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Problems in Formalization (AKA The Limits of Logic)

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Problems in Formalization (AKA The Limits of Logic)

Summary (I)

- Information Levels
 - Define Information by What it Does
 - Nominal||Attribute Form
- Hierarchy of Attributes
 - Basis for Lattice Descriptions
- Medical Reasoning and Practice
 - Vertical
 - Oriented Toward Attributes

Summary (II)

- Cooperative Computation
- Formalization a Necessity
 - Enables Computation
 - Aids Conception
- Terminological Imperative
 - Not the only Imperative
 - Machine Processible
 - Human Understandable

How Do We Achieve It ?

- Formal Symbolization
 - Establish Tokens for Terms
 - Logical Relationships Among Terms
 - Definitional
 - Contextual
- Understandable by Humans
 - Use Names We Recognize
 - Represent Contexts
- Interface to Aid Us in Establishing Tokens for a Given Operation

The Naïve Approach

- Controlled Set of Terms
- Controlled Definitions
- Enforce Use

Problems

- Terms often idiosyncratic
- Users do not understand definitions
- Difficult to maintain
- Not scalable
 - Need tools
 - Tools have formal methods

First Refinement

- Use Entry Terms
- Enable User to Find Correct Controlled Term
- Transparent Equivalence of Terms in System

More Sophisticated

- Concept Orientation
- Build a Thesaurus
 - One Token - One Meaning
 - Disambiguate Terms
- Content is King

Cimino's Desiderata

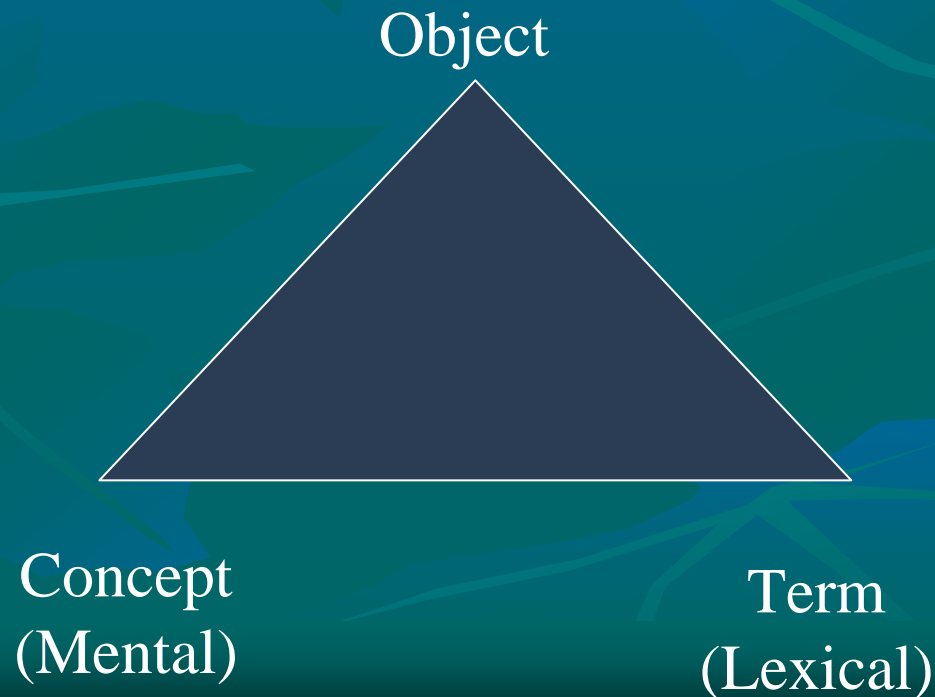
- Concept Orientation
- Multipurpose
- Multiple Granularity
- Polyhierarchical
- Unambiguous
- Formal Definitions
- Nonredundancy

Cimino's Desiderata (Technical)

- Meaningless Identifiers
- Concept Permanence
- No “NEC”
- Evolve Gracefully

The Concept of Concepts

- Lexical Concepts
- Mental Representations
- The Semiotic Triangle



Instances and Categorical Names

- Instances
 - Proper Names - single entities
 - Looks easy
 - Authority File
 - But, patient identification remains problematic
 - Semiotic Triangle makes sense
- Categorical Names
 - Natural Objects in Lattice Description
 - Other Objects (Artifacts) Are Different

Intensionality and Extensionality

- Frege - Use in Expressions
- Sense
 - Morning Star is bright (when?)
 - Evening Star is bright
- Reference
 - Venus = Morning Star = Evening Star

Natural and Coded Expressions

- Context Implied by Connotation
 - Diabetic Ketoacidosis
 - Diabetes with Ketoacidosis
- Conversational Implicatives
 - Patient denies Alcohol Use

Linguistic Complications

- Zipf's Law
- Metaphoric Language
- Anaphoria

Concepts as Synonym Classes

- Definition of Synonymy
 - Extensional
 - Intensional
- Identity versus Equivalence
- Plesionymy

Coding Expressions

- The “Fuzzy Concept”
- Entry Vocabulary
 - Plesionyms
 - Pseudosynonyms
 - Overlapping Meanings

Precoordination and Postcoordination

- Defined
 - Single Term = precoordinated
 - Composite Expression = postcoordination
- Atomic Expressions
- Level of Discourse Determines Atomicity

Representational Integrity

- One Meaning - One Place
- Exemplified
 - Pregnancy/complications and Pregnancy Complications
 - Pneumococcal Pneumonia
- More than Non-redundancy
 - Pre- and Post-Coordination
 - Multiple Expressions
- No Unrecognized Synonymy

Achieving RI

- Entry Combinations
- Mapping Rules
- Description Logic

Description Logic

- Development of Models and Axes
- Axes of Description
- Axes analogous to Comptean hierarchy?
- Assertion of synonymy if values on axis are identical

Axis Development

- Authoritative
 - Validity
 - Currency
- Update Model

Axes of Description -Criteria

- Orthogonality
- Suitability
- URU Criteria
 - Understandable
 - Reproducible
 - Useful
- Formal Ontology?

Does DL Work?

- Identity at level of abstraction
- Intended meaning may be deeper
- Like diagnosis, often a problem of recognition

Paradoxes in Terminology

- Content seemingly defies logic
- The way we use words often defies formal definitions
 - Wave-particle duality
 - The Escher phenomenon
 - Godel's Theorem
- Logicians do not understand content
 - Categorical Names of Artifacts
 - Natural Objects (open lattice description)

Conclusions about Terminology

- Perfect Formalization Impossible
 - Entry Vocabulary Helps
 - Human Linguistic Shortcuts
 - Logical Limits
- Representational Integrity Important
 - Description Logic an Important Step
- Updates Demand Attention!

The Importance of Updates

- Nature of Scientific Discovery
 - Find Something New
 - Assert A Property
 - What Makes It Different
 - Undiscovered Relationships
- Knowledge Must be Reflected in Terminology
- How Is It Reflected in Previously Encoded Knowledge?

Update Penalty

- Add Local Terms
- Maintain Representational Integrity
- Every update
 - Reconciliation
 - Resynchronization

Living in the Real World

- Perfection is Impossible
- Understand Where Breakdowns Occur
- Engineering Choices
 - Needs for Formality
 - Engines
 - Interfaces
 - User needs