TECHNICAL REPORT

ISO/IEC TR 19075-5

First edition
2016-12-15

Information technology — Database languages — SQL Technical Reports —

Part 5: Row Pattern Recognition in SQL

Technologies de l'information — Langages de base de données — SQL Rapport techniques —

Partie 5: Reconnaissance de formes de lignes dans SQL

Reference number
ISO/IEC TR 19075-5:2016(E)

© ISO/IEC 2016



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword. vii
Introduction. viii
1 Scope. 1
2 Normative references. 3
2.1 ISO and IEC standards. 3
3 Row pattern recognition: FROM clause. 5
3.1 Example of ONE ROW PER MATCH. 5
3.2 Example of ALL ROWS PER MATCH. 8
3.3 Summary of the syntax. 10
3.4 The row pattern input table. 11
3.4.1 The row pattern input name. 12
3.4.2 The row pattern input declared column list. 13
3.5 MATCH_RECOGNIZE. 14
3.6 PARTITION BY. 14
3.7 ORDER BY. 14
3.8 Row pattern variables. 14
3.9 MEASURES. 16
3.10 ONE ROW PER MATCH *vs.* ALL ROWS PER MATCH. 16
3.10.1 Handling empty matches. 16
3.10.2 Handling unmatched rows. 20
3.11 AFTER MATCH SKIP. 22
3.12 PATTERN. 24
3.12.1 PERMUTE. 25
3.12.2 Excluding portions of the pattern. 26
3.13 SUBSET. 27
3.14 DEFINE. 28
3.15 The row pattern output table. 29
3.15.1 Row pattern output name. 30
3.15.2 Row pattern output declared column list. 30
3.16 Prohibited nesting. 31
3.16.1 Row pattern recognition nested within another row pattern recognition. 32
3.16.2 Outer references within a row pattern recognition query. 32
3.16.3 Conventional query nested within row pattern recognition query. 33
3.16.4 Recursion. 34
3.16.5 Concatenated row pattern recognition. 34

©ISO/IEC 2016 – All rights reserved

4 Expressions in MEASURES and DEFINE. 35
4.1 Row pattern column references. 35
4.2 Running *vs.* final semantics. 36
4.3 RUNNING *vs.* FINAL keywords. 40
4.4 Aggregates. 41
4.5 Row pattern navigation operations. 42
4.5.1 PREV and NEXT. 42
4.5.2 FIRST and LAST. 43
4.5.3 Nesting FIRST and LAST within PREV or NEXT. 45
4.6 Ordinary row pattern column references reconsidered. 46
4.7 MATCH_NUMBER function. 47
4.8 CLASSIFIER function. 47
5 Row pattern recognition: WINDOW clause. 51
5.1 Example of row pattern recognition in a window. 51
5.2 Summary of the syntax. 53
5.2.1 Syntactic comparison to windows without row pattern recognition. 54
5.2.2 Syntactic comparison to MATCH_RECOGNIZE. 55
5.3 Row pattern input table. 55
5.4 Row pattern variables and other range variables. 56
5.5 Windows defined on windows. 57
5.6 PARTITION BY. 58
5.7 ORDER BY. 58
5.8 MEASURES. 58
5.9 Full window frame and reduced window frame. 59
5.9.1 ROWS BETWEEN CURRENT ROW AND. 59
5.9.2 EXCLUDE NO OTHERS. 59
5.10 AFTER MATCH SKIP. 60
5.11 INITIAL *vs.* SEEK. 60
5.12 PATTERN. 60
5.13 SUBSET. 61
5.14 DEFINE. 61
5.15 Empty matches and empty reduced window frames. 61
5.16 Prohibited nesting. 63
5.16.1 Row pattern recognition nested within another row pattern recognition. 63
5.16.2 Outer references within a row pattern recognition query. 63
5.16.3 Conventional query nested within row pattern recognition query. 64
5.16.4 Recursion. 64
5.16.5 Concatenated row pattern recognition. 65
6 Pattern matching rules. 67
6.1 Regular expression engines. 67
6.2 Parenthesized language and preferment. 68
6.2.1 Alternation. 69
6.2.2 Concatenation. 69

