

SQL

- The name is an acronym for Structured Query Language. It is actually far richer than a query language: supports both a DML and a DDL.
- First proposal: SEQUEL (IBM Research, 1974); First implementation in SQL/DS (IBM, 1981)
- Standardization crucial for its diffusion
 - Since 1983, de facto standard;
 - First official standard, 1986; revised in 1989;
 - Second standard, 1992 (SQL-2 or SQL-92);
 - Third standard, 1999 (SQL-3 or SQL-99)
- Most relational DBMS support the base functionality of the standard and offer proprietary extensions.

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Elementary Domains — Character

- Character
 - Single characters or strings;
 - Strings may be of variable length;
 - A Character set different from the default one can be used (e.g., Latin, Greek, Cyrillic, etc.)
 - Syntax:

character [varying] [(Length)]
[character set CharSetName]

It is possible to use char and varchar, for character and character varying respectively

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```

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More Elementary Domains Bit Single Boolean values or strings of Boolean values (may be variable in length); Svntax: bit [varying] [(Length)] Exact numeric domains Exact values, integer or with a fractional part Four alternatives: numeric(6.3) numeric [(Precision [, Scale])] decimal [(Precision [, Scale])] integer # of significant digits decimal digits smallint CSC343 Introduction to Databases - University of Toronto SQL I: DDL - 5

Temporal Instant Domains

- Temporal instants
 - date has fields year,month,day
 time[(Precision)][with time zone]
 has fields hour,minute,second
 timestamp[(Precision)][with time zone]
- Temporal intervals

interval FirstUnitOfTime[to LastUnitOfTime]

- Units of time are divided into two groups: (i) year, month, (ii) day, hour, minute, second
- For example, year(5) to month allows intervals up to 99999yrs + 11mo

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Approximate Numeric Domains

- Approximate numeric domains
 - Approximate real values
 - Based on a floating point representation float [(*Precision*)] e.g., 0.17E16, 0.41E-6 double precision

```
real - behaves like float, but has variable
precision
```

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User-Defined Domains

- Comparable to definitions of variable types in programming languages.
- A domain is characterized by name, elementary domain, default value, set of constraints
- Syntax:
- create domain DomainName as ElementaryDomain [DefaultValue] [Constraints]
- Example:
 - create domain Mark as smallint default null

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Default Domain Values

- Define the value that the attribute must assume when a value is not specified during row insertion.
- Syntax: default < Generic Value | user | null >
- Generic Value represents a value compatible with the domain, in the form of a constant or an expression.
- **user** is the login name of the user who assigns a value to this attribute.

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Table Definition

- An SQL table consists of an ordered set of attributes, and a (possibly empty) set of constraints
- Statement create table defines a relation schema, creating an empty instance.
- Syntax: create table TableName (AttributeName Domain [DefaultValue] [Constraints] {, AttributeName Domain [DefaultValue] [Constraints] } [OtherConstraints])

Example of create table

FirstName character(20) not null,

character (15)

character(15),

on delete set null on update cascade,

unique(Surname,FirstName)

character(6) primary key,

character(20) not null,

references Department(DeptName)

numeric(9) default 0,

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create table Employee

RegNo

Dept

Salary

City

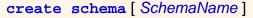
Surname

(

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Schema Definition

- A schema is a collection of objects: domains, tables, indexes, assertions, views, privileges
- A schema has a name and an owner (who determines authorization privileges)
- Syntax:



```
[ [ authorization ] Authorization ] { SchemaElementDefinition }
```

```
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```

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```
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```

Intra-Relational Constraints

- Constraints are conditions that must be verified by every database instance
- Intra-relational constraints involve a single relation
 - not null (on single attributes)
 - unique: permits the definition of keys; syntax:
 - for single attributes: **unique**, after the domain
 - for multiple: unique (Attribute {, Attribute })
 - primary key: defines the primary key (once for each table; <u>implies not null</u>); syntax like unique
 - check: described later

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Inter-Relational Constraints

Constraints may involve several relations:

- check: checks whether an assertion is true;
- references and foreign key permit the definition of referential integrity constraints;
 - Syntax for single attributes
 references after the domain
 - Syntax for multiple attributes
 foreign key(Attribute{, Attribute})
 references ...
- It is possible to associate reaction policies to violations of referential integrity constraints.

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Example of Intra-Relational Constraints

• Each pair of **FirstName** and **Surname** uniquely identifies each element

```
FirstName char(20) not null,
Surname char(20) not null,
unique(FirstName,Surname)
```

Note the difference with the following (stricter) definition:

```
FirstName char(20) not null unique,
Surname char(20) not null unique,
```

```
• • •
```

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```
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```

Reaction Policies

Violations arise from

- (a) updates on referred attribute or
- (b) row deletions.
- **Reactions** operate on internal table, after changes to an external table.
- Reactions are:
 - cascade: propagate the change;
 - set null: nullify the referring attribute;
 - set default: assign default value to the referring attribute;
 - **no action**: forbid the change on external table.
- Reactions may depend on the event; syntax:
- on < delete | update >

```
< cascade | set null | set default | no action >
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```

Example

```
create table Employee
(
    RegNo char(6),
    FirstName char(20) not null,
    Surname char(20) not null,
    Dept char(15),
    Salary numeric(9) default 0,
    City char(15),
    primary key(RegNo),
    foreign key(Dept)
        references Department(DeptName)
        on delete set null
        on update cascade,
    unique(FirstName,Surname)
)
```

```
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```

```
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```

Relational Catalogues

- A *relational catalogue* contains the data dictionary, i.e., a description of the relational schema D of the database.
- It is based on a relational schema MD whose relations describe the relations, columns, domains in D but also MD (reflectivity).
- The SQL-2 standard describes a Definition_Schema (composed of tables) and an Information_Schema (composed of views).

ColName Pos Default Nullable

Null

Υ

0

Ν

Υ

Υ

Υ

Ν

Υ

Υ

Ν

Ν

N Y

Ν

1

2

3

4

1

2

3

3

4

5

```
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```

ReaNo

Name

Dept

Name

Head

Pos

Default

Nullable

Address

TableNm 1

ColName 2

Sal

Column

TableNm

Employee

Employee

Employee

Employee

Dept

Dept

Dept

Column

Column

Column

Column

Column

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Δ

Relational

Catalogue

Schema Updates

Two SQL statements:

- alter (alter domain...,alter table ...)
- drop < schema | domain | table | view |
 assertion >

ComponentName [restrict | cascade]

- Examples:
 - alter table Department
 add column NoOfOffices numeric(4)
 - drop table TempTable cascade

```
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```

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Practise

What is the DDL for the database schema store containing Employee and Dept on the previous slide?