Weaving a Decentralized Semantic Web of (Personal) Knowledge

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Abstract

In its current form the Semantic Web gives meaning to information on the web so that machines can "understand" it. To realise the potential of the Semantic Web for weaving meaning, we are seeking a paradigm shift away from knowledge exchange facilitated by machine "understanding" to one where human understanding plays a more significant role in the creation and exchange of semantic addressable knowledge across decentralised knowledge networks and communities.

The Semantic Web maps strings to associative contexts of notable Things. We are developing tools which empower individuals to weave their own Semantic Web of Personal Knowledge, in a form that can be shared in decentralised emergent social knowledge networks.

TrailMarks is a Research and Authoring Tool for Thought, which helps individuals in augmenting their tacit awareness, through developing, sharing and collaborating on knowledge organised as a graph. It is a working kernel for a Knowledge Augmentation framework. We describe a Semantic Graph model which we call MindGraph, which renders documents virtual, and enables scholarly work to be 'born semantic'. The content created using MindGraph forms a potentially emergent Global Giant Semantic Web of decentralized Knowledge.

Experience the Web: as an extension of your Mind

With Trailmarks users can capture the intertwingularity of their thoughts and engagement with the web in their own privately stored Personal Knowledge Graph, creating a lifelong, digital archive organised as a Semantic Graph we call MindGraph. Five years ago, we started experimenting with graph based Knowledge Presentation and Semantic Authoring frameworks designed to afford interactions as simple as editing an email message. MindGraph's Knowledge (Re)Presentation and Authoring Framework renders Documents obsolete. Using today's tools scholars cannot easily reuse their previous work. Knowledge is trapped and scattered in documents and silos. We transclude contributions so that they retain their connections to all other works. The very act of transclusion in MindGraph creates new connections between graph contexts, enriching equally the source of transclusion and the context where it is used, thus facilitating future work and discoveries.

In a world without documents searching for a phrase would be like having a personal search engine which can bring to mind what you had in mind. All that you have gathered and written about the Things which interest you is instantly available, and connected to other relevant

Things in meaningful ways. Visualizations can greatly boost comprehension, helping us focus on what interest us. Best of all it enables us to pick up a thread exactly where the author left off. New “papers” can be extracted and created through the deep rearranging, creating new connections, Things, and narrative trails, without losing the connection to existing work. Addresses of nodes in MindGraph can act as portals to adjacent knowledge.

TrailMarks integrates with Hypothesis and the MEMEX of WorldBrain.io by linking to annotations and named search results. TrailMarks can turn web pages shared on Android into resource dots, allowing the possibility of associated mashups. With MindGraph and TrailMarks we create the associative indexing of content which Vannevar Bush envisaged for the MEMEX, further enhancing it with situated ontologies. This enhances our ability to consult the ‘Common Record’, improving its growth and quality.

Parallels can be drawn between the direction we are propounding and Tim Berners Lee’s SoLid project. Applications in SoLiD use Linked Data Graph owned by the user. There are no files, but queries retrieve the data to be operated on as Resource Description Framework (RDF) data. The results of these operations are also persisted as RDF. TrailMarks operates analogously, except it uses MindGraph for semantic identification of Things of interest in the course of writing and research. Modifying Jerry Fodor’s metaphor, with Semantic Scholarship in TrailMarks we can transform the caterpillars of current scholarship into butterflies in flight .

The research and drafting behind this paper was developed with our minimal workable prototype of TrailMarks using Linked Text. In TrailMarks you can get an overview of a paper by selectively showing semantically identifiable fragments. We cannot do that here. And we have no space to give you an overview. You can gain some idea of what this overview would be like by scanning the first paragraph of each section.

MindGraph: Knowledge Presentation vs RePresentation

RDF was designed to graft a “machine-understandable” layer over the content created for human consumption. MindGraph is designed to focus first on the mental models needed to create semantic content for human consumption. Without users having to think about it, TrailMarks builds a Knowledge Graph behind the scenes. In the design of MindGraph our knowledge representation choices were informed by the need to reduce the overall cognitive load, presenting users with easy to grasp mental models of what they are doing.

In building our exploratory prototypes we sought to make them capable of describing their own capabilities. These capabilities are designed to be intuitive, habitable and tinkerable. In experimenting with application ontologies Tim Berners Lee is orbiting around the same strange attractor of using the underlying semantic graph as a vehicle for articulating capabilities.

Structured Claims and Transitional Modeling in MindGraph

Our focus is not on codifying knowledge, but on creating opportunities for articulations grounded in integrated semantic web research. MindGraph introduces Structured Claims, which allows additional meaning to be captured. In line with Transitional Modeling principles, MindGraph enables us to capture uncertainty and conflicting views. Instead of

trying to resolve conflicts by enforcing agreement over what is to be recorded, causing information loss, Transitional Modeling enables conflicting information to be recorded and resolved at the time of access.

