_experience the commitment ™

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Semantic Technology

In relation to SOA . . .

Definition . . . Merriam-Webster's Dictionary

Defines **semantic** as:

'relating to meaning in language'

and defines semantics as:

'the study of meanings'.

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Definition . . . Wikipedia

Semantic technology

From Wikipedia, the free encyclopedia

In software, **semantic technology** encode meanings separately from data and content files, and separately from application code.

This enables machines as well as people to understand, share and reason with them at execution time. With semantic technologies, adding, changing and implementing new relationships or interconnecting programs in a different way can be just as simple as changing the external model that these programs share.

With traditional information technology, on the other hand, meanings and relationships must be predefined and "hard wired" into data formats and the application program code at design time. This means that when something changes, previously unexchanged information needs to be exchanged, or two programs need to interoperate in a new way, the humans must get involved.

Off-line, the parties must define and communicate between them the knowledge needed to make the change, and then recode the data structures and program logic to accommodate it, and then apply these changes to the database and the application. Then, and only then, can they implement the changes.

Semantic technologies are "meaning-centered." They include tools for:

- autorecognition of topics and concepts,
- information and meaning extraction, and
- categorization.

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Definition . . .

"Most of the Web's content today is designed for humans to read, not for computer programs to manipulate meaningfully. Computers can adeptly parse Web pages for layout and routine processing—here a header, there a link to another page—but in general, ***computers have no reliable way to process the semantics [meaning of what is on a page].***"

- Tim Berners-Lee

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Types of Expressiveness

Implicit

to involve or indicate by inference, association, or necessary consequence rather than by direct statement

NOT ACTIONABLE without human interpretation or custom coding

Explicit

fully revealed or expressed without vagueness, implication, or ambiguity: *leaving no question as to meaning or intent*

