {b, a, c} = {c, a, b}

# Relational Rules

## 3. The **All Rows Must Be Unique** Rule

Since tables are sets of rows and columns, and because the elements of a set have no intrinsic order, the only way we can insure our ability to get at every row in a table is for every row to be unique.

Were that not the case, some rows in the table would be indistinguishable. (Like crossing the streams, that would be bad.)



# Relational Rules

## 3. The **All Rows Must Be Unique** Rule

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| 007 | Sean | spy | pronounces "S" like "Sh" | charm |
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People

| pid | name | profession | skill1 | skill2 |
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| 007 | Sean | spy | pronounces "S" like "Sh" | charm |
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| 007 | Sean | spy | pronounces "S" like "Sh" | charm |

# Relational Rules

## Does this database obey the rules?

### People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
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### Products

| prodId | name | city | qtyOnHand | priceUSD |
|---|---|---|---|---|
| p01 | Heisenberg Compensator | Dallas | 47 | 67.50 |
| p02 | Universal Translator | Newark | 2399 | 5.50 |
| p03 | Commodore PET | Duluth | 1979 | 65.02 |
| p04 | LCARS module | Duluth | 3 | 47.00 |
| p05 | Remo drumhead | Dallas | 8675309 | 16.61 |
| p06 | Trapper Keeper | Dallas | 1982 | 2.00 |
| p07 | Flux Capacitor | Newark | 1007 | 1.00 |
| p08 | HAL 9000 memory core | Newark | 200 | 1.25 |
| p09 | Red Barchetta | Toronto | 1 | 379000.47 |

### Customers

| pid | paymentTerms | discountPct |
|---|---|---|
| 1 | Net 30 | 21.12 |
| 4 | Net 15 | 4.04 |
| 5 | In Advance | 5.50 |
| 7 | On Receipt | 2.00 |
| 8 | Net 30 | 10.00 |

### Agents

| pid | paymentTerms | commissionPct |
|---|---|---|
| 2 | Quarterly | 5.00 |
| 3 | Annually | 10.00 |
| 5 | Monthly | 2.00 |
| 6 | Weekly | 1.00 |

### Orders

| orderNum | dateOrdered | custId | agentId | prodId | quantityOrdered | totalUSD |
|---|---|---|---|---|---|---|
| 1011 | 2020-01-23 | 1 | 2 | p01 | 1100 | 58568.40 |
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| 1025 | 2020-04-01 | 8 | 3 | p07 | 888 | 799.20 |
| 1026 | 2020-05-01 | 8 | 5 | p03 | 808 | 47282.54 |

*Originally from Database Principles, Programming, and Performance by Patrick O'Neil and Elizabeth O'Neil. Modified over and over by Alan G. Labouseur.*

# Relational Rules

## Expanded Summary

- All entries in a table must be single-valued.
- Each column must have a distinct name.
- All values in a column are values of the same attribute.
- The order of columns is immaterial.
- Every row is distinct (unique).
- The order of rows is immaterial.

# Keys

| | |
|---|---|
| **Super Key** | any field (column) or set of fields that uniquely identify every row in a table |
| **Candidate Key** | a minimal super key |
| **Primary Key** | the chosen candidate key |
| **Foreign Key** | a value in one table that must match the primary key of another table |

# Keys

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People

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Customers

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# Keys

## **Candidate Key** a minimal super key

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| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
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# Keys

**Primary Key** the chosen candidate key

People

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Agents

| pid | paymentTerms | commissionPct |
|---|---|---|
| 2 | Quarterly | 5.00 |
| 3 | Annually | 10.00 |
| 5 | Monthly | 2.00 |
| 6 | Weekly | 1.00 |

?

?

Orders

| orderNum | dateOrdered | custId | agentId | prodId | quantityOrdered | totalUSD |
|---|---|---|---|---|---|---|
| 1011 | 2020-01-23 | 1 | 2 | p01 | 1100 | 58568.40 |
| 1012 | 2020-01-23 | 4 | 3 | p03 | 1200 | 74871.83 |
| 1015 | 2020-01-23 | 5 | 3 | p05 | 1000 | 15696.45 |
| 1016 | 2020-01-23 | 8 | 3 | p01 | 1000 | 60750.00 |
| 1017 | 2020-02-14 | 1 | 3 | p03 | 500 | 25643.89 |
| 1018 | 2020-02-14 | 1 | 3 | p04 | 600 | 22244.16 |
| 1019 | 2020-02-14 | 1 | 2 | p02 | 400 | 1735.36 |
| 1020 | 2020-02-14 | 4 | 5 | p07 | 600 | 575.76 |
| 1021 | 2020-02-14 | 4 | 5 | p01 | 1000 | 64773.00 |
| 1022 | 2020-03-15 | 1 | 3 | p06 | 450 | 709.92 |
| 1023 | 2020-03-15 | 1 | 2 | p05 | 500 | 6550.98 |
| 1024 | 2020-03-15 | 5 | 2 | p01 | 880 | 56133.00 |
| 1025 | 2020-04-01 | 8 | 3 | p07 | 888 | 799.20 |
| 1026 | 2020-05-01 | 8 | 5 | p03 | 808 | 47282.54 |

