

## Appendix A. Quanta and Predicate Logic

An analysis is made here of operators in first and second order logic and their expressibility in Quanta.

### A.1. Universal Quantification

Example:  $\forall x \in \text{bird}, \text{fly}(x)$   
Interpretation: Every bird can fly  
Quanta: bird | has | property | flight

Universal quantification is implicit in Quanta. For any statement about class X, this statements is taken to be true for every instance of X. This can be overridden by providing explicit contradiction in an instance. The instance is then taken to be the correct one. In the above example, since many classes of bird cannot fly it may be easier simply to not introduce this statement, or to make it modal (some can fly).

### A.2. Existential Quantification

Example:  $\exists x \in \text{bird}, \text{fly}(x)$   
Interpretation: Some bird can fly  
Quanta: sparrow | has | property | flight

Existential quantification is not directly expressible in Quanta. This is because it is a statement of limited specificity. As a fact-based resource, Quanta requires all information to be explicit. It is necessary to state *which* bird can fly. For example, a sparrow can fly.

### A.3. Logical Conjunction

Example:  $\text{like}(\text{Mary}, \text{apples}) \wedge \text{likes}(\text{Mary}, \text{oranges})$   
Interpretation: Mary likes apples and Jane likes oranges  
Quanta: Mary | like | apples  
Jane | like | oranges

Logical conjunction is simply expressed by presenting both facts to Quanta.

#### A.4. Logical Disjunction

Example:  $\text{like}(\text{Mary}, \text{apples}) \vee \text{likes}(\text{Mary}, \text{oranges})$

Interpretation: Mary likes apples or Jane likes oranges

Quanta: Mary | may | like | apples  
Jane | may | like | oranges

Logical disjunction, like existential quantification, cannot be expressed directly in Quanta. As Quanta is fact-based, the user typically enters only that which is known such as "mary | likes | apples" or "mary | may | like | apples.". Quanta does not automatically handle the conclusion, i.e. deduction, that "Jane | not | like | oranges". In the future, *rules* may be introduced into Quanta to permit logical disjunction and existential quantification.

#### A.5. Logical Negation

Example:  $\neg \text{like}(\text{Mary}, \text{apples})$

Interpretation: Mary does not like apples

Quanta: Mary | not | like | apples

Quanta handles negation as an adverb preceding the verb. Note that this requires Quanta to process the sentence at the higher grammatical level (lower performance). Usually this is only an issue when doing deduction or inference, not while navigating or visualizing data.

#### A.6. Modal Logic

Example:  $\diamond \text{like}(\text{Mary}, \text{apples})$

Interpretation: Mary might like apples.

Quanta: Mary | may | like | apples

Modal logic, including might, perhaps, could, should, are also handled as adverbs or adjectives preceding verbs and nouns.

## A.7. Second-Order Logic

Example:  $\exists x \in \text{person, believes}[ x, \forall y \in \text{bird, fly}(y) ]$

Interpretation: There is a person who believes that birds can fly  
Quanta: bird | has | property | flight | REF | belief | Mary

Second-order statements are possible in Quanta using the REF keyword placed at the end of a sentence. The REF keyword indicates that any following words are statements *about* that sentence. Three of the most common examples are "belief", "source" and "user". Belief indicates that only a specific person or group believes in the statement, source indicates the origin of a fact, and user indicates the specific user that entered the information. Several REF phrases may be attached to any statement. (Note in the example that the existential quantifier has been converted into a specific person, see A.2 above)

## Appendix B - Quanta Formal Ontology

Appendix B introduces all formal levels of the Quanta ontology. The system uses a layered ontology. Higher layers depend on lower ones, but not vice versa. The four levels correspond to the *foundational* (L1), *linguistic* (L2), *structural* (L3), and *generic* (GO) levels. The Generic Ontology (GO) represents actual content and is presented in Appendix C.

### B.1. Quanta Foundational Ontology (L1)

- a. A database is a set of nodes and sentences
- b. A node is a data type and a full index
- c. A data type is a unit of text, sound, image, time, or a reference
- d. A reference is a numerical link to another node
- e. A sentence is a set of references
- f. A full index is the set of sentences in which a particular node N is found (anywhere in the sentence)
- g. A primary index is the subset a full index in which the node N is found first in the sentence.

### B.2. Quanta Linguistic Ontology (L2)

- a. A part-of-speech is a node of text
- b. A part-of-speech may be a proper noun, noun, verb, predicate, adverb, or adjective
- c. A sentence consists of several references to parts-of-speech (whose arrangement is defined by Layered Grammars, Ch. )
- d. At least one node must exist, which is a noun.  
This special noun is called "quanta"
- e. A sentence must consist of at least one noun, and one verb.  
The noun must come first.
- f. A reference is the specific noun: "REF"
- g. A sourced sentence is any which contains: REF | source | X
- h. A tagged sentence is any which contains: REF | user | X
- i. A believed sentence is any which contains: REF | belief | X