ACTIONABLE without human interpretation or custom coding

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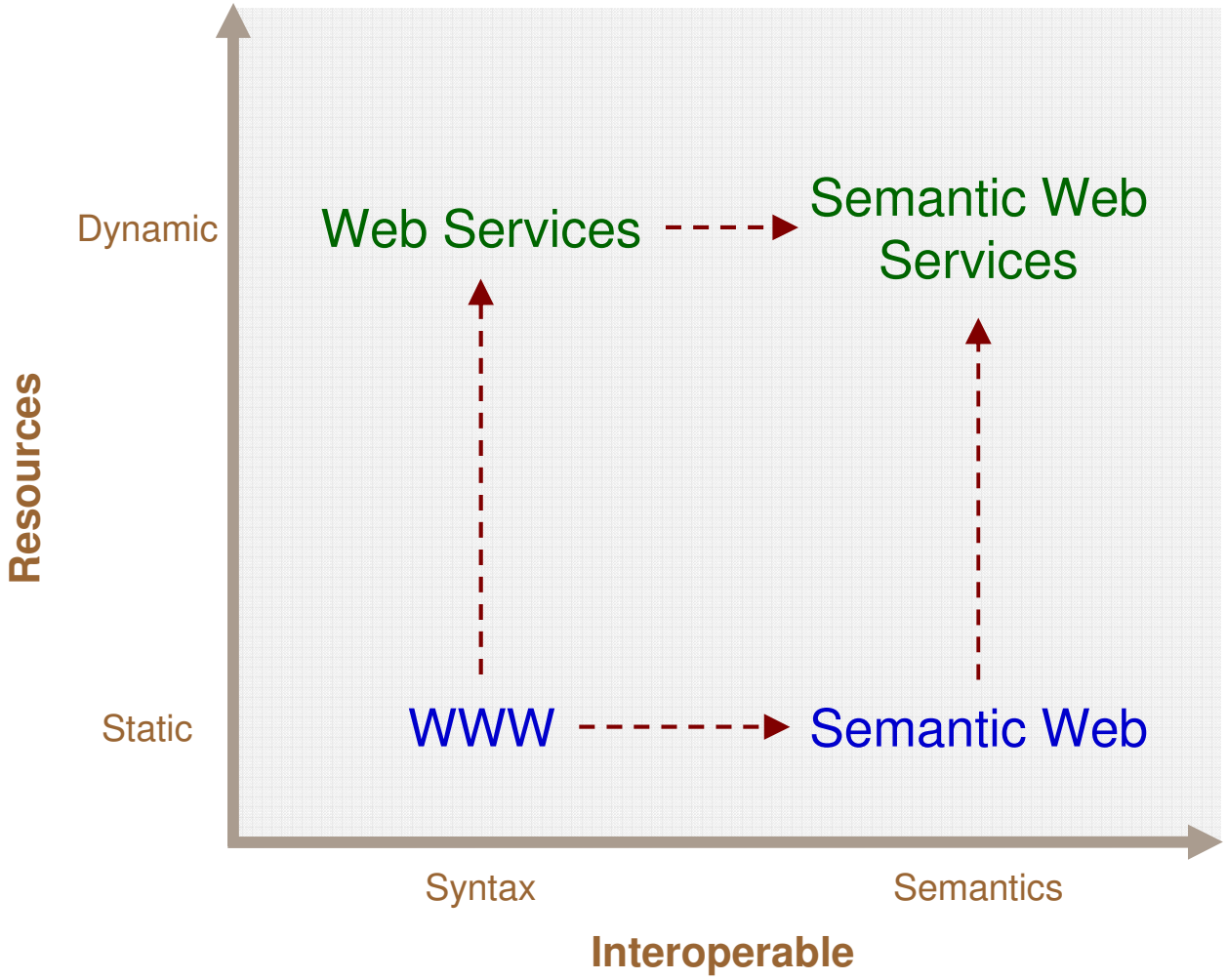
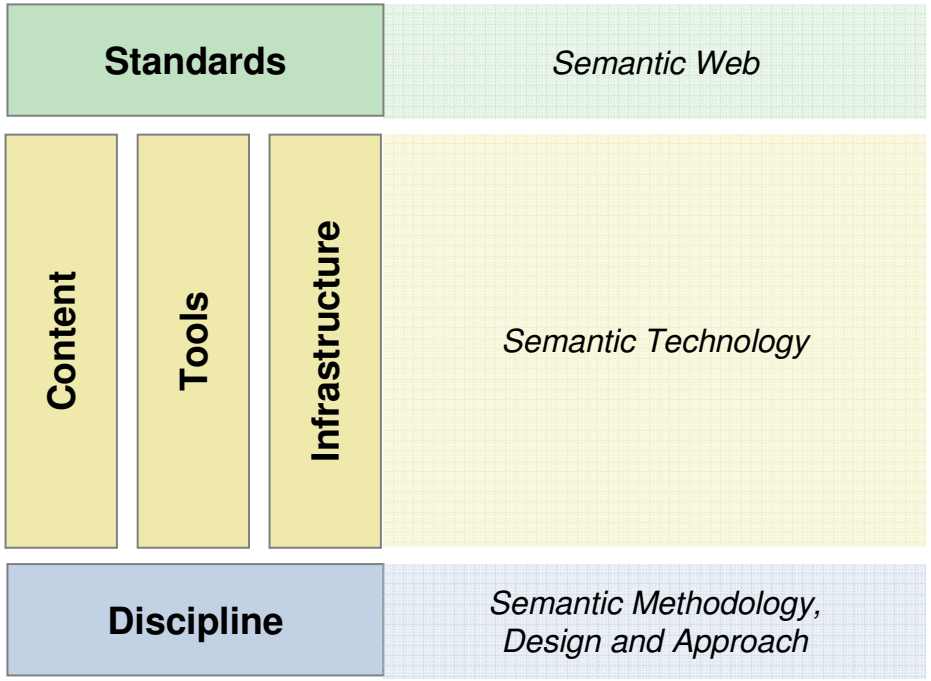
Problem Space



Facets of Semantic Technology



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Facets of Semantic Technology

Standards

- RDF
- OWL
- SWRL
- OWL-S
- WSMO
- WSDL-S

Content

- High Level Standard Ontologies
- Shared ABox Ontologies
- Enterprise Ontologies
- Project Ontologies
- Mapping/Bridging Ontologies
- Tagged Content

Tools

- Ontology Editors
- Vocabulary Editors
- Knowledge Editors
- Document Annotators
- Mapping Editors
- Collaboration Tools
- Legacy Understanding Tools
- Development Environments

Infrastructure

- Inference Engines
- Semantic Brokers
- Entity Extraction
- EII Engines
- Smart Query

Discipline

•Knowledge Management
•Facilitating the utilization of Semantic Technology

A more organized view of Semantic Technology has been offered by Dave McComb of Semantic Arts Group:

