Mapping ISO 19115-1 geographic metadata standards to codemeta

Ted Habermann Corresp. 1

1 The HDF Group, Champaign, Illinois, United States

Corresponding Author: Ted Habermann
Email address: ted.habermann@gmail.com

The codemeta project recently proposed a vocabulary for software metadata. ISO Technical Committee 211 has published a set of metadata standards for geographic data and many kinds of related resources, including software. In order for ISO metadata creators and users to take advantage of the codemeta recommendations, a mapping from ISO elements to the codemeta vocabulary must exist. This mapping is complicated by differences in the approaches used by ISO and codemeta, primarily a difference between hard and soft typing of metadata elements. These differences are described in detail and a mapping is proposed that includes sixty-four of the sixty-eight codemeta V2 terms. The codemeta terms have also been mapped to dialects used by twenty-one software repositories, registries and archives. The average number of terms mapped in these cases is 11.2. The disparity between these numbers reflects the fact that many of the dialects that have been mapped to codemeta are focused on citation or dependency identification and management while ISO and codemeta share additional targets that include access, use, and understanding. Addressing this broader set of use cases requires more metadata elements.

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2 codemeta

3 Ted Habermann[1]
4 [1] The HDF Group, Champaign, Illinois, United States
5
6 Corresponding Author:
7 Ted Habermann[1]
8 1800 S. Oak Street, Suite 203, Champaign, IL, 61820-7059, United States
9 Email address: ted.habermann@gmail.com

Abstract

11 The codemeta project recently proposed a vocabulary for software metadata. ISO Technical
12 Committee 211 has published a set of metadata standards for geographic data and many kinds of
13 related resources, including software. In order for ISO metadata creators and users to take
14 advantage of the codemeta recommendations, a mapping from ISO elements to the codemeta
15 vocabulary must exist. This mapping is complicated by differences in the approaches used by
16 ISO and codemeta, primarily a difference between hard and soft typing of metadata elements.
17 These differences are described in detail and a mapping is proposed that includes sixty-four of
18 the sixty-eight codemeta V2 terms. The codemeta terms have also been mapped to dialects used
19 by twenty-one software repositories, registries and archives. The average number of terms
20 mapped in these cases is 11.2. The disparity between these numbers reflects the fact that many of
21 the dialects that have been mapped to codemeta are focused on citation or dependency
22 identification and management while ISO and codemeta share additional targets that include
23 access, use, and understanding. Addressing this broader set of use cases requires more metadata
24 elements.

Introduction

26 The Codemeta Project (Codemeta Project) recently proposed 1) a vocabulary for documenting
27 software, 2) mappings between metadata fields used by a broad range of software repositories,
28 registries and archives (Codemeta Crosswalk), and 3) developed software with the purpose of
29 facilitating automatic translation between different representations of software metadata. The
30 vocabulary was designed to support several different software use cases, including citation,
31 discovery, use and, to some degree, understanding.
32 The ISO Technical Committee 211 has developed generic metadata standards that are widely
33 used for geographic data of many kinds. These standards were also designed as a foundation that
34 can be built on to document many kinds of things and support many use cases (Habermann,
35 2018).
36 This paper describes a mapping between the conceptual model that underlies ISO metadata
37 (ISO 19115-1) and Codemeta with the goal of facilitating the creation of codemeta-compliant
38 descriptions of software that is documented using the ISO standards. The communities that
39 developed these two metadata dialects share the important goal of comprehensive standards that
40 address multiple use cases for many disciplines. Both groups pursue this goal by developing
41 consensus, but the details of the processes used to develop their standards differ. ISO TC211
42 represents a traditional International standards body with well-defined processes, publication

43   methods and a business model that includes costs to users for standards documents. Codemeta
44   represents a community of volunteer practitioners with an initial set of proposed conventions
45   open on the Web and an invitation for adoption, experimentation and evolution.
46   In addition to these process differences, there are also differences between the structures and
47   implementations of these two models. These are described below with the mappings following.

48 Dialect Coverage and Scope

49   Mapping metadata for software between different schemas and dialects is an important
50   technical goal of codemeta. This goal is supported using a crosswalk file that is maintained and
51   contributed to in the codemeta git repository (Codemeta, 2018). This file lists the codemeta terms
52   along with equivalents in twenty-one dialects. This crosswalk is the basis for translating content
53   between these dialects.
54   A similar situation occurs in many in science communities that are trying to support multiple
55   use cases, i.e. document, share, and trust, for datasets using multiple metadata dialects (see
56   Gordon and Habermann, 2018). The concept of "Dialect Coverage" has come up in those studies
57   as the amount (%) of the concepts in a particular recommendation that a dialect includes. In the
58   codemeta case, this is the number of codemeta concepts that can be represented in the dialects
59   listed in the crosswalk file (Crosswalk Data). Figure 1 shows this count for each of the twenty-
60   one dialects. These counts were determined from the crosswalk file by counting the number of
61   cells with content in each column using a spreadsheet count() function. Both versions of
62   codemeta and ISO 19115-3 are included on the left side of this Figure as well.
63   The data show that the ISO dialect covers very close to all (64/68) of the codemeta concepts
64   and the other twenty-one dialects cover an average of 11.23/68, suggesting that codemeta is more
65   similar to ISO than it is to other dialects that have done crosswalks. The difference between the
66   ISO mapping and others is striking. It likely reflects the difference between the small number of
67   metadata elements used for discovering and citing software (or data) and the larger number
68   needed to be able to use it and trust it. In the current software citation landscape, this is the
69   difference between the complete codemeta vocabulary, i.e. all metadata for code (over sixty
70   items), and the FORCE11 Software Citation Guidelines, i.e. metadata for code citation (Smith et
71   al., 2016) which includes only ten items.
72   In some cases, multiple codemeta terms are mapped to the same ISO elements. Most of this
73   ambiguity is related to differences in the two models and approaches that are discussed in detail
74   below. ISO elements that are mapped to more than one codemeta term are identified with * in the
75   crosswalk tables below.

