Knowledge Federation Patterns

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Abstract. While the technology now allow us to depart from the conventional ways of creating and sharing knowledge, which have been developed based on printed text as medium, the global conditions invite such departure. Knowledge federation is envisioned both as a better alternative, and as a research project and community dedicated to its development. This article is a working definition of knowledge federation, a statement of purpose and an agenda, based on the dialogs of the participants of the First International Workshop on Knowledge Federation.

Keywords: knowledge federation, knowledge organization, e-learning, socio-semantic web.

1 Introduction

In recent years we have witnessed a blossoming of initiatives and communities whose goal is to bring to life new ways of creating, communicating and organizing knowledge, which have been made possible by the Web: Semantic Web, Pragmatic Web, Web 2.0, Topic Maps, Wikimedia, Global Sensemaking… Why create a new one?

What has motivated us to organize the First International Workshop on Knowledge Federation was our shared intuition that there was still a piece missing in the puzzle, or better said an unexplored area in this problem space, which when opened up would yield substantial new developments, and substantially augment the prospects of the existing ones. While we called this new domain 'knowledge federation,' each of us came to Dubrovnik with a somewhat different idea about what 'knowledge federation' means. On the last day of the workshop we undertook to combine and reconcile, or as we called it *federate* our ideas. The present article is in part a record of the results of this dialogue, and in part its further elaboration, which evolved through our reflections and conversations after the conference.

The shared task of our meeting was to co-create knowledge federation and to open up this field of activity to others. Instead of attempting to condense all the various connotations of knowledge federation into a single 'official' definition, which would

limit the space for development and indeed be contrary to the very idea of knowledge federation, we allow everyone to maintain a somewhat different, personal idea and definition. In this way we allow this notion to evolve as our understanding progresses.

We therefore define knowledge federation by pointing at certain *patterns* [1] that delineate it, those that have been presented at the workshop. We offer them as examples, and we invite the creation of other *patterns*.

A central purpose of knowledge federation is to improve communication – between the academic and other communities, and across cultural traditions. This *federated* article is intended to give our initiative a clear profile and direction, and at the same time be our message to the larger community.

We begin this outline of knowledge federation *patterns* with the most abstract ones (motivating issues and principles), and we end with the more concrete ones (example systems and our strategy for the future).

2 Motivating Issues

Knowledge federation is a way to respond to several well-recognized needs.

2.1 Collective Intelligence

An alternative subtitle might be 'global issues' or 'wicked problems' or even a name of a concrete issue such as 'climate change.' We choose instead to focus on collective intelligence, understood as our collective ability to comprehend and solve any of our complex problems, and all of them together.

A moment of thought will suffice to see that our present organization of knowledge production and sharing, where the scientists work on specialized problems within a discipline and the journalists focus on sensations, is not the best possible way to align everyone's contribution to the shared task of providing vision and guidance to a society in rapid change. Knowledge federation directly addresses this issue.

2.2 Cultural Evolution

It has been said that the global issues are a consequence of a misbalanced style of development we've had during the past century, when sciences and technology progressed rapidly, without being backed up by a suitable development of social institutions and culture. This left us culturally unprepared to handle the power of the technology safely, and to our true benefit [2].

If some of our problems will eventually escalate and put us under high pressure, the ability of our culture to evolve fast will decide whether our societal structures will transform under pressure, or break down.

On the more positive side, we point at the global meme pool that has recently become available to us, not the least on the Web, which offers an unprecedented wealth of culture building materials. Knowledge federation undertakes to develop the

tools, the practices and the very values that will support the creation of new memes from the existing ones.

2.3 Cognitive Overload

A lot has been written lately about the amount of produced information exceeding what we humans are able to process. Several remedial technologies have been developed, such as the Semantic Web and the Topic Maps. We submit that the organization, abstraction and presentation of knowledge (or in other words its 'digestion,' to bring it into a form suitable for human consumption) are profoundly creative *human* tasks that will not be resolved by technology alone. Those tasks will have to be performed by reliable and democratic *social processes*, with the help of the technology. In knowledge federation our goal is complete solutions, and we undertake to develop whatever is still missing.

2.4 Efficiency and Effectiveness

The practice where everyone writes a single document that everyone can read online, represented by the Wikipedia, is radically more efficient than when everyone writes a separate document, and we end up with so many documents that need to be processed and combined together. The Wikipedia, however, is only a single point in a large space of possibilities. Knowledge federation is envisioned as a framework within which we think about knowledge production and acquisition in systemic and technical terms, define suitable criteria and implement good procedures.

2.5 Trustworthiness

By exhibiting a document on the Web and allowing everyone to object or comment, we expose it to public scrutiny. A goal of knowledge federation is to develop procedures for co-creating reliable information.

3 Principles

Like political federation, and like democracy, knowledge federation may be understood as a set of principles or values.

3.1 Preservation Principle

The value of *preservation* demands that we preserve all knowledge artifacts that may be of value. Knowledge federation does not discriminate, not even on the basis of veracity.