 ©ISO/IEC 2016 – All rights reserved

6.2.3 Quantification. 70
6.2.4 Exclusion. 71
6.2.5 Anchors. 72
6.2.6 The empty pattern. 72
6.2.7 Infinite repetitions of empty matches. 72
6.3 Pattern matching in theory and practice. 75
Index. 79

©ISO/IEC 2016 – All rights reserved

Tables

Table

Page

1 Sample Data. . . . 8
2 Results of ONE ROW PER MATCH. . . . 8
3 Results of ALL ROWS PER MATCH. . . . 9
4 Row pattern recognition syntax summary. . . . 10
5 Analysis of sample data permitting empty matches. . . . 17
6 Result of query permitting empty matches. . . . 18
7 Results of query using SHOW EMPTY ROWS. . . . 19
8 Results of query using OMIT EMPTY ROWS. . . . 20
9 Results of ALL ROWS PER MATCH. . . . 21
10 Original and renamed column names. . . . 31
11 Ordered row pattern partition of data. . . . 37
12 RUNNING and FINAL in MEASURES. . . . 38
13 Ordered row pattern partition of data. . . . 39
14 Ordered row pattern partition of data. . . . 40
15 Example data set and mappings for FIRST and LAST. . . . 44
16 Data set and mappings for nesting example. . . . 45
17 Window Example Query Results. . . . 53
18 Row pattern recognition in windows — syntax summary. . . . 54
19 Results for empty match and no match. . . . 61
20 Computation of matches and window function results. . . . 62
21 Input data. . . . 75
22 Mapping of first element. . . . 76
23 Mapping of second element. . . . 76
24 Mapping of third element. . . . 77

©ISO/IEC 2016 – All rights reserved

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide 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 JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 32, *Data management and interchange*.

A list of all the parts in the ISO 19075 series, can be found on the ISO website.

©ISO/IEC 2016 – All rights reserved

Introduction

This Technical Report discusses the syntax and semantics for recognizing patterns in rows of a table, as defined in [ISO9075-2].

[ISO9075-2] defines two features regarding row pattern recognition:

— Feature R010, “Row pattern recognition: FROM clause”

— Feature R020, “Row pattern recognition: WINDOW clause”

These two features have considerable syntax and semantics in common, the principle difference being whether the syntax is placed in the FROM clause or in the WINDOW clause.

The organization of this Technical Report is as follows:

1) Clause 1, “Scope”, specifies the scope of this Technical Report.

2) Clause 2, “Normative references”, identifies standards that are referenced by this Technical Report.

3) Clause 3, “Row pattern recognition: FROM clause”, discusses Feature R010, “Row pattern recognition: FROM clause”.

4) Clause 4, “Expressions in MEASURES and DEFINE”, discusses scalar expression syntax in row pattern matching.

5) Clause 5, “Row pattern recognition: WINDOW clause”, discusses Feature R020, “Row pattern recognition: WINDOW clause”. Clause 5, “Row pattern recognition: WINDOW clause”, does not duplicate material already presented in Clause 3, “Row pattern recognition: FROM clause” and Clause 4, “Expressions in MEASURES and DEFINE”, which should be read even if the reader is only interested in Feature R020, “Row pattern recognition: WINDOW clause”.

6) Clause 6, “Pattern matching rules”, discusses the formal rules of pattern matching.

©ISO/IEC 2016 – All rights reserved

Information technology — Database languages — SQL Technical Reports —

Part 5:
Row Pattern Recognition in SQL

1 Scope

This Technical Report discusses the syntax and semantics for recognizing patterns in rows of a table, as defined in [ISO9075-2].

©ISO/IEC 2016 – All rights reserved

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2.1 ISO and IEC standards

[ISO9075-2] ISO/IEC 9075-2:2016, *Information technology — Database languages — SQL — Part 2: Foundation (SQL/Foundation)*.

©ISO/IEC 2016 – All rights reserved