### B.3. Quanta Structural Ontology (L3)

- a. A class C is any noun for which there exists at least one sentence in the quanta database where: X | is a | C
- b. An instance E is any noun for which there is no sentence: X | is a | E
- c. An existential verb is any of the following verbs: "is a", "is part of", "is contained in", "is also", "is member of"
- d. An existential sentence is a sentence S of the form: X | V | Y, in which V is one of the existential verbs
- e. A property sentence is a sentence S of the form: N | has | P | N  
(for example, cat | has | color | black)
- f. A taxonomy is a set of sentences S, of the form: N | V | N, whose sentences form a tree on some verb V.
- g. A classification is a taxonomy
- h. An ontology is a set of *existential* sentences S in which all have the same source, or all have no source
- i. The quanta generic ontology (GO) is the ontology where none of the sentences are sourced sentences
- j. A user ontology is an ontology in which all sentences have the same source R
- k. Multiple classification - A noun may have any number of sentences that are property sentences
- l. Multiple inheritance - A noun may have any number of sentences that are existential sentences
- m. Multiple taxonomies - A quanta database may contain any number of taxonomies
- n. Multiple ontologies - A quanta database may contain any number of ontologies
- o. [Connectivity Rule] An ontology O is said to be *connected* if, given any noun N in O, there exist a root node R, and a set of sentences S1, S2, S3, of the form: X | is a | Y... such that the sentences form a path from N to the root node R. For example:
  - S1: N | is a | X1
  - S2: X1 | is a | X2
  - S3: X2 | is a | X3
  - S4: X3 | is a | R

## Appendix C - Quanta Generic Ontology (GO)

The Quanta Generic Ontology represents a base ontology for generic terms across disciplines. Only an excerpt of the top-level and the subtree on Physical entities is listed.

### C.1. Top-Level

- Quanta
  - Noun
    - Classification
      - Ontology
      - Subject
      - Period
      - Genre
      - Style
      - Linnean Taxonomy
    - Property
    - Entity
      - Non-Physical Entity
        - Thought
        - Way of Living
        - Physical Condition
        - Theological Entity
        - Religion
        - Mathematical Object
      - Physical Entity see C.2
    - Event
    - Process
  - Verb
    - States-of-Being
    - Substance Verbs
    - Descriptive Verbs
    - Action Verb
  - Preposition

## C.2. Physical Entities (excerpt)

Physical Entity	<i>Additional sub-items</i>
Natural Entity	
Energy	
Subatomic Particle	
Element	Hydrogen, Helium, Oxygen
Molecule	
Virus	
Mineral	
Rock	
Geological Object	Island, Volcano, Body of Water
Atmospheric Object	Cloud, Rain, Storm, Hurricane
Astronomical Object	Planet, Moon, Star, Galaxy
Organic Entity	Cell, Tissue, Organ, Organism
Man-Made Entity	
Organizational Unit	
Geographic Place	Village, Town, City, Country
Social Unit	University, Company, Government
Educational Unit	Class, Program of Study, Credit
Semiotic Unit	
Typographic Seme	Letter, Symbol, Glyph
Spatial Seme	Map, Graph, Network
Informational Seme	Image, Website, Document
Language	Natural, Artificial
Civil Object	Road, Bridge, House, Building
Material	Writing Material, Building Material
Written Work	Book, Article, Journal, Lecture
Visual Work	Drawing, Painting, Sculpture
Tool	
Writing Tool	
Power Enhancing Tool	
Transportative Tool	
Communicative Tool	
Informational Device	

## Appendix D. Qubit - Data Mining Results

The following is a sample of raw data produced by the Qubit data mining software. Input consists of a set of artists' first and last names with each name on a single line. The goal is to download images, titles, years and location of paintings produced by these artists from Wikipedia. An "X" in the year indicates that Qubit was unable to process a year for that painting (the year indicated is the artist's date of birth). It is clear that on many instances, liberal use of syntax makes it difficult for Qubit to process the input. Any information not processed is included with the last field (location). There are 30 examples in this small sampling of the 1000 items downloaded.

Title	Year	Filename	Artist	Location (or not processed)
The construction of fort Kharnaq	1494	1494-Kamaleddin-Behzad-construction.jpg	Kamaleddin Behzad	c. 1494-1495.
Germany	1494 X	1494X-Ambrosius-Holbein-Germany.jpg	Ambrosius Holbein	
Lucus van Leyden	1494 X	1494X-Lucas-van-Leyden-Lucus.jpg	Lucas van Leyden	
Leonardo's servant and assistant	1495	1495-Leonardo-da-Vinci-Leonardo's.jpg	Leonardo da Vinci	
.jpg	1497	1497-Perugino-Self-portrait	Perugino	Self-portrait, 1497-1500.
The Last Supper (1498)	1498	1498-Leonardo-da-Vinci-Last.jpg	Leonardo da Vinci	Painted in Milan
One of his miniature	1498 X	1498X-Giorgio-Giulio-Clovio-One.jpg	Giorgio Giulio Clovio	
Michelangelo's Piet� was carved in 1499	1499	1499-Michelangelo-Buonarroti-Michelangelo's.jpg		
Mona Lisa (1503�1507)	1503	1503-Leonardo-da-Vinci-Mona.jpg	Leonardo da Vinci	
.jpg	1503	1503-Marcel-Duchamp-Mona.jpg	Marcel Duchamp	
	1503	1503-Mariotto-Albertinelli-Visitation	Mariotto Albertinelli	The Visitation, painted for the Congregazione di San Martino 1503.
Andrea Doria as Neptune	1503 X	1503X-Agnolo-Bronzino-Andrea.jpg	Agnolo Bronzino	
.jpg	1503 X	1503X-Agnolo-Bronzino-Venus	Agnolo Bronzino	Venus, Cupid, Folly
The Vision of St Bernard ca 1504 (Uffizi)	1504	1504-Fra-Bartolommeo-Vision.jpg	Fra Bartolommeo	

