**CRM*inf*: the Argumentation Model**

**An Extension of CIDOC-CRM to support argumentation**

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Figure 1: Graphical representation of a case of scholarly reading

# Classes

**I1 Argumentation**

Subclass of: [E13](#_E13_Attribute_Assignment) Attribute Assignment

Superclass of: [S4](#_S4_Observation_1) Observation

 [I5](#_I5_Inference_Making) Inference Making/[S5](#_S5_Inference_Making_1) Inference Making

 [I7](#_I7_Belief_Adoption) Belief Adoption

Scope note: This class comprises the activity of making honest inferences or observations. An honest inference or observation is one in which the E39 Actor carrying out the I1 Argumentation justifies and believes that the I6 Belief Value associated with resulting I2 Belief about the I4 Proposition Set is the correct value at the time that the activity was undertaken and that any I3 Inference Logic or methodology was correctly applied.

 Only one instance of E39 Actor may carry out an instance of I1 Argumentation, though the E39 Actor may, of course, be an instance of E74 Group.

Properties: [J2](#_J2_concluded_that) concluded that (was concluded by): [I8](#_S2_Sample_Taking) Belief

Examples:

* My classification and dating of this bowl (I5)
* My adoption of the belief that Dragendorff type 29 bowls are from the 1st Century AD (I7)

**I2 Belief**

Subclass of: I8 Belief

Superclass of

Scope note: This class comprises the notion that the associated I4 Proposition Set is held to have a particular I6 Belief Value by a particular E39 Actor. This can be understood as the period of time that an individual or group holds a particular set of propositions to be true, false or somewhere in between.

Properties: [J4](#_J4_that_(is) that (is subject of): [I4](#_S4_Observation) Proposition Set

 [J5](#_J5_holds_to) holds to be: [I6](#_I6_Belief_Value) Belief Value

Examples:

* My belief that Dragendorff type 29 bowls are from the 1st Century AD
* Dragendorff’s belief that type 29 bowls are from the 1st Century AD

In First Order Logic:

 I2(x) ⊃ I8(x)

**I5 Inference Making**

Subclass of: [I1](#_S1_Matter_Removal) Argumentation

Superclass of: [S6](#_S6_Data_Evaluation) Data Evaluation

 [S7](#_S7_Simulation_Prediction) Simulation or Prediction

 [S8](#_S8_Categorical_Hypothesis) Categorical Hypothesis Building

Equivalent to [S5](#_S5_Inference_Making_1) Inference Making

Scope note: This class comprises the action of making honest propositions and statements about particular states of affairs in reality or in possible realities or categorical descriptions of reality by using inferences from other statements based on hypotheses and any form of formal or informal logic. It includes evaluations, calculations, and interpretations based on mathematical formulations and propositions.

 It is characterized by the use of an existing I2 Belief as the premise that together with a set of I3 Inference Logic draws a further I2 Belief as a conclusion.

 Documenting instances of I5 Inference Making primarily enables tracing the dependency of knowledge from conclusion to premise through subsequent inferences, possibly back to primary evidence, so that the range of influence of knowledge revision at any intermediate stage of complex inference chains on current convictions can be narrowed down by query. The explicit reference to the applied inference logic further allows scholars or scientists to assess if they can or would follow the documented argument. The class is not intended to promote the use of computationally decidable systems of logic as replacements of scholarly justifications of arguments, even though it allows for documenting the use of decidable logic, if that was deemed adequate for the problem at hand.  Principles of scholarly justifications of arguments are also regarded as kinds of inference logic.

Properties: [J1](#_J1_used_as) used as premise (was premise for): [I8](#_S2_Sample_Taking) Belief

[J3](#_J3_applies_(was) applies (was applied by): [I3](#_S3_Sample_Taking) Inference Logic

Examples:

* My classification and dating of this bowl

In First Order Logic:

 I5(x) ⊃ I1(x)

**I8 Belief**

Subclass of: E2 Temporal Entity

Superclass of: I2 Belief

 I9 Citation

Scope note: This class comprises the holding of beliefs by individuals or groups about the truth or not of some propositions.

Examples:

* My belief that Nero was not singing while Rome was burning.