Knowledge creation requires a framework which allows its users to express their ideas unencumbered by the framework itself. They should also be free to use their own terms to relate and characterise things, i.e. to formulate their own conceptualizations in their own situated ontologies. MindGraph goes beyond assigning reliability indicators to claims, as in Transitional Modeling, MindGraph allows claims about claims in a Semantic Structuring of claims. A collection of claims are allowed as targets for claims.

Intertwingularity: Linked Data meets Linked Text

Linked Text like Linked Data can appear as targets in semantic claims. Linked Text is hypertext which incorporates semantic claims about Things - that are nodes in the graph called Dots. Linked Text belongs to a specific Dot, which when making the links is referred to as the source. That which a claim bidirectionally links to is referred to as the target. This target can be another Dot, or collection of Dots, or can be semantically identifiable as an HTML fragment. Once semantically identified a claim can be reused in many different contexts, possibly with variants. No more copy paste.

Linked Text claims are written using a straightforward semantic markdown in a simple WYSIWYG HTML editor that owes much inspiration to Engelbart's work especially his description of Authorship Provision in Augment. As claims are added they introduce terms which express the intent of the user when making the claim. When elaborated they articulate an emergent ontology. Unlabelled connections between Things are less useful for machines, but as Wikis show they are extremely valuable for humans. Hyperlinks in Linked Text are navigable in both directions. The importance of bidirectional links for the Web was recognized from the outset, but they were deemed to be not feasible. On the Decentralised Web they become feasible.

"Connecting the Dots" induces Gestalt switches which lead to new insights and serendipitous findings. Five years ago, we created a Personal Research Knowledge Graph builder which harnessed Freebase Linked Data for the LinkedUp Challenge. At the time we had difficulties explaining why Freebase is Linked Data. Today the idea of placing Research Knowledge Graphs at the heart of scholarly communications is gaining traction, and in fact the entire Linked Data Cloud can be thought of as a Knowledge Graph. Our current prototype TrailMarks integrates with our own WikiData Explorer, a remake of the Freebase Explorer, which allows visual exploration and importation of the entities to anchor our own graph.

Last year's Blue Sky Track winner at the ISWC 18, entitled "Capturing meaning: Toward an abstract Wikipedia", issued a challenge to bridge the gap between knowledge representation schemes and human natural languages. MindGraph rises to that challenge.

Beyond Documents: The HyperMap is the territory

MindGraph enables you to generate Documents of all kinds. MindGraph can itself describe the generation process. We used this approach to generate WebSlides, project plans, timesheets, papers, etc. The camera-ready copy of this paper will be produced this way, along

with on-line versions, so that search engines can index them. The crucial point is that they do not even have to be saved as documents: they can be “virtual” with all versions generated from the underlying graph. Without having a stale version lying around, searches within Trailmarks can return everything you have written on a specific subject, plus all the context where it belongs. Voronoi Diagrams can produce Gestalts which allow drilling down to any level of granularity. We call this visualization a HyperMap, where the map is the territory.

Beyond Ontologies: The power of changing your mind

MindGraph seamlessly integrates the articulation of knowledge with the elaboration of the terms used to organize and make sense of this knowledge. Terms can be introduced on the fly without breaking the flow of articulation. Instead of trying to fit a prior ontology, these organizing terms arise mutually with the knowledge they organize. Knowledge thus co-evolves with its own conceptualization.

In semantic articulation naming things unambiguously is more important than getting them right first time. We need to let suitable names emerge through use. The terms we use will become our situated emergent ontologies that take us “Beyond Ontologies” to new, not yet notable, domains.

Knowledge Interoperability: HyperKnowledge

MindGraph supports peer-to-peer collaboration. Users run self-sovereign Knowledge interoperability hubs within their own browsers. They can connect to collaborate with other hubs using peer to peer or server based protocols. These hubs can be operated on behalf of individuals, participants in decentralized social knowledge networks, communities, or institutions operating HyperKnowledge Federation hubs.

HyperKnowledge is an open source project aimed at creating self hosted Open Knowledge Federation and Community Hubs. It uses an Event Driven Knowledge Exchange protocol. HyperKnowledge is being developed in close cooperation with TrailMarks and the TopicQuests Foundation's work in knowledge federation with topic maps. The rise of the Decentralized Web has brought with it a plethora of new protocols and tools, such as IPFS, HoloChain, InfoCentral, Scuttlebutt, Haja networks. They open up new possibilities for building a decentralised social Semantic Web of Knowledge.

Paradigm Regained: Bootstrapping Knowledge Augmentation

The Paradigm Shift from machine “understanding” to real human understanding advocated in this paper, seeks to regain the lost paradigm of the Augmentation Research Center. While inventing the personal computer they were bootstrapping and co-evolving NLS. As stated in the abstract of Doug Engelbart’s 1962 report, they focused on "improving the intellectual effectiveness of the individual human being". Like the Meta compiler in NLS, we bootstrap and co-evolve TrailMarks and MindGraph, improving both while using them. By using knowledge codified as Linked Data as the common ground for collaborative knowledge work a Semantic Web of Knowledge can emerge on the Decentralised Web which can move us closer to the goal of improving Collective Intelligence.