Pastoral Concert (c. 1508). Louvre	1508	1508-Giorgione-Pastoral.jpg	Giorgione	Paris.
The Tempest (c. 1508) Gallerie dell'Accademia	1508	1508-Giorgione-Tempest.jpg	Giorgione	Venice, Italy
Baptism of Christ by Francesco Raibolini (1509)	1509	1509-Francesco-Raibolini-Baptism.jpg	Francesco Raibolini	at the Gemäldegalerie Alte Meister, Dresden
.jpg	1509	1509-Leonardo-da-Vinci-rhombicuboctahedron	Leonardo da Vinci	The rhombicuboctahedron, as it appeared in the Luca Pacioli's Divina Proportione
Lot and his daughters (ca. 1509).	1509	1509-Lucas-van-Leyden-Lot.jpg	Lucas van Leyden	by Leonardo
Sleeping Venus (c. 1510) Gemaldegalerie Alte Meister	1510	1510-Giorgione-Sleeping.jpg	Giorgione	Dresden
	1510	1510-Hans-Baldung-Three.jpg	Hans Baldung	Vienna
Studies of Embryos by Leonardo da Vinci (circa 1510)	1510	1510-Leonardo-da-Vinci-Studies.jpg	Leonardo da Vinci	
In this early portrait (ca. 1510)	1510	1510-Titian-In.jpg	Titian	traditionally known as Ariosto and used by Rembrandt as a pattern for his own self-portrait looking disdainful and self-assured.
Portrait in red chalk	1512	1512-Leonardo-da-Vinci-Portrait.jpg	Leonardo da Vinci	circa 1512 to 1515, widely (though not universally) accepted as a genuine self-portrait.
	1514	1514-Dosso-Dossi-Circe.jpg	Dosso Dossi	
The Moneylender and his Wife (1514) Oil on panel	1514	1514-Quentin-Matsys-Moneylender.jpg	Quentin Matsys	71 x 68 cm Musée du Louvre, Paris
	1516	1516-Titian-It.jpg	Titian	
	1518	1518-Ambrosius-Holbein-Portrait.jpg	Ambrosius Holbein	
Detail of a self-portrait	1518 X	1518X-Tintoretto-Detail.jpg	Tintoretto	
The Mystic Marriage of St. Catherine (c. 1520)	1520	1520-Correggio-Mystic.jpg	Correggio	Correggio's most important contribution to the High Renaissance art

## Bibliography

### Chapter 1

- [1-1] Plato, Lee, D. (trans). The Republic. London: Penguin Classics, 1955, 509d ff.
- [1-2] Aristotle, W.S. Hett (trans). Aristotle: On the Soul. Parva Naturalia. On Breath. Loeb Classical Library, 1975, 3.4.430a1
- [1-3] Lucretius, Esolen, A. (trans). On the Nature of Things: De Rerum Natura, The John Hopkins University Press, 1995
- [1-4] Pierce, Charles. How to Make Our Ideas Clear. *Popular Science Monthly*, Jan 1878, 12, 286-302
- [1-5] Wittgenstein, L., Ogden, C.K. (trans.). Tractatus Logico-Philosophicus. Dover Publications, 1998
- [1-6] Plato, Nehamas A., Woodruff, P. Phaedrus. Hacked Publishing Company, 1995, 265d
- [1-7] Sayers, W.C. Berwick. A Manual of Classification for Librarians and Bibliographers. London: Andre Deutsch, 1959, p. 5
- [1-8] Polanyi, Michael, G. Marjorie (ed.). Knowing and Being: Essays by Michael Polanyi. Chicago: University of Chicago Press, 1969
- [1-9] Casson, Lionel. Libraries in the Ancient World. New Haven: Yale University Press, 2001, 37
- [1-10] Wiegand, Wayne. The "Amherst Method": The Origins of the Dewey Decimal Classification Scheme. *Libraries & Culture Spring*, 1998, 33 (2), 1998, Retrieved Apr 1st, 2007 from:  
[http://www.gslis.utexas.edu/~landc/33\\_2\\_TOC.htm](http://www.gslis.utexas.edu/~landc/33_2_TOC.htm)
- [1-11] Svenonius, Elaine. The Intellectual Foundation of Information Organization. Cambridge MIT Press 2000
- [1-12] Ranganathan, S.R. Impact of growth in the universe of subjects on classification. Copenhagen: Danish Centre for Documentation, International Federation for Documentation, Committee on Classification Research FID/CR Report, 1972, 12, p. 1-20
- [1-13] Arms, William Y. Digital Libraries. Cambridge: MIT Press, January 2000
- [1-14] Bush, Vannevar. As We May Think. *The Atlantic Monthly*, 1945, 176 (1), p. 107
- [1-15] Burners-Lee, Tim. Weaving the Web. San Francisco: Harper San Francisco, Sept 1999

