WikiNizer™ Research: A Personal Knowledge Graph Builder Harnessing Freebase Linked Data

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ABSTRACT

WikiNizer™ **R**esearch (WikiNize**R**) is a visual Wiki-like knowledge orgaNizer which constructs Personal Knowledge Graphs. By enabling us to visualize "meta" levels of reflection, WikiNizeR facilitates our sense making and problem solving. Using Freebase as a linked data source it harvests and contextualizes semantically structured information, empowering us to curate a private Knowledge Graph of Things, which a view also to enhancing collaborative knowledge work. Its users integrate open web data within the content driven graph architectures of their personal learning environments. It enables us to elaborate upon the emergent dynamic graphs which articulate the typed connections that exist between 'Things' of interest, facilitating the emergence of novel concepts in the associated complexes of content which are organized into node based structures. It supports a connectivist learning model; and as a "self-curating" semantic knowledge management tool it can be used in problem and project based learning to explore resources and conceptual relationships, helping us to define learning paths and workflows, or design meta-level didactic object structures and activities. It is a tool which helps us track meaning construction in a situated, intent dependent and dynamic manner. It is a holistic solution which integrates web research, linked data, annotation, note-taking and knowledge organization into a Lifelong Personal Digital Archive of "born reproducible", *ab initio* re-purposable, and re-enactable, Research Objects.

Track: Open Track

1. INTRODUCTION

WikiNizer™ **R**esearch (WikiNize**R**) is a **Wiki** like visual orga**Nizer** of Personal Knowledge Work and Lifelong Learning. The Knowledge Architectures that WikiNizeR manages are constituted as graphs of 'Things', captured in atomic notes, which can be assigned types and properties on the fly. These Things can also be connected by typed links (links with labels also introduced on the fly) which generate a graph of the user's growing knowledge about Things of interest. These links, types, and properties, because they can be viewed and modified at the meta level, generate an emerging, situated, Meta Knowledge Graph. This meta graph sets out what sorts of Things we are dealing with, and how they can be related in a way that best captures our intentions and ideas. What emerges is a Self Curated, Personal Knowledge Graph that is private but which can be shared. Not losing sight of the collaborative aspects of personal knowledge work, WikiNizeR, which is the first component of the WikiNizer™ toolbox, offers collaboration via Google Docs.

WikiNizeR is deeply integrated and compatible with Freebase. Freebase underlies Google's community curated public Knowledge Graph which powers semantic search. Freebase is itself "A community-curated database of well-known people, places, and things". It is a semantic wiki-style graph knowledge base of over 45 million topics, approaching 3 thousand million facts, and as of the 4th September 2014 with tens of thousands of meta terms, and growing exponentially. WikiNizeR can also be viewed as a personal semantic wiki, which like Freebase can bring the power of semantic search, turning strings to things, to a self curated knowledge base of things. Beyond being a kind of Semantic Wiki, WikiNizeR is also a *Personal* and a *Visual* Wiki with meta-reflective meta-design capabilities. Being 'Personal' and 'Visual' means that it avoids the high levels of cognitive load which characterises Freebase, but exploits its "soft" (non formal) semantic capabilities. Like Freebase it is a web app, built initially for the desktop but with mobile first and offline first principles adhered to in its design.

Business Idea: We see a gap in the market of knowledge management solutions which support personal knowledge work *end to end*. That is, from the first note you make on a topic of interest, through the detailed research and presentation of your findings and ideas, which create re-usable, re-purposable, reproducible, and re-enactable dynamic Research and Knowledge Objects, which together eventually constitute a self-organizing Lifelong Personal Digital Archive of all your work. It provides a place where you can keep and have the tools that help you to 'bring to mind what you have in mind'. Our holistic solution fills the gap in personal knowledge management tools, and is not only available for desktops, but also for *mobile* devices.

