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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for world-wide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75% of the national bodies casting a vote.

This international standard was prepared by Joint Technical Committee ISO/IEC, JTC 1, Information Technology.

This international standard has the general title: Information technology - SQL Multimedia and Application Packages. It specifies how ISO/IEC 9075 Database Language SQL may be used for a number of generic application contexts. This international standard consists of the following parts:

Part 1: Framework (SQL/MM Framework) describes the fundamental concepts on which specifications in other parts of this international standard are based. It also defines terms, notations and conventions used in this international standard. This part specifies general requirements for conformance.

Part 2: Full Text (SQL/MM Full Text) specifies the facilities needed for defining and manipulating full text data.

Part 3: Spatial (SQL/MM Spatial) specifies the facilities needed for defining and manipulating spatial data.

Part 4: General Purpose Facilities (SQL/MM General Purpose Facilities) specifies the facilities for defining and manipulating data in mathematical and engineering contexts.

Part 5: Still Image (SQL/MM Still Image) specifies the facilities for defining and manipulating image data.

Parts other than part 1 specify requirements, and all are dependent on various parts of ISO/IEC 9075 and also on this part of this international standard.

Introduction

The organization of this part of this international standard is as follows:

- 1) Clause 1, "Scope", specifies the scope of this part of this international standard.
- 2) Clause 2, "Normative references", identifies additional standards that, through reference in this international standard, constitute provisions of this part of this international standard, and hence to all parts of this international standard.
- 3) Clause 3, "Definitions and use of terms", defines terms used in this international standard.
- 4) Clause 4, "Concepts", describes the concepts used in this international standard.
- 5) Clause 5 summarises the content of each of the parts of this international standard described in Clause 4, "Concepts".
- 6) Clause 6 defines notation and conventions used in other parts of this international standard.
- 7) Clause 7 describes issues relating to the implementation of this international standard.
- 8) Clause 8 specifies requirements that apply to conformance requirements for all or some of the parts of this international standard.
- 9) Annex A is an informative Annex. It describes the formal procedures for maintenance and interpretation of this international standard.

**Information Technology — Database Languages —
SQL Multimedia and Application Packages —
Part 1: Framework**

1 Scope

The scope of this international standard is the definition of a set of packages of generic data types common to various kinds of data used in multimedia and other application areas, to enable that data to be stored and manipulated in an SQL database. Each package is defined as a part of this international standard.

This part of this international standard is concerned with those concepts, notations and conventions that are common to two or more other parts of this international standard. In particular it describes the way ISO/IEC 9075 is used to define the data types and their behavioural interface appropriate to each application area.

2 Normative references

The following standards contain provisions that, through reference in this part of this text, constitute provisions in this part of this international standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this international standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid international standards.

ISO/IEC 9075-1: 199x, Information technology - Database languages - SQL - Part 1: Framework

ISO/IEC 9075-2: 199x, Information technology - Database languages - SQL - Part 2: Foundation

ISO/IEC 9075-4: 199x, Information technology - Database languages - SQL - Part 4: Persistent stored modules

3 Definitions, notations and conventions

3.1 Definitions

3.1.1 Definitions taken from ISO/IEC 9075

There are many terms used in this international standard which are used with the same meaning as in ISO/IEC 9075. These terms and their definitions are given in ISO/IEC 9075-1 and in ISO/IEC 9075-2. The following terms and their definition are those used in this part of this international standard.

3.1.1.1 assignment

An operation that replace the instance at a site (known as the *target*) with a new instance of a (possibly, though not necessarily different) value (known as the *source*).

3.1.1.2 attribute of a user defined data type

An attribute of a user defined data type is a property of that data type the values of which may be changed using prescribed functions or routines.

3.1.1.3 component of a user defined data type

An attribute or operation of the user defined data type

3.1.1.4 data type

A set of representable values.

3.1.1.5 implementation-defined

Possibly differing between SQL-implementations, but specified by the implementor for each particular implementation.

3.1.1.6 implementation-dependent

Possibly differing between SQL-implementations, but not specified by ISO/IEC 9075, and not required to be specified by the implementor for any particular SQL-implementation.

3.1.1.7 interface of a user defined data type

The set of comprising every function such that the data type of at least one of its parameters or result is that user defined data type.

3.1.1.8 locator type

A locator type is an SQL-session object that can be used to reference SQL-data.