## Chapter 2

- [2-1] U.S. Supreme Court. *Nix vs. Hedden*, 149 U.S. 304. May 1893
- [2-2] Baldinger, Kurt. Semantic Theory: Towards a Modern Semantics. New York St. Martin's Press 1980
- [2-3] Kuhn, Thomas. The Structure of Scientific Revolutions. Chicago: University of Chicago Press, 1962
- [2-4] Ross, Kelly L. *The Greek, Indian and Chinese Elements*. 2007. Retrieved Apr 1st, 2007 from <http://www.friesian.com/elements.htm>
- [2-5] Dear, Peter. The Intelligibility of Nature. Chicago: University of Chicago Press, 2006
- [2-6] Verdier, Nicolas. Hierarchy: A Short History of a Word in Western Thought. *Hierarchy in Natural and Social Sciences*, Springer-Verlag, 2006, 3
- [2-7] Linneaus, Carolus. *Systema Naturae (A System of Nature)*. 1735
- [2-8] Darwin, Charles. *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. London: John Murray 1st edition. 1859
- [2-9] Euclid, Thomas L. Heath. The Thirteen Books of Euclid's Elements. 1956
- [2-10] Novak, J.D. and Canas, A.J. *The Theory Underlying Concepts Maps and How to Construct Them*. *Florida Institute for Human and Machine Cognition*, 2006. Technical Report IHMC CmapTools 2006-01, 2006
- [2-11] Novak, J.D. Learning, Creating and Using Knowledge: Concept maps as facilitative tools for schools and corporations. Mahwah: Lawrence Erlbaum & Associates 1998
- [2-12] Dalton, John. A New System of Chemical Philosophy. Manchester, 1808, 1810, 1827.
- [2-13] Mendeleev, Dimitri. Principles of Chemistry. St. Petersburg: Osnovy Khimii, 1869
- [2-14] Olle, William T. The Codasyl Approach to Data Base Management. John Wiley & Sons, 1978
- [2-15] Codd, E.F. *A Relational Model of Data for Large Shared Data Banks*. *Communications of the ACM*, 1970, 13 (6), p. 377-387
- [2-16] Licklider, J.C.R. Libraries of the Future. Cambridge: MIT Press, Mar 1965

- [2-17] Arms, William Y. Digital Libraries. Cambridge: MIT Press, Jan 2000
- [2-18] Engelbart, Douglas C. Augmenting Human Intellect: A Conceptual Framework. Menlo Park, CA. Summary Report AFOSR-3223. SRI Project 3578 for Air Force Office of Scientific Research, Stanford Research Institute, 1962
- [2-19] Johnson, J. & Roberts, T.L. The Xerox Star: A Retrospective. *IEEE Computer*, Sept 1989, p. 11-15
- [2-20] Spence, Robert. Information Visualization. New York: ACM Press, 2001.
- [2-21] Tufte, Edward R. The Visual Display of Quantative Information. Cheshire: Graphics Press, 1992
- [2-22] Martin, G. Steven. The Hunting of the Src. *Nature Reviews Molecular Cell Biology*, 2001, 2, p. 467-475
- [2-23] Ewald, P.P. Fifty Years of X-Ray Diffraction. Springer, 1962. Retrieved Apr 1st, 2007 from [http:// www.iucr.org / iucr-top / publ / 50YearsOfXrayDiffraction / index.html](http://www.iucr.org/iucr-top/publ/50YearsOfXrayDiffraction/index.html)
- [2-24] Robertson, G., Mackinlay, J. & Card, S. Cone Trees: Animated 3D Visualizations of Hierarchical Information. *Proceedings of CHI'91 Conference on Human Factors in Computing Systems*, New Orleans, May 1991, p. 189-194
- [2-25] Shneiderman, Ben. Tree visualization with tree-maps. *ACM Transactions on Graphics*, ACM Press, New York. 1992, 11 (1), p. 92-99
- [2-26] Munzner, Tamara. Exploring Large Graphs in 3D Hyperbolic Space. *IEEE Computer Graphics and Applications*, July 1998, 18 (4), p. 18-23
- [2-27] Tolman, E.C. Cognitive Maps in Rats and Man. *Psychological Review*, 1948, 55, p. 189-208
- [2-28] Paul, Christiane. Digital Art. New York: Thames & Hudson Ltd. 2003, p. 174-182
- [2-29] Fry, Benjamin. *Organic Information Design*. Master's thesis. MIT Media Lab, May 1997. Retrieved Apr 1st 2007 from: [http:// acg.media.mit.edu / people / fry / thesis /](http://acg.media.mit.edu/people/fry/thesis/)
- [2-30] Chomsky, Noam. Syntactic Structures. The Hague/Paris: Mouton 1957
- [2-31] Manning, C. & Hinrich, S. Foundations of Statistical Natural Language Processing. Cambridge: MIT Press, May 1999

### Chapter 3

- [3-1] Cole, John Y. A Brief History of the Library of Congress. Library of Congress, 2006. Retrieved 4/1/2007 from <http://www.loc.gov/loc/legacy>
- [3-2] Lyman, Peter & Varian, H.R. How Much Information?. University of California Berkeley, 2000. Retrieved from 4/1/2007 from <http://www.sims.berkeley.edu/how-much-info>
- [3-3] Manning, C. & Hinrich, S. Foundations of Statistical Natural Language Processing. Cambridge: MIT Press, May 1999
- [3-4] Stenmark, Dick. Information vs. Knowledge: The Role of Intranets in Knowledge Organization. *IEEE Proceedings of the 35th Hawaii International Conference on System Sciences*, 2002
- [3-5] Spek, R. and Spijkervet A. Knowledge Management: Dealing Intelligently with Knowledge. Utrecht: CIBIT, 1997
- [3-6] Davenport, T.H. & Prusak, L. Working Knowledge. Boston: Harvard Business School Press, 1998
- [3-7] Davenport, T.H. Information Ecology. New York: University Press, 1997
- [3-8] Nonaka, I. and Takeuchi, H. The Knowledge-Creating Company. New York: Oxford University Press, 1995
- [3-9] Shannon, C. and Weaver, W. A Mathematical Theory of Communication. Urbana: University of Illinois Press, 1948
- [3-10] Kurzweil, Raymond. The Age of Intelligent Machines. Cambridge: MIT Press, 1992
- [3-11] Ogden, C.K. and Richards, I.A. The Meaning of Meaning: A Study of the Influence of Language upon Thought and of the Science of Symbolism. University of Cambridge Magdalene College, 1923
- [3-12] Baldinger, Kurt. Semantic Theory: Towards a Modern Semantics. New York: St. Martin's Press 1980
- [3-13] Svenonius, Elaine. The Intellectual Foundation of Information Organization. Cambridge MIT Press 2000 64
- [3-14] Luhn, Hans Peter. Keyword-in-Context Index for Technical Literature. Yorktown Heights, NY Technical Report RC-127, IBM, 1959