*Originally from Database Principles, Programming, and Performance by Patrick O'Neil and Elizabeth O'Neil. Modified over and over by Alan G. Labouseur.*

# Keys

**Primary Key** the chosen candidate key

People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
| 6 | Ms. | Demetra | Plakas | Esq. | Santa Monica | 1960-11-09 |
| 7 | Ms. | Terri Lyne | Carrington | | Boston | 1965-08-04 |
| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
| 9 | Mr. | Alan | White | III | Pelton | 1949-06-14 |

Products

| prodId | name | city | qtyOnHand | priceUSD |
|---|---|---|---|---|
| p01 | Heisenberg Compensator | Dallas | 47 | 67.50 |
| p02 | Universal Translator | Newark | 2399 | 5.50 |
| p03 | Commodore PET | Duluth | 1979 | 65.02 |
| p04 | LCARS module | Duluth | 3 | 47.00 |
| p05 | Remo drumhead | Dallas | 8675309 | 16.61 |
| p06 | Trapper Keeper | Dallas | 1982 | 2.00 |
| p07 | Flux Capacitor | Newark | 1007 | 1.00 |
| p08 | HAL 9000 memory core | Newark | 200 | 1.25 |
| p09 | Red Barchetta | Toronto | 1 | 379000.47 |

Customers

| pid | paymentTerms | discountPct |
|---|---|---|
| 1 | Net 30 | 21.12 |
| 4 | Net 15 | 4.04 |
| 5 | In Advance | 5.50 |
| 7 | On Receipt | 2.00 |
| 8 | Net 30 | 10.00 |

Agents

| pid | paymentTerms | commissionPct |
|---|---|---|
| 2 | Quarterly | 5.00 |
| 3 | Annually | 10.00 |
| 5 | Monthly | 2.00 |
| 6 | Weekly | 1.00 |

Orders

| orderNum | dateOrdered | custId | agentId | prodId | quantityOrdered | totalUSD |
|---|---|---|---|---|---|---|
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| 1012 | 2020-01-23 | 4 | 3 | p03 | 1200 | 74871.83 |
| 1015 | 2020-01-23 | 5 | 3 | p05 | 1000 | 15696.45 |
| 1016 | 2020-01-23 | 8 | 3 | p01 | 1000 | 60750.00 |
| 1017 | 2020-02-14 | 1 | 3 | p03 | 500 | 25643.89 |
| 1018 | 2020-02-14 | 1 | 3 | p04 | 600 | 22244.16 |
| 1019 | 2020-02-14 | 1 | 2 | p02 | 400 | 1735.36 |
| 1020 | 2020-02-14 | 4 | 5 | p07 | 600 | 575.76 |
| 1021 | 2020-02-14 | 4 | 5 | p01 | 1000 | 64773.00 |
| 1022 | 2020-03-15 | 1 | 3 | p06 | 450 | 709.92 |
| 1023 | 2020-03-15 | 1 | 2 | p05 | 500 | 6550.98 |
| 1024 | 2020-03-15 | 5 | 2 | p01 | 880 | 56133.00 |
| 1025 | 2020-04-01 | 8 | 3 | p07 | 888 | 799.20 |
| 1026 | 2020-05-01 | 8 | 5 | p03 | 808 | 47282.54 |

*Originally from Database Principles, Programming, and Performance by Patrick O'Neil and Elizabeth O'Neil. Modified over and over by Alan G. Labouseur.*

# Keys

**Foreign Key** a value in one table that must match the primary key of another table

People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
| 6 | Ms. | Demetra | Plakas | Esq. | Santa Monica | 1960-11-09 |
| 7 | Ms. | Terri Lynn | Carrington | | Boston | 1965-08-04 |
| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
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| p02 | Universal Translator | Newark | 2399 | 5.50 |
| p03 | Commodore PET | Duluth | 1979 | 65.02 |
| p04 | LCARS module | Duluth | 3 | 47.00 |
| p05 | Remo drumhead | Dallas | 8675309 | 16.61 |
| p06 | Trapper Keeper | Dallas | 1982 | 2.00 |
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| 7 | On Receipt | 2.00 |
| 8 | Net 30 | 10.00 |

Agents

| pid | paymentTerms | commissionPct |
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| 5 | Monthly | 2.00 |
| 6 | Weekly | 1.00 |

Orders

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|---|---|---|---|---|---|---|
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| 1012 | 2020-01-23 | 4 | 3 | p03 | 1200 | 74871.83 |
| 1015 | 2020-01-23 | 5 | 3 | p05 | 1000 | 15696.45 |
| 1016 | 2020-01-23 | 8 | 3 | p01 | 1000 | 60750.00 |
| 1017 | 2020-02-14 | 1 | 3 | p03 | 500 | 25643.89 |
| 1018 | 2020-02-14 | 1 | 3 | p04 | 600 | 22244.16 |
| 1019 | 2020-02-14 | 1 | 2 | p02 | 400 | 1735.36 |
| 1020 | 2020-02-14 | 4 | 5 | p07 | 600 | 575.76 |
| 1021 | 2020-02-14 | 4 | 5 | p01 | 1000 | 64773.00 |
| 1022 | 2020-03-15 | 1 | 3 | p06 | 450 | 709.92 |
| 1023 | 2020-03-15 | 1 | 2 | p05 | 500 | 6550.98 |
| 1024 | 2020-03-15 | 5 | 2 | p01 | 880 | 56133.00 |
| 1025 | 2020-04-01 | 8 | 3 | p07 | 888 | 799.20 |
| 1026 | 2020-05-01 | 8 | 5 | p03 | 808 | 47282.54 |