3.1.1.9 mutator function

A mutator function is a function which can change an attribute value of a user defined data type

3.1.1.10 observer function

An observer function is a function that can return an attribute value of a user defined data type

3.1.1.11 signature of an SQL-invoked routine

A routine that is allowed to be invoked only from within SQL.

3.1.1.12 SQL-environment

The context in which SQL-data exists, and SQL-statements are executed.

3.1.1.13 SQL-invoked routine

An SQL-invoked routine is a routine that can be invoked from SQL. It is either a function or a procedure.

3.1.1.14 user defined data type

A user defined data type is a data type defined other than in ISO/IEC 9075 for a specific purpose. A user defined data type is defined in terms of the standard data types included in ISO/IEC 9075.

3.1.2 Definitions used in this part of this international standard

3.1.2.1 application context

An application context is an area which may be found in several enterprises in which particular generic data types are used. Examples are free form text, spatial data and mathematical data (such as complex numbers and angles).

3.1.2.2 generic data type

A generic data type is a kind of data (over and above the data types already defined in ISO/IEC 9075) which is used in a wider context than that of a single enterprise and for which there are hence advantages in standardizing the way it is represented.

3.1.2.3 meta-variable

A meta-variable is a variable which is used to define implementation-dependent or implementation-defined constants.

3.1.2.4 multimedia

Any data types other than conventional data, examples being graphic audio and visual.

3.1.2.5 routine

A routine is an <SQL-invoked routine> as defined in ISO/IEC 9075-1.

3.1.2.6 user defined type

A user defined type is a user defined data type together with the methods which may be used to access and change instances of the user defined type.

3.1.3 Definitions used in other parts of this international standard

Each application area covered in this standard is covered in a separate part. The terms and associated definitions, which are specific to that application area, are defined in that part of this international standard.

3.2 Notations

The notation, which is used in each part of this international standard, is defined in ISO/IEC 9075-1.

3.3 Conventions

The conventions which are used to define generic data types and their associated routines in the other parts of this international standard to define are defined in clause 6 of this part of this international standard.

4 Concepts

4.1 Requirements for generic kinds of data

International standard ISO/IEC 9075 defines the Database Language SQL, which is a language used to define and manipulate data in an SQL environment. For the purposes of this international standard, this data is referred to as an SQL database.

Using the data definition facilities of ISO/IEC 9075, an enterprise may develop an SQL database based on the kinds of data chosen for some specific purpose determined by the specific requirements of the enterprise.

Many kinds of data are used in a wider context than that of an individual enterprise, in which case there are benefits in being able to use a generic specification for the definition and manipulation of these kinds of data.

These benefits include the enabling of the following:

- a) shared understanding of this data;
- b) exchange of this data;
- c) provision of manipulations facilities to process this data.

Recognition of these benefits has resulted in the development of international standards and of publicly available specifications for a number of generic data types.

These data types are distinguished according to their use, including text, spatial, graphic, audio and video data.

Many enterprises now have requirements to use such generic data types combined with their own enterprise-specific data types in an SQL database. These requirements include the manipulation of component elements of a generic data type, enabling both the construction and recording of structured data types within an SQL database, and the use of these components in selection and retrieval of data from an SQL database. This international standard addresses these requirements.

4.2 Approach

ISO/IEC 9075 includes facilities for defining a user-defined type, which has attributes specified as SQL data types or other user-defined types. A user-defined type may be defined as a subtype of one or more other types, with inheritance of their attributes. A column of an SQL table can be defined as a user-defined type.

A user-defined type is encapsulated, and can only be manipulated by associated routines, which may be functions or procedures.

An attribute has automatically an associated observer and mutator function to retrieve and change its value. Further routines may be defined in which the body of the routine, being the component that determines behaviour on invocation of the routine, is specified either by SQL statements or by reference to an external routine prepared in some other programming language.

Each part of this international standard defines a number of user-defined types and associated routines, defined according to ISO/IEC 9075. The types and routines of each part are intended for use with a specific kind of data. Each part constitutes a package that aims to satisfy the requirements for including generic data types for that kind of data in an SQL database.

Each user-defined type is fully defined, including a specification of its name and all attributes with their type, using the SQL syntax of ISO/IEC 9075. For each routine there is a specification of its signature, which is its name and of all parameters with their type. This specification uses the using the SQL syntax as defined in ISO/IEC 9075.

A routine body is specified either by SQL statements or by reference to a definition, which is given either in some formal language or as descriptive text.

