

rough title:

KM for use in SmartThings projects

was:

Large Linked Data

**Sketch of a potential *linked-data* system
that could deal w/large data volumes
w/example influences/components**

bit.ly/TP8gfz

Large Triple/Graph Processing
dealing with communicating distributed
stores and streaming data feeds
more of a lpython/parallel /ROS approach

making a *BBN-SHARD* like
system using *UT-Austin's*
Knowledge-Machine in Lisp

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bobak7.wix.com/bobak

Possible app: mapreduce based graph-store

by bringing together ideas behind BBN's SHARD mapreduce on hdfs flat files of triples, &/or using aspect of lpython's parallel-libs, Storm, &ROS with the reasoning done by UT-Austin's Knowledge-Machine and SciDB like array storage/ops for heavy numerics

SHARD



Graph processing on HDFS
fast distributed triple-store

SciDB



open-src data-mgt&analytics
array-ops scaling to petabytes

KM: The Knowledge-Machine



frames to OWL, use of access-limited-logic

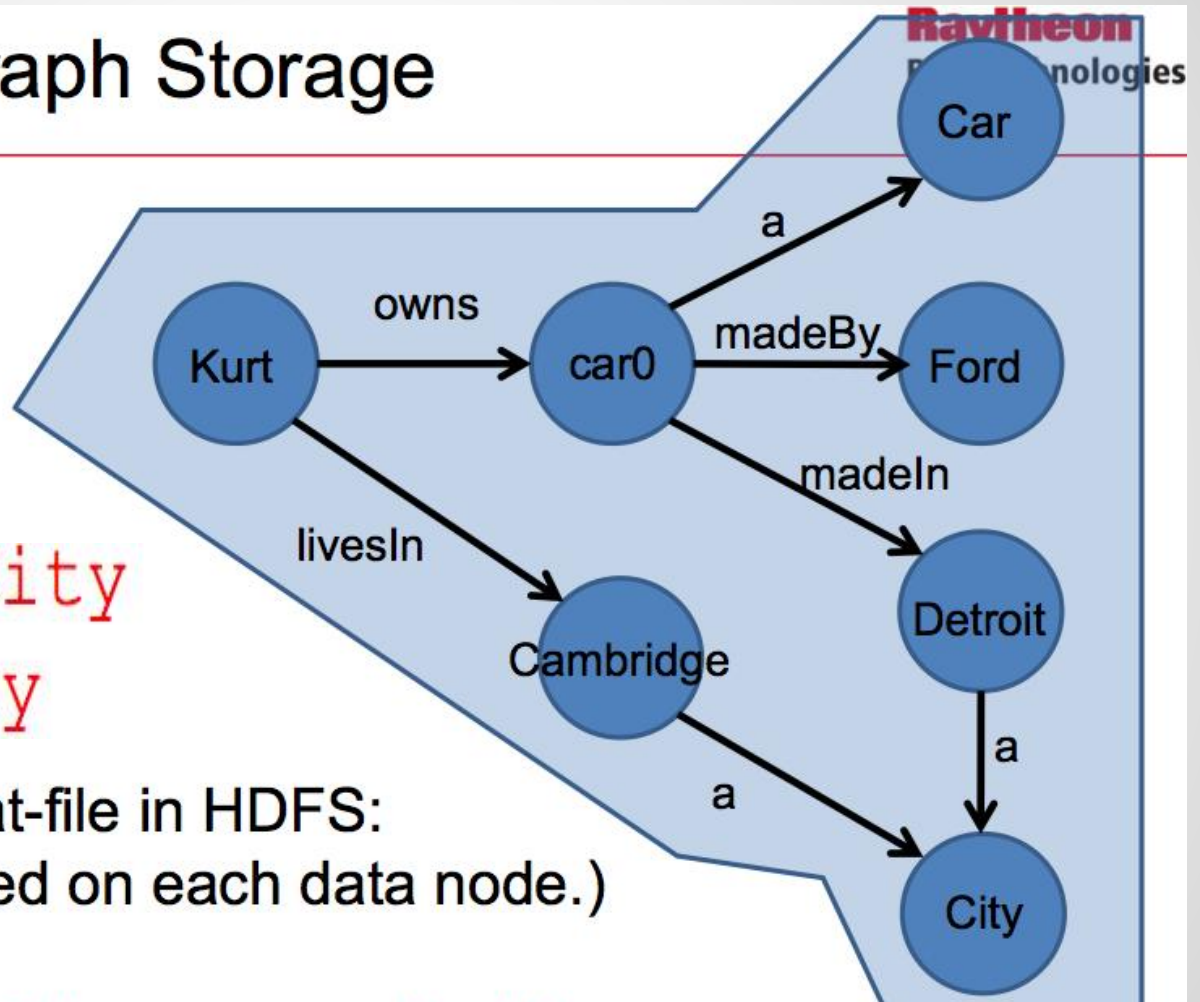
KM is a powerful, frame-based language with clear first-order logic semantics. It contains sophisticated machinery for reasoning, including selection by description, unification, classification, and reasoning about actions using a situations mechanism.