The attitude that the Preservation Principle fosters is the one of a good librarian, who carefully preserves the books and makes them available, irrespective of her personal opinions and values.

On a more profound level we may compare the value of *preservation* with the attitude of supportive listening associated with David Bohm's dialogue technique [3]. In knowledge federation we strive to overcome our personal and cultural biases and advance towards co-creation and coherence.

A result of this attitude is that every individual utterance will be preserved without alteration, and without being disqualified by a majority opinion. This supports new thinking.

3.2 *Aggregation* Principle

The value of *aggregation* encourages us to take active responsibility for the organization of knowledge, and for the social production of meaning.

The Aggregation Principle encourages us to strive to develop simple general insights that can serve as guidelines for action and for lifestyle and other choices, by fusing disparate evidence and reconciling conflicting opinions. This principle is served by developing suitable social processes, practices, tools and values.

The Aggregation Principle challenges the conventional assumption that the creative contributions are only in the 'basic sciences,' i.e. technical and detailed, by postulating that knowledge exists on all levels of abstraction and generality. And it is indeed on the highest level of generality that we find elegant principles that illuminate many disparate conditions and instances – the most powerful, most liberating and most useful knowledge.

4 Knowledge Federation as an Idiom

'Knowledge federation' may be used as a verb and a noun.

4.1 Knowledge Federation as a Verb

As an activity, knowledge federation means joining together multiple individual knowledge artifacts under a single identity. This may take any form, ranging from a simple *subject-centric* organization of those artifacts by using a topic map or a dialog map [4], to creating a new artifact from the fragments of existing ones [5], to uniting the individual artifacts under a high-level view that reconciles their differences and highlights what is common and essential.

4.2 Knowledge Federation as a Noun

As a noun, knowledge federation is either a form of social organization of knowledge production, or a manner of organizing the knowledge itself. Both may be understood

by analogy with political federation, which is a union of parts that have preserved their identity and autonomy.

5 An Academic Discipline

During the workshop we discussed whether knowledge federation merits to be an academic discipline of its own right, but we reached no conclusion. We later resolved this controversy as follows.

5.1 A New Kind of Discipline

Since knowledge federation aims to overcome the traditional-disciplinary barriers to knowledge sharing and creation, a knowledge federation traditional discipline would be a contradiction in terms. We therefore organize the knowledge federation discipline as – a knowledge federation.

By doing that we develop a new template of organization.

A knowledge federation is a discipline in a similar way as Nike is a company. International corporations no longer own their production line. Rather, goods are produced within value chains – reconfigurable associations of internationally distributed units. Knowledge federation is a similar new pattern of social organization of knowledge work, where experts from different disciplines join other stake holders in a virtual sense, to accomplish a shared task, without changing their disciplinary affiliations.

5.2 A Discipline of a New Kind

The subject of study of our new discipline is knowledge federation. Its goal is to develop all that is needed for this new way of organizing and creating knowledge.

The pertaining body of knowledge will in part be developed within the knowledge federation community, and in part imported from other disciplines. Hence this knowledge too will be organized as a federation.

6 A Strategy

Knowledge federation is a strategy in two ways – for resolving contemporary issues, and for enhancing knowledge work. Both strategy lines were conceived by Doug Engelbart [6].

6.1 Self-organizing our Collective Mind

Knowledge federation augments our collective intelligence (collective ability to understand and resolve complex issues) by improving the structure and the functioning of our 'collective brains,' and in particular the agility of our 'global brain.' Knowledge federation may be understood as self-organization within the 'global brain.'

6.2 Enhancing Knowledge Work

Knowledge federation implements Engelbart's general observation that largest improvements can be reached by improving our ability to improve (i.e. by 'C-level knowledge work'). For this he conceived a strategy called 'bootstrapping,' where C-level knowledge workers accelerate their progress by implementing their own ideas in their own work.

We implement this strategy by evolving the knowledge federation work within a community of knowledge workers that is organized as a knowledge federation.

7 Example Theoretical Contributions

Several *patterns* of theoretical contribution were presented on the workshop.

7.1 Federating Knowledge from Other Fields

Knowledge federation develops its body of knowledge in part by selecting, importing and adapting or digesting or in a word – *federating* the relevant knowledge from other disciplines.

An example is Alexander Sigel's article "Knowledge Federation from a Knowledge Organization Perspective: A Position Paper" [7]. Having evolved from the library science, knowledge organization is a discipline that embodies the pertaining theoretical and practical insights that have been developed through centuries. In the article Sigel takes up the challenge of adapting the insights that are most relevant for knowledge federation.

7.2 Developing Required Insights

Part of our job is to identify and resolve various specific theoretical questions that pertain to knowledge federation.

An example is the compendium of questions related to the task of federating knowledge across disparate languages and ontologies. Some of those questions are discussed in the article "From Subjects to Concept Clouds – Why semantic mapping is necessary" by Hendrik Thomas, Bernd Markscheffel and Tobias Redmann [8].