4.3 Implementation of this international standard

Conformance to any one other part of this international standard may be claimed by an implementation, in which case it is required to provide its users with the capability of using all the user-defined types according to the specifications of that part of this international standard.

An implementor of a part of this international standard has the freedom to provide a routine in any way that has the same effect as the specification of its body in that part. In particular, a specification of a routine body using SQL does not have to be implemented exactly as given, but may be implemented by another set of SQL statements or by an external routine having the same effect.

4.4 Use of this international standard

The requirements described in Clause 4.1 involve data for user-defined types being recorded and manipulated with other enterprise data in an SQL database. Data can be in an SQL database only when a column of a table is defined as an appropriate type to record it. The user-defined types defined in subsequent parts of this international standard can be used for this purpose in three different ways.

The first way is for a column's type to be specified as one of the user-defined types of a part of this standard. This requires the USAGE privilege for the user-defined type (see Clause 7.2). The routines defined by the standard are used to manipulate the data. This requires the EXECUTE privilege for the routines (see Clause 7.4).

The second way is for a new user-defined type to be defined as a subtype of one of the user-defined types of a part of this standard, with further attributes to satisfy specific enterprise requirements. This requires the UNDER privilege for the user-defined type (see Clause 7.3). The new user-defined type can then be used as a column's type, as in the first way. The routines defined by the standard can be used to manipulate the new user-defined type (though further routines may be needed). This requires the EXECUTE privilege to be authorized for the routines (see Clause 7.4).

The third way is for a new user-defined type to be defined with an attribute that is one of the user-defined types of this standard, with further attributes to satisfy specific enterprise requirements. This requires the USAGE privilege for the user-defined type (see Clause 7.2). The new user-defined type can then be used as a column's type, as in the first way. New routines are required for the new user-defined type, but they must incorporate routines defined by the standard to manipulate data for the attribute that is one of the user-defined types of this standard. This requires the EXECUTE privilege to be authorized for the routines (see Clause 7.4).

This enables a new user-defined data type to be constructed from a number of the data types provided in different parts of this of this standard, and so enable multimedia data to be defined.

Whichever way is considered most appropriate for a specific enterprise context, any user-defined type can be used only in an SQL environment.

An SQL agent is a compilation unit that interacts with an SQL environment. It can only interact via SQL data types for which there is a defined mapping to the data types of programming language for which an international standard is available.

5 Parts of this international standard

The parts of this international standard currently under development are as follows.

5.1 Part 1: Framework (SQL/MM Framework)

Part 1 of this international standard provides a specification of both the technical basis and the conventions used in all other parts.

5.2 Part 2: Full Text (SQL/MM Full Text)

Part 2 of this international standard specifies user-defined data types for full text data and for a number of structured search patterns. It also defines routines for transforming character strings to and from those data types, and for searching full text data according to a given search pattern.

5.3 Part 3: Spatial (SQL/MM Spatial)

Part 3 of this international standard specifies user-defined data types for co-ordinates, geometric data, specifically points, lines and areas, and spatial data based on geometric data. It also defines routines for transforming numeric data to and from co-ordinates, and hence other data types, and for manipulating and searching geometric and spatial data.

5.4 Part 4: General Purpose Facilities (SQL/MM General Purpose Facilities)

Part 4 of this international standard specifies user-defined data types for angles and for complex numbers. It also defines routines for transforming numeric data to and from these data types, and for performing mathematical operations on these data types and on numeric data.

5.5 Part 5: Still Image (SQL/MM Still Image)

Part 5 of this international standard specifies user-defined data types for image data that is formatted according to any one of a number of image standards, such as ISO/IEC xxxx, JPEG. It also defines routines for transforming bit strings to and from these data types, and for manipulating and searching data about images.

6 Notations and conventions used in other parts

6.1 Notation

The notation used in the specification of user-defined types and association routines is, wherever possible, the language SQL as defined in ISO/IEC 9075.

6.2 Conventions

6.2.1 Clause structure

Within each part, the specification of user-defined types having a common purpose is contained within a single clause of that part of this international standard. For each user-defined type there is a sub-clause, which contains further sub-clauses giving the definition of the type and each of its associated routines.

6.2.2 Organization of specifications

Each sub-clause defining a user-defined type or routine has the following unnumbered sections.