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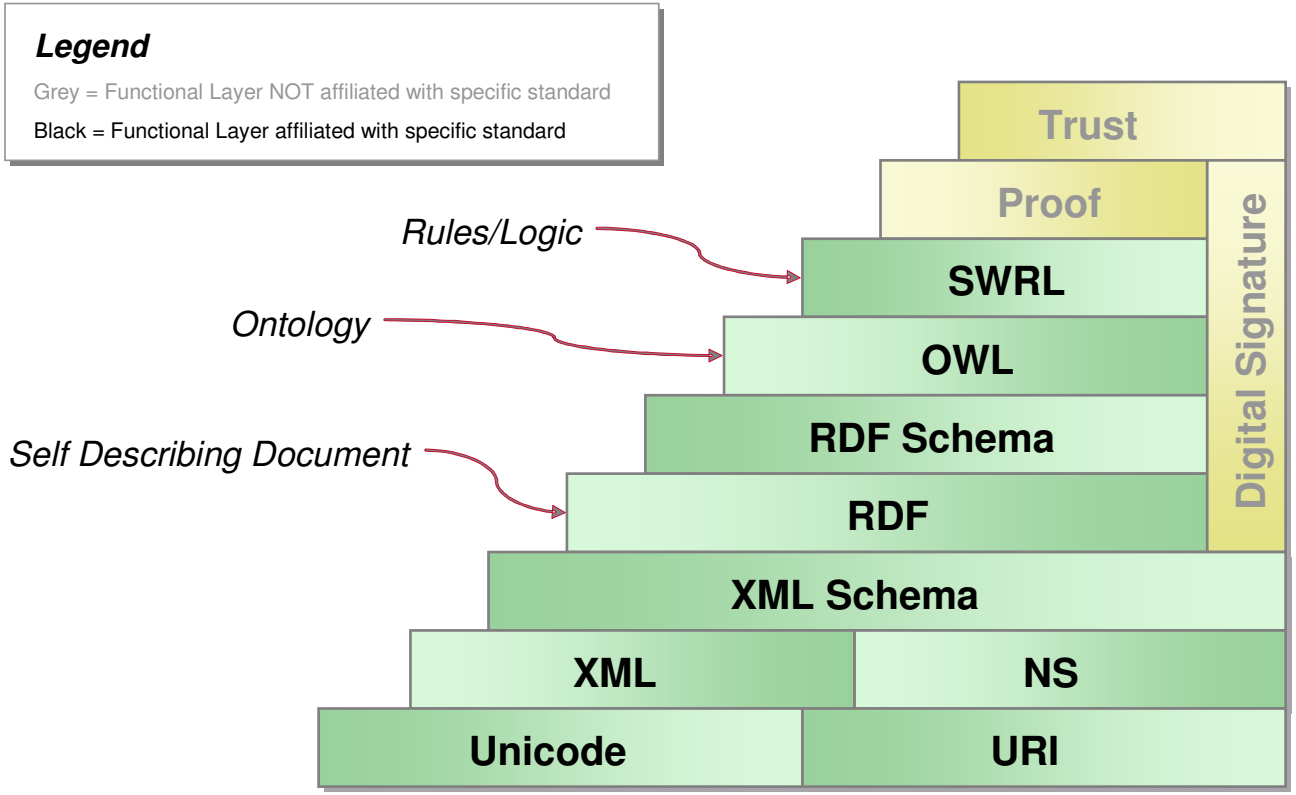
W3C's Semantic Web

Exhibit 5 – Core Semantic Web Standards Stack Today



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W3C's Semantic Web

Standard	Full Name	Purpose	Practical Considerations
SWRL	Semantic Web Rule Language	Rule Execution	Adds more complex reasoning and ability to execute action
OWL	Web Ontology Language	Inference and Reasoning	Query rules and other rules for concepts and relationships
RDF Schema	-	Frames and Classes	Adds Classes, Properties, and Subclasses
RDF	Resource Description Framework	Assertions and Merging	Defines 3 way relationships of instances as subject, predicate, and object as known as Triplets. By defining knowledge in this form, inference is possible
XML Schema	-	Data Structure and Validation	
NS	Name Space	Distinctiveness	
XML	Extensible Mark-up Language	Data, Meta Data, and Parsing	
URL	Universal Resource Locator	Logical Addressing	

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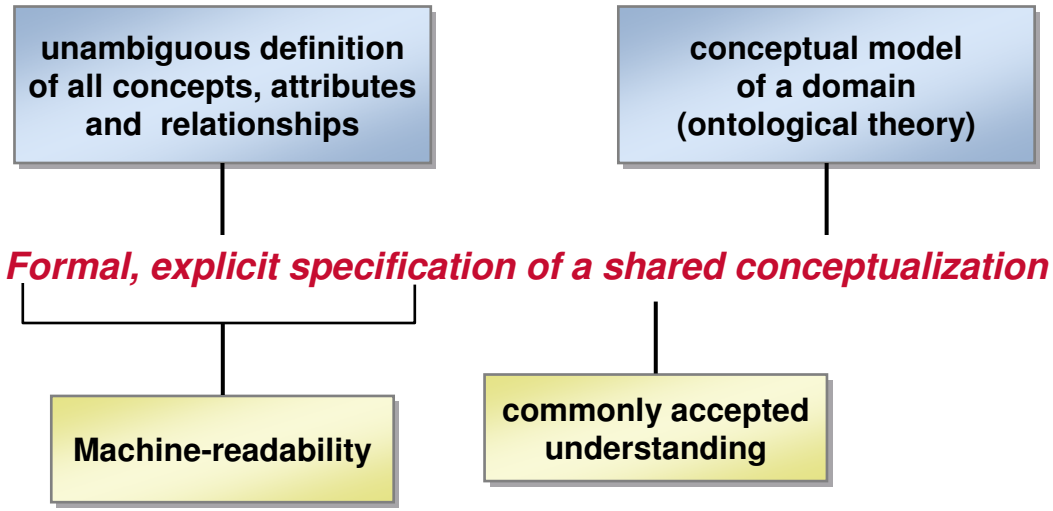
Defining Ontology vs Taxonomy