*Originally from Database Principles, Programming, and Performance by Patrick O'Neil and Elizabeth O'Neil. Modified over and over by Alan G. Labouseur.*

# Keys and Referential Integrity

The enforcement of the Primary Key (PK) — Foreign Key (FK) relationship is perhaps the most important aspect of Relational Databases. This property is called **referential integrity**. It insures consistency and accuracy, and thus leads to data quality. Data cannot become information without it.

Because of the importance of keys, it's critical that we — as database designers and data architects — **never** let end users control the content of key fields. For that reason, *artificial keys* are often a smart choice.

An *artificial key* is one that we make up. CWID is an example.

# SQL

SELECT

FROM

WHERE

People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
| 6 | Ms. | Demetra | Plakas | Esq. | Santa Monica | 1960-11-09 |
| 7 | Ms. | Terri Lyne | Carrington | | Boston | 1965-08-04 |
| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
| 9 | Mr. | Alan | White | III | Pelton | 1949-06-14 |

# SQL

SELECT some columns
FROM
WHERE

People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
| 6 | Ms. | Demetra | Plakas | Esq. | Santa Monica | 1960-11-09 |
| 7 | Ms. | Terri Lyne | Carrington | | Boston | 1965-08-04 |
| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
| 9 | Mr. | Alan | White | III | Pelton | 1949-06-14 |

# SQL

SELECT some columns
FROM some table
WHERE

People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
| 6 | Ms. | Demetra | Plakas | Esq. | Santa Monica | 1960-11-09 |
| 7 | Ms. | Terri Lyne | Carrington | | Boston | 1965-08-04 |
| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
| 9 | Mr. | Alan | White | III | Pelton | 1949-06-14 |

# SQL

SELECT some columns
FROM some table
WHERE some condition holds true

People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
| 6 | Ms. | Demetra | Plakas | Esq. | Santa Monica | 1960-11-09 |
| 7 | Ms. | Terri Lyne | Carrington | | Boston | 1965-08-04 |
| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
| 9 | Mr. | Alan | White | III | Pelton | 1949-06-14 |

# SQL

SELECT firstName
FROM People
WHERE homeCity = 'Toronto'

People

| pid | prefix | firstName | lastName | suffix | homeCity | DOB |
|---|---|---|---|---|---|---|
| 1 | Dr. | Neil | Peart | Ph.D. | Toronto | 1952-09-12 |
| 2 | Ms. | Regina | Schock | | Toronto | 1957-08-31 |
| 3 | Mr. | Bruce | Crump | Jr. | Jacksonville | 1957-07-17 |
| 4 | Mr. | Todd | Sucherman | | Chicago | 1969-05-02 |
| 5 | Mr. | Bernard | Purdie | | Teaneck | 1939-06-11 |
| 6 | Ms. | Demetra | Plakas | Esq. | Santa Monica | 1960-11-09 |
| 7 | Ms. | Terri Lyne | Carrington | | Boston | 1965-08-04 |
| 8 | Dr. | Bill | Bruford | Ph.D. | Kent | 1949-05-17 |
| 9 | Mr. | Alan | White | III | Pelton | 1949-06-14 |

# SQL

## SQL Script for AD&D database: Players, Items, and Inventory tables, and a few queries

```
create table Players (
   pid   int not null,
   name  text,
   rank text,
 primary key (pid)
);

insert into Players(pid, name, rank)
values (1, 'James',   'Captain'),
       (2, 'Leonard', 'Admiral');

select *
from Players;


create table Items (
   iid   char(1) not null,
   name  text,
   descr text,
 primary key (iid)
);

insert into Items (iid, name, descr)
values ('A', 'wand',  '...'),
       ('B', 'gem',   '...'),
       ('C', 'mace',  '...'),
       ('D', 'sword', '...');

select *
from Items;
```

```
create table Inventory (
   pid          int     not null references Players(pid),
   iid          char(1) not null references Items(iid),
   dateAcquired date,
  primary key(pid, iid)
);

insert into Inventory (pid, iid, dateAcquired)
values (1, 'A', '2020-01-23'),
       (1, 'B', '2020-01-23'),
       (2, 'B', '2020-01-23'),
       (2, 'C', '2020-01-23');

select *
from Inventory;

-- Players and their Items
select Players.name, Items.name
from Players inner join Inventory on Players.pid = Inventory.pid
             inner join Items on Inventory.iid = Items.iid;

-- Unused Items
select *
from Items
where iid not in (select iid
                  from Inventory);

-- Item use count v1
select iid, count(iid)
from Inventory
group by iid
order by count(iid) DESC;
```