76 Model Characteristics

77   The ISO metadata standards are based on a [UML model](#) that is harmonized across all
78   standards developed and managed by the committee. The model is built around classes and
79   attributes that describe the structure of the standards and the relationships among objects. ISO
80   19115-1 includes thirteen top-level classes that provide details on identification, content,
81   constraints, distribution, quality, usage, reference systems, spatial representation and several
82   other areas.
83   The ISO standard includes a scope element at the root of each record that gives the type of
84   resource described by the metadata. The default scope is dataset, but other options include:
85   aggregate, application, attribute, attributeType, collection, collectionHardware,

86   collectionSession, coverage, dimensionGroup, document, feature, featureType, fieldSession,
87   initiative, metadata, model, nonGeographicDataset, otherAggregate, platformSeries, product,
88   productionSeries, propertyType, repository, sample, sensor, sensorSeries, series, service,
89   **software**, tile, transferAggregate (see Habermann, 2018). Mapping the codemeta vocabulary to
90   the ISO standard is an initial step toward defining the content that could be included in ISO
91   metadata records that describe software and applications, i.e. those where the scope is software.
92   The most commonly used representation of the ISO standards is XML (ISO 19115-3). ISO
93   XPaths uniquely identify metadata content and follow the structure of the UML model, with
94   levels in the XML alternating between objects (with types) and properties. This results in XML
95   that is "striped" like the XML representation of the Resource Description Framework (RDF)
96   (W3C, 2014), i.e. role/type/role/type/content. Types generally start with two uppercase letters
97   (MD, CI, ...) that indicate the UML package that they are defined in (metadata, citation, ...)
98   followed by an underscore (MD_, CI_, ...). Properties (termed roles in this discussion) are in
99   lower camel case.
100   A significant benefit of the striped XML is that properties can be defined with abstract objects
101 that can share properties while being instantiated with different types. For example, the ISO
102 CI_Party object is abstract and includes name and contactInfo properties. It is extended and
103 specialized by CI_Individual and CI_Organisation objects which inherit name and contactInfo
104 properties add properties that are relevant for people and organizations, e.g. organizations can
105 include individuals, logos, and position names. This approach also facilitates reuse by allowing
106 standard objects (e.g. people, organizations, or citations) to be referenced using links rather than
107 repetitive content (https://geo-ide.noaa.gov/wiki/index.php?title=ISO_Components).
108   Another benefit of this approach in ISO is the same as that in the schema.org case –
109 communities can extend object definitions when necessary and, in the ISO case, the resulting
110 extended objects fit naturally into the ISO XML representation. This approach is similar to the
111 schema extension model used in codemeta to add properties deemed important by the codemeta
112 community to the more general SoftwareSourceCode schema that is also a specialization of the
113 schema.CreativeWork schema.
114   The namespace for each element in the XML is identified using a standard namespace prefix
115 (mdb, cit, ...). Asterisks are used in the XPaths to indicate locations where several objects can be
116 used. For example, mdb:identificationInfo/*/ indicates that either mdb:MD_DataIdentification or
117 srv:SV_ServiceIdentification objects can occur in that location.
118   A simplified notation is introduced for paths through the UML conceptual model in this
119 document that includes only the role names and no information that is specific to the XML
120 representation. For example, the XPath
121 /mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:resourceSpecificUsa
122 ge/mri:MD_Usage/mri:identifiedIssues/cit:CI_Citation/cit:onlineResource/cit:CI_OnlineResourc
123 e/cit:linkage is replaced by the concept path:
124 identificationInfo.resourceSpecificUsage.identifiedIssues.onlineResource.linkage. These
125 simplified "concept paths" improve readability and emphasize equivalences between codemeta
126 and ISO in the conceptual space. Specific XPaths can be constructed from these concept paths
127 when necessary to implement translation of existing ISO content to codemeta representations.
128 The reverse translation is not unique.
129   Codemeta specifies a vocabulary rather than a structural model. It includes properties from
130 several schema.org schemas listed in Table 1 along with the number of items from each schema
131 (Crosswalk Data). These schemas exist in a schema.org hierarchy which is similar in many ways

132   to the ISO structure. SoftwareApplication and SoftwareSourceCode schemas are both
133   specializations of the Thing > CreativeWork schema. Codemeta extends these schemas (in
134   codemeta.SoftwareSourceCode) with several properties that lack clear equivalents in
135   schema.org.

Hard Types and Soft Types

137   All standards and vocabularies need to make choices between hard or soft typing of objects
138   they are describing. Hard typing requires specific names for items and is the only choice
139   available in implementations where names alone can be used to distinguish between items, e.g.
140   codemeta. For example, if publication and revision dates are required for complete descriptions
141   of a resource, hard typed representations would include two items: e.g. publicationDate and
142   revisionDate. Soft Typing can be used in dialects which support item attributes as well as values,
143   e.g. XML. In that case, these two dates would be represented with the same name (XML
144   element) and distinguished by a type attribute: <datetype="publication"> and
145   <datetype="revision">.
146   The difference between these two approaches emerges as the dialects evolve. Hard types
147   evolve by adding new elements to the underlying model, i.e. adding creationDate (or some other
148   type of date) when it becomes apparent that it is needed, and unambiguous definitions of those
149   elements. Soft types evolve by adding items to the shared vocabulary of date types, typically a
150   codelist or thesaurus.
151   The critical difference between hard and soft types boils down to differences in governance
152   models and change tolerance. In communities that use hard types, members must be tolerant to
153   changes in the models and, typically, changes in tooling built on them. Communities that use soft
154   typing must have mechanisms for sharing and evolving vocabularies, typically control bodies or
155   rules.
156   The ISO model is soft-typed and the Codemeta model is hard-typed. Table 2 lists some of the
157   documentation concepts that illustrate the contrast between these approaches. The first row
158   shows the differences in how dates are treated. The codemeta vocabulary includes four types of
159   dates listed in the second column of Table 2. If other date types are required to describe software,
160   maybe dateDeprecated for example, new terms would be found in schema.org or added to the
161   vocabulary to address those needs. The ISO approach involves a single date concept and a
162   codelist that includes sixteen options, shown in the third column of Table 2. That codelist is
163   designed to be extended by communities with other needs without impacting the structure of the
164   standard. In this example, the date type codelist already includes the term "deprecated".

Citations

166   Connecting users to resources is one of the most important roles of metadata. It is also one of
167   the most ubiquitous. Several classes of citations are important:
168   1. Citation to the resource being described in the metadata (*Resource Citation*). The role of these
169   citations is to provide guidance on how the resource being described should be cited and there is
170   only one of these in each metadata record.
171   2. Citations to related resources (*Related Resource Citation*). These are generic references to
172   some other resource and generally include information about the relationship between the
173   resource being described and the related resource. See, for example, the RelatedIdentifier
174   element in the DataCite metadata schema (DataCite Metadata Working Group, 2017) which

175   includes relatedIdentifierType and relationType attributes as additional information.
176   3. Citations to other, typically specific, resources (*Specific Resource Citations*). For example, the
177   ISO object that describes data processing includes a citation in the role of softwareReference that
178   specifically provides a reference to software used in the processing.
179   Other examples of these citation types are included in the following discussion.