## Chapter 4

- [4-1] Bush, Vannevar. As We May Think. *The Atlantic Monthly*, 1945, 176 (1), p. 107
- [4-2] Licklider, J.C.R. Libraries of the Future. Cambridge: MIT Press, Mar 1965, p. 33
- [4-3] Asimov, Isaac. Foundation. Spectra, 1951
- [4-4] Kochen, Manfred. The Growth of Knowledge. Wiley, 1967, p. 11
- [4-5] Van Doren, Charles. L'Encyclopediae francaise. *The American Behavioral Scientist*, Sept 1962, 6 (1), p. 23-26
- [4-6] Casson, Lionel. Libraries in the Ancient World. 2001, p. 37
- [4-7] Cutter, Charles Ammi. Rules for a Dictionary Catalog. The Library Association, 1962
- [4-8] Avram, Henriette D. The MARC Pilot Project. Final Report. *Library of Congress*, Z 699 U525, 1968
- [4-9] Arms, William Y. Digital Libraries. Cambridge: MIT Press, Jan 2000
- [4-10] Quint, Barbara. Google and Research Libraries Launch Massive Digitization Project. *Information Today*. Retrieved Apr 1st, 2007 from <http://newsbreaks.infotoday.com/nbreader.asp?ArticleID=16307>
- [4-11] Notes from the January 2006 Meeting of the NDIIIP. Library of Congress 2006. Retrieved Apr 1st, 2007 from [http://www.digitalpreservation.gov/partners/project\\_mtg010906.html](http://www.digitalpreservation.gov/partners/project_mtg010906.html)
- [4-12] Collison, Robert. *Encyclopaediae: Their History Throughout the Ages*. New York: Fafner Publishing Co., 1964, 1st ed.
- [4-13] Smellie, William (ed.). *Encyclopaedia Britannica. Encyclopaedia Britannica Inc. 1768-1771*, 1st ed.
- [4-14] Encarta. Microsoft Product Details. Retrieved Apr 1st, 2007 from <http://www.microsoft.com/products/encarta/ProductDetails.aspx?pid=002>
- [4-15] Greenstein, Shane & Devereux, Michelle. The Crisis at Encyclopaedia Britannica. *Northwestern University Kellogg School of Management*. Retrieved Apr 1st, 2007 from <http://www.kellogg.northwestern.edu/faculty/greenstein/images/htm/Research/Cases/EncyclopaediaBritannica.pdf>
- [4-16] Wikipedia (definition). In Wikipedia, The Free Encyclopedia March 2007 <http://en.wikipedia.org/wiki/Wikipedia>

- [4-17] Mayfield, Kendra. Not Your Father's Encyclopediae. *Wired Magazine*. Jan 28th 2003
- [4-18] Licklider, J.C.R. Man-Machine Symbiosis. *IRE Transactions on Human Factors in Electronics*, HFE-1 1960 4 11
- [4-19] Leiner, B., Cerf, V., Clark, D., Kahn, R., Kleinrock, L., Lynch, D., Postel, J. Roberts, L. & Wolff, S. A Brief History of the Internet. *Internet Society (ISOC)*. Dec 20th, 2003. ver 3.32. Retrieved Apr 1st, 2007 from: <http://www.isoc.org/internet/history/brief.shtml>
- [4-20] Burners-Lee, Tim. Weaving the Web. Harper: San Francisco, Sept 1999 p. 182
- [4-21] Fallows, D. & Rainie, L. The popularity and importance of search engines. Data memo. PEW Internet & American Life Project, Aug 2004 [http://www.pewinternet.org/pdfs/PIP\\_Data\\_Memo\\_Searchengines.pdf](http://www.pewinternet.org/pdfs/PIP_Data_Memo_Searchengines.pdf)
- [4-22] Kleinberg, Jon. Structure of the Web. *Science*. Nov 2001, 294 (30), p. 1849-50
- [4-23] Manning, C. & Hinrich, S. Foundations of Statistical Natural Language Processing. Cambridge: MIT Press, May 1999
- [4-24] Bray, Tim. A conversation with Tim Bray: Searching for ways to tame the world's vast stores of information. *Association for Computing Machinery*, Feb 2005, 3 (1)
- [4-25] Cathey, R., Beitzel, S., Jensen, E., Pilotto, A., Grossman, D. Measuring the scalability of relationally mapped semistructured queries. *Proceedings of ITCC 2004 International Conference on Information Technology: Coding and Computing*, 2004. Vol 2. p. 219-223. Apr 2004.
- [4-26] Shanmugasundaram, J., Tufte, K., He, G., Zhang, C., DeWitt, D., Naughton, J. Relational Databases for Querying XML Documents: Limitations and Opportunities. *Proceedings of the 25th VLDB Conference*, 1999. Edinburgh, Scotland.
- [4-27] W3C Working Group. W3C Resource Description Framework (RDF) schema specification. <http://www.w3.org/TR/1998/WD-rdf-schema>. March 1999.
- [4-28] Doctorow, Cory. Metacrap: Putting the torch to seven straw-men of the meta-utopia. Opinion article. Aug 2001 Ver 1.3. Retrieved Apr 1st, 2007 from <http://www.well.com/~doctorow/metacrap.htm>
- [4-29] Goth, Greg Data-Driven Enterprise: Slouching toward the Semantic Web. *IEEE Distributed Systems Online*, Art. No. 0306-o3006, 2006, 7(3)
- [4-30] Bachman, Charles W. Data structure diagrams. *Communications of the ACM*, 1969, 16 (11)

