Knowledge Representation Terms Reconciled to XBRL Semantics

There are different approaches to representing knowledge. These approaches have similarities and differences[1][2]. These approaches provide different levels of semantics and therefore provide differences in machine reasoning capabilities[3]. The following table compares and contrasts what is needed in the real world with what is provided by XBRL, RDF+OWL, and UML:

Real World Term (Dimensional model, set theory[4], computations, etc.)	**XBRL**	**RDFS[5], OWL[6], SKOS[7]**	**UML[8][9]**
A *classification system*[10] is a grouping of something based on some criteria. Definition and classification of concepts and entities (things) that exist in the real world and the relationships between them.	Taxonomy	Ontology	Package
Classification system version information		owl:versionInfo	Tagged value on package
CLASS: A set or category of things having some property in common and differentiated from other sets by kind, type, or quality. Group of real world things that go together for a specific reason. (Could be concrete or abstract)	Not defined. *(Could be defined using XBRL definition relations)*	owl:Class; rdfs:Class, rdf:type; *Defined as: Buckets used to group things.*	Class. *Defined as: A collection of objects that have the same characteristics.*
SUB CLASS: Ability to organize classes into a hierarchy. Specialization of classes; broader terms versus narrower terms.	general-special	rdfs:subClassOf	Specialization of classes
PROPERTY: A property is a trait, quality, feature, attribute, or peculiarity which is used to define its possessor and is therefore dependent on the possessor (entity or thing which has the property). A property belongs to something. For example, the color of a ball belongs to and is therefore is dependent on (is a property of) the ball.	Not defined. *(Could be defined using XBRL definition relations)*	rdf:Property, rdfs:subPropertyOf rdfs:domain,rdfs:range	Attribute
DEFINED BY: Authoritative source of information.	Reference link	rdfs:isDefinedBy; rdfs:seeAlso	Tagged value
DOCUMENTATION: Human readable definition or documentation of a concept.	Label link	rdfs:Comment	Note
SAME IDENTITY: Class “A” and class “B” are the exact same real world thing. *(Example, the class Equity and the class NetAssets are exactly the same thing.)*	Not defined. *(Could be defined using XBRL definition relations)*	sameClassAs; owl:sameAs; owl:differentFrom	--NO SUPPORT--
EQUIVLANCE: Class “A” and class “B” have the exact same members. *(Example, class LiabitiesAndPartnerCapital and the class LiabilitiesAndStockHolderEquity are both equivalent to LiabilitiesAndEquity.)*	Not defined. *(Could be defined using XBRL definition relations)*	equivalentTo owl:equivalentClass	--NO SUPPORT--

[1] *Extending the UML Language for Ontology Development*, http://www.omg.org/ontology/documents/sosym.pdf

[2] *Knowledge Representation/Translation in RDF+OWL, N3, KIF, UML and the WebKB-2 languages*, http://www.webkb.org/doc/model/comparisons.html

[3] Comparison of strong/weak semantics and relative machine reasoning capacity, http://www.xbrlsite.com/2014/Library/ExpressivenessAndReasonaingCapacityComparison.jpg

[4] Set theory, http://en.wikipedia.org/wiki/Set_theory

[5] Difference between RDFS and OWL, http://www.cambridgesemantics.com/semantic-university/rdfs-vs.-owl

[6] RDF and OWL terminology, http://www.slideshare.net/rlovinger/rdf-and-owl

[7] SKOS is an RDF Schema, so basically it is the same as RDFS except it defined specific useful things, http://www.w3.org/TR/2008/WD-skos-reference-20080829/skos.html

[8] Unified Modeling Language, http://www.uml.org/

[9] Basic UML tutorial, https://www.ibm.com/developerworks/rational/library/content/RationalEdge/sep04/bell/

[10] Types of classification systems, http://xbrl.squarespace.com/journal/2014/3/30/understanding-classification-systems.html

