

The SILK* System: Scalable Higher-Order Defeasible Rules

* <http://silk.semwebcentral.org>

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SILK & Hyper LP: Overview

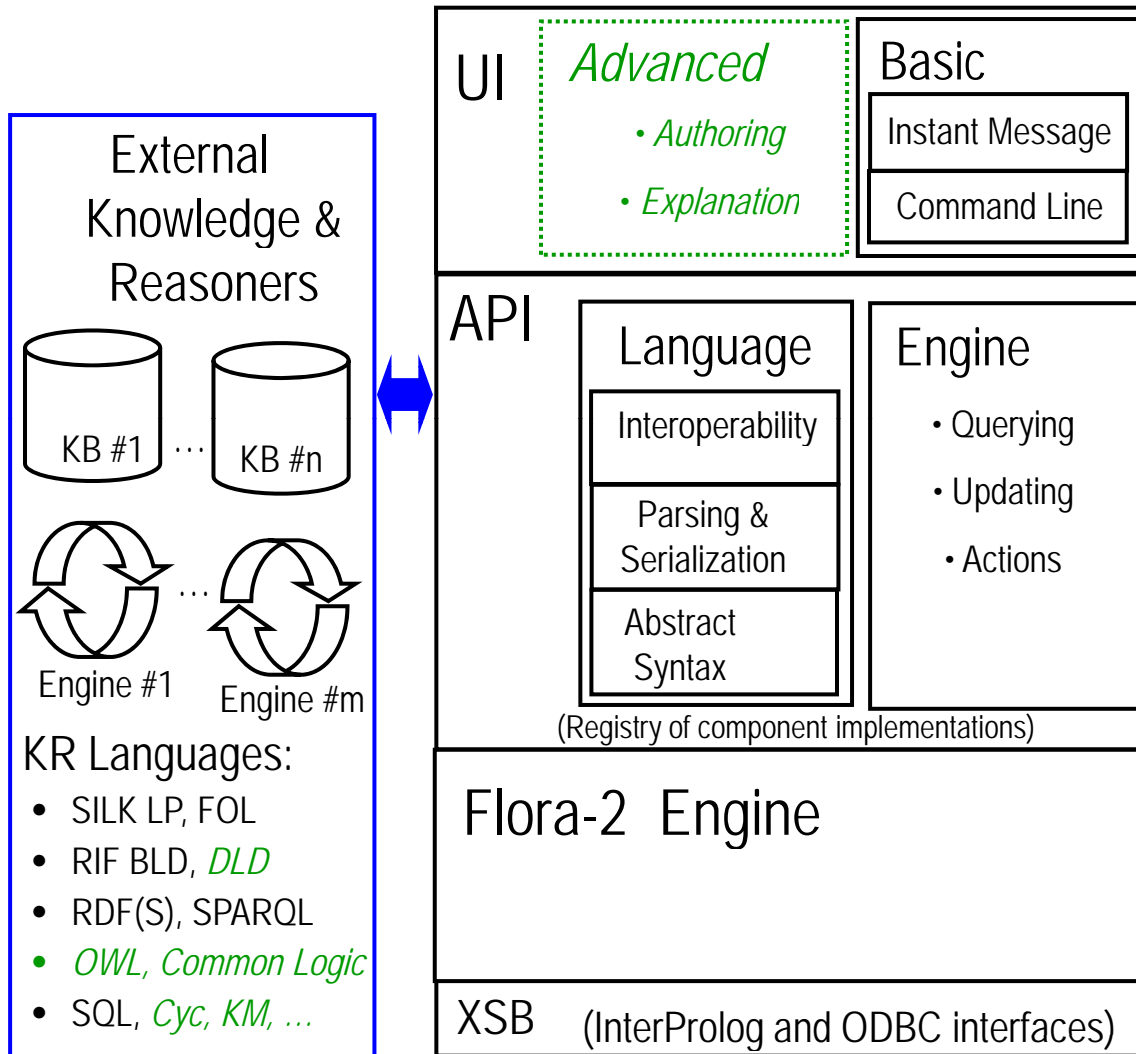
- A KR Language and KR System with reasoner, UI, interchange
 - Syntax & semantics, forward & backward inferencing*, Java API, translators
- Goal: Expressiveness + Semantics + Scalability + Web
- Focus: Defaults and Processes, esp. for e-science/e-business question answering
- Largest rule research program in the US** (2008-); by Vulcan, primarily via contractors
- *Hyper LP* KR newly combines **new** features and previous advanced features
 - Higher-Order Defaults, cf. generalized Courteous LP / Defeasible Logic + HiLog / F-Logic
 - “Argumentation Theories” meta-rules approach: much more efficient, flexible, clean [ICLP-2009]
 - **Sound Interchange with FOL**, via Hypermonotonic mapping
 - FOL clause of length k maps to k directional rules (1 for each choice of head literal)
 - Reactiveness (external Actions, Events, Queries), cf. generalized Production LP
 - Webized; interchange; well-founded unstratified; derived equality; frame/OO syntax; ...
- Scalable
 - Computationally: complexity same as Horn LP! \Rightarrow As web-scalable as Relational DBMS
 - Semantically: tolerates conflict from data quality, updating, ontological misalignment, etc.
- Status: prototype engine, language spec, and theory for expressive core
 - V1 (early 2009) adds Higher-Order Defaults to FLORA-2
 - V2 in development (~ early 2010) adds more features and Java API (Demo is of pre-alpha!)
 - Extensive requirements analysis, use cases, benchmarking; ReCyc translation