- 1) **Purpose:** This section shall contain a brief description of the purpose of the user-defined type or routine.
- 2) **Definition:** This section shall contain the ISO/IEC 9075 syntax used to define the type or routine. In order to distinguish SQL syntax from other text in this international standard, SQL syntax is specified in a non-proportional type font. <key word>s, as defined in ISO/IEC 9075, are in uppercase. Parameter and variable identifiers are in lower case or mixed case. Data type, attribute and SQL-invoked routine identifiers are specified as prescribed in sub-clause 6.2.3 of this international standard, "Data type, attribute and SQL-invoked routine identifiers".
- 3) **Definitional Rules:** This section shall contain an enumerated list of rules to be applied when defining the type or routine. If this section is empty, the section heading shall be omitted.
- 4) **Description:** This section shall contain an enumerated list of rules describing the type or routine. For a type, the first item shall contain a statement indicating the attributes and routines that are part of the public specification. For a routine, the first item shall contain the definition of the routine's parameters. If this section is empty, the section heading shall be omitted.

If there is any discrepancy between the interpretation of a given Definition and its associated Description, then any SQL specification shall take precedence.

6.2.3 Data type, attribute and SQL-invoked routine identifiers

Within the specification of a user-defined type or routine, data type identifiers, attribute identifiers and routine identifiers shall obey the following rules:

- 1) two capital letters and an underscore shall be used as a prefix; for example, Full-Text uses FT_;
- 2) underscore character shall not be used except in the prefix (i.e. only alphanumeric characters [a-zA-Z0-9]);
- 3) each word used in the identifier shall have an initial capital letter; for example, FT_Primary;
- 4) italic type font shall be used in a Definitional Rules section and in a Description section.

6.2.4 Parameter identifiers

Parameter identifiers shall be in lowercase. To distinguish parameters from other identifiers used in these sections, parameters shall be in an italic type font when used in the Definitional Rules and the Description sections.

6.2.5 Meta-variables

Meta-variables used to define implementation-dependent or implementation-defined constants shall follow the conventions of sub-clause 6.2.3 of this part of this international standard, "Data type, attribute and SQL-invoked routine identifiers".

6.2.6 Definitional variables

To distinguish Definitional variables from other identifiers in the Definitional Rules or Description sections, definitional variables used in a Definitional Rules section or in a Description section shall be in an uppercase italics type font.

6.2.7 Exceptions

Except where otherwise specified, the phrase "an exception condition is raised:", followed by the name of a condition, shall be used in a Definitional Rules section or in a Description section to indicate one of the following:

The execution of a routine is unsuccessful.

Application of Definitional Rules or Description items may be terminated.

The effect on any assignment target and SQL descriptor area of an SQL-statement that terminates with an exception condition (unless this condition is explicitly defined in ISO/IEC 9075), is implementation-dependent.

The phrase "a completion condition is raised:", followed by the name of a condition, shall be used in a Definitional Rules section or in a Description section to indicate that application of Definitional Rules or Description items is not terminated. In such a case, diagnostic information is to be made available; unless an exception condition is raised, the execution of the SQL-statement is successful.

6.2.8 Status codes

ISO/IEC 9075 specifies that a parameter, SQLSTATE, shall be used for the purpose of indicating any exception or completion conditions by means of a five-character status code. This parameter shall also be used in each part of this international standard; each part shall contain a clause giving the values of SQLSTATE for the routines defined by that part.

The first two characters in an SQLSTATE parameter shall be a class value. To distinguish the values in different parts of this international value, Table 1 gives the class value which shall be used in each part of this international standard.

Table 1 — SQLSTATE Class Values

SQL/MM Part	Class
Part 1: Framework	H1
Part 2: Full-Text	H2
Part 3: Spatial	H3
Part 4: General Purpose Facilities	H4
Part 5: Still Image	H5

Note: it seems rather odd to have a code for Part 1!

7 Implementation requirements

In addition to the provisions given for each part of this standard, an implementation of any part shall satisfy the following requirements.

7.1 Schemas

ISO/IEC 9075 specifies that an object such as an SQL-invoked routine, a user-defined type, a domain, a table, a view, or a privilege shall be part of exactly one schema.

This international standard does not include a statement for creating a schema. For an implementation of any part of this standard, an implementation-defined set of <schema definition> statements shall be effectively executed such that each <schema definition> statement that contains a <schema element> for a schema object defined in that part shall contain exactly one <schema element> for each object defined by that part. The number of such schemas and their names is implementation-defined.