Personal Knowledge Management: There are hundreds if not thousands of solutions which provide computer support for collaborative knowledge work within predominantly enterprise and institutional settings. In comparison, the number of solutions for personal knowledge work are miniscule. There are a few established and powerful solutions, typically for the desktop, and with price tags over $100. Solutions that would work on all the users devices are few and far between, and all can be considered as point solutions. Trapped in their "walled gardens" users lack an end to end workflow. Instead they create beautiful mind maps, which are not an integral part of a holistic knowledge work flow.

Access Level: A WikiNizeR closed beta is launching in September this year. It is being launched as a Chrome only web app available initially on the desktop. Except for the direct manipulation graph editor it also already works on Android. A fully working version for Android is planned to be launched within a month. (IOS is not supported.) It integrates with Freebase for Linked Data and uses Google Drive for storing users data, hence a Google account is required. Core personal capabilities will be available for free even after the beta period, only requiring

Google Sign In. Since users of WikiNizeR will keep all their data in their own Google Drive providing a free service does not have much running costs. This allow us to keep the price of future premium services lower than it would be if we had to subsidize free services that would otherwise cost $1 per free user per year.

More advanced capabilities, including higher levels of semantic collaboration and analysis, will be made available later, but all the extras would be under $10 dollar per year. The guiding principle is to get paid for services rendered. "Give away free that which does not cost money to deliver." The first release of WikiNizeR helps to get off the ground the process of bootstrapping which aims at delivering a next generation concept organization tool, as articulated in our published papers on WikiNizeR. (Cf. [1-5]) Using existing capabilities we are well on the way to completing within WikiNizeR a full "Intent Graphical" Model of all its capabilities. This model is set out as a Capability Graph as an example of a personal knowledge graph that can be accessed in WikiNizeR. Even in its current form, without further components of the WikiNizer™ toolbox, it is already useful as a way of documenting and visualizing the capabilities of the live system. As we advance the means by which we can turn these models into constituents of the running system, we get the benefits of intellectual manageability, and the improvements in the stability and extensibility of the system. More importantly as system capabilities in our Intent Graphic Modelling get themselves elaborated as knowledge graphs, they become fully explorable, learnable and personalizable, by the users. The entire user interface therefore becomes but a specific dynamic visualization of use case dependent trails within the capability graph. In the second stage of bootstrapping the system will become user extensible, and co-evolvable through meta-design, [5,7] turning it into a Knowledge Augmentation Engine.

2. SYSTEM DESCRIPTION

Representing the process of the growth in our personal knowledge, and sharing the emerging conceptual structures that emerge within problem solving contexts, is a major task for individual learners, and a critical coaching and tutoring problem. Knowledge obtained from the web or other resources needs to be personalized, reorganized, and contextualized, in order to filter our misconceptions. Visualization of information about 'Things' and their conceptual organization help us with problem definition, and consequently their solution. WikiNizeR is a Personal knowledge Management tool which represents and organizes "associative complexes" within computer augmented personal Knowledge Architectures.

Our holistic solution has the following **key benefits for personal knowledge organization** carried out on both desktop and mobile devices:

- Note taking with the assurance that everything you ever "write down to think" when problem solving could make it into its solution.
- Your Web research leverages the semantic search capabilities of Freebase, integrating and deepening the knowledge you find there within your own Personal Knowledge Graph.
- Annotating and saving screenshots and entire web pages as PDF files on your Google Drive.
- Building personal knowledge graphs of Things of interest along with all the emergent meta knowledge needed to organize and make sense of your learning.
- Focusing on selected parts of your graph, and generating Propositional Trails which highlight the propositions implied by the links you have introduced. E.g., if say an "Engelbart" node has a creation label which makes a connection to the node "Augmentation Research" the proposition can then be read as saying "Engelbart created Augmentation Research". Complementing this conceptual graph function, as you follow the links from either the note or node "Augmentation Research", you see all the facts contained in your graph organized into a propositional trail.
- Build trails across your accumulating body of personal records by designating nodes of interest and links to follow.
- Package these trails into Personal Research Objects for working out solutions to your problems, and then sharing them in ways that are *ab initio* explorable, re-purposable and re-presentable in a whole range of dynamically reproducible and consumable formats to any required depth.
- Offering a single place to keep all you care about in a Personal Digital Archive.
- All system capabilities are themselves presented as Knowledge Objects which comprise behavioral aspects, so that they are explorable and usable in personalized forms: "As knowledge is indivisible, ever evolving and expanding, so should the means we use to manage its growth." This is critical, the needs of the user, and the needs of the knowledge management capabilities grow along with growth of the knowledge, which they create and manage.