Used in Halo/Calo precursor to Siri

I used for medical free-text concept-labeling experiments, along w/MMTx/MetaMap POS/..

SHARD: (Scalable, High-Performance, Robust and Distributed)

HDFS Graph Storage



Cambridge a City

Detroit a City

Graphs saved as flat-file in HDFS:
(Portions of file saved on each data node.)

Kurt owns car0 livesIn Cambridge

Car0 a Car madeBy Ford madeIn Detroit

graph/triple-store processing via mapreduce

BBN's SHARD triple-store uses flat HDFS files w/great benchmarks. I think this could be done w/Lisp, and have considered doing some of the reasoning w/KnowledgeMachine, which was used in the HALO, then CALO project which turned into Siri.

SHARD http://www.lotico.com/slides/20110208/Rohloff_Meetup_02_08_2011.pdf

-but w/KnRep&Reasoning done w/:

KM <http://www.cs.utexas.edu/~mfkb/km/> example class-defn:

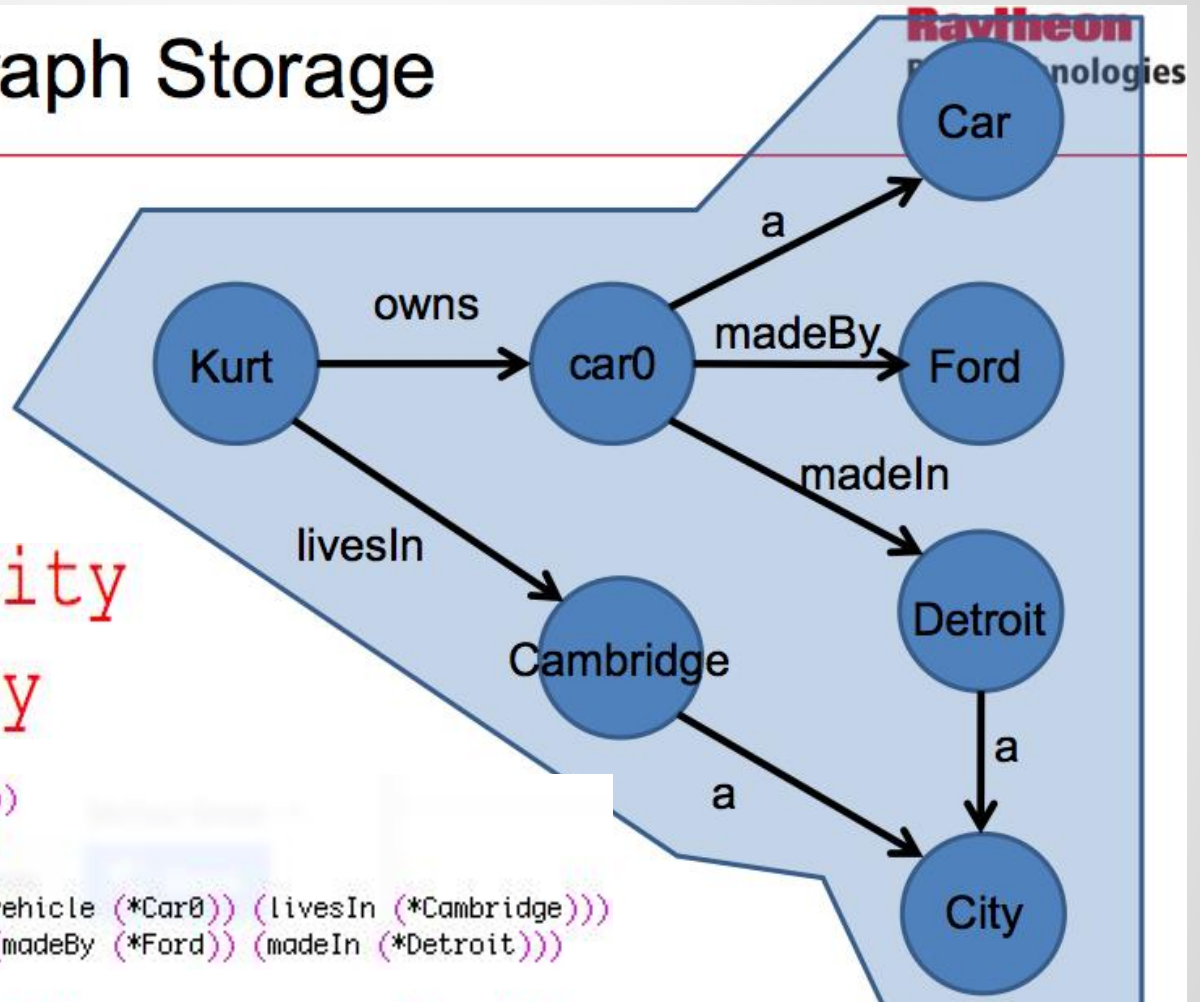
```
;;; "Cars are vehicles."  
;;; superclasses(Car, Vehicle) ∧ terms(Car, "car") ∧ terms(Car, "vehicle")  
(Car has ; properties of the class  
  (superclasses (Vehicle))  
  (terms ("car" "automobile"))) ; ie. words of phrases used to denote cars
```

```
;;; "Cars have four wheels, an engine, and a chassis"  
;;;  $\forall c \text{ isa}(c, \text{Car}) \rightarrow \text{wheel-count}(c, 4)$   
;;;  $\forall c \text{ isa}(c, \text{Car}) \rightarrow \exists e, ch \text{ isa}(e, \text{Engine}) \wedge \text{isa}(ch, \text{Chassis}) \wedge \text{parts}(c, e) \wedge \text{parts}(c, ch)$   
(every Car has  
  (wheel-count (4))  
  (parts ((a Engine) (a Chassis))))
```