- [4-31] Codd, E.F. A Relational Model of Data for Large Shared Data Banks. *Communications of the ACM*, 1970, 13 (6), p. 377-387
- [4-32] Asimov, Isaac. Asimov's Biographical Encyclopedia of Science & Technology. Doubleday, 2nd Ed. 1982. Ref. 1139, p. 723
- [4-33] Hegner, Stephen J. Limitations of the Relational Model. *Principles of Database Systems (TDBC86)*. Lecture notes. Fall 2005. Retrieved from: [http://www.cs.umu.se/kurser/TDBC86/H05/Slides/20\\_OH\\_rellim.pdf](http://www.cs.umu.se/kurser/TDBC86/H05/Slides/20_OH_rellim.pdf)
- [4-34] National Research Council. Funding A Revolution: Government Support for Computing Research, Ch 6. Rise of Relational Databases. National Academy Press, 1999
- [4-35] Kim, Won. Introduction to Object-Oriented Databases. Cambridge: MIT Press, 1990
- [4-36] Rao, B.R. Object-Oriented Database Technology, Applications and Products. New York: McGraw-Hill, Inc.1994
- [4-37] Stonebraker, M. & Moore, D. Object-Relational DBMS: The Next Great Wave. Morgan: Kaufmann Publishers, 1996
- [4-38] Tesniere, Lucien. Elements de Syntaxe Structurale. Paris Librarie C. Klincksieck, 1950. 2nd ed.
- [4-39] Klein, S. & Simmons, R. Syntactic dependence and the computer generation of coherent discourse. *Mechanical Translation*, 1963, 7 (2)
- [4-40] Sowa, John. Conceptual Structures (Systems Programming Series). Longman: Higher Education, 1983
- [4-41] Buchanan, Bruce & Shortliffe, E. (eds.) Rule-based Expert System: The MYCIN Experiment of the Stanford Heuristic Programming Project. Reading: Addison-Wesley Publishing Company, 1984
- [4-42] Gyssens, M., Paradaens, J., Gucht, D. A Graph-Oriented Object Database Model. *Proceedings of the 9th ACM Special Interest Group on Management of Data (SIGMOD) Symposium on Principles of Database Systems*, 1990. ACM Press, New York, NY. 417-424
- [4-43] Levene, M. & Loizou, G. A Graph-Based Data Model and Its Ramifications. *IEEE Transactions on Knowledge and Data Engineering*. IEEE Educational Activities Department, 1995. Piscataway, NJ. 7(5), p. 809-823
- [4-44] Cardelli, L. (Microsoft Research) Describing Semistructured Data. *ACM SIGMOD Record*, 2001. ACM Press, New York, NY. 30 4 80-85
- [4-45] Levene, M. On the Information Content of Semi-Structured Databases. *Acta Cybernetica*, 1998. Szeged, Hungary 13 3 257-275

## Chapter 5

- [5-1] Sowa, John. Conceptual Structures (Systems Programming Series). Longman: Higher Education, 1983
- [5-2] Asimov, Isaac. Asimov's Biographical Encyclopedia of Science & Technology. Doubleday, 2nd Ed. 1982
- [5-3] Tompa, F.W. A data model for flexible hypertext database systems. *ACM Transactions*, 1989
- [5-4] Levene, M. & Loizou, G. A Graph-Based Data Model and Its Ramifications. *IEEE Transactions on Knowledge and Data Engineering*, IEEE Educational Activities Department, 1995. Piscataway, NJ. 7(5) p. 809-823
- [5-5] Catarci, T. & Tarantino, L. A Hypergraph-based Framework for Visual Interaction with Databases. *Journal of Visual Languages and Computing*, 1995, 6, p. 135-166
- [5-6] Shapiro, S. & Ali, S. Natural Language Processing Using a Propositional Semantic Network with Structured Variables. *Minds and Machines*, 1993. 3 (4)
- [5-7] Chomsky, Noam Three models for the description of language. *IRE Transactions on Information Theory*, 1956, 2, p. 113-124
- [5-8] Klein, E., Sag, I., Pullum, G. Generalised Phrase Structure Grammar. Harvard: University Press, 1985
- [5-9] Gyssens, M., Paradaens, J., Gucht, D. A Graph-Oriented Object Database Model. *Proceedings of the 9th ACM Special Interest Group on Management of Data (SIGMOD) Symposium on Principles of Database Systems*, 1990, p. 417-424
- [5-10] Levene, M. On the Information Content of Semi-Structured Databases. *Acta Cybernetica*, 1998. Szeged, Hungary 13 3 257-275
- [5-11] Gamma, E., Helm, R., Johnson, R. & Vlissides, J. Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley Professional, 1st ed. 1995
- [5-12] Brin, Sergey & Page, Lawrence The Anatomy of a Large-Scale Hypertextual Web Search Engine. *Proceedings of the 7th International Conference on the World Wide Web*, 1998. Brisbane, Australia. p. 107-117