Real World Term (Dimensional model, set theory[4], computations, etc.)	XBRL	RDFS[5], OWL[6], SKOS[7]	UML[89]
SET DISJOINT: Things belonging to one class "A" cannot also belong to some other class "B". *(Example, a member of the Person class set of things can never be a member of the Country class set of things.)*	Not defined. *(Could be defined using XBRL definition relations)*	owl:disjointWith	
SET COMPLIMENT: Things that are members of one class "A" are all the things that do not belong to the other class "B" *(Example, a member of the class of LivingThings set of things is the entire set of things that do not belong to the DeadThings set of things.)*	Not defined. *(Could be defined using XBRL definition relations)*	owl:complementOf	--NO SUPPORT--
SET INVERSE: A relationship of type "X" between "A" and "B" implies a relationship of type "Y" between "B" and "A". *(Example, IF <starsIn><inverseOf><hasStar>; AND IF <MenInBlack><hasStar><WillSmith>; THEN <WillSmith><starsIn><MenInBlack>)*	Not defined. *(Could be defined using XBRL definition relations)*	owl:inverseOf	Relationship
SET UNION: The members of set "C" include all the members of set "A" and all the members of set "B".	Not defined. *(Could be defined using XBRL definition relations)*	owl:unionOf	--NO SUPPORT--
SET INTERSECTION: The members of set "C" include all the members of set "A" that are also members of set "B".	Not defined. *(Could be defined using XBRL definition relations)*	owl:intersectionOf	--NO SUPPORT--
SET MEMBERSHIP: Number of members of a set[11]	????????????????	Cardinality	Multiplicity
A relationship between "A" and "B" is also true between "B" and "A".	Not defined. *(Could be defined using XBRL definition relations)*	owl:SymmetricProperty	--NO SUPPORT--
A relationship between "A" and "B" and between "B" and "C" is also true between "A" and "C".	Not defined. *(Could be defined using XBRL definition relations)*	owl:TransitiveProperty	--NO SUPPORT--
Characteristic of property inheritance	Not defined	Defined	Defined
		samePropertyAs	--NO SUPPORT--
Data types or data type property (includes restrictions on data types allowed by XML Schema, facets)	XML Schema Datatypes[12], XBRL Data type registry[13]	XML Schema Datatypes	No standard data types it seems
Unique identifier	Name or ID?	Label	Name
Units	Units, XBRL Units Registry[14]	--NO SUPPORT--	--NO SUPPORT--
DIMENSIONAL MODEL: A **characteristic** describes a fact (a characteristic is a property of a fact). A characteristic or distinguishing aspect provides information necessary to describe a fact or distinguish one fact from another fact. A fact may have one or many distinguishing characteristics.	Aspects[15] (XBRL dimensions, tuples)	--NO SUPPORT--	--NO SUPPORT--
DIMENSIONAL MODEL: A **fact** is reported. A fact defines a single, observable, reportable piece of information contained within a financial report, or fact value, contextualized for unambiguous interpretation or analysis by one or more distinguishing characteristics (properties of the fact). A fact value is one property of a fact. Every fact has exactly one fact value.	Simple facts (XBRL item), complex facts (tuples)	--NO SUPPORT--	--NO SUPPORT--
DIMENSIONAL MODEL: A **hypercube** is used to combine facts which go together for some specific reason. (AKA cube, matrix, table, lattice, array)	Hypercube, Network	Government Linked Data, Data Cube Vocabulary[16]	--NO SUPPORT--

[11] Cardinality, http://en.wikipedia.org/wiki/Cardinality

[12] XML Schema Data Types, http://www.w3.org/TR/xmlschema11-2/

[13] XBRL International Data Type Registry, http://www.xbrl.org/dtr/dtr.xml

[14] XBRL International Units Registry, http://www.xbrl.org/utr/utr.xml

[15] XBRL International Abstract Model 2.0, http://www.xbrl.org/specification/abstractmodel-primary/pwd-2012-06-06/abstractmodel-primary-pwd-2012-06-06.html

[16] Data Cube Vocabulary, http://www.w3.org/2011/gld/wiki/Data_Cube_Vocabulary

Real World Term (Dimensional model, set theory[4], computations, etc.)	XBRL	RDFS[5], OWL[6], SKOS[7]	UML[89]
COMPUTATIONS: A roll up computes a total from a set of concepts (stock or flow). This equation is: A + B + *n* = Total.	XBRL calculation relations	--NO SUPPORT--	Yes
COMPUTATIONS: A roll forward reconciles a balance (stock) between two points in time (flow). This equation is: beginning balance + changes = ending balance.	XBRL Formula	--NO SUPPORT--	--NO SUPPORT--
COMPUTATIONS: An adjustment reconciles an originally stated balance to a restated balance between two different report dates. This equation is: originally reported balance + adjustment = restated balance.	XBRL Formula	--NO SUPPORT--	--NO SUPPORT--
COMPUTATIONS: A member aggregation is a collection-member type whole-part relation. This equation is: Sum(concept).	XBRL Formula	--NO SUPPORT--	Yes
Hierarchy of relations	XBRL presentation relations	Yes	Yes
General relations	XBRL definition relations, XBRL Link Role Registry (LRR)[17]	Relations	Relations
Business rules	XBRL Formula	Rule Interchange Format (RIF)	--NO SUPPORT--
WHOLE-PART RELATIONS: A meronym denotes a constituent part of, or a member of something. (Whole-Part type relations[18])	XBRL definition relations, XBRL Link Role Registry (LRR)	Relations in general, but not specific relations types	Relations in general, but not specific relations types
WHOLE-PART RELATIONS: HasPart (same as integral object-component)			
WHOLE-PART RELATIONS: IsPartOf (component-integral object)			
WHOLE-PART RELATIONS: member-collection; collection-member			
Open World Assumption and Closed World Assumption	Unspecified[19]	OPEN or CLOSED	CLOSED
Simple and generic descriptions of electronic resources, Dublin Core[20]	--NO SUPPORT--	Supports use of Dublin Core metadata	--NO SUPPORT--
Notion of “abstract”	YES	NO	Unknown

Why do go through all of the trouble of doing this? Machine readable information. The more a machine can understand, the more a machine can do for humans. These capabilities allow systems to express and make sense of first order logic[21].

All men are mortal.

Socrates is a man.

Therefore, Socrates is mortal.

There are two key parts of first-order logic. The syntax determines which collections of symbols are legal expressions in first-order logic, while the semantics determine the meanings behind these expressions. While no first-order theory has the strength to describe fully and categorically structures with an infinite domain; they can describe fully structures within a finite domain.

[17] XBRL International Link Role Registry, http://specifications.xbrl.org/registries/lrr-2.0/

[18] *A Taxonomy of Part-Whole Relations*, http://csjarchive.cogsci.rpi.edu/1987v11/i04/p0417p0444/MAIN.PDF

[19] CWA (closed world assumption) previously existed in XBRL but was removed.

[20] Dublin Core, http://wiki.dublincore.org/index.php/User_Guide

[21] First Order Logic, http://en.wikipedia.org/wiki/First-order_logic