- **Taxonomy** or **Schema** is a **Vocabulary** plus **Structure**
- **Ontology** is a **Taxonomy** plus a set of **Constraints**, **Relationships**, and **Rules**

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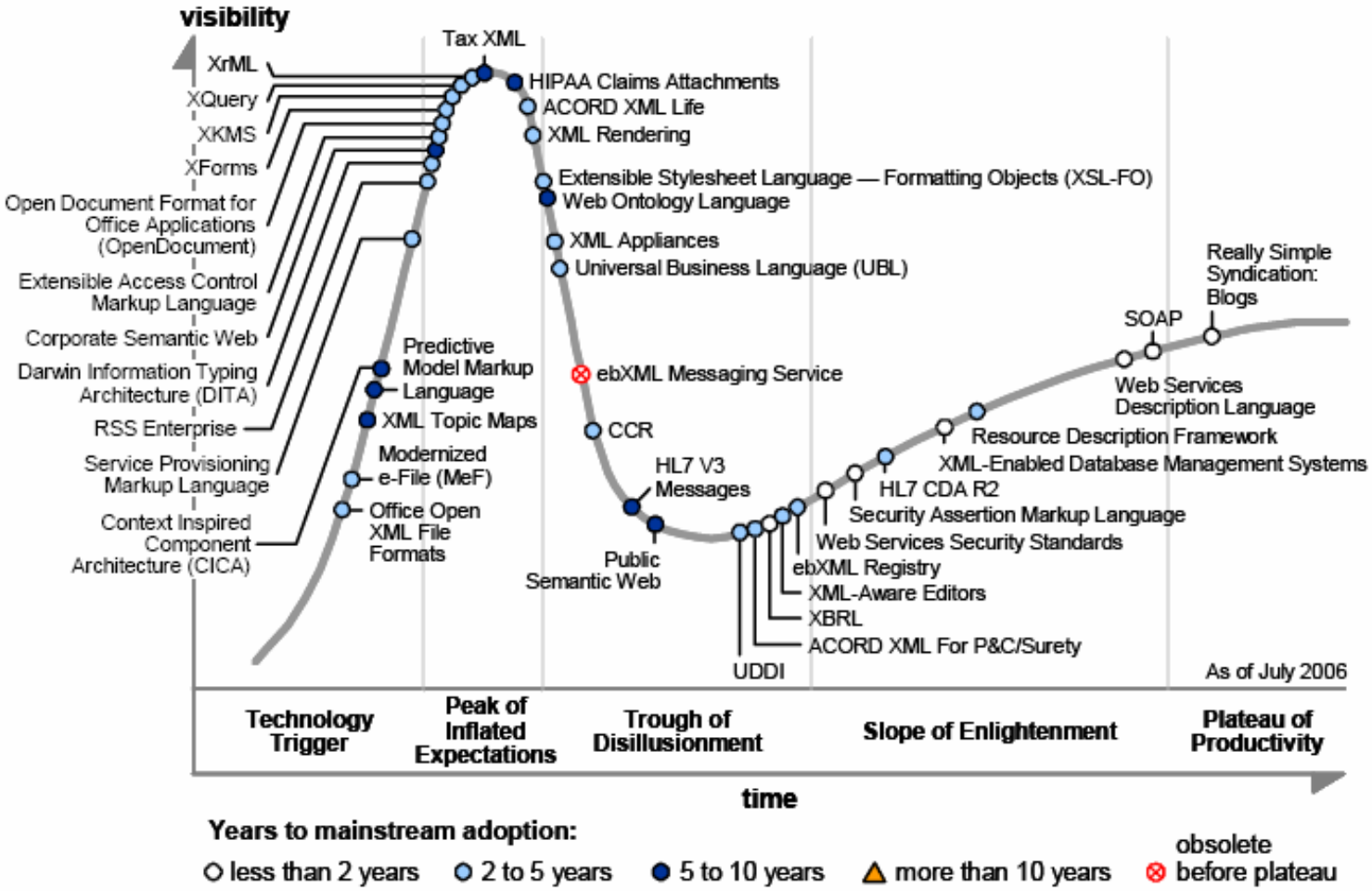
Hype Cycle of XML Technologies . . .