Datasets: Freebase turns strings into things. This is the essence of Semantic Search. If the Freebase search does not turn up the thing we are interested in we can always resort to Google Search and following links. When the user authorizes WikiNizeR to allow read access to all the files in their drive, they can use keyword searches for all the documents on their own Google Drive. All keyword searches within WikiNizeR trigger corresponding search in Freebase, so there is an opportunity to link the user's notes on a given topic to their equivalents in Freebase, so that semantically relevant information could be brought in and extended into a Personal Knowledge Graph.

How the data is used in the user interface: When you are doing web research on a topic of interest, start with an integrated Freebase Search. If it returns something of interest to you, a new node can be created based on the information you get from Freebase. For specific type of things in Freebase, like 'persons', or other significant relationships, such as 'influenced', 'influenced by' (edge direction matters and is signified with thickness), peers can be used to find related persons automatically. When you expand a Freebase node like these you get all the appropriately related things added automatically to your graph. Some of them will prove to be irrelevant so they can be removed. The process can be repeated for some time with the new things that have been added. You can therefore quickly integrate knowledge about Things that you find in Freebase into your own personal knowledge graph. Once these Things are present in this form, the user can add new links and additional deeper knowledge found in Freebase, to follow one's interest. (Cf. http://alpha.wikinizer.com/LinkedUpChallenge/augment1.png)

Within WikiNizeR the user deals with 7 kinds of things: Notes, Links, Types, Properties, Reference Nodes, Knowledge Objects, and Research Objects . "Research Objects" describes an emerging approach to the publication, and exchange of scholarly information on the Web which aims to improve its re-use and reproducibility. A Research Object within WikiNizeR is a Knowledge Object with an executable behavioral specification.

Notes are the atomic units of the system. They have a local unique ID, a title, icon, stub and a body. When creating a note use a Google image search to pick a suitable icon possibly using *Awesome Screenshot* Chrome extension to capture images from parts of web pages. The granularity of a note is set by the requirement that considered in itself can be the target of

meaningful, labeled links from other notes/nodes. Thus each note is a kind of entity with a local unique ID (LUID). Each link is of a named type elaborated in a separate meta level workflow. Everything that is possible at the note level work *homoiconically* at the meta level – it is turtles all the way up.

A WikiNizeR Notebook is a collection of notes. They also define a context or neighborhood of notes/nodes. Notebooks, which have predefined structure which map to the Google Doc semantic markup, can also contain reference nodes that define references to other WikiNizeR Notebooks. All the Notebooks ever created are added as reference nodes to the system notebook, called My Notebooks. This notebook gets created at first use, and contains reference nodes to all the Notebooks which are created at first use. These include a Notebook dedicated to Getting Started Information. This document contains references to other Notebooks. A Notebook that contains references to other Notebooks, together with appropriate links that carry computational interpretation between these references, is called a Research Object or Knowledge Object, which is a Live Graph, with executable behavioral specifications (a graph of descriptions of system capabilities which boil down to executable nodes). When the user "reads" Getting Started she obtains information about the system by browsing such a graph. The simplest form of Research Object is a Trail that contains references to nodes and rules for obtaining a fixed traversal sequence of nodes. These rules are a simple example of an executable behavioral specification. This is just like the Trails envisaged by Vannevar Bush for his MEMEX.

The "My Notebooks" system notebook creates an initial context for the user. All work that can be accomplished within WikiNizeR is carried out in the context of some Notebook.