In First Order Logic:

 I8(x) ⊃ E2(x)

**I9 Citation**

Subclass of: I8 Belief

Superclass of:

Scope note: This class comprises beliefs in the correct reading or scholarly interpretation of the overt message intended by an instance of E73 Information Object (“source”), in which the interpretation of the source is formulated as a set of formal propositions or regarded to be unambiguously given in a natural language form. An instance of I9 Citation implies believing the authenticity of the respective instance of E73 Information Object relative to an explicitly stated provenance, but does not mean believing the respective propositions. Rather, the truth of the cited message is subject of another scholarly interpretation process. It further does not pertain to arguing about hidden or cryptic meanings of a source, which is subject of yet another scholarly interpretation process.

Properties: [J8 understands (is understood by): E73 Information Object](#_J1_used_as)

[J9 believes in provenance (provenance is believed by): I10 Provenance Statement](#_J1_used_as)

[J10](#_J1_used_as) reads as: I4 Proposition Set

Examples:

* My citation/and belief that the extant book De Vita Caesarum attributed to Gaius Suetonius Tranquillus stated 121AD that Nero was singing in Rome while it was burning from July 19 on in 64 AD[[1]](#footnote-1).

In First Order Logic:

 I9(x) ⊃ I8(x)

**I10 Provenance Statement**

Subclass of: I4 Proposition Set

Superclass of:

Scope note: This class comprises statements about the provenance of an instance of E73 Information Object with known content at the time of making the provenance statements. An instance of I10 Provenance Statement must contain propositions about the presence of a carrier of the respective instance of E73 Information Object in an event or spatiotemporal context of reference. Characteristically, it may pertain to the writing by a known author at a known or unknown date or place, or to the existence of the text known to some public regardless the truth of authorship.

Examples:

* The Latin content of the extant book De Vita Caesarum attributed to Gaius Suetonius Tranquillus was published in Rome 121AD and not alienated in its propositional content by essential transcription errors until its currently known form.
* The exemplar of The Merchant of Venice, Quarto 1 (1600) owned by The British Library, shelf number BL C.34.k.22 was published 1600AD by Thomas Heyes.

In First Order Logic:

 I10(x) ⊃ I4(x)

# Argumentation Model Property Declaration

The properties are comprehensively declared in this section using the following format:

* Property names are presented as headings in bold face, preceded by unique property identifiers;
* The line “Domain:” declares the class for which the property is defined;
* The line “Range:” declares the class to which the property points, or that provides the values for the property;
* The line “Subproperty of:” is a cross-reference to any properties that this is a subproperty of;
* The line “Superproperty of:” is a cross-reference to any subproperties the property may have;
* The line “Scope note:” contains the textual definition of the concept the property represents;
* The line “Examples:” contains a bulleted list of examples of instances of this property.

# Properties

**J1 used as premise (was premise for)**

Domain: [I5](#_I5_Inference_Making) Inference Making

Range: [I8](#_S2_Sample_Taking) Belief

Subproperty of: [P17](#_P17_was_motivated) was motivated by (motivated)

Superproperty of:

Quantification: many to many, necessary (1,n:0,n)

Scope note: This property associates an instance of I8 Belief with the instance of I5 Inference Making that used it as a premise.

Examples:

* My classification and dating of this bowl (I5) used as premise my belief that Dragendorff type 29 bowls are from the 1st Century AD (I)
* My classification and dating of this bowl (I5) used as premise my belief in the observations of this bowl (I2)

In First Order Logic:

 J1(x,y) ⊃ I5(x)

 J1(x,y) ⊃ I8(y)

J1(x,y) ⊃ P17(x,y)

**J2 concluded that (was concluded by)**

Domain: [I1](#_S1_Matter_Removal) Argumentation

Range: [I8](#_S2_Sample_Taking) Belief

Subproperty of: [P116](#_P116_starts_(is) starts (is started by)

Superproperty of:

Quantification: one to many, necessary, dependent (1,n:1,1)

Scope note: This property associates an instance of I8 Belief with the instance of I1 Argumentation that concluded it.

