

**BUILDING AN INTELLECTUAL KNOWLEDGE SOCIETY WITH
ONTOLOGY:
Technologies and Platforms**

Azamat Sh. Abdoullaev

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PREFACE

Of all sorts of intellectual pursuits, nothing appears of greater import than to give a formal account of the world understandable both by humans and computing machines. Art, religion, science, and technology by their specific ways seek to model, explain, or represent reality, but only one human activity is thoroughly and systematically committed to the grand cause of technical inquiry into the whole world, its cardinal classes, properties, and relations. Being the hardest, most exacting but mostly awarding and winning, such an ambitious search for the whole world knowledge is defined as the mother science of ontology. Being a theoretical groundwork and knowledge base of basic sciences and technologies, ontology is the heart and soul of all human learning, wisdom and reasoning, unveiling the common nature, mechanisms and meanings of things and their relationships diversified as the key levels and kinds of reality: natural, mental, social, cultural, technological, or informational. As the source science of all knowledge bases and domain theories, it develops the most general theories and representational languages about reality giving the most profound and consistent accounting of things, entities, or beings, their properties and relationships.

All kinds of science, basic or applied, hard or soft, theoretical or empirical, fundamental or descriptive, natural or humanitarian, to some degree partake in the general theory of entities and relationships as special sciences, or domain specific ontologies. Again, all types of knowledge, theoretical, formal, experimental or practical, presuppose essential, ontological knowledge of things. Implicitly or explicitly, ontological principles can be found among mostly general theories, mostly universal axioms and laws, and in mostly interesting scientific problems. As underlying ideas, ontological categories, classes, concepts, notions, and terms lead the list of the great ideas making the very substance of the grand elemental conceptions. For they are the abstractions by which thought knows the world and minds think things, the terms in which we formulate major principles and facts of reality, the notions in which we make definitions, put fundamental questions, and solve decisive problems. Ontological ideas constitute the very framework of mental contents and cognitive processes as the heart of mental life. With that, they reside in languages, natural or artificial, as the mind in the body, as pungency in pepper; since the syntactic and grammatical categories and semantic classes are inherently tied to world things. Our human language is pervaded with ontological categories, in terms of which we describe the fundamental constituents and properties of reality and explain the complex dynamics of the nonlinear world.

All great human actions and intellectual achievements, all our rational practice of choice and moral codes are intrinsically guided by ontological rules and principles as the basic truths of reality. The large order of ontology is to produce the explanatory schemas of all being and reality, giving the guiding principles and rules for a wide variety of special truths. The ontological verities come up as the basic laws of reality occupying the highest level in the hierarchy of truths and meanings: mental, logical, mathematical, semantic, verbal, scientific, empirical as well as moral, ethical, esthetic, and religious. So the quest of underlying truths, universal and necessary, is the ultimate goal of the fundamental ontology and ontological theories, aimed to uncover the general knowledge and universal laws applicable to all existence and its basic levels, parts, and domains.

Still this is not all the deeds of the science of reality, the world science of ontology. Unprecedented and profound impacts on human life and culture as well as on the dominancy of human beings as the only creatures of sapience and the end-all of evolution are deeply anticipated with the beginning of the third millennium. Ontology by means of its radically new ontological technologies and applications as reality representation and reasoning systems underpins the most sophisticated information technology such as large-scale knowledge systems and intellectual technologies like the emerging World Wide Intelligent Web. Providing the unifying reality modeling schemes and languages for intelligent technology, ontology is bridging the real world and the information universe, giving the dynamic world modeling fundamentals, principles, constructs, representations, and algorithms for building ontological technology, a radically new class of intelligent technologies and knowledge systems. Thus the world science becomes the central cause of a never-seen before global social transformation, an Intellectual Knowledge Society, **a state of technological civilization where societal evolution and environmental development are advanced by knowledge infrastructures, intellectual semantic technology, and knowledgeable government.**

The ultimate goal of our research is to develop the world science as reality representation and reasoning framework and the universal schema of things in the world, revealing the nature of ontology, its subject matter and scope, categories and principles, knowledge inputs and technological outputs. While striving for this hard aim, the author involved many people to publicly discuss the most challenging questions and issues referring to the subject of ontology and intelligent technology, invoking constructive comments, criticisms, and advices. Much gratitude is due to all the active members of the on-line Internet fora: "Standard Upper Ontology Working Group" (WG Chair: James Schoening); "The Ontology and Taxonomy Coordinating WG", ONTAC (WG Chair: Pat Cassidy); and the Semantic Web Interest Group of the World Wide Web Consortium (chair Dan Brickley). A particular appreciation must be shown to Prof. John F. Sowa for the critical but inspiring on-line debates of the decisive issues of ontology, meaning, knowledge representation, semantic web, and intellectual technologies.

