NIST & CATEGORY THEORY

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Outline

• Overview of NIST, ITL, and SSD
• NIST & Category Theory
• Summary
NIST – Bird’s eye view

The National Institute of Standards and Technology (NIST) is where Nobel Prize-winning science meets real-world engineering.

With an extremely broad research portfolio, world-class facilities, national networks, and an international reach, NIST works to support industry innovation – our central mission.
NIST’s Mission

• To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.
NIST Research Focus Areas

- Energy
- Healthcare
- Environment
- Information Technology and Cybersecurity
- Manufacturing
- Physical Infrastructure
Director

Associate Director for Laboratory Programs/Deputy Director
- Physical Measurement Laboratory
- Materials Measurement Laboratory
- Engineering Laboratory
- Information Technology Laboratory
- NIST Center for Neutron Research
- Center for Nanoscale Science and Technology

Associate Director for Innovation and Industry
- Baldrige National Quality Program
- Hollings Manufacturing Extension Partnership
- Technology Innovation Program

Associate Director for Management Resources
- Chief Facilities Management Officer
- Chief Financial Officer
- Chief Human Capital Officer
- Chief Information Officer
- Chief Safety Officer
SSD Purpose & Mission

• Inspire confidence and cultivate trust in software, systems, and measurements
  □ by accelerating the development and adoption of correct, reliable, interoperable, testable software
Focus Area: Software

• **Software Identification and Quality Metrics (SIQ)**

  *Objective:* Accelerate the development and adoption of correct, reliable, testable software, by developing methods and standard reference data sets for software quality assurance

  *IT Areas:* Common weakness enumerations, software assurance metrics, reference datasets, computer forensics, software performance and scalability

  *Domains of interest:* Software

• **Software-Based Measurements (SBM)**

  *Objective:* Develop software tools for aiding measurement science and for analyzing how well the software implementation of various algorithms to determine ground truth work

  *IT Areas:* Uncertainty analysis, data/information/knowledge analytics

  *Domains of interest:* Biomedical imaging, bioinformatics
Focus Area: Systems

• **Standards (STD)**
  
  *Objective:* Help define and promulgate timely, technically sound, open standards for the interoperation of software systems

  *IT Areas:* Semantics (ontologies), Information modeling

  *Domains of interest:* Health, voting, CPS, social networks, cloud, smart grid, materials

• **Interoperability/Conformance Testing (ICT)**

  *Objective:* Develop tools and techniques for testing the exchange protocols developed for software interoperability and for ensuring that software implementations conform to intended specifications

  *IT Areas:* Formalization of specifications, test suites

  *Domains of interest:* Health, voting, biomedical, cyber physical systems (CPS), social networks, materials
SSD Purpose & Mission

Inspire trust and cultivate confidence in software, systems, and measurements

by accelerating the development and adoption of correct, reliable, interoperable, testable software
Interacting with NIST

- Guest Researchers/Faculty Associates
- Grants and Contracts
- IPA
- Summer Students
- NRC Post Doctoral Program
- Collaborative Proposals
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Roadmap for Systems Integration/Interoperability

- Common models of data
- Explicit, formal semantics
- Self-describing systems
- Self-integrating systems
Ontology Spectrum

From less to more expressive

**Logical Theory**
- First Order Logic
- Modal Logic
- Description Logic
- DAML+OIL, OWL
- UML

**Conceptual Model**
- ER
- Extended ER
- XTM
- RDF/S

**Thesaurus**
- ER
- DB Schemas, XML Schema

**Taxonomy**
- Relational Model, XML

Strong semantics

Is Disjoint Subclass of with transitivity property

Has Narrower Meaning Than

Is Sub-classification of

Semantic Interoperability

Syntactic Interoperability

Courtesy: Leo Obrst, MITRE
Ontology Spectrum

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**Syntactic Interoperability**
- Relational Model, XML

**Semantic Interoperability**
- Is Sub-Classification of
- Has Narrower Meaning Than

**Structural Interoperability**
- Is Subclass of

**Strong semantics**
- Is Disjoint Subclass of with transitivity property

**Weak semantics**

Courtesy: Leo Obrst, MITRE
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Some Future Expectations

- Provide a generic template for structuring knowledge
  - May be CT can form basis for OKN
- Produce use cases
- Implement tools
- Develop evaluation methodologies