Features Comparison – More Systems & Stds

Level	Groups of Features	<i>SILK2</i>	<i>Flora</i>	<i>RIF- BLD</i>	<i>Jena</i>	<i>Onto- broker</i>	<i>Jess</i>	<i>IBM C.R.</i>	<i>DLV</i>	<i>SQL</i>	<i>SPA- ROL</i>	<i>Common Logic</i>	<i>OWL2 RL</i>	<i>OWL2 DL</i>
Basic	Horn chain. etc.	Y	Y	Y	Y	Y	Y	Y	Y	R.	R.	Y	R.	R.
Advanced	<i>(Level summary)</i>	Most!	lots	some	some	some	some	some	some	some	some	some	some	some
	Equality	Y	Y	Y	R.	R.	R.	N	Y	R.	R.	Y	R.	Y
	Functions	Y	Y	Y	N	N	N	Y	Y	N	N	Y	N	N
	Frames etc.	Y	Y	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.	R.
	Closed-World	Y	Y	N	N	Y	R.	R.	most	R.	R.	N	N	N
	Higher-Order	Y	Y	N	N	N	R.	N	N	R.	R.	Y	R. bit	R. bit
	Actions	Y	N	N	N	N	Y	Y	N	N	N	N	N	N
	Base Defaults	Y	N	N	N	N	N	Y	N	N	N	N	N	N
	Webized	Y	R.	Y	Y	R.	R.	R.	R.	N	Y	Y	Y	Y
Hyper	<i>(Level summary)</i>	1st!	N	N	N	N	N	N	N	N	N	N	N	N
	H-O. Defaults	Y	N	N	N	N	N	N	N	N	N	N	N	N
	Weak. Classi.	Y	N	N	N	N	N	N	N	N	N	N	N	N
<u>Misc.</u>		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Other Expres.	Dev.	inherit.	-	-	-	events	-	disju.	R.	R.	classical	-	classic.
	Efficiency	good	good	NA	fair	good	fair	poor	good	NA	NA	NA	NA	NA

- Summarizes detailed analysis of 40 KR expressive features, 17 systems.
- Notes: Dev. = Developing, R. = Restricted; C.R.=Common Rules; disju.=disjunctive.