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The "My Notebooks" system notebook creates an initial context for the user. All work that can be accomplished within WikiNizeR is carried out in the context of some Notebook. Every note belongs to one specific Notebook. So typically all workflows start with picking or creating a Notebook as the context. Within the context of a Notebook new notes can be added, and then linked simply by giving a name for the link. At a later stage, in a separate workflow, the user is given the opportunity to elaborate the intended meaning of a link and its possible relations to other links and types.

Keeping track of all the defined links and types there are additional system Notebooks or contexts for each: My Links, My Types, and My Properties. System Notebooks keep track of Contexts. (In principle, every Notebook defines its use case dependent Context, which is reflected in these system Notebooks.) Links can be created across Notebooks. Within a given Notebook notes from another notebook can also be transcluded. When a new Notebook is created this fact is reflected by a new node being added to the My Notebooks system notebook. Hence, by definition, anything you do within WikiNizeR takes place within a Context. Contexts form their own graph, using the same linking, transclusion operation that are available for nodes. These graphs visualize the Knowledge Architecture of the Things and their relations in a given Context and every user interaction is situated and carried out within a context.

The most significant implication of all this is that the basic work pattern is always the same, regardless of the context, and what sort of things with which we are dealing. Similar pattern of universally applicable workflows can (in parts) be seen within Freebase. The Wiki like organization in WikiNizeR works just like this: In a search you follow links and find the right context (Notebook) for what you have in mind. Then you explore, and navigate in the graph. When elaborating something you create a note, and link it to a node in the graph indicating the nature of the link. The implications of insisting on finer granularity, and requiring articulation of how things are linked, are profound. What you end up with is something which reflects, in the structure of the notes/nodes you have created, what you have in mind. Together with the links, and their subsequent meta level elaborations, all the semantically relevant aspects that make them conceptually transparent become part of a personal knowledge graph.

Implementation Details: During the beta test period, our webapp is served from alpha.wikinizer.com. In production use, the users will "host" the web app from their own drive. When the server becomes ultra thin, by shifting most of the load to client devices and Google services, this supplies an architecture, responsible only for arranging updates to be triggered, handling authentication, and eventually the e-commerce of Research/Knowledge Object. The app itself is package distributed, and purchased as a Research Object itself.

We are using the latest advances in technologies. Namely, Google drive SDK, Freebase, and other Google Javascript REST APIs, HTML 5 working in Chrome on Android as well as on the desktop, plus Chrome extensions, graph databases, the "good parts" of JavaScript, (as Crockford described in his seminal book: "Javascript the Good Parts") all becoming available over the past year. As the javascript Object Notation JSON created by Crockford continues its relentless march to eclipse XML, more and more Linked Data Sources and APIs are becoming available, hastening the "rise of the API economy". WikiNizeR is built around public APIs offered by Google and will integrate more APIs in the near future. In line with our general approach we are developing a novel way of delivering an API for WikiNizeR. In doing so we are aiming to maintain compatibility with the emerging Linked Data Platform standards. With this, WikiNizeR is poised to be part of the emerging API economy not just as a consumer, but a producer of open cloud accessible capabilities.

Innovative Aspects: All our ideas are about 50-70 years old. Bush MEMEX is 70 next year. Engelbart's published his framework for bootstrapping systems of HCI augmenting the human intellect 52 years ago. [Cf. http://www.1962paper.org/] Ted Nelson's hypertext with bidirectional typed links, intertwingularity and transclusion, have been around for nearly as long. The web scale integration of structure, collaboration, boostrapping, and raising collective IQ, all however still seem to be just a pipe dream. In this sense we are realizing the best ideas 'of old', with the nascent new technologies described above. In the wake of the million-fold increase in memory, storage, and CPU, coupled with the network speed that makes the computer "hollow out", we can say that the time for these ideas has come. What years earlier would have required hundreds of men can now be accomplished by less than a dozen. It becomes possible because there is no need to build complex infrastructure any more, we can leverage the power in both our and Google's pocket.