Examples:

* My classification and dating of this bowl (I5) concluded that my belief that this bowl is from the 1st Century AD (I2)

In First Order Logic:

 J2(x,y) ⊃ I1(y)

 J2(x,y) ⊃ I8(y)

J2(x,y) ⊃ P116(x,y)

**J8 understands (is understood by)**

Domain: I9 Citation

Range: [E73](#_E73_Information_Object) Information Object

Subproperty of:

Superproperty of:

Quantification: many to one, necessary (1,1:0,n)

Scope note: This property associates an instance of I9 Citation with the instance of E73 Information Object it interprets with respect to its intended overt message.

* My citation that Nero was singing in Rome while it was burning *understands* the extant book De Vita Caesarum by Gaius Suetonius Tranquillus

In First Order Logic:

 J8(x,y) ⊃ I7(x)

 J8(x,y) ⊃ E73(y)

**J9 believes in provenance (provenance is believed by)**

Domain: I9 Citation

Range: I10 Provenance Statement

Subproperty of:

Superproperty of:

Quantification: many to one, necessary (1,1:0,n)

Scope note: This property associates an instance of I9 Citation with the instance of I10 Provenance Statement that defines the believed provenance of the instance of E73 Information Object referred to in the instance of I9 Citation.

Examples:

* My citation that Nero was singing in Rome while it was burning *believes in provenance* that the content of the extant book De Vita Caesarum by Gaius Suetonius Tranquillus was published in Rome 121AD

In First Order Logic:

 J9(x,y) ⊃ I9(x)

 J9(x,y) ⊃ I10(y)

**J10 reads as**

Domain: I9 Citation

Range: I4 Proposition Set

Subproperty of:

Superproperty of:

Quantification: many to one, necessary (1,1:0,n)

Scope note: This property associates an instance of I9 Citation with the instance of I4 Proposition Set that formulates the interpretation.

Examples:

* My citation that Nero was singing in Rome while it was burning *reads as* “Nero, while watching Rome burn, exclaimed how beautiful it was, and sang an epic poem about the sack of Troy while playing the lyre”

In First Order Logic:

 J9(x,y) ⊃ I9(x)

 J9(x,y) ⊃ I4(y)

# Referred Classes and Properties

Since our model refers to and reuses parts of the CIDOC Conceptual Reference Model ( ISO21127) and CRMsci this section provides a comprehensive list of all constructs used from both ISO21127 and CRMsci. Also included are the definitions from version 5.1.2 of the CRM and version 1.2 of CRMsci. The complete definition of the CIDOC Conceptual Reference Model and CRMsci can be found on the official site: <http://www.cidoc-crm.org/official_release_cidoc.html>.

### Referred CIDOC CRM Classes

This section contains the complete definitions of the classes of the CIDOC CRM Conceptual Reference Model version 5.1.2 referred to by the model. The additional elements from CRMinf are highlighted in red.

**E2 Temporal Entity**

Subclass of: S15 Observable Entity

Superclass of: E4 Period

 S16 State

 [I8](#_S2_Sample_Taking) Belief

Scope note: This class comprises all phenomena, such as the instances of E4 Periods, E5 Events and states, which happen over a limited extent in time.

 In some contexts, these are also called perdurants. This class is disjoint from E77 Persistent Item. This is an abstract class and has no direct instances. E2 Temporal Entity is specialized into E4 Period, which applies to a particular geographic area (defined with a greater or lesser degree of precision), and E3 Condition State, which applies to instances of E18 Physical Thing.

Examples:

* BronzeAge (E4)
* the earthquake in Lisbon 1755 (E5)
* the Peterhof Palace near Saint Petersburg being in ruins from 1944 – 1946 (E3)

Properties:

P4 has time-span (is time-span of): E52 Time-Span

P114 is equal in time to: E2 Temporal Entity

P115 finishes (is finished by): E2 Temporal Entity

P116 starts (is started by): E2 Temporal Entity

P117 occurs during (includes): E2 Temporal Entity

P118 overlaps in time with (is overlapped in time by): E2 Temporal Entity

P119 meets in time with (is met in time by): E2 Temporal Entity

P120 occurs before (occurs after): E2 Temporal Entity

**E73 Information Object**

Subclass of: [E89](#_E89_Propositional_Object) Propositional Object

[E90](#_E90_Symbolic_Object) Symbolic Object

Superclass of: [E29](#_E29_Design_or_Procedure) Design or Procedure

[E31](#_E31_Document) Document

[E33](#_E33_Linguistic_Object) Linguistic Object

[E36](#_E36_Visual_Item) Visual Item

[I4](#_S4_Observation) Proposition Set

Scope note: This class comprises identifiable immaterial items, such as a poems, jokes, data sets, images, texts, multimedia objects, procedural prescriptions, computer program code, algorithm or mathematical formulae, that have an objectively recognizable structure and are documented as single units.