SILK V2 Architecture and *V3 Directions*



- V2 Functionality
 - Higher-order defaults reasoning, combines many other advanced KR features
 - SILK and external KR language support integrated tightly with reasoning engine

- *Future Items*
 - *Meet Process req.'s*
 - *More UI is key: graphical, limited NL*
 - *Integrate with AURA*
 - *SILK KR: truth maintenance, probabilistic & constraints, parallelization*

- Test Sets Focus
 - Defaults, Process
 - AP esp. Bio

Demo Scenario: Environmental Watchdog for River System Pollution

1. **RDF(S)**: import RDF streaming sensor data about fish counts on river stretches. The data reflects drastic declines on some stretches. We also import an RDFS ontology about FishCounts, Stretches, Rivers, etc.
2. **External SPARQL Query**: obtain RDF data from SPARQL endpoint (dbpedia.org) about ?river1 flowsInto ?river2
3. **RIF-BLD**: load RIF-BLD rules (not expressible in RDFS) about transitivity of flowsInto
4. **External ODBC Query**: obtain emergency responder info, from an Excel spreadsheet
5. **SILK-FOL**: load FOL axioms expressing definitions about pollution
6. **SILK Defeasible Reasoning**: use the preceding knowledge to infer toxic discharge and affected rivers, via SILK defeasible rules that describe process causality & inertia
7. **Persistent Query with Triggered External Action**: monitor for such toxic discharge, and when triggered send emails to emergency responders
8. **Receive Updates**: e.g., sensor data above, or later cleanup of pollution

RUN DEMO!

SILK & Hyper LP: Conclusions

- Radically extends the KR power of W3C OWL, SPARQL, and RIF – and of SQL
 - Defaults and robust conflict handling – *cope with knowledge quality and context*
 - Higher-order and flexible meta-reasoning – *elevate meta-data to meta-knowledge*
 - Actions and events, cf. production rules and process models – *activate knowledge*
- Raises the KR abstraction level for business users (SMEs) and NL KA/UI
- Use cases in biomed, business policies, ontology mapping, e-commerce, ...
- Redefining the KR playing field for Semantic Web, business rules, and rule-based process management
 - Defaults and Higher-Order – yet retain computational web scalability
 - Escape from fragility of FOL – yet retain grade-AAA model-theoretic semantics
- Motto: “Transforming Knowledge”
 - Composes a set of KR transformations for ...
 - Expressive extensions – language and semantics
 - Translations between KR/syntaxes, for interchange
 - Reuse of previous LP algorithms and implementations



How You can be Involved

- **General Contact: Benjamin Grosf** benjaming@vulcan.com
 - Suggest design, use cases, experts, cooperations
- **Visit the SILK webpage and sign up for the mailing list so you'll be alerted of announcements about SILK**
 - URL: <http://silk.semwebcentral.org>
 - Mailing list: silk-announce@semwebcentral.org (very low volume)
- **Provide comments on SILK and RIF DLD language design**
 - Initial public draft in early 2010; selected earlier reviewers starting Nov. 2009
 - Proposed RIF Default Logic Dialect that extends BLD with defaults and actions
 - Corresponding to a large expressive subset of SILK; uses RIF Framework for Logic Dialects (FLD)
 - Initial public draft approx. Nov. 30, 2009
- **Try out SILK software**
 - Prototype, free for research and non-commercial use. E.g., via instant messaging.
 - V2 release in 2010; selected earlier users of the pre-alpha and V1 starting Nov. 2009

SILK Contributors current/past (partial list)

- Vulcan (Benjamin Grosf, Mark Greaves, Dave Gunning)
- Stony Brook University (Michael Kifer; students H. Wan, S. Liang, P. Fodor)
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- SRI International (Vinay Chaudhri, David Martin, Ken Murray, Bill Jarrold)
- Automata (Paul Haley)
- Cycorp (Keith Goolsbey, Doug Lenat, Ben Rode)
- Ontoprise GmbH (Daniel Hansch, Jurgen Angele)
- Boeing (Peter Clark)
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