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From Linked Data to Networked Knowledge

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Printing Press (Gutenberg 1450)



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Photography (Daguerre 1839)



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Phonograph (Edison 1877)



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Movies (Lumiere 1895)



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Posited by Vannevar Bush in "As We May Think" The Atlantic Monthly, July 1945

"A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility"

















oNLine System- NLS, 1968 (Doug Engelbart, SRI)



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"By 'augmenting human intellect' we mean increasing the capability of a man to approach a complex problem situation, to gain comprehension to suit his particular needs, and to derive solutions to problems."

The Mouse; Word Processing; Data Sharing; Hypertext;















ARPANET (1969) (John Postel, David Crocker, Vint Cerf)



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Xanadu (Ted Nelson Digital Enterprise Research Institute ~1960-???)



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World Wide Web (Tim Berners-Lee 1989)

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WWW (Tim Berners-Lee) "There was a second part of the dream [...] we could then use computers to help us analyse it, make sense of what we re doing, where we individually fit in, and how we can better work together."













Making Progress...



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Memex (Vannevar Bush) A memex is "a device in which an individual stores all his books, records, and communications."

Augmenting Human Intellect

(Doug Engelbart)

"By "augmenting human intellect" we mean increasing the capability of a man to approach a complex problem situation, to gain comprehension to suit his particular needs, and to derive solutions to problems."

WWW (Tim Berners-Lee)

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"There was a second part of the dream [...] we could then use computers to help us analyse it, make sense of what we re doing, where we individually fit in, and how we can better work together."















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- Scalability: No growth scalability problem (e.g., no back links from HTML pages)
- 2. No censorship: no lengthy permission or review process
- 3. Positive feedback loop: exploit Metcalf's Law

SEVENTH FRAMEWORI







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Metcalfe's law: The value of a network is proportional to the square of the number of connected members















Metcalfe's Law 1: Links



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Metcalfe's Law 2



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1. Scalability. No centralized infrastructure (e.g., a central object repository) required.

2. *No censorship*. It must be possible to publish data without having to ask for prior permission.

3. *Positive feedback loop*. Capitalize on Metcalfe's Law.















- 1. Global Object Identity.
- 2. Composability: The value of data can be increased if it can be combined with other data. Composability has a number of consequences:
 - 1. schema-less. (Combined data originating from difference sources unlikely to conform to a schema)
 - 2. self-describing
 - 3. *"object centric"*. In order to integrate information about different entities data must be related to these entities.
 - *4. graph-based*. The composition of multiple object-centric data sources results in a graph in the general case.











Observations



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- The relational model does not fulfill these requirements (not composable, no global object id)
- XML is not object centric and not composable.
- Graph based data formats are composable
- RDF fulfills these requirements.
- Claim: Any data format that fulfills the requirements is "more or less" isomorphic to RDF.















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The usual two Ingredients

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- 1. RDF Resource Description Framework Graph based Data – nodes and arcs
 - □ Identifies objects (URIs)
 - □ Interlink information (Relationships)
- 2. Vocabularies (Ontologies)
 - □ provide shared understanding of a domain
 - □ organise knowledge in a machine-comprehensible way
 - □ give an exploitable meaning to the data















Linked Open Data cloud domains



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Do we *really* need Ontologies?

(as we have them right now)

















Anything wrong with this picture?



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Wasn't the Web about sharing?



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Could modeling not be easy?



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Issues with Ontologies



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- Differentiation in Classes and Instances is difficult: no single way to abstract the world (observe Upper Ontology wars....aehm...discussions!)
- Choices between Instances and Classes done at design cause usability issues (different treatment in applications) (animal-mammal-whale)
- Ontologies cement power structures (prevent information sharing)

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Sharing is only top-down





How did classes/instances happen?