Status Maturity: What we have today is a (minimal viable) prototype of a system that supports Personal Knowledge Work, focusing on research, and making sense by weaving a personal knowledge graph that harvests Google's Knowledge Graph via Freebase. In this sense WikiNizeR is the simplest possible personal knowledge augmentation engine that can work in order to bootstrap further capabilities off the ground.

Link to our submission:
http://alpha.wikinizer.com/LinkedUpChallenge

3. DISTINGUISHING FEATURES

Innovation in Education: Representing the process of the growth in our personal knowledge, and sharing the emerging conceptual structures that emerge within problem solving contexts, is a major task for individual learners, and a critical coaching and tutoring problem. Knowledge obtained from the web or other resources needs to be personalized, reorganized, and contextualized, in order to filter our misconceptions. A *dynamic* conceptual organization of our knowledge not only helps us to define problems, it also helps us to discover their solution.
WikiNizeR is a suitable personal knowledge management environment for the representation and organization of "associative complexes" in computer augmented Personal Learning Architectures. Compared with traditional educational approaches, it supports a *connectivist* learning model, and can also be used in problem and project based conceptions for defining learning paths, work flows, and supplying concept and resource networks..
In a formal educational settings, it is able to replace Learning Design and LAMS 2 type educational Meta Modeling as a tool for designing structures of meta-level didactic objects, as its default however, it favours connectivist web scale e-didactics, which utilize Linked Data. Its *mobile learning* oriented implementation, which is based on RESTful programming, is compatible with the Experience/Tin Can API, and a Learning Record Store. [6]
The contextual organization of information is a basic drive in all aspects of learning. There is a large body of products which help learners accomplish knowledge organization tasks within learning contexts. Many of them are of a *visual* nature, providing custom made representation schemes for concepts and related data. Topic and Concept Mapping, Circle Diagrams, SemNet, GMap, Conceptual Graphs are all well evaluated, and research results support the efficacy of visual knowledge acquisition and organization. In comparison with traditional educational technologies WikiNizeR **makes the learning process more efficient because of the following features**:
- Scalable linking of educational data and resources (Each note and node is a kind of entity with a global unique ID.)
- Refined concept mapping/graphing technique for finer distinction of ideas (Everything that is possible at the note level works homoiconically at the meta level - it is turtles all the way up)
- The granularity of a note and its associations is set by the requirement that it can be the target of a link as a whole, starting from other notes/nodes, and can itself be linked to other notes/nodes in meaningful ways (because every note is implemented as a node).
- Fine-grained Type Hierarchies, admit and define META+META types. (Each link is of a named type elaborated in a separate meta level workflow).
- Freely definable link-set for Learning Process modeling (in consequence of the above-mentioned features).
- The possibility of constructing dependency links between concepts and skills (Types of dependencies can be defined at the meta level).
- Articulation of Common Core subjects as personalized knowledge graphs. (Existing Common Core subjects can be elaborated in the form of interrelated topic and concept maps and complemented with Freebase Linked Data and web resources).
- Knowledge discovery, and organization tailored for the *human sciences* support the dynamic nature of research in these fields. (Everything is a node connected through links on the fly, to which the user gives meaning that captures the domain specific, context dependent intent to organize things).
- Web capturing and preservation support recall and comprehension. (Keyword based search function and versioning of WN notebooks on Google Drive supplement personal archiving).
- Filtering and visualization of Linked Data based on a Bottom-Up Strategy (which focuses on finding relevant data sources via manual data selection on the fly).
- Flexible, content driven semantic organization, contrasted with the separate development and 'post-hoc' correlation of content organization and ontology building. (At the heart of the differences between formal as well as other manually created ontologies is the fact that WikiNizeR works with attributes that people consider relevant to entities in the context of their learning process. While it is able to map any ontology into the context which is exportable in a RDF form, its workflow is built on "content driven" contextual semantic knowledge organization)

Mental map preservation: Mental map preservation has been a topic at the forefront of dynamic graph layout. The level of layout stability can vary between approaches balancing stability, complexity, and quality. Our approach allows the user to adjust the positions of nodes according to their knowledge organization criteria, saving the layout in accordance with an inherent trade-off between stability, complexity, and space. Our solution relies on force directed visualization of *arbor.js* which affords innovative possibilities. *Arbor.js* leaves entirely to the user of the library the specifics of node and edge rendering and associated interactions.