ISO Citations

181   ISO 19115-1 includes all three types of citations:
182   • The *Resource Citation* is unique and occurs at a specific location in the conceptual
183   model: identificationInfo.citation (XPath =
184   /mdb:MD_Metadata/mdb:identificationInfo/*/mri:citation/cit:CI_Citation).
185   • *Related Resource Citations* also occur at a specific location in the model,
186   identificationInfo.associatedResource (XPath =
187   /mdb:MD_Metadata/mdb:identificationInfo/*/mri:associatedResource/mri:MD_Associate
188   dResource/mri:name/cit:CI_Citation along with two codelists (associationType and
189   initiativeType) that provide information about how the resource is associated.).
190   • *Specific Resource Citations* occur in a number of locations in the ISO model as part of
191   specific classes. For example, citations to additional documentation occur at
192   identificationInfo.additionalDocumentation and citations to quality reports occur at
193   dataQualityInfo.standaloneQualityReport.
194   All ISO Citations include elements of traditional citations to books or papers e.g. title, authors
195   (people or organizations in many roles), dates (many types), series information, page numbers,
196   etc., as well as identifiers (ISSN, ISBN, and other types) and URLs with titles, descriptions and
197   types. The XPaths to these items from each ISO citation root are shown in Table 3.

Codemeta Citations

199   Codemeta includes twenty-six terms that represent resources that are related to or support the
200   use of the software being described. These terms have several different types (Text, URL, Text
201   or URL, CreativeWork, CreativeWork or URL, Computer Language or text, ...). In the mappings
202   below, these terms are mapped to the ISO citations. The specific types can be described by
203   adding the paths in Table 3 to the concept or XPaths.

Distribution

205   Many of the distribution systems for geographic data described by ISO metadata include
206   repositories (generally called archives or data centers) that manage and preserve data while
207   providing on-going support for users. ISO metadata standards accommodate approaches to
208   resource distribution with or without descriptions of repositories (termed distributors) and each
209   repository can provide several URLs (transferOptions) for each resource. These onlineResources
210   can have any of the functions included in the CI_OnLineFunctionCode codelist in Table 2. The
211   most common online functions are download and information and these are used in the mappings
212   to indicate direct access to the resource (function=download) or information about the resource
213   (function=information).

Additional Documentation

215   The codemeta vocabulary includes many items that are intended to help users use and
216 understand the software described in the metadata. In the ISO standards, these items can be
217 described in two ways: as associated resources (identificationInfo.associatedResource) or as
218 additional documentation (identificationInfo.additionalDocumentation). I have chosen the later
219 in these cases. In dialects without specific citations, e.g. Datacite, these would be referred to as
220 relatedIdentifiers with appropriate relationTypes as the DataCite dialect is soft typed (DataCite
221 Metadata Working Group, 2017).
222   One important goal of codemeta is to enable authors to cite software that is used to store,
223 process, analyze, and visualize the data and model results that they use in their work. Increasing
224 citations from the scientific literature is large part of this goal, but there are also significant
225 opportunities to improve the completeness of dataset metadata by citing software. This is
226 generally done as part of the provenance or lineage section of the metadata. The ISO standards
227 provide several specific resource citations for citing software, including:
228   • resourceLineage.processStep.processingInformation.algorithm.citation,
229   • resourceLineage.processStep.processingInformation.softwareReference, and
230   • resourceLineage.processStep.processingInformation.documentation.

Mappings

232   The mappings between codemeta and ISO are presented here in a series of tables that
233 correspond to the source schema.org schemas used in order to provide some structure that may
234 help clarify the relationships and improve understanding. The process of creating the mappings
235 involved three steps: 1) obvious connections, i.e. description -> identificationInfo.abstract, or
236 name -> identificationInfo.citation.title, 2) more complicated connections like those discussed
237 above, and 3) matching intended types as closely as possible, i.e. codemeta terms that were
238 intended to be identifiers were mapped to ISO identifier codes (identifier ->
239 identificationInfo.citation.identifier.code) and those that were intended to be URLs were mapped
240 to ISO linkages (downloadUrl ->
241 distributionInfo.transferOptions.onLine[function='download'].linkage). This process is, of
242 course, more subjective than objective, and the resulting mappings reflect experience authoring
243 the ISO standards and working with them in multiple contexts over the last decade.
244   The mappings include the property names, types, and descriptions from the codemeta
245 vocabulary, conceptual paths for the ISO items (ISO 19115-1), and XPaths from the standard
246 XML representation (ISO 19115-3). The conceptual paths are provided here in lieu of the ISO
247 definitions for simplicity. The complete ISO conceptual model with definitions is available in an
248 HTML view (ISO Conceptual Model). In some cases, multiple codemeta terms are mapped to
249 single ISO elements, as described in the Additional Documentation section above. These cases
250 are marked with * in the tables.
251   These mappings are also available in machine-readable forms (Habermann, figshare, 2018
252 and Habermann, codemeta, 2018).

Schema:Person

254   The schema.Person schema provides a vocabulary for properties of people. In the ISO
255 standards, people and organizations are both referred to as parties and names can be given as any
256 combination of individual names, organization names, or positions. This mapping includes seven
257 items listed in Table 4.

Schema:Thing

The schema.Thing schema provides a vocabulary for properties of the most generic type of item. In the context of codemeta, this item is the resource described by the metadata which is software. In ISO 19115-1, properties related to the identification of the resource being described are in the identificationInfo section and many of the properties are included in the citation to that resource. As described above, these properties (title, identifier, and link) are included in all citations in the ISO model. This mapping includes six items listed in Table 5.

Schema:Thing.CreativeWork

The Thing.CreativeWork schema provides a vocabulary for the most generic kind of creative work, including books, movies, photographs, software programs, etc. This mapping includes twenty-four items listed in Table 6.

Schema:Thing.CreativeWork.SoftwareSourceCode

The Thing.CreativeWork.SoftwareSourceCode schema provides a vocabulary for describing computer programming source code. This mapping includes four items listed in Table 7.

Codemeta:SoftwareSourceCode

The codemeta:SoftwareSourceCode schema extends Thing.CreativeWork.SoftwareSourceCode with terms created by the codemeta project. This mapping includes ten items listed in Table 8.

Schema:Thing.CreativeWork.SoftwareApplication

The Thing.CreativeWork.SoftwareApplication schema provides a vocabulary for describing a software application. This mapping includes fifteen items listed in Table 9.

Conclusions

The ISO metadata standards were originally developed by ISO Technical Committee 211 to serve as the standard and structured part of the documentation needed to discover, access, use, and understand datasets. The standards acknowledge that they are generic, and they include several mechanisms for extension to address specific needs of communities that build on the standards. The generic nature of these standards is reflected in the breadth of the codelist that can be used to describe the scope of a particular metadata record (see list in Model Characteristics Section above and Habermann, 2018).