Figure 1. Hype Cycle for XML Technologies, 2006



Source: Gartner (July 2006)

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Semantic Technology – 7 General Areas of Application

1. **Unstructured Data Search**
   - Entity Extraction
   - Natural Language processing
   - Needle in a hay stack
2. **Knowledge Management**
   - Meta Level Semantics
   - Taxonomy
   - Vocabulary
   - Ontology Development
3. **Artificial Intelligence**
   - Inference
   - Logic
   - TBox Applications
   - Testing and Versioning
4. **Integration**
   - Service Discovery
   - Semantic Parity
   - Distributed data access
   - Semantic Brokers
   - Message Modeling and Mapping
   - Architectures
5. **Structured Data Capture**
   - New Semantically Based Applications
   - Semantic Modeling as a basis for Data Modeling
6. **Rules**
   - Agents
   - Rules Based Systems
   - Business Rules
   - Production Rules
7. **Federated Query**
   - Search (based on term meaning)
   - Simple View
   - Composites
   - Heterogenous Query
   - Recombinant
   - Microformats

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Some Semantic Web Services . . .

Standard	Description	Function
OWL-S	Web Ontology Language for Services	UDDI like intermediary utilizing OWL like engine to resolve service usage
SWSL	Semantic Web Services Language	Used to specify the Semantic Web Services Ontology (SWSO) as well as individual Web services. The language consists of two parts: SWSL-FOL, a full first-order logic language, and SWSL-Rules, as rule-based language. SWSL-FOL is primarily used for formal specification of the ontology and is intended to provide interoperability with other first-order based process models and service ontologies. In contrast, SWSL-Rules is designed to be an actual language for service specification.
WSMO	Web Service Modeling Ontology	WSMO is a complete conceptual model for Semantic Web Services and related aspects. Identifies four main elements: Web Services, Goals, Ontologies, and Mediators
WSML	Web Services Modelling Language	Provides a formal grounding for the conceptual elements of WSMO, based on: •Description Logics •Rule Languages •First-Order Logic
WSDL-S	Semantic Web Services Description Language	Extension to WSDL to co-locate semantic information with interface definition

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Some SOA Challenges . . .

Standard?	Function
?	Service Discovery
?	Semantic Parity
?	Limited validation of contract
?	Dynamic Update of Transaction Interface
?	Etc . . .

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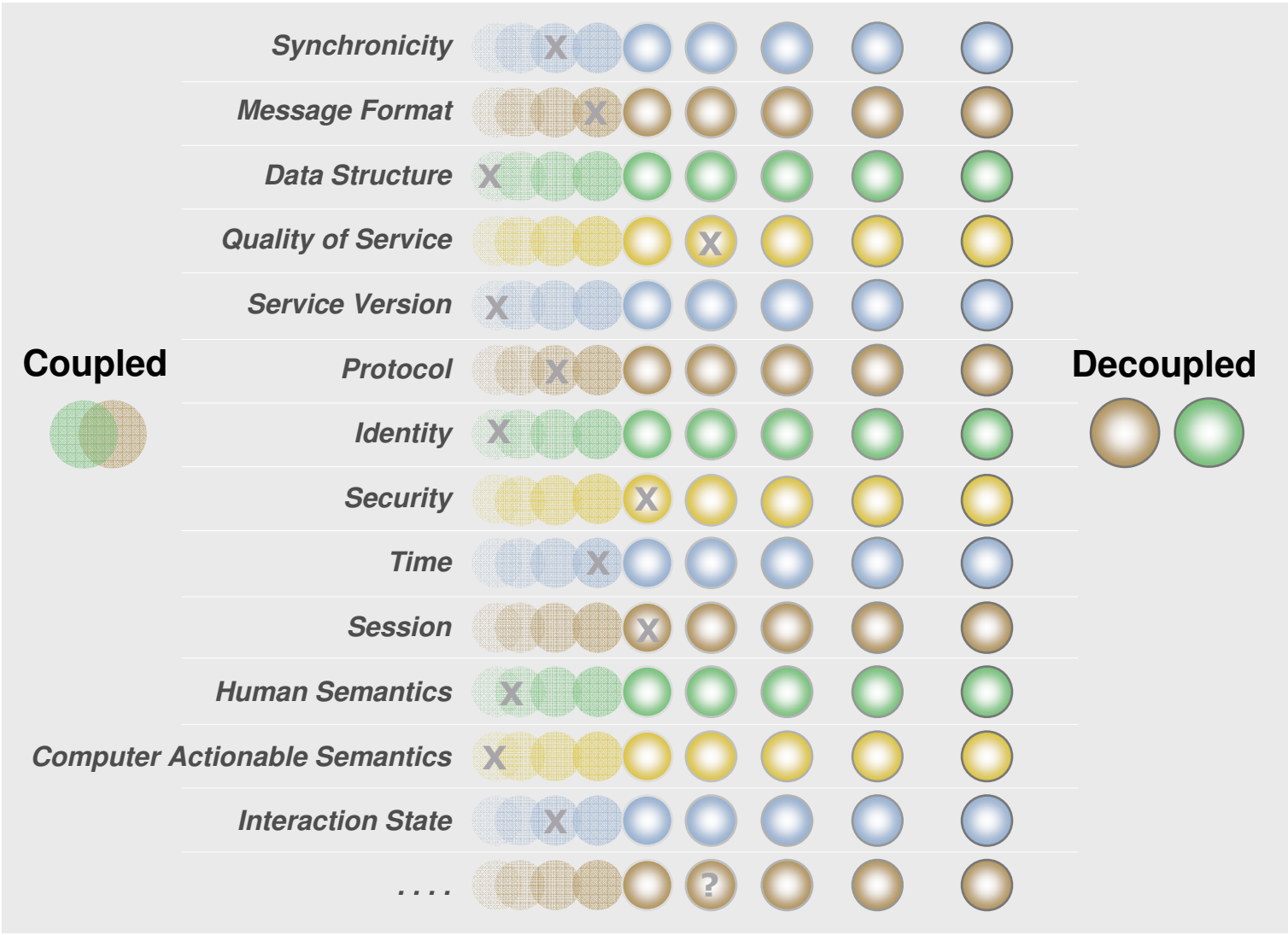
Degrees and Dimensions of Coupling . . .