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- Predecessor: Frame Representation Systems
- Prototypes: KRL, RLL, and JOSIE employ prototype frames to represent information about a typical instance of a class as opposed to the class itself and as opposed to actual instances of the class." [Karp, 1993]
- AFAIK: Formalisation classes as subsets and instances as elements [Hayes, 1979].
- Formalization of Frame Systems (Description Logic) picked up on [Hayes, 1979] and left out alternatives











Note: How did DL & Ontologies/Classes happen in the Semantic Web?



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- Stefan Decker, Dieter Fensel, Frank van Harmelen, Ian Horrocks, Sergey Melnik, Michel C. A. Klein, Jeen Broekstra: Knowledge Representation on the Web. Description Logics 2000: 89-97
- OIL -> DAML+OIL -> OWL -> OWL 2.0















Class- vs. Prototype-based Digital Enterprise Research Institute



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Class-based:

- Classes share methods and define common properties
- Inheritance along class chain
- Instances have exactly the properties and behavior defined by their class
- Structure typically cannot be changed at runtime

Prototype-based:

- No classes, only objects >
- Objects define their own > properties and methods
- Objects delegate to their > prototype(s)
- Any object can be the prototype > of another object

Prototype-based languages unify objects and classes

From: A. Lienhard, O. Nierstrasz: Prototype based programming http://www.slidefinder.net/0/03prototypes/03prototypes/10603817















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> JavaScript,
> Self,
> NewtonScript,
> Omega, Cecil,

From: A. Lienhard, O. Nierstrasz: Prototype based programming http://www.slidefinder.net/0/03prototypes/03prototypes/10603817











How it could look like: Digital Enterprise Research Institute (Horizontal Information



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Sharing)













You can have Ontologies as well...



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FOAF as Prototypes



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Object foaf:Agent weblog URL twitterID String

Object foaf:Person hasPrototype foaf:Agent fromSource: http://xmlns.com/foaf/spec/#term_Agent knows foaf:Agent age [0...120] gender {Male, Female} ishuman yes

Object deri:Stefan hasPrototype foaf:person

fromSource: <u>http://xmlns.com/foaf/spec/#term_Person</u> weblog <u>http://blog.stefandecker.org</u> twitterID stefanjdecker age 44 gender Male













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- Delegation vs. Copying (deep, shallow)
 - □ When to delegate (freshness)
 - □ When to copy (access too slow, unsecure, unreliable)
 - □ Caching, update strategies?
- Determining object boundaries (e.g., via a scoperelationship between URIs). E.g., deri:stefan isScopeOf deri:address. Automatically possible?
- Object modification non monotonicity?
- Referencing an object (URI & Source!)
- Specialization: Exact semantics?













Research Agenda



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- Knowledge Representation Constructs (Specialisation)
- Logic based Formalisation of Prototypes
- Reasoning (e.g., with Rules)
- Complexity
- Large Scale Storage, Querying
- Collaboration facilities















Get the car out of the mud...













Linked Open Data cloud -



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but we need 100s!"

















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Knowledge Pipeline

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Example



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Find all topics in publications relevant to "neoplasm" and clinical trials relevant to the publications topics!