An E73 Information Object does not depend on a specific physical carrier, which can include human memory, and it can exist on one or more carriers simultaneously.

Instances of E73 Information Object of a linguistic nature should be declared as instances of the E33 Linguistic Object subclass. Instances of E73 Information Object of a documentary nature should be declared as instances of the E31 Document subclass. Conceptual items such as types and classes are not instances of E73 Information Object, nor are ideas without a reproducible expression.

Examples:

* image BM000038850.JPG from the Clayton Herbarium in London
* E. A. Poe's "The Raven"
* the movie "The Seven Samurai" by Akira Kurosawa
* the Maxwell Equations

Properties:

### Referred CIDOC CRM Properties

This section contains the complete definitions of the properties of the CIDOC CRM Conceptual Reference Model version 5.1.2 referred to. We apply the same format conventions as in mentioned above.

###

### P165 incorporates (is incorporated in)

Domain: [E73](#_E73_Information_Object) Information Object

Range: [E90](#_E90_Symbolic_Object_1) Symbolic Object

Subproperty of: [E90](#_E90_Symbolic_Object_1) Symbolic Object. [P106](#_P106_is_composed_) is composed of (forms part of): [E90](#_E90_Symbolic_Object_1) Symbolic Object

Quantification: (0,n :0,n)

Scope note: This property associates an instance of E73 Information Object with an instance of E90 Symbolic Object (or any of its subclasses) that was included in it.

This property makes it possible to recognise the autonomous status of the incorporated signs, which were created in a distinct context, and can be incorporated in many distinct self-contained expressions, and to highlight the difference between structural and accidental whole-part relationships between conceptual entities.

It accounts for many cultural facts that are quite frequent and significant: the inclusion of a poem in an anthology, the re-use of an operatic aria in a new opera, the use of a reproduction of a painting for a book cover or a CD booklet, the integration of textual quotations, the presence of lyrics in a song that sets those lyrics to music, the presence of the text of a play in a movie based on that play, etc.

In particular, this property allows for modelling relationships of different levels of symbolic specificity, such as the natural language words making up a particular text, the characters making up the words and punctuation, the choice of fonts and page layout for the characters.

When restricted to information objects, that is, seen as a property with E73 Information Object as domain and range the property is transitive.

A digital photograph of a manuscript page incorporates the text of the manuscript page

Examples:

* The content of Charles-Moïse Briquet’s ‘Les Filigranes: dictionnaire historique des marques du papier’ (E32) P165 incorporates the visual aspect of the watermark used around 1358-61 by some Spanish papermaker(s) and identified as ‘Briquet 4019’ (E37)
* The visual content of Jacopo Amigoni’s painting known as ‘The Singer Farinelli and friends’ (E38) *P165 incorporates* the musical notation of Farinelli’s musical work entitled ‘La Partenza’ (E73)
* The visual content of Nicolas Poussin’s painting entitled ‘Les Bergers d’Arcadie’ (E38) *P165 incorporates* the Latin phrase ‘Et in Arcadia ego’ (E33)

In First Order Logic:

 P165(x,y) ⊃ E73(x)

 P165(x,y) ⊃ E90(y)

 P165(x,y) ⊃ P106(x,y)

# Bibliography

Doerr, M., Kritsotaki, A., & Boutsika, A. (2011). [Factual argumentation - a core model for assertions making](http://dl.acm.org/citation.cfm?id=1921615). *Journal on Computing and Cultural Heritage (JOCCH)* , *3*(3), 34, New York, NY, USA : ACM

CRMsci, version 1.2 - Doerr, M. and Kritsotaki, A. 2014

1. https://en.wikipedia.org/wiki/The\_Twelve\_Caesars [↑](#footnote-ref-1)