The codemeta project recently proposed over sixty terms that can be used in metadata for software. This recommendation provides a framework that provides insight into what ISO metadata for software might contain. The ISO metadata standards include several elements that directly cite software, e.g. the processingInformation.softwareReference or algorithm.citation elements, and the primary purpose of the mappings proposed here is to support ISO users that want to 1) express software metadata in a dialect that they are familiar with and 2) to facilitate translation of software metadata written using ISO standards to codemeta-compliant JSON-LD. Note that the purpose is different than the primary purpose of the crosswalks proposed on the codemeta project site which is to facilitate automated translations between different JSON-LD vocabularies and RDF. Adding an ISO crosswalk to the codemeta framework was the original

297   goal of this work, but the differences identified and described here are significant enough to
298   make that impossible. This translation may be facilitated with an XSLT built specifically for that
299   purpose, like the one created by Peroni et al., 2012, but that is beyond the scope of this initial
300   comparison.
301   The process of creating a mapping between these two representations surfaced some
302   differences that complicate the mapping. Some of these differences are related to hard and soft
303   typing used in the two models and others are related to increased flexibility that is required in a
304   generic standard like ISO for documenting citations, distribution channels, and related resources.
305   The differences in approach described here probably apply to many mappings from XML to
306   RDF representations. Peroni et al., 2012 identified and discussed some similar challenges when
307   mapping between JATS XML and SPAR Ontologies. They attributed these differences to
308   "differing philosophical viewpoints for XML and RDF", then described two reasons that XML
309   element names are ambiguous when used in isolation: attributes and hierarchical structure. They
310   suggest that the JATS standard (and by implication all XML representations) is "deliberately
311   vague" and that the hierarchical structure of XML is "not formalized and implicitly lives outside
312   the XML schema of the language". It is certainly true that XML element names can be
313   ambiguous without associated attributes and hierarchical structure but ignoring those methods of
314   providing meaning in XML and then stating that elements alone are ambiguous does not
315   contribute to understanding differences between how these two approaches describe resources.
316   I examine these differences in more detail and offer an explanation that is related to different
317   approaches to defining types: XML can use attributes and structure to provide information about
318   types and meaning while RDF must rely on unambiguous and shared definitions of terms. To use
319   the case described in Peroni et al., 2012, the JATS element "article" is definitely ambiguous.
320   That is why the definition of the element includes an attribute called article-type to clarify the
321   type of the article being described. Details of the importance of attributes for semantics in XML
322   is described in detail by Seligy, 2018 along with potential problems that result from ignoring
323   attribute values.
324   Peroni et al, 2012 also acknowledge the requirement for unambiguous definitions that are
325   shared across communities. They state that "A cornerstone of the Semantic Web is the use of
326   open published ontologies to give precise and universally available definitions to terms, so that
327   RDF statements, whatever else they are, are unambiguous in their meaning." While this may be a
328   goal of ontology development efforts, many of the definitions currently used in codemeta and
329   schema.org (shown in Tables 5-9) are unclear, non-unique, and ambiguous.
330   ISO mappings are proposed for sixty-four of the sixty-eight codemeta V2 terms. These
331   mappings can be used to create codemeta-compliant metadata from existing stores of ISO
332   metadata and to add codemeta compliant software citations in the future. This compares to an
333   average of 11.2 mappings for other dialects included in the codemeta crosswalk. This disparity
334   reflects the use cases targeted by the dialects. Many of the dialects that have been mapped to
335   codemeta are focused on citation or dependency identification and management while ISO and
336   codemeta share additional targets that include access, use, and understanding.

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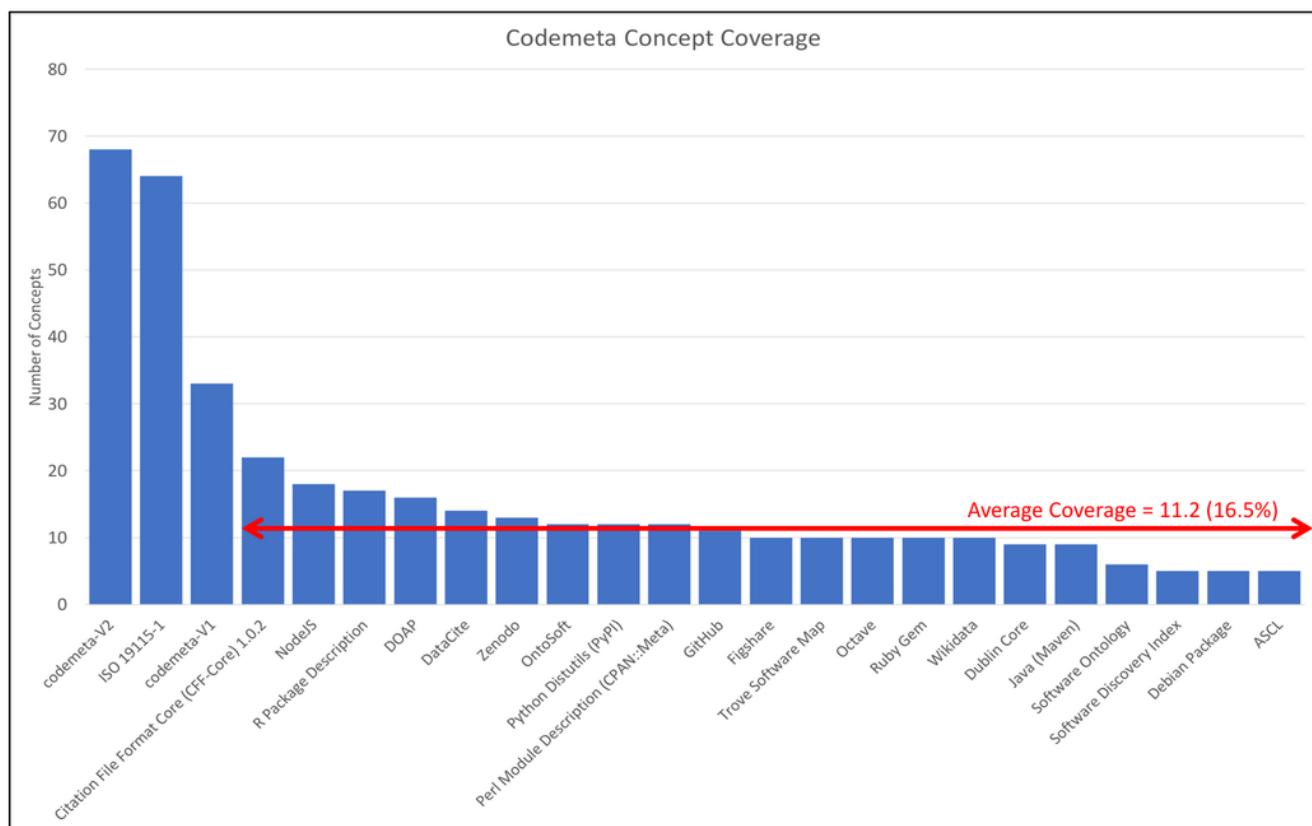
Figure 1

Coverage of codemeta concepts in multiple dialects.