## Chapter 6

- [6-1] Aristotle. Categories. Sec. 1, Part 5
- [6-2] Kirk, G.S & Raven, J.E. The Presocratic Philosophers. Cambridge: University Press. 1963
- [6-3] Quine. On What There Is. *Review of Metaphysics*. 1948
- [6-4] Cincharella, Nino. Time, Being and Existence: Lecture Two. Lecture notes. 2004. Retrieved Apr 1st, 2007 from: [http://www.stoqnet.org/lat\\_notes.html](http://www.stoqnet.org/lat_notes.html)
- [6-5] Peirce, Charles S. On a New List of Categories. *Proceedings of the American Academy of Arts and Sciences* 7, 1868, p. 287-298
- [6-6] Gruber, T.R. A translation approach to portable ontologies. *Knowledge Acquisition*. 1993, 5(2), p. 199-220
- [6-7] H. Wache, T. Vogele, U. Visser, H. Stuckenschmidt, G. Schuster, H. Neumann, S. Hubner. Ontology-Based Integration of Information: A Survey of Existing Approaches. *IJACI-01 Workshop: Ontologies and Information Sharing*. 2001
- [6-8] Smith, Barry. Ontology and Information Systems. *Forthcoming in the Stanford Encyclopedia of Philosophy 2005*. Retrieved Apr 1st, 2007 from [http://ontology.buffalo.edu/ontology\(PIC\).pdf](http://ontology.buffalo.edu/ontology(PIC).pdf)
- [6-9] A Tribute to S.R. Ranganathan, the Father of Indian Library Science. *Information Scientist*. Feb 1984, 7, p. 37-44
- [6-10] Pullan, M., Watson, M., Kennedy, J., Raguenaud, C., Hyam, R. The Prometheus Taxonomic Model: a practical approach to representing multiple taxonomies. *Taxon*, 2000. 49 (1) p. 55-75
- [6-11] Gruninger, M. & Lee, J. Ontology: Application and Design. *Communications of the ACM*. Feb 2002, 45(2), p. 39
- [6-12] Dear, Peter. The Intelligibility of Nature. Chicago: University of Chicago Press, 2006
- [6-13] Reat, N. Ross. The Salistamba Sutra: Tibetan Original, Sanskrit Reconstruction and English Translation. Motilal Banarsidass, Dehli, India. 1993
- [6-14] Coad, P. & Nicola, J. Object-Oriented Programming. Prentice Hall, PTR 1993. ISBN 0-13-032616X
- [6-15] Sowa, J.F. Knowledge Representation: Logical, Philosophical and Computational Foundations. Pacific Grove, CA Brooks / Cole 2000

- [6-16] Hayes, Patrick J. Naive physics I: Ontology for liquids. Hobbs & Moore 1985, p. 71-107
- [6-17] Gaarder, Jostein. Sophie's World: A Novel about the History of Philosophy. Berkley, Mar 1996.
- [6-18] Bhattacharya, Bela. Dependent Origination in Buddhism. Gangtok, India *Bulletin of Tibetology, Sikkim Research Institute of Tibetology*. 1982, 4, p. 4-13
- [6-19] Heraclitus, H. Brooks, Hillman, J. Fragments: The Collected Wisdom of Heraclitus. Viking Adult. Feb 2001
- [6-20] Wittgenstein, L., Ogden, C.K. (trans.) Tractatus Logico-Philosophicus. Dover Publications, 1998
- [6-21] Hilbert, D. & Ackermann, W. Grundzuge der theoretischen Logik (Principles of Theoretical Logic). Springer-Verlag, 1928. ISBN 0-8218-2024-9
- [6-22] Lenat, Douglas B. Cyc: A Large-Scale Investment in Knowledge Infrastructure. *Communications of the ACM*, Nov 1995, 38 (11)
- [6-23] Fellbaum, Christiane, ed. WordNet: An Electronic Lexical Database, MIT Press, May 1998.
- [6-24] Pease, A., Niles, I., and Li, J. 2002. The Suggested Upper Merged Ontology: A Large Ontology for the Semantic Web and its Applications. In *Working Notes of the AAAI-2002 Workshop on Ontologies and the Semantic Web*, Edmonton, Canada, July 28-Aug 1, 2002.