The Essence of the Problem . . .

Why do we continue to Handicap Computers . . ?

“computers have no idea what is on a page“

1. **Identification** of data
   - Not requiring human’s to do all the manual work . . .
2. **Meaning** of data
   - **Human Perspective** – significance of data consistently interpreted and utilized
   - **Computer Perspective** – Machine actionable . . . And there are many actions that could be desired . . .

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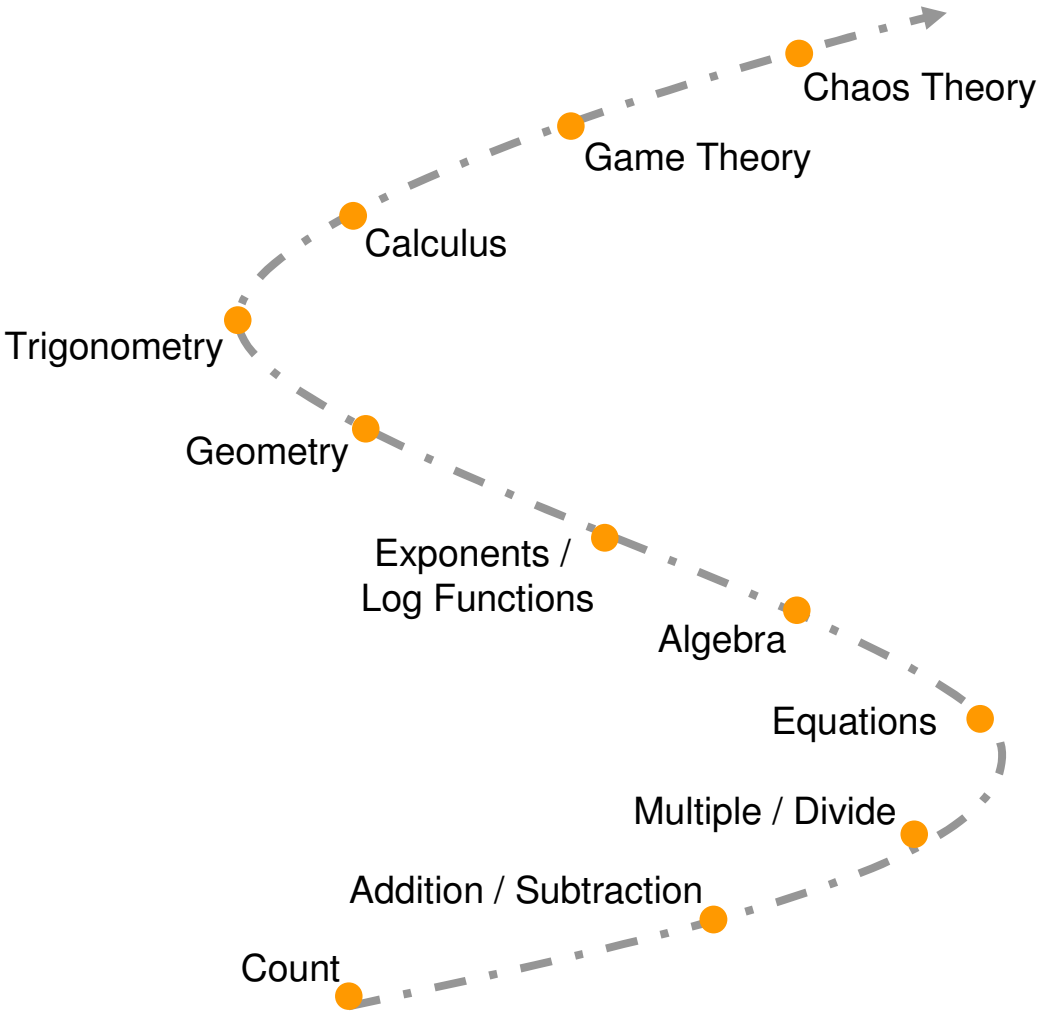
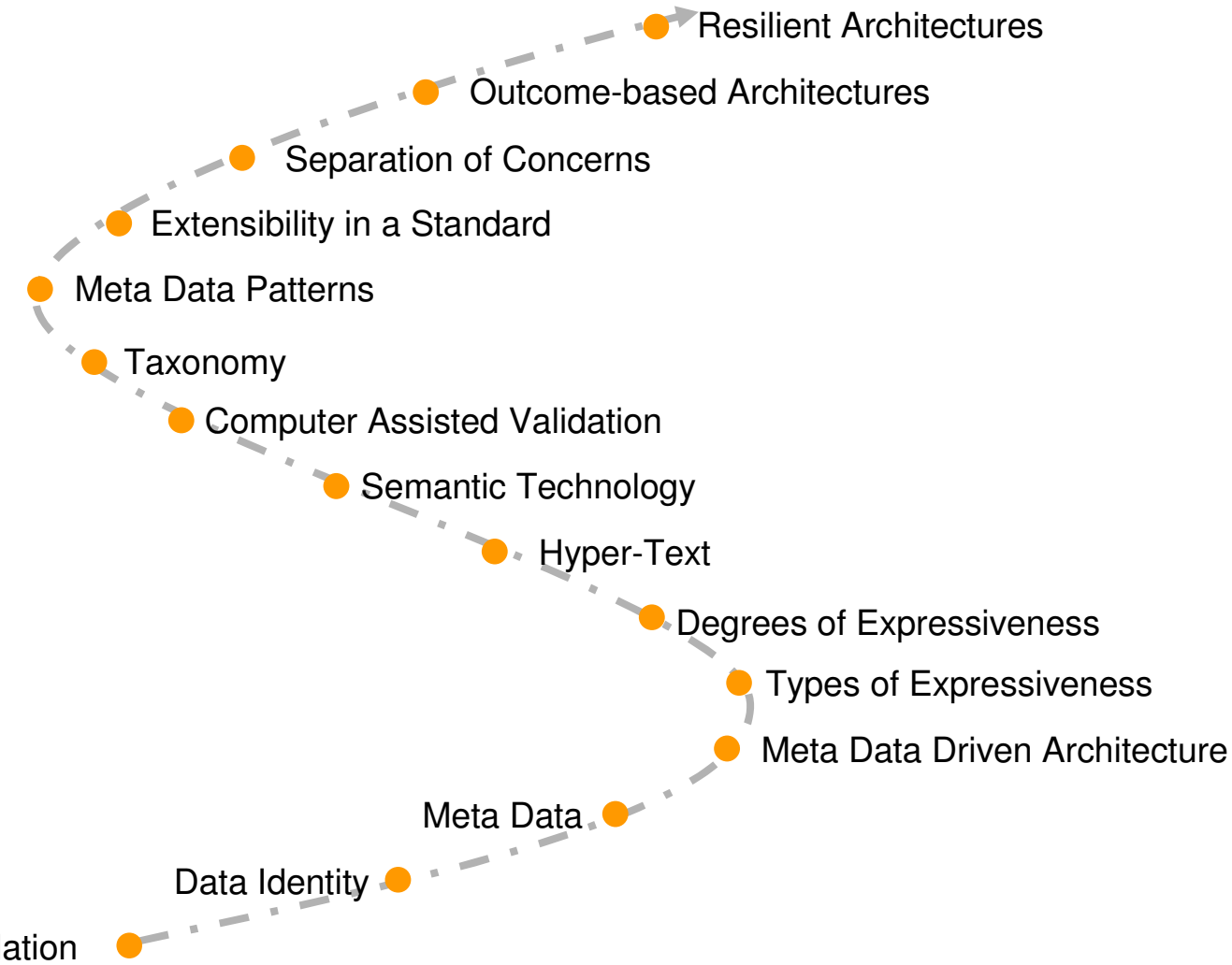
A Progression of Concepts . . . Math