The average number of codemeta concepts covered by twenty-one dialects is 11.2. The ISO dialect covers sixty-four of sixty-eight codemeta concepts.

Schema.org schemas and item counts for codemeta vocabulary.

Source	#Terms	Source	#Terms
schema:CreativeWork	24	schema:Thing	6
schema:SoftwareApplication	15	schema:SoftwareSourceCode	4
codemeta:SoftwareSourceCode	10	schema (not mapped)	2
schema:Person	7		

Codemeta hard types and related ISO codelists.

Item	Codemeta items	ISO 19115-1 codelist values*
Dates	embargoDate dateCreated dateModified datePublished	*CI_DateTypeCode*: creation publication revision expiry lastUpdate lastRevision nextUpdate unavailable inForce adopted deprecated superseded validityBegins validityExpires released distribution
People and Organizations	author contributor creator copyrightHolder editor funder producer provider publisher sponsor affiliation	*CI_RoleCode*: resourceProvider custodian owner user distributor originator pointOfContact principalInvestigator processor publisher author sponsor coAuthor collaborator editor mediator rightsHolder contributor funder stakeholder maintainer
Online Resource Types	buildInstructions contIntegration issueTracker readme id identifier downloadUrl installUrl codeRepository relatedLink sameAs url	*CI_OnLineFunctionCode*: download information offlineAccess order search completeMetadata browseGraphic upload emailService browsing fileAccess
Associations	supportingData	*DS_AssociationTypeCode*: crossReference largerWorkCitation partOfSeamlessDatabase stereoMate isComposedOf collectiveTitle series dependency revisionOf
Keyword	Keywords programmingLanguage applicationCategory applicationSubCategory	*MD_KeywordTypeCode*: discipline place stratum temporal theme dataCentre featureType instrument platform process project service product subTopicCategory taxon

2   ** ISO 19115-1 Codelists from http://standards.iso.org/iso/19115/resources/Codelist/cat/codelists.html*

Relative xPaths to titles, identifiers, and URLs in ISO citations.

Item	xPath from CI_Citation
Title	cit:CI_Citation/cit:title/gco:CharacterString (concept = title)
Identifier	cit:CI_Citation/cit:identifier/mcc:MD_Identifier/mcc:code/gco:CharacterString (concept = identifier.code)
URL	cit:CI_Citation/cit:onlineResource/cit:CI_OnlineResource/cit:linkage/gco:CharacterString (concept = onlineResource.linkage)

Mapping of codemeta terms from the schema.Person schema to ISO 19115-1 and ISO 19115-3.

Property	Type	Description	ISO 19115-1	ISO 19115-3
address	PostalAddress or Text	Physical address of the item.	party.contactInfo.address.deliveryPoint	cit:party/cit:CI_Organisation/cit:contactInfo/cit:CI_Contact/cit:address/cit:CI_Address/cit:deliveryPoint/gco:CharacterString
affiliation	Text	An organization that this person is affiliated with. For example, a school/university	party.name*	cit:party/cit:CI_Organisation/cit:name/gco:CharacterString
email	Text	Email address	party.contactInfo.address.electronicMailAddress	cit:party/cit:CI_Organisation/cit:contactInfo/cit:CI_Contact/cit:address/cit:CI_Address/cit:electronicMailAddress/gco:CharacterString
familyName	Text	Family name. In the U.S., the last name of an Person. This can be used along with givenName instead of the name property.	party.name*	cit:party/cit:CI_Individual/cit:name/gco:CharacterString
givenName	Text	Given name. In the U.S., the first name of a Person. This can be used along with familyName instead of the name property	party.name*	cit:party/cit:CI_Individual/cit:name/gco:CharacterString
identifier	URL	URL identifer, ideally an ORCID ID for individuals, a FundRef ID for funders	party.partyIdentifier.code	cit:party/cit:CI_Organisation/cit:partyIdentifier/mcc:MD_Identifier/mcc:code/gco:CharacterString
name	Text	The name of an Organization, or if separate given and family names cannot be resolved, for a Person	party.name*	cit:party/cit:CI_Organisation/cit:name/gco:CharacterString

2   * Multiple codemeta terms are mapped to this ISO XML element, some with different attributes

Mapping of codemeta terms from the schema.Thing schema to ISO 19115-1 and ISO 19115-3.

Property	Type	Description	ISO 19115-1	ISO 19115-3
description	Text	A description of the item.	identificationInfo.abstract	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:abstract/gco:CharacterString
identifier	PropertyValue or URL	The identifier property represents any kind of identifier for any kind of Thing, such as ISBNs, GTIN codes, UUIDs etc. Schema.org provides dedicated properties for representing many of these, either as textual strings or as URL (URI) links. See background notes for more details.	identificationInfo.citation.identifier.code	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:identifier/mcc:M D_Identifier/mcc:code
name	Text	The name of the item (software, Organization)	identificationInfo.citation.title	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:title/gco:Characte rString
relatedLink	URL	A link related to this object, e.g. related web pages	identificationInfo.citation.onlineResource [function='information']*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:onlineResource/ci t:CI_OnlineResource/mdb:MD_Metadata/mdb:i dentificationInfo/*/mri:citation/cit:CI_Citation/c it:onlineResource/cit:CI_OnlineResource[gmd:fu nction/gmd:CI_OnLineFunctionCode,'informatio n'] /cit:linkage
sameAs	URL	URL of a reference Web page that unambiguously indicates the item's identity. E.g. the URL of the item's Wikipedia page, Wikidata entry, or official website.	identificationInfo.citation.onlineResource [function='information']*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:onlineResource/ci t:CI_OnlineResource/mdb:MD_Metadata/mdb:i dentificationInfo/*/mri:citation/cit:CI_Citation/c it:onlineResource/cit:CI_OnlineResource[gmd:fu nction/gmd:CI_OnLineFunctionCode,'informatio n'] /cit:linkage
url	URL	URL of the item.	identificationInfo.citation.onlineResource [function='download']*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:onlineResource/ci t:CI_OnlineResource[gmd:function/gmd:CI_OnLi neFunctionCode,'download']/cit:linkage

2   * Multiple codemeta terms are mapped to this ISO XML element, some with different attributes

Mapping of codemeta terms from the Thing.CreativeWork schema to ISO 19115-1 and
ISO 19115-3.