Within **rendering** we make use of the following *main* **techniques:**

- Elements of the same set are identified by colored labels and links.
- Manual layout adjustment can nudge a force directed graph to settle into an equilibrium more closely reflecting what the graph is about to the user and of course helps to minimize overlaps.
- Dragging a node in a force directed graph moves along a cluster of nodes that are linked to it, giving a visual clue to the user what is closely related to her interest.
- Similarly the ability to turn links on and off and animate them, is a feature that supports transparency even possibly showing path animated node-links.

We adopted the following **functions supporting mental preservation:**
-The user can determine the location of the coloured nodes or the path
- Edges are coloured and labeled according to their types with a dynamically generated palette and shown in a legend that allows controlling of what is shown.
- Anchored layouts
- User-selected multiple foci
- Transitions of bundled edges
- Stepwise transitions, change of focus and depth
- Stepwise animation for navigation based on a spring algorithm
- Stepwise animation moving (parts of) the graph together
- Force-directed layout with virtual forces
-.Simulated annealing with customizable weights for optimization efficient algorithm and GPU implementation
- More efficient dynamic initial positions of nodes, which can be saved, reused, and re-adjusted in a force-directed layout with additional energy factors between time steps
- *In situ* integration of small visualizations
- Cluster evolution on a timeline for navigating animated node-link diagrams
- Context sensitive, intelligent, dynamic menu widgets in the form of a radial popup for applying operations to selected nodes.

- Two different views (Dynamic Graph with cross links and Hypertree view) for representing associative relations and "structural" knowledge organization hierarchies.
- The user can navigate in both the Graph view and in the Hypertree, and edit in the Graph view. When navigating in the emergent knowledge graph, the student is able to focus his attention on a concept, and explore the concepts, which are associated with it. The structural relations of the concept allow answering to this kind of needs. The structural relations can be predefined subclass relations, "instance of" relations, or just co-occurrences representing the interest of the student/user constructing an association graph of their choice in the form of a hierarchic structure of a hypertree.

Audience: Knowledge workers, or anybody needing to do web research. People who "write to think" and wish to break out of the "walled gardens" of point solutions where they are not customers but the products that are being sold. Instead we offer WikiNizeR for those who would prefer to cultivate their own personal knowledge graphs, for those who favor private Digital Archives where they can record ideas and all their learning in a form that is reusable. These potential users look for a "digital habitat" where they can harness the power of semantic search on the Web with Freebase by themselves and within their own WikiNizeR world without being burdened with high levels of cognitive load. Our potential users are not only Tech or Expert users who understand the semantic web and other advanced technologies, or have experience in using ontologies, but Lay-users (who span the categories of novice to casual Users) including not only students, but also lifelong learners, teachers, academics, postgraduates, learning designers, educational professionals, and web researchers, etc.

Usability: We are experimenting with an approach to user experience design pioneered by Engelbart and his team back in the Sixties, based on explicit description of system capabilities, and automatically managing all screen factors. The key is to build on the core capability of WikiNizeR as an augmentation engine [4] which is able to provide a first class representation of all the capabilities of the system, and to provide mechanism which turns this elaboration into user interface components, and combines them into activity 'screens' which support specific activities. Work is progressing to gradually replace hand coded and designed user interaction elements in this design style. Even in its incomplete state the current "Get Started Graph substitutes descriptions, serving as user guides and documentation. The testers have found the graph and the hypertree based navigation extremely powerful; indeed, they have found that jiggling the graph into desired shape is itself a thrilling experience.