It is assumed that the default character set of the SQL-schema in which an SQL-invoked routine specified in this standard is created includes the characters used in all character string literals contained in the body of that routine and a space character denoted by a blank space in such literals.

7.2 USAGE Privileges on User-defined Types

ISO/IEC 9075 specifies that a user shall have the USAGE privilege on a domain or a user-defined type before the user can refer to it for the purpose of defining other objects such as SQL-invoked routines, tables, view, domains or user-defined types.

The parts of this international standard do not include a GRANT USAGE statement for the domains and user-defined types defined in any part. For an implementation of any part of this international standard, a GRANT statement granting USAGE privilege for each object defined by that part to an implementation-defined set of grantees shall be effectively executed when these domains and user-defined types are created, (except when explicitly noted in a Definitional Rule in that part). Whether or not the GRANT statement includes WITH GRANT OPTION is implementor defined.

7.3 UNDER Privileges on User-defined Types

ISO/IEC 9075 specifies that a user shall have the UNDER privilege on a user-defined type A before the user can use it for defining subtypes of A.

Each part of this international standard does not include a GRANT UNDER statement for the user-defined types defined in that part. For an implementation of any part of this international standard, a GRANT statement granting UNDER privilege for each object defined by that part to an implementation-defined set of grantees shall be effectively executed when these user-defined types are created, (except when explicitly noted in a Definitional Rule in that part). Whether or not the GRANT statement includes a WITH GRANT OPTION is implementor-defined.

7.4 EXECUTE Privileges on Routines

ISO/IEC 9075 specifies that a user shall have the EXECUTE privilege on a routine before that user can execute the routine.

Each part of this international standard does not include a GRANT EXECUTE statement for the routines defined in that part. For an implementation of any part of this international standard, a GRANT statement granting EXECUTE privilege for each routine defined by that part to an implementation-defined set of grantees shall be effectively executed when the routine is created, (except where explicitly noted in a Definitional Rule for that part. Whether or not the GRANT statement includes a WITH GRANT OPTION is implementation-defined.

8 Conformance

8.1 Implementations

Each other part of this international standard shall provide a specification to which an implementation may claim conformance, independently of any other part.

A conforming implementation for a part of this international standard shall support the public user-defined types and functions specified in the Definition section and Description Rules section for that part. The implementation shall supply <SQL-invoked routine>s whose <routine body> is either an <SQL routine body> or an <external body reference> that specifies PARAMETER STYLE SQL as defined in Subclause 12.5, "<SQL-invoked routine>" in part 2 of ISO 9075. The implementation is not required to perform the exact sequence of actions defined in the Description Rules section or in the <SQL routine body>s contained that part, but shall achieve the same effect as that sequence.

8.2 Relationship to other International Standards

A conforming implementation shall also support those parts of international standard ISO/IEC 9075 which are required for the use of user-defined data types and routines.

8.3 Claim of conformance

A claim of conformance to this international standard shall state the part or parts of this international standard, to which conformance is claimed.

In addition, a claim for conformance shall include definitions for all elements and actions that the part or parts, of this international standard specifies as implementation-defined.

8.4 Extensions and options

A conforming implementation for a part of this international standard may provide support for additional implementation-defined routines defined using the data types defined in that part.

An implementation remains a conforming implementation even if it provides user options to process the defined routines in a non-conforming manner.

Annex A: ISO/IEC JTC1 formal procedures (informative)

ISO/IEC JTC1 has formal procedures for revision, maintenance, and interpretation of JTC1 international standards. Clause 6.13 of the JTC1 Directives, "Maintenance/correction of defects in JTC1 Standards", specifies procedures for creating and processing "defect reports". Defect reports may result in technical corrigenda, amendments, interpretations, or other commentary on an existing International Standard.

In addition, SC32, the JTC1 subcommittee that developed this international standard, has procedures for raising new "questions" about topics related to existing SC32 projects. Questions may result in interpretations, new project proposals, or possibly new defect reports.

Potential new questions or new defect reports addressing the specifications of ISO/IEC 9075 should be communicated to:

Secretariat, ISO/IEC JTC1/SC32

Index

Index entries appearing in **boldface** indicated a page where the word, phrase, attribute, routine, or type was described; index entries appearing in *italics* indicates a page where the attribute, routine, or type was declared; and index entries appearing in roman type indicate a page where the word, phrase, attribute, routine, or type was used.