Property	Type	Description	ISO 19115-1	ISO 19115-3
author	Organization or Person	The author of this content or rating. Please note that author is special in that HTML 5 provides a special mechanism for indicating authorship via the rel tag. That is equivalent to this and may be used interchangeably.	identificationInfo.citation. citedResponsibleParty[role='author'].party.name or identificationInfo.citation. citedResponsibleParty[role='originator'].party.name	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[cit:role/cit:CI_RoleCod e='author'] or /mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[cit:role/cit:CI_RoleCod e='originator']
citation	CreativeWork or URL	A citation or reference to another creative work, such as another publication, web page, scholarly article, etc.	identificationInfo.associatedResource.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:associatedResource/mri:MD_AssociatedReso urce/mri:name/cit:CI_Citation
contributor	Organization or Person	A secondary contributor to the CreativeWork or Event.	identificationInfo.citation.citedResponsibleParty [not(role='author' or role='principalInvestigator' or role='originator')].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[not(cit:role/cit:CI_Role Code='author' or cit:role/cit:CI_RoleCode='principalInvestigator' or cit:role/cit:CI_RoleCode='originator')] /cit:party/*/cit:name
copyright Holder	Organization or Person	The party holding the legal copyright to the CreativeWork.	identificationInfo.resourceConstraints.reference. citedResponsibleParty	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:resourceConstraints/mco:MD_LegalConstrai nts/mco:reference/cit:CI_Citation/cit:citedRespo nsibleParty/cit:CI_Responsibility
copyright Year	Number	The year during which the claimed copyright for the CreativeWork was first asserted.	identificationInfo.resourceConstraints.reference. date[dateType='publication'].date	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:resourceConstraints/mco:MD_LegalConstrai nts/mco:reference/cit:CI_Citation/cit:date/cit:CI _Date[cit:dateType/cit:CI_DateTypeCode='public ation']/cit:dateType
creator	Organization or Person	The creator/author of this CreativeWork. This is the same as the Author property for CreativeWork.	identificationInfo.citation.citedResponsibleParty [role='author'].party.name or identificationInfo.citation.citedResponsibleParty[role='o riginator'].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[cit:role/cit:CI_RoleCod e='author'] or /mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[cit:role/cit:CI_RoleCod e='originator']
date Created	Date or DateTime	The date on which the CreativeWork was created or the item was added to a DataFeed.	identificationInfo.citation.date[dateType='creation']. date*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:date/cit:CI_Date[c it:dateType/cit:CI_DateTypeCode='creation']/cit: date/gco:DateTime
date Modified	Date or DateTime	The date on which the CreativeWork was most recently modified or when the item's entry was modified within a DataFeed.	identificationInfo.citation.date[dateType='revision']. date*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:date/cit:CI_Date[c it:dateType/cit:CI_DateTypeCode='revision']/cit: date/gco:DateTime

Property	Type	Description	ISO 19115-1	ISO 19115-3
date Published	Date	Date of first broadcast/publication.	identificationInfo.citation.date[dateType='publication'].date*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:citation/cit:CI_Citation/cit:date/cit:CI_Date[cit:dateType/cit:CI_DateTypeCode='publication']/cit:date/gco:Date
editor	Person	Specifies the Person who edited the CreativeWork.	identificationInfo.citation.citedResponsibleParty[role='editor'].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:citation/cit:CI_Citation/cit:citedResponsibleParty/cit:CI_Responsibility[cit:role/cit:CI_RoleCode='editor']
encoding	MediaObject	A media object that encodes this CreativeWork. This property is a synonym for associatedMedia. Supersedes encodings.		
fileFormat	Text or URL	Media type, typically MIME format (see IANA site) of the content e.g. application/zip of a SoftwareApplication binary. In cases where a CreativeWork has several media type representations, 'encoding' can be used to indicate each MediaObject alongside particular fileFormat information. Unregistered or niche file formats can be indicated instead via the most appropriate URL, e.g. defining Web page or a Wikipedia entry.	identificationInfo.resourceFormat.formatSpecificationCitation	/mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:resourceFormat/mrd:MD_Format/mrd:formatSpecificationCitation/cit:CI_Citation
funder	Organization or Person	A person or organization that supports (sponsors) something through some kind of financial contribution.	identificationInfo.citation.citedResponsibleParty[role='funder'].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:citation/cit:CI_Citation/cit:citedResponsibleParty/cit:CI_Responsibility[cit:role/cit:CI_RoleCode='funder']
hasPart	CreativeWork	Indicates a CreativeWork that is (in some sense) a part of this CreativeWork. Reverse property isPartOf	identificationInfo.associatedResource[associationType='isComposedOf'].name*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:associatedResource/mri:MD_AssociatedResource[mri:associationType/mri:DS_AssociationTypeCode='isComposedOf']/mri:name/cit:CI_Citation
isAccessible ForFree	Boolean	A flag to signal that the publication is accessible for free.	distributionInfo.distributionFormat.formatDistributor.distributionOrderProcess.fees	/mdb:MD_Metadata/mdb:distributionInfo/mrd:MD_Distribution/mrd:distributionFormat/mrd:MD_Format/mrd:formatDistributor/mrd:MD_Distributor/mrd:distributionOrderProcess/mrd:MD_StandardOrderProcess/mrd:fees
isPartOf	CreativeWork	Indicates a CreativeWork that this CreativeWork is (in some sense) part of. Reverse property hasPart	identificationInfo.associatedResource[associationType='LargerWorkCitation'].name*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:associatedResource/mri:MD_AssociatedResource[mri:associationType/mri:DS_AssociationTypeCode='LargerWorkCitation']/mri:name/cit:CI_Citation
keywords	Text	Keywords or tags used to describe this content. Multiple entries in a keywords list are typically delimited by commas.	identificationInfo.descriptiveKeywords[type='theme'].Keyword*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:descriptiveKeywords/mri:MD_Keywords[mri:type/mri:MD_KeywordTypeCode='theme']/mri:keyword/gco:CharacterString
license	CreativeWork or URL	A license document that applies to this content, typically indicated by URL.	identificationInfo.resourceConstraints.reference	/mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:resourceConstraints/mco:MD_LegalConstraints/mco:reference/cit:CI_Citation