Performance: We do not operate any servers. All computer functions run on users' devices (including smart devices) plus on Google infrastructure. We integrate semantic collaboration and delegate all storage, backup, synchronization, access control, group management tasks using Google Works (previously known as Google Apps for Business) to Google. Hence the system is as scalable as Google itself. We therefore have response times of the kind, which are familiar to people who use Google services. Freebase also has a fantastic response time that is measurable in milliseconds, and so even with increasing users, or content data, scalability is granted. The current alpha setup is running from our own private server, but is ready to be moved to the Google App for Business wikinizer.com account.

Data usage and quality: We rely on Freebase, a "melting pot" of datasets, and its 'soft' user developed ontology as our only linked data source. In our tests we have found Freebase data to be of very high quality. In many areas it lacks depth, but it does have a wide breadth. Freebase needs applications like WikiNizer to add depth to the data that they use. It is in our longer term plan to provide the means to assist users to give some of their personal knowledge graphs back to Freebase. As much of the capability of the app is already based on an explicit intent graphic model, we have a new and unique opportunity to accumulate information about usage patterns over time, and use that to suggest customization opportunities to the user, as well as dynamically drawing their attention to other, so far undiscovered but relevant capabilities. In the alpha test of the yet unreleased Android version we were able to "mine" the users own browsing histories and search histories to build a dynamic model of their own interests for themselves. WikiNizeR is already "Tin Can Ready" (is built for a rich user activity model which contains the Experience Api as a subset). WikiNizeR Notebooks can be used as a clustered personal triple store, its model can handle all that Tin Can requires, (JSON activity stream, statements). WikiNizeR users' devices could communicate with external Learning Record Store or as a self hosted distributed, soon to be peer to peer web based LMS.

Of course, we make use of Google Search and Image search. The latter is complemented by *Awesome Screenshot* which also serves our visualization approach, which applies icons and pictures to refer to the essence of the nodes.

Mendeley has just launched its own new API for Beta testing. We are planning to make use of it while our product is in Beta test.

Legal & Privacy: WikiNizeR is set up so that it does not handle user data but works with data on the user's Google Drive. There are two levels of access. As a minimum, WikiNizeR requires storage area to be set aside for its own use by the app. If the user wishes to extend the capability of WikiNizeR to integrate keyword search of all of the user's content on his drive, this extra permission need to be added.

Freebase attribution is based on Creative Commons that allows commercial use (CC-BY which is used by roughly 49 datasets). It is the second most popular license utilized by Linked Datasets, and it states "You are free to make commercial use of the work."

The most difficult issue we foresee relates to the fair use of images. Freebase, for example, no longer allows image uploads to nodes. We consider our use of unattributed images to be "fair use" while we are in restricted stealth mode pre launch beta. All images in use will be attributes purchased or sought permission for before public release. We are still seeking legal advice on the particular type of licence that we would wish to use in the future since some confusion concerning CC-BY has led to lawsuits in the past against the companies using the data covered under CC-BY. For more details, please check the FAQ on the Creative Commons website.

4. DISCUSSION

11 years ago, with the support of a DTI Smart award, we started working on a feasibility study of personalized mobile computing to support personal knowledge work. By Personal Knowledge work we meant all the personal information management tasks that go beyond appointment diaries, mails, social updates, and news feeds. In a process of Seek, Make Sense, and Share, the goal was to find a way of bootstrapping into a world of user interaction where it is possible to go beyond the 'sweet spot' of the palm philosophy. On a limited screen size mobile device according to the Zen of Palm there is a point where further addition of features results in marked deterioration of User Experience. The 'sweet spot' is the point just before that would happen. Current UI Design guidelines hark back to this well known figure: Fig. 1.4 (page 13).

For limited screen size mobile devices dictate to limit the feature set to avoid degrading the user experience. The fundamental tenets of the Palm philosophy, of instant availability of capabilities on mobile devices still holds, but the assumption that

people would not want to spend too much time using their mobile device at a time has clearly lost its validity.