7.3 Theorizing Knowledge Federation

Finally, we need a theory of knowledge federation itself. Two of the presented articles had this emphasis.

Yuzuru Tanaka's article "Knowledge Federation: Necessity and Required Technologies" [5] discusses the need for knowledge federation, and develops a suitable taxonomy and an outline of required technologies.

The article "Knowledge Federation as a Principle of Social Organization of Knowledge Creation and Sharing" [9] by Dino Karabeg and Roy Lachica identifies some of the main building blocks of a knowledge federation (understood as a form of social organization of knowledge creation and sharing, for ex. within an academic discipline) and proposing them as subjects for research and tool development.

In addition to these, each of the contributions reflecting specific systems and approaches, which are outlined below, also theorizes the represented approach, and illuminates knowledge federation from the corresponding angle.

8 Example Approaches and Systems

Several knowledge federation systems and systemic approaches have been discussed on the workshop. They point at a variety of possibilities.

8.1 Meme media

The meme media approach, developed by Yuzuru Tanaka since the late 1980s [5], focuses on the development of new memes (basic units of knowledge) by combining existing ones. In practice the memes may be fragments of Web documents or Web services. The meme media are enabling technologies, allowing us to turn those fragments into Lego-like building blocks, and to join them together by making compound building blocks. Envisioned applications range from real-time monitoring of data from multiple sources to producing media content and facilitating cultural evolution.

The corresponding technical tools are IntelligentPad and IntelligentBox.

8.2 Hypermedia Discourse

The contribution by Simon Buckingham Shum [4] specializes the 'social processes' approach to knowledge federation by focusing on the form of discourse by which problems are framed and meaning is constructed in teams of analysts, e.g. deliberation over alternatives, dialogue seeking common ground, or rational debate and argumentation. This work draws on the conceptual foundations offered by fields such as argumentation, cognitive coherence relations and organizational sensemaking.

The technical tools that exemplify this approach include Compendium, ClaiMaker and Cohere.

8.3 Knowledge Gardening

Knowledge gardening is an approach developed by Jack Park [10], inspired by Douglas Engelbart's Dynamic Knowledge Repository. In this approach a record of knowledge is not envisioned as a document, but as a living system, which includes also people. In a knowledge garden one user can plant an idea and others can bring it to fruition. Instead of having to search through documents, a user can be notified when the status of knowledge associated with one of his subjects of interest changes.

The prototype platform is called TopicSpaces.

8.4 Semantic Folksonomies

Roy Lachica has enhanced the conventional folksonomy model in several ways that are relevant for knowledge federation, notably by adding semantic associations, and by estimating the quality and the relevance of the resources.

His prototype platforms are Fuzzzy.com [11] and Omnicious, which is under development.

8.5 Key Point Dialogs

Key point dialogs are a series of prototype systems and implementation experiments, whose goal is to help a community of people reach a 'key point' – an overarching and direction setting insight [12].

The prototype online tools under development are WiKeyPoDia.org and KommuneWiki.org.

9 Our Action Plan

We will continue our activity by developing a functioning instance of a knowledge federation among ourselves, an instance of a federated education model, by organizing the knowledge federation workshops and in other ways.

9.1 Developing an Instance of Knowledge Federation

We will implement a knowledge federation as our own way of working together.

An advantage of this approach is that by creating a *whole* prototype of the knowledge federation practice, we will be able to identify and develop all its elements. This will allow us to make knowledge federation feasible for general use.

Aurther advantage is that we will be able to test the ideas in practice and improve the solutions.

The federated organization will bootstrap the development of our own work and community.

9.2 Developing a Knowledge Federation Course

We will develop a federated knowledge federation course, where the learning resources will be co-created by international researchers and other participants, and offered to learners world-wide.

9.3 Organizing the Knowledge Federation Workshops

The next International Workshop on Knowledge Federation will take place in Dubrovnik, October 3-6, 2010.

After 2010 we will continue to organize yearly workshops in the Inter University Centre (IUC) Dubrovnik.

We are planning to include a yearly international graduate course, through the IUC Dubrovnik, beginning in Fall 2011.

10   Concluding remark

Around the year 1950 the first computers came to the market and we developed computer science as the discipline and the profession whose task was to create algorithms, programming languages and everything else that was needed for taking advantage of that new medium. A half-century later the Web came, and our task now is to develop the tools and the skills that this new medium requires.

'Programming the Web,' if we may stretch the programming metaphor, is different from programming a single computer. The Web allows us to 'program' on the scale of the Web. The corresponding 'instructions' involve both people acts and machine acts. An example of a 'program' may be a whole new social organization of the creation and communication of knowledge within an academic discipline, and also globally.

Since it modifies some of the most powerful organs of our 'social organism,' and affects some of its most sensitive 'tissues,' his new sort of 'programming' will need to be done in a new way. It will need to be done through a democratic and reliable evolutionary *social* process, involving all relevant forms of expertise, and all stake holders.

By developing knowledge federation research and a practical instance of knowledge federation, we will also be able to develop a methodology for 'programming' on the scale of the Web.

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