Property	Type	Description	ISO 19115-1	ISO 19115-3
position	Integer or Text	The position of an item in a series or sequence of items. (While schema.org considers this a property of CreativeWork, it is also the way to indicate ordering in any list (e.g. the Authors list). By default arrays are unordered in JSON-LD		
producer	Organization or Person	The person or organization who produced the work (e.g. music album, movie, tv/radio series etc.).	identificationInfo.citation.citedResponsibleParty [role='creator'].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[cit:role/cit:CI_RoleCod e='creator']/cit:party/*
provider	Organization or Person	The service provider, service operator, or service performer; the goods producer. Another party (a seller) may offer those services or goods on behalf of the provider. A provider may also serve as the seller. Supersedes carrier.	identificationInfo.pointOfContact [role='pointOfContact'].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/srv: SV_ServiceIdentification/mri:pointOfContact/ cit:CI_Responsibility[cit:role/cit:CI_RoleCode='pr ovider']/cit:party/*
publisher	Organization or Person	The publisher of the creative work.	identificationInfo.citation.citedResponsibleParty [role='publisher'].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[cit:role/cit:CI_RoleCod e='publisher']/cit:party/*
sponsor	Organization or Person	A person or organization that supports a thing through a pledge, promise, or financial contribution. e.g. a sponsor of a Medical Study or a corporate sponsor of an event.	identificationInfo.citation.citedResponsibleParty [role='sponsor'].party.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:citedResponsibleP arty/cit:CI_Responsibility[cit:role/cit:CI_RoleCod e='sponsor']/cit:party/*
version	Number or Text	The version of the CreativeWork embodied by a specified resource.	identificationInfo.citation.edition	/mdb:MD_Metadata/mdb:identificationInfo/mri: MD_DataIdentification/mri:citation/cit:CI_Citatio n/cit:edition/gco:CharacterString

2   * Multiple codemeta terms are mapped to this ISO XML element, some with different attributes

Mapping of codemeta terms from the Thing.CreativeWork.SoftwareSourceCode schema to ISO 19115-1 and ISO 19115-3.

Property	Type	Description	ISO 19115-1	ISO 19115-3
Code Repository	URL	Link to the repository where the un-compiled, human readable code and related code is located (SVN, github, CodePlex).	distributionInfo.distributor.distributorTransferOptions. onLine[function='download'].linkage or distributionInfo.distributor.distributorTransferOptions. onLine[function='information'].linkage or distributionInfo.transferOptions.onLine [function='download'].linkage or distributionInfo.transferOptions.onLine [function='information'].linkage or identificationInfo.citation.onlineResource [function='download'].linkage or identificationInfo.citation.onlineResource [function='information'].linkage*	/mdb:MD_Metadata/mdb:distributionInfo/mrd: MD_Distribution/mrd:distributor/mrd:MDDistri butor/mrd:distributorTransferOptions/mrd:MD DigitalTransferOptions/mrd:onLine/cit:CI_OnLin eResource[cit:function/cit:CI_OnLineFunctionCo de='information']/cit:linkage/gco:CharacterStrin g or /mdb:MD_Metadata/mdb:distributionInfo/mrd: MD_Distribution/mrd:transferOptions/mrd:MD DigitalTransferOptions/mrd:onLine/cit:CI_OnLin eResource[cit:function/cit:CI_OnLineFunctionCo de='information'] /cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:onlineResource/ci t:CI_OnLineResource[cit:function/cit:CI_OnLineF unctionCode='information'] /cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:distributionInfo/mrd: MD_Distribution/mrd:distributor/mrd:MDDistri butor/mrd:distributorTransferOptions/mrd:MD DigitalTransferOptions/mrd:onLine/cit:CI_OnLin eResource[cit:function/cit:CI_OnLineFunctionCo de='download'] /cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:distributionInfo/mrd: MD_Distribution/mrd:transferOptions/mrd:MD DigitalTransferOptions/mrd:onLine/cit:CI_OnLin eResource[cit:function/cit:CI_OnLineFunctionCo de='download'] /cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:onlineResource/ci t:CI_OnLineResource[cit:function/cit:CI_OnLineF unctionCode='download'] /cit:linkage/gco:CharacterString
ProgrammingLanguage	Computer Language or Text	The computer programming language.	identificationInfo.descriptiveKeywords[type='theme']. keyword*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:descriptiveKeywords/mri:MD_Keywords[mri :type/mri:MD_KeywordTypeCode='theme']/mri: keyword/gco:CharacterString
Runtime Platform	Text	Runtime platform or script interpreter dependencies (Example - Java v1, Python2.3, .Net Framework 3.0). Supersedes runtime.	identificationInfo.environmentDescription*	/mdb:MD_Metadata/mdb:identificationInfo/mri :MD_DataIdentification/mri:environmentDescri ption/gco:CharacterString
Target Product	Software Application	Target Operating System / Product to which the code applies. If applies to several versions, just the product name can be used.	identificationInfo.associatedResource.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:associatedResource/mri:MD_AssociatedRes ource/mri:name/cit:CI_Citation

2 * Multiple codemeta terms are mapped to this ISO XML element, some with different attributes

Mapping of codemeta terms from the codemeta.SoftwareSourceCode schema to ISO 19115-1 and ISO 19115-3.

Property	Type	Description	ISO 19115-1	ISO 19115-3
build Instructions	URL	link to installation instructions/documentation	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:additionalDocumentation/cit:CI_Citation
cont Integration	URL	link to continuous integration service	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:additionalDocumentation/cit:CI_Citation
development Status	Text	Description of development status, e.g. Active, inactive, supsended. See repostatus.org	identificationInfo.status	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:status/mcc:MD_ProgressCode
embargo Date	Date	Software may be embargoed from public access until a specified date (e.g. pending publication, 1 year from publication)	identificationInfo.citation.date[dateType='released']. date*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:citation/cit:CI_Citation/cit:date/cit:CI_Date[cit:dateType/cit:CI_DateTypeCode='released']/ci t:date/gco:DateTime
funding	Text	Funding source (e.g. specific grant)	identificationInfo.associatedResource*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:associatedResource/mri:MD_AssociatedRes ource/mri:name/cit:CI_Citation
issueTracker	URL	link to software bug reporting or issue tracking system	identificationInfo.resourceSpecificUsage. identifiedIssues.onlineResource.linkage	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:resourceSpecificUsage/mri:MD_Usage/mri:i dentifiedIssues/cit:CI_Citation
maintainer	Person	Individual responsible for maintaining the software (usually includes an email contact address)	identificationInfo.pointOfContact	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:pointOfContact
readme	URL	link to software Readme file	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:additionalDocumentation/cit:CI_Citation
reference Publication	ScholarlyArticle	An academic publication related to the software.	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:additionalDocumentation/cit:CI_Citation
software Suggestions	SoftwareSourceC ode	Optional dependencies, e.g. for optional features, code development, etc	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/ mri:additionalDocumentation/cit:CI_Citation

2 *Multiple codemeta terms are mapped to this ISO XML element, some with different attributes

Mapping of Codemeta terms from the schema:Thing.CreativeWork.SoftwareApplication schema to ISO 19115-1 and 19115-3.