A Progression of Concepts . . . IT Architecture



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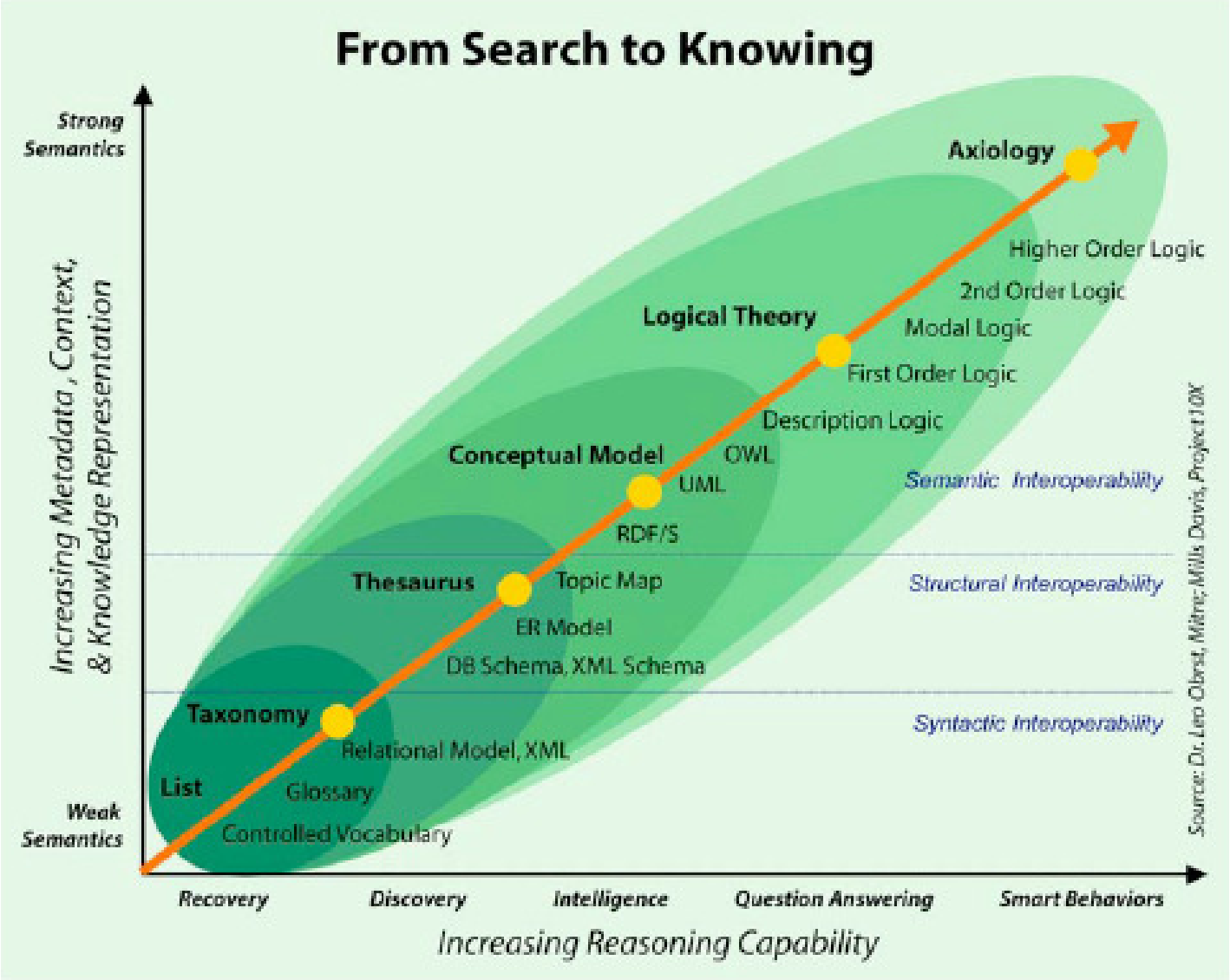
What's Next . . ?


From Search to Knowing
Strong Semantics
Increasing Metadata, Context, & Knowledge Representation
Weak Semantics
Axiology
Higher Order Logic
2nd Order Logic
Logical Theory
Modal Logic
First Order Logic
Description Logic
Conceptual Model
OWL
UML
RDF/S
Semantic Interoperability
Thesaurus
Topic Map
ER Model
DB Schema, XML Schema
Structural Interoperability
Taxonomy
Relational Model, XML
List
Glossary
Controlled Vocabulary
Syntactic Interoperability
Source: Dr. Leo Obrst, Mitre; Mills Davis, Project10X
Recovery
Discovery
Intelligence
Question Answering
Smart Behaviors
Increasing Reasoning Capability