ABSTRACT.

The book redevelops the emergent Knowledge Society intellectual technologies as real ontology technologies producing the natural language knowledge systems capable to effectively represent and reason about reality, its diverse aspects and levels, systems, states, changes, processes, and nonlinear complexities. The study examines the world as the largest unbounded environment and the universal class of all kinds of things by giving an ontological analysis and mathematical representation of its constituents, properties and states, dynamics and behavior, and all key relationships. The whole research project is performed with the goal to design a standard world model capable to uniformly organize human knowledge, to create powerful reasoning systems and to secure communication interoperability between two species of intelligences, existing human beings and nascent computing reasoning systems, bringing the fundamental revolution in human values and ways of life.

To this effect, it is constructed a formal theory of entities and relationships in the form of unified framework ontology (UFO) serving as Reality Modeling Framework (RMF) or World Description Framework (WDF) or Reality Representation and Reasoning (RRR) Framework or the Universe of Discourse of Anything for intelligent beings, natural and artificial. So it maps the corresponding elements and structures of the real world, the mental world and the computing software world and thus designed to function as the common language for computers and persons. The novel combination of the ontological and mathematical fundamentals resulted in the consolidative account of the general classes of things such as substances and objects; states and properties; changes, actions, processes, and events; relationships, connections, and associations. Some fundamental solutions and significant answers resulting from the study are as follows.

Above all, the all-entity description framework allows for a reference system of knowledge standards underlying the key concepts of scientific knowledge, the basic constructs of minds, the major categories of languages, and the metadata models and reasoning schemas of information systems. Crucially, the UFO also provides for a unified (causal) account of the nonlinear dynamic world of complex systems, physical, chemical and biological, cognitive and conceptual, economic and social, engineering and informational, revealing the fundamental principles and rules of their complicated behavior and dynamic changes.

This presents the entity reference as a representational and inferential framework for the rising generation of intelligent applications equal to reason about different pieces of reality in causal and predictive ways.

It is also shown that the UFO as the canonical theoretical system makes the largest context of use within which can be described and explained the major classes and relationship patterns of physical, mental, or cultural worlds as well as the natural language semantics. Again, the natural language is proved to be the most effective knowledge and reasoning language not only for persons but also for computing machines, able to process and communicate semantic information about the world and its domains in NL forms. This capacity opens up the possibility of linguistic intellectual systems such as encyclopedic intelligences (as a Virtual or Digital Aristotle) and global knowledge web resources (as the UFO driven Real Web) and so bringing order, meaning, and intelligence to the heterogeneous content of the WWW.

To find a fundamental solution, the book is proposing the unifying account of the dynamic world combining into a single frame the significant elements of various models, schemas, and data languages such as upper ontologies, the ER extended data models, data integration systems, and Web ontology languages. Representing the content of reality, its meanings and natural language constructions to formal reason of humans and to programming machines will make possible the powerful knowledge technologies and intellectual systems, all along the strategic lines of information universe:

Reality or the World → Knowledge of the World {(Unified Framework Ontology + Mathematics + Semantics + Science) + Real Logic of Things} → Natural Language → Informatics and Computer Science → NL Engineering and AI Technology → NL Knowledge Machines (systems, applications, agents, robots, software programs, tools) → Encyclopedic Intelligences (Virtual or Digital Aristotle) → Real Web → Global Intelligent Cyberspace (worldwide RRR networks of NL machines and human beings)

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Supplement: the Virtual Aristotle's Lexicon

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**Idea Gr
REFERE**

Idea Group, Inc.
701 E. Chocolate Avenue
Suite 200
Hershey, PA 17033, USA

Tel: 717-533-8845

Toll Free: 1-866-342-6657

Fax: 717-533-8661
or 717-533-7115

Email: cust@idea-group.com