SHARD:

Using Hadoop to Build a Scalable, Distributed Triple Store

HDFS Graph Storage



Cambridge a City

Detroit a City

```
(*Cambridge has (instance-of (City)))  
(*Detroit has (instance-of (City)))
```

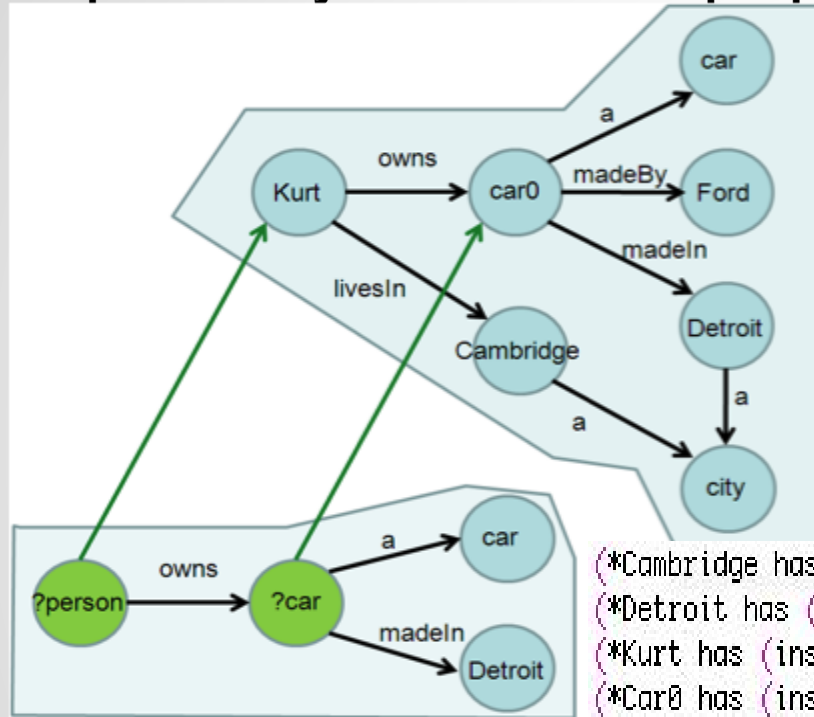
```
(*Kurt has (instance-of (Person)) (vehicle (*Car0)) (livesIn (*Cambridge)))  
(*Car0 has (instance-of (Vehicle)) (madeBy (*Ford)) (madeIn (*Detroit)))
```

Kurt owns car0 livesIn Cambridge

Car0 a Car madeBy Ford madeIn Detroit

Shard sparql query w/ KM equivalent

https://dist-systems.bbn.com/people/krohloff/shard_overview.shtml



SRI has OWL interop

So might also w/sparql

```
(*Cambridge has (instance-of (City)))  
(*Detroit has (instance-of (City)))  
(*Kurt has (instance-of (Person)) (vehicle (*Car0)) (livesIn (*Cambridge)))  
(*Car0 has (instance-of (Vehicle)) (madeBy (*Ford)) (madeIn (*Detroit)))
```

```
SELECT ?person  
WHERE {  
  ?person :owns ?car .  
  ?car :a :car .  
  ?car :madeIn :Detroit .  
}
```

(Car has (superclasses (Vehicle)))

;when vehicle predicate inherits from owns can say:

(the owns-of of (a Car) with ((madeIn *Detroit)))

;or just ask:

(the vehicle-of of (a Car) with ((madeIn *Detroit)))

Streaming is very flexible

Allowing polyglot programming (can mix in elts in any language needed)

Hadoop Streaming

Hadoop provides an API to MapReduce that allows you to write your map and reduce functions in languages other than Java. *Hadoop Streaming* uses Unix standard streams as the interface between Hadoop and your program, so you can use any language that can read standard input and write to standard output to write your MapReduce program.

Streaming is naturally suited for text processing (although, as of version 0.21.0, it can handle binary streams, too), and when used in text mode, it has a line-oriented view of data. Map input data is passed over standard input to your map function, which processes it line by line and writes lines to standard output. A map output key-value pair is written as a single tab-delimited line. Input to the reduce function is in the same format—a tab-separated key-value pair—passed over standard input. The reduce function reads lines from standard input, which the framework guarantees are sorted by key, and writes its results to standard output.

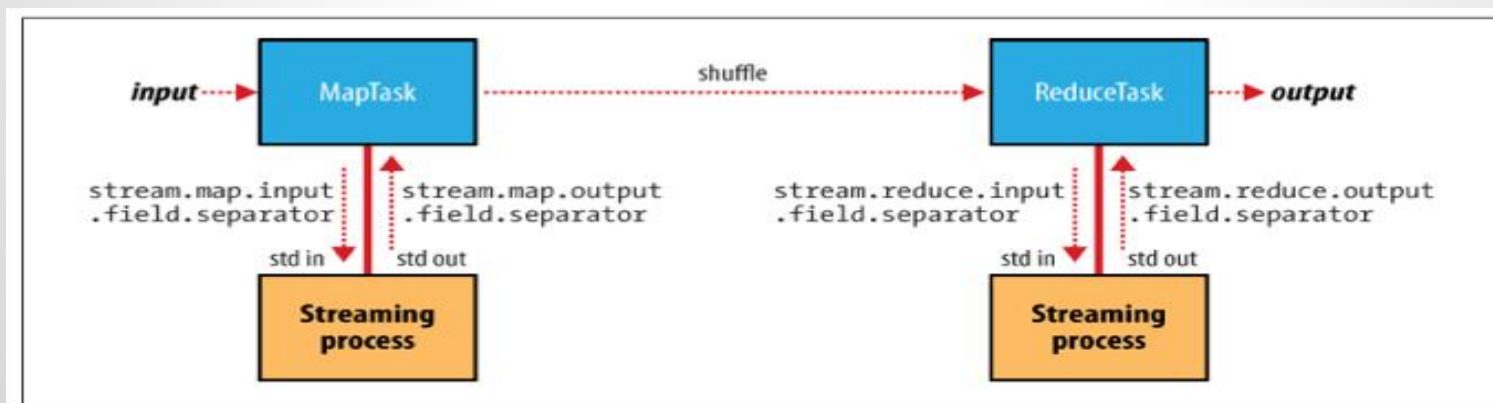


Figure 7-1. Where separators are used in a **Streaming** MapReduce job

example streaming setup files

```
hadoop fs -rmr streaming/results
```

```
hadoop jar /usr/lib/hadoop/contrib/streaming/hadoop-streaming-0.20.2.jar \  
-verbose \  
-input streaming/input-dir \  
-output streaming/results \  
-mapper "sbcl --core km.core --load mapper.cl" \  
-reducer "sbcl --core km.core --load reducer.cl" \  
-file mapper.cl \  
-file reducer.cl \  
-file km.core
```

Other types of Streaming

Instead of batch Hadoop, there is [Storm](#) like live streaming, &/or Ipython's [parallel](#) libs, both of which [use](#) MQ.

There are also [streaming sparql engines](#) like C-SPARQL and Instans, and just streaming triples into your reasoner, which can deal w/updated data.

Keeping it distributed and closer to pub/sub msgs of interest; Like through use of [ROS](#)

Clojure (cascalog&storm) (JVM v CL) interop

A *Storm* like system could help deal with some of the *velocity problem*.

Can get KM in ABCL, might mix w/clojure vs a rewrite.

Look great, but I'd rather build up in Lisp, and move it toward what Clojure can do, vs. not building on the rich set of Lisp Libs.

Could probably use cl-zmq as a starting place for a storm