Although it was quite quaint in the early 2000s to use a PDA, it was clear to us that it should be possible for knowledge work to take place on the go, bootstraping a co-evolving system which has explicit intent graphic capabilities of the system. As the user explores the app's capability repertoire, using a limited set of intuitive user interaction patterns, they can use any capability as it is discovered, giving a pervasive user experience which requires no new learning in the way it could be driven. Given that, personalization becomes possible, not just the look, or arrangement of controls, but the workflows available, enabling them to be reached easily at any point. With this there is no longer any need to limit the feature set just because the device screen is limited. In doing so we have unknowingly been engaged in building systems akin to what Bush speculated about, and which Engelbart built, on a "milli iPhone", and which Ted Nelson worked towards. We did not set out to build the MEMEX etc, like *twin.gl* or *Artficial Memory* are doing now, but built something very much like it. At the same time we have been travelling pretty much the same journey as Engelbart. Our goal is more limited, we think that the road which leads to augmenting collaborative human intellect requires first that we empower the individual knowledge worker, and later let them collaborate. Thankfully to date it is possible to address the individual knowledge workers directly without the need to get funding from corporations. Success of Brain, and many other mind mapping applications, Evernote, Pocket, ReadItLater, Pinterest, etc and all the other point solutions for personal knowledge management, tell us that there is a market in this gap. If only we could avoid being trapped in the "walled gardens" of point solutions which may deliver "sweet spots", but do not cater for our deep needs for reuse, repurposing, and reproducibility. We believe that we are building that proverbial "better mousetrap", and will soon enough see if people will flock to our doors. In June a new Graph Database called Cayley, developed by a Googler, Barak Michener, has been launched as a database that would enable developers to set up their own Knowledge Graphs. We are investigating the possibility for basing our future support for collaborative knowledge work on this technology.

On the 28th of August Mendeley has launched its new Beta API. We are excited at the prospect of integrating WikiNizeR with Mendeley with its comparable capabilities developed for Freebase.

WikiNizer Research is also going to adopt the Wolfram Computable Document Format as its raw knowledge exchange format, which will enable a clearing house of collaborative conceptualizations to be launched more quickly than we originally anticipated. "Launched by the Wolfram Group, the CDF standard is a computation-powered knowledge container — as everyday as a document, but as interactive as an app. Adopting CDF gives ideas a broad communication pipeline accelerating research, education, technical development, and progress." (http://www.wolfram.com/cdf/) CDF has the potential to bring about the technological revolution which is a precondition of a much needed cultural change in the way knowledge is produced, collaborated upon, and disseminated.

5. CONCLUSIONS

In our earlier papers we described our roadmap as "From Personal to Collaborative Concept Organization" [3] and we situated our 'WikiNizer™ technology' within Doug Engelbart's Vision. We spelled out how the first module of a Personal Knowledge Augmentation Engine, WikiNizer™ Research augments personal knowledge building by implementing WikiNizer™ Kernel and a Visual Semantic Wiki-like environment. [1] This environment enables us to organize personal Knowledge Architectures into visual Knowledge Graphs. We compared the features of our personal knowledge management solution with other Semantic Wikis, [1, p. 9] and suggested that flexible content dependent graph structures on all levels, enable us to represent and model *both* symbolic (lexical and higher) and sub-lingual "cognitive structures" and processes which belong to the domain of *personal knowledge.* We conclude that personal knowledge management is enhanced by *externalizing* our cognitive models and mental maps, and that bootstrappable visual tools are able to mobilize cognitive structures which enhance the efficacy of our problem solving. WikiNizer™ renders this assertion empirically testable, and it therefore can be considered a benchmark of an experimental epistemology. WikiNizeR built Knowledge Graphs give us the underpinnings of a more comprehensive e-didactic approach to conceptualization and contextualization. In this sense, our technology gives us an augmented Exploratory Epistemology which enhances both personal knowledge building and networked learning.

6. REFERENCES

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