Property	Type	Description	ISO 19115-1	ISO 19115-3
application Category	Text or URL	Type of software application, e.g. 'Game, Multimedia'.	identificationInfo.descriptiveKeywords[type='theme'].keyword*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:descriptiveKeywords/mri:MD_Keywords[mri:type/mri:MD_KeywordTypeCode='theme']/mri:keyword/gco:CharacterString
application SubCategory	Text or URL	Subcategory of the application, e.g. 'Arcade Game'.	identificationInfo.descriptiveKeywords[type='theme'].keyword*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:descriptiveKeywords/mri:MD_Keywords[mri:type/mri:MD_KeywordTypeCode='theme']/mri:keyword/gco:CharacterString
download Url	URL	If the file can be downloaded, URL to download the binary.	distributionInfo.distributor.distributorTransferOptions.onLine[function='download'].linkage or distributionInfo.transferOptions.onLine[function='download'].linkage or identificationInfo.citation.onlineResource[function='download'].linkage	/mdb:MD_Metadata/mdb:distributionInfo/mrd:MD_Distribution/mrd:distributor/mrd:MD_Distributor/mrd:distributorTransferOptions/mrd:MD_DigitalTransferOptions/mrd:onLine/cit:CI_OnlineResource[cit:function/cit:CI_OnLineFunctionCode='download']/cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:distributionInfo/mrd:MD_Distribution/mrd:transferOptions/mrd:MD_DigitalTransferOptions/mrd:onLine/cit:CI_OnlineResource[cit:function/cit:CI_OnLineFunctionCode='download'] /cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:identificationInfo/*/mri:citation/cit:CI_Citation/cit:onlineResource/cit:CI_OnlineResource[cit:function/cit:CI_OnLineFunctionCode='download'] /cit:linkage/gco:CharacterString
fileSize	Text	Size of the application / package (e.g. 18MB). In the absence of a unit (MB, KB etc.), KB will be assumed.	distributionInfo.transferOptions.transferSize or distributionInfo.distributionFormat.formatDistributor.distributorTransferOptions.transferSize or distributionInfo.distributor.distributorTransferOptions.transferSize	/mdb:MD_Metadata/mdb:distributionInfo/mrd:MD_Distribution/mrd:transferOptions/mrd:MD_DigitalTransferOptions/mrd:transferSize/gco:Real or /mdb:MD_Metadata/mdb:distributionInfo/mrd:MD_Distribution/mrd:distributionFormat/mrd:MD_Format/mrd:formatDistributor/mrd:MD_Distributor/mrd:distributorTransferOptions/mrd:MD_DigitalTransferOptions/mrd:transferSize/gco:Real or /mdb:MD_Metadata/mdb:distributionInfo/mrd:MD_Distribution/mrd:distributor/mrd:MD_Distributor/mrd:distributorTransferOptions/mrd:MD_DigitalTransferOptions/mrd:transferSize/gco:Real
installUrl	URL	URL at which the app may be installed, if different from the URL of the item.	distributionInfo.distributor.distributorTransferOptions.onLine[function='download'].linkage or distributionInfo.transferOptions.onLine[function='download'].linkage or identificationInfo.citation.onlineResource[function='download'].linkage	/mdb:MD_Metadata/mdb:distributionInfo/mrd:MD_Distribution/mrd:distributor/mrd:MD_Distributor/mrd:distributorTransferOptions/mrd:MD_DigitalTransferOptions/mrd:onLine/cit:CI_OnlineResource[cit:function/cit:CI_OnLineFunctionCode='download']/cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:distributionInfo/mrd:

Property	Type	Description	ISO 19115-1	ISO 19115-3
				MD_Distribution/mrd:transferOptions/mrd:MD_DigitalTransferOptions/mrd:onLine/cit:CI_OnlineResource[cit:function/cit:CI_OnLineFunctionCode='download']/cit:linkage/gco:CharacterString or /mdb:MD_Metadata/mdb:identificationInfo/*/mri:citation/cit:CI_Citation/cit:onlineResource/cit:CI_OnlineResource[cit:function/cit:CI_OnLineFunctionCode='download']/cit:linkage/gco:CharacterString
memory Requirements	Text or URL	Minimum memory requirements.	identificationInfo.environmentDescription*	/mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:environmentDescription/gco:CharacterString
operating System	Text	Operating systems supported (Windows 7, OSX 10.6, Android 1.6).	identificationInfo.environmentDescription*	/mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:environmentDescription/gco:CharacterString
permissions	Text	Permission(s) required to run the app (for example, a mobile app may require full internet access or may run only on wifi).	identificationInfo.resourceConstraints or identificationInfo.resourceConstraints.reference.onlineResource.linkage	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:resourceConstraints/mco:MD_LegalConstraints or /mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:resourceConstraints/mco:MD_LegalConstraints/mco:reference/cit:CI_Citation/cit:onlineResource/cit:CI_OnlineResource/cit:linkage
processor Requirements	Text	Processor architecture required to run the application (e.g. IA64).	identificationInfo.environmentDescription*	/mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:environmentDescription/gco:CharacterString
release Notes	Text or URL	Description of what changed in this version.	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:additionalDocumentation/cit:CI_Citation
software Help	CreativeWork	Software application help.	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:additionalDocumentation/cit:CI_Citation
software Requirements	SoftwareSourceCode	Required software dependencies	identificationInfo.additionalDocumentation*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:additionalDocumentation/cit:CI_Citation
software Version	Text	Version of the software instance.	identificationInfo.citation.edition	/mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:citation/cit:CI_Citation/cit:edition
storage Requirements	Text or URL	Storage requirements (free space required).	identificationInfo.environmentDescription*	/mdb:MD_Metadata/mdb:identificationInfo/mri:MD_DataIdentification/mri:environmentDescription/gco:CharacterString
supporting Data	DataFeed	Supporting data for a Software Application.	identificationInfo.associatedResource.name*	/mdb:MD_Metadata/mdb:identificationInfo/*/mri:associatedResource/mri:MD_AssociatedResource/mri:name/cit:CI_Citation

2   * Multiple codemeta terms are mapped to this ISO XML element, some with different attributes