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Australian/New Zealand Standard™

Geographic information — Spatial schema

AS/NZS ISO 19107:2020

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Australian/New Zealand Standard™

Geographic information — Spatial schema

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee IT-004, Geographical Information/Geomatics, to supersede AS/NZS ISO 19107:2005, *Geographic information — Spatial schema.*

The objective of this Standard is to specify conceptual schemas for describing the spatial characteristics of geographic entities, and a set of spatial operations consistent with these schemas. It treats "vector" geometry and topology. It defines standard spatial operations for use in access, query, management, processing and data exchange of geographic information for spatial (geometric and topological) objects. Because of the nature of geographic information, these geometric coordinate spaces will normally have up to three spatial dimensions, one temporal dimension and any number of other spatially dependent parameters as needed by the applications. In general, the topological dimension of the spatial projections of the geometric objects will be at most three.

This Standard is identical with, and has been reproduced from, ISO 19107:2019, *Geographic information — Spatial schema*.

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The terms "normative" and "informative" are used in Standards to define the application of the appendices or annexes to which they apply. A "normative" appendix or annex is an integral part of a Standard, whereas an "informative" appendix or annex is only for information and guidance.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing documents is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 ISO documents 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 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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

This second edition cancels and replaces the first edition (ISO 19107:2003), which has been technically revised. The main changes compared to the previous edition are as follows:

— It now forms a logical subset of this second edition. In other words, this document is 100 % backwardly compatible with its previous version, ISO 19107:2003, except in a few areas (in NURBS) where the previous version contained technical errors that are corrected in this revision.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides conceptual schemas for describing, representing and manipulating the spatial characteristics of geographic entities. Standardization in this area is the cornerstone for other geographic information design, specification and standardization.

"Vector" data consists of geometric primitives used to construct expressions of the spatial characteristics of geographic features. "Raster" data is based on the division of the extent covered into small units according to a tessellation of the space. This document deals only with vector data.

There is a hierarchy of complexity in the "geometry" of the underlying object used in various coordinate systems. These may use reference planes (map geometry – Euclidean), reference spheres (spherical geometry — using spherical trigonometry), reference ellipsoids (ellipsoidal geometry using Gaussian or Riemannian metrics) or more complex surfaces (usually using numeric approximations for calculation). The coordinates of a point locate it on, or in relation to, the reference geometry. With the exception of "map geometry," the usual Euclidean formulae for distance and area do not apply directly in the coordinate system.

Topology expressions provide qualitative descriptions of the spatial relations between geometry objects. Topology deals with the characteristics of geometric figures that remain invariant if the space is deformed elastically. Topological properties do not change when information is transformed from one coordinate system to another, usually including the coordinate function that map from R2 or R3 to the reference geometry. Topological properties in the domain of the coordinate system will be identical to those on the geographic surface; but the metric properties may change significantly (e.g. distance, area, direction).

Spatial operators are functions and procedures that use, query, create, modify or delete spatial objects. This document defines the taxonomy of some of the more important operators, their definitions and implementations. The goals are to:

— Define spatial operators unambiguously, so that different implementations will yield comparable results within the limitations of accuracy and resolution.

— Use these definitions to define a set of standard operations that will form the basis of compliant systems and thus act as a test-bed for implementers and a benchmark set for validation of compliance.

— Define an operator algebra that will allow combinations of the base operators to be used predictably in the query and manipulation of geographic feature data.

Standardized conceptual schemas for spatial characteristics will increase the ability to share geographic information between applications. These schemas will be used by geographic information system and software developers and users of geographic information to provide consistently understandable spatial data structures and functions.

This document is technical because geometry is a technical topic. Euclid was speaking of a simpler form of geometry to the most powerful man in his world when he said:

There is no royal road to geometry (μή εἶναι βασιλικήν ἀτραπόν ἐπί γεωμετρίαν).

Euclid to Ptolemy I Soter (General with Alexander the Great, Pharaoh of Egypt) —

Attributed by Proclus (412–485 AD) in Commentary on the First Book of Euclid's Elements

NOTES

Australian/New Zealand Standard

Geographic information — Spatial schema

1 Scope

This document specifies conceptual schemas for describing the spatial characteristics of geographic entities, and a set of spatial operations consistent with these schemas. It treats "vector" geometry and topology. It defines standard spatial operations for use in access, query, management, processing and data exchange of geographic information for spatial (geometric and topological) objects. Because of the nature of geographic information, these geometric coordinate spaces will normally have up to three spatial dimensions, one temporal dimension and any number of other spatially dependent parameters as needed by the applications. In general, the topological dimension of the spatial projections of the geometric objects will be at most three.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 19103, *Geographic information — Conceptual schema language*

ISO 19108, *Geographic information — Temporal schema*

ISO 19109, *Geographic information — Rules for application schema*

ISO 19111, *Geographic information — Spatial referencing by coordinates*

ISO/IEC 11404:2007, *Information technology — General-Purpose Datatypes (GPD)*

ISO/IEC 19505-2:2012, *Information technology — Object Management Group Unified Modeling Language (OMG UML) — Part 2: Superstructure*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11404, ISO 19103, ISO/IEC 19505-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

NOTE Common words from geometry, such as point, curve, line, surface solid, etc., take the common meanings unless they are used as classifier names (usually interfaces), in which case they are a digital representation of the geometric concept. Common mathematical terms that are not defined here take on their common meanings in mathematics (see [15], [10], ISO/IEC 11404 or a standard text on the topic, such as the "N. Bourbaki"[1)] series currently published by Springer Verlag, in French, English and German). Care should be taken since mathematical terms can be context sensitive, and can easily be confused with common words. For example, "open" set, "closed" curve, "closed" set, "rational" function, "boundary," "interior," "closure", "exterior", "function" and others from common language but have very specific meanings in mathematics and in this document. Where necessary to prevent confusion, existing definitions have been elaborated to make their intent in this document explicit. Mathematical terms include common vocabulary from geometry, topology, calculus, geodesy and differential geometry. Many of these terms can be sufficiently common that inclusion is not necessary. They are included here to prevent confusion especially for terms like the ones listed above that have another meaning in another context.

1) N. Bourbaki is the pen-name for the "Association des collaborateurs de Nicolas Bourbaki" (Association of Collaborators of Nicolas Bourbaki) of mathematicians first published in 1935 and dedicated to "formalizing" mathematics. The group has an office at the "École Normale Supérieure" in Paris. See https://en.wikipedia.org/wiki/