C fi 🗋 www.ncbi.nlm.nih.gov/pubmed/23724163		2 🔍 💷 🛄	stance Overview - Open × (ey 10.196.107.68/home × CT Anterior and Posterior Seg	×			
S NCBI Resources 🖸 How To 🖸	Sign in to	+	C f C clinicaltrials.gov/ct2/show/NCT01196325?term=VEGF&rank=1				
Publicad gov Publication Advanced	Search	ip.	ClinicalTrials.gov	Search for studies	Example: "Heart attack" AND "Los Angeles"	Se	
Display Settings: Abstract Send to;			A service of the U.S. National Institutes of Health		Advanced Search Help Studies by Topic	Glos	
<u>Am / Transl Bes</u> , 2013 May 24.5(4):393-403. Pret 2013. Beyond anti-VEGF: dual-targeting antiangiogenic and antiproliferative therapy.	Add to Favorites •		Find Studies - About Clinical Studies - Submit Studies - F	Resources About This Site			
<u>Chen CT. Hung MC</u> Department of Molecular and Cellular Oncology, The University of Texas MD Anderson Cancer Center Houston, TX, USA. Abstract Antiangiogenesis is a promising antitumor strategy that inhibits tumor vascular formation to suppress tumor growth. Specifically, targeting VEGF has shown threapenductibenefits in many cancer types, leading to its approval as the first antiangiogenic drug by the Food and Drug Administration in the United States. It is known, however, that patients will experience unfavorable side effects as the VEGF and/or VEGF receptor signaling gathway is also required for homeostasis in normal tissues. Moreover, due to the cryotastic nature of antiangiogenic, cancer cells that are not killed by these	Related citations in PubMed	-	Home > Find Studies > Search Results > Study Record Detail		т	ext Siz	
	Dual targeting of tumor angiogenesis and chemotherapy by endost [Mol Cancer Ther.	1	Trial record 1 of 1194 for: VEGF Previous Study Return to List Next Study +				
	Review Combination of antiangiogenesis wit chemotherapy for more e [Mol Cancer Ther.	8]	Anterior and Posterior Segment Vascular Changes Following Laser and Anti-Vascular Endothelial Growth Factor (VEGF)				
drugs later develop an even more malignant phenotype, resulting in tumor invasion and metastasis. Although there have been many attempts to reduce drug resistance and increase therapeutic efficacy by combining antiangiogenic drugs with chemotherapy, the cumulative toxicity of	mbination of vascular endothelial growth factor septor/platelet-derived [Clin Cancer Res. 2008]						
antiangiogenic combinations limits their feasibility as treatments, as chronic angiogenesis inhibition typically reduces the antitumor defect of the co- administered chemotherapeutics. To overcome these problems, it is circlat or explore new strategies that limit tumor resistance and side effects and also increase the exposure of chemotherapy drugs at the tumor site. Here, we review current understanding of antiangiogenic drugs and introduce a new combination strategy that links direct antiangiogenic protein and enzyme prodrug system with dual-targeting antiangiogenic and antiproliferative therapeutic effect in tumor microenvironment. This strategy has the potential to overcome these clinical hindrances and may serve as a paradigm for the next generation of antiangiogenic drugs.	Targeting the EGF/VEGF-R system by tyros kinase inhibitors- [Langenbecks Arch Surg.	- 6]	Full Text View Tabular View No Study Results Posted	Disclaimer How to Read a Study	Record		
	Review Reappraising antiangiogenic therapy breast cancer. [Breast	1					
	See revi	-	Purpose				
KEYWORDS: 5-fluorouracil, Antiangiogenesis, bevacizumab, chemotherapy, endothelial cell-targeting	Se	-	The study will investigate changes in the structure and function of blood vesse diabetic eve disease. Sixty four volunteers will be recruited including age-matu	els in the front and back of the eye follo ched control subjects and diabetic patie	wing laser and anti-VEGF treatments for sight-th ents who require conventional or contemporary t	treatm	
PMID: 23724163 [PubMed - In process]	Recent activity		pre-existing diabetic eye disease. Volunteers will be assessed before and after treatment using state-of-the-art techniques to measure vision, the rate of blood flow and str at the front and back of the eye and the effectiveness of blood flow delivery. Changes following treatment in these novel, non-invasive techniques will be quantified and described. We anticlate that conventional and new / developing treatments will ead to narrowing of the vesses and consequent reduction of blood flow at heak and fr				
	Blastic plasmacytoid dendritic cell neoplasm. P	ed	the eye. There will be a strong relationship between structural changes of the study will improve our understanding of the impact of the various treatments or	eye and functional changes of blood v n the entire eye. The research will also	essels at the front and back of the eye. The rest ensure an improved understanding of the mech	ults of inanism	
	[Advances in blastic plasmacytoid dend cell neoplasm].	ed b	action of the various treatments and will provide insight of reasons for good or	r poor outcomes, based upon specific o	hanges in structure and blood flow.		













Workflow



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A Network of Knowledge



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