## Chapter 7

- [7-1] Silverman, L.K. Upside-Down Brilliance: The Visual Spatial Learner. DeLeon Publishing, Inc. 2002. ISBN 193218600X.
- [7-2] Tufte, E. Envisioning Information. Graphics Press, 1990.
- [7-3] Ware, C. Information Visualization: Perception for Design. Elsevier Inc. 2004
- [7-4] Tufte, E. Visual Explanations. Graphics Press, 1997.
- [7-5] Spence, Robert. *Information Visualization*. ACM Press, 2001, p. 135-138
- [7-6] Tolman, E.C. Cognitive Maps in Rats and Man. *Psychological Review* 1948, 55, p. 189-208
- [7-7] Rosling, Hans. History's Arrow. TED Talks 2006. *The Future We Will Create*, 2006. Monteray, CA. Retrieved Apr 1st, 2007 from: [http://www.ted.com/tedtalks/tedtalksplayer.cfm?key=hans\\_rosling](http://www.ted.com/tedtalks/tedtalksplayer.cfm?key=hans_rosling)
- [7-8] Mamedov, A.M. Relationship between thermal conductivity, speed of sound, and isobaric heat capacity of liquids. *Journal of Engineering Physics and Thermophysics*, Springer, NY. 1980. 39 (2)
- [7-9] Robertson, G., Mackinlay, J., Card, S. Cone Trees: Animated 3D Visualizations of Hierarchical Information. *ACM Special Interest Group in Computer-Human Interaction (SIGCHI)*, 1991. ACM Press, New York, N. p. 189-194
- [7-10] Cockburn, A., McKenzie, B. An Evaluation of Cone Trees. *People and Computers XIV: British Computer Society Conference on Human Computer Interaction*, 2000. Springer-Verlag, p. 425-436
- [7-11] Shneiderman, Ben. Tree visualization with tree-maps: 2D space-filling approach. *Transactions on Graphics*, ACM Press, New York, NY ACM 1992. 11 (1), p. 92-99
- [7-12] Lamping J., Rao R., Pirolli P. A focus and context technique based on hyperbolic geometry for visualizing large hierarchies. *Proceedings of ACM SIGCHI 1995 Conference on Human Factors in Computing Systems*, 1995. p. 401-408
- [7-13] Munzner, Tamara. Exploring Large Graphs in 3D Hyperbolic Space. *IEEE Computer Graphics and Applications*, July 1998. 18 (4), p. 18-23
- [7-14] Wang, W., Wang, Hui, Dai, G., Wang, Hongan Visualization of large hierarchical data by circle packing. *Proceedings of ACM SIGCHI 2006 Conference on Human Factors in Computing Systems*, 2006. Montreal, Quebec, Canada. p. 517-520

- [7-15] Rosenberg, D. The Trouble with Timelines. *Cabinet Magazine*, 2004, 13  
Retrieved Apr 1st, 2007 from:  
<http://www.cabinetmagazine.org/issues/13/timelinesIntro.php>
- [7-15] Huynh, D., Drucker, S., Baudisch, P., Wong, C. Time quilt: Scaling up zoomable photo browsers for large, unstructured photo collections. *SIGCHI 2005 Extended abstracts on Human Factors in Computing Systems*, 2005. Portland, OR. p. 1937-1940
- [7-16] Huynh, D. Timeline. Simile, MIT CSAIL. 2006
- [7-17] Foley, J., van Dam, A., Feiner, S., Hughes, J. Computer Graphics: Principles and Practice. Addison-Wesley Professional, 1995
- [7-18] Eades, P. A heuristic for graph drawing. *Congressus Numerantium*, 1984. 42, p. 149-160
- [7-19] Kamada, T. & Kawai, S. An algorithm for drawing general undirected graphs. *Information Processing Letters*, 1989. 31 (1), p. 7-15
- [7-20] Becker, R.A., Eick, S.G., Wilks, A.R. Visualizing Network Data. *IEEE Transactions on Visualization and Computer Graphics*, 1995, 1, p. 16-28
- [7-21] Westphal, C. & Blaxton, T. Data Mining Solutions. New York: Wiley, 1998
- [7-22] Davenport, E., Buckner, K. & Barr, K. SO-grams: A personalisation toolkit for intranet users. *Knowledge Management and Kommunikationssystem, Proceedings des 6 Internationalen Symposiums fur Informationswissenschaft (ISI '98)*, 1998
- [7-23] Hendley, R.J., Draw, A.J., Wood, A.M., Beale, R. Narcissus: Visualising Information. *IEEE Proceedings on Information Visualization*, 1995. p. 90-96
- [7-24] Neumann, P. Carpendale, S., Agarawala, A. PhylloTrees: Phyllotactic Patterns for Tree Layout. *The Eurographics Association Eurographics / IEEE VGTC Symposium on Visualization*, 2006
- [7-25] Chen, Chaomei. Information Visualization: Beyond the Horizon. Springer 2004
- [7-26] Philips, W.A. & Baddeley, A.D. Reaction time and short-term visual memory. *Psychonomic Science*, 1971. 22 (2), p. 73-74

]

## Chapter 8

- [8-1] Douglas E. Comer, Internetworking with TCP/IP Englewood Cliffs, NJ Prentice Hall 1995, Vol. 1
- [8-2] David Gourley & Brian Totty, HTTP: The Definitive Guide, O'Reilly Media, Inc. 2002
- [8-3] Tim Berners-Lee, Semantic Web Road Map, W3C World Wide Web Consortium, 1998. Retrieved June 2007 from:  
<http://www.w3.org/DesignIssues/Semantic.html>
- [8-4] C. Hedrick, RFC 1058 - Routing Information Protocol, Network Working Group, 1988. Request for Comments (RFCs) are available from the Internet Engineering Task Force (IETF) at: <http://tools.ietf.org/rfc/>
- [8-5] Douglas E. Comer, Internetworking with TCP/IP Englewood Cliffs, NJ Prentice Hall 1995, Vol. 1, Sec. 22.10, p. 391-393
- [8-6] Berners-Lee, T., Bray, T., Connolly, D., Cotton, P., Fielding, R., Jeckle, M., Lilley, C., Mendelsohn, N., Orchard, D., Walsh, N., Williams, S., Architecture of the World Wide Web, Volume One, W3C World Wide Web Consortium, Dec 2004, Ver. 20041215

## Chapter 9

- [9-1] Hoetzlein, R.C. & Schwartz, D., GameX: A Platform for Incremental Instruction in Computer Graphics and Game Design Los Angeles, CA SIGGRAPH 2005, Educators Program. 2005
- [9-2] Tom DeMarco, Controlling Software Projects: Management, Measurement and Estimation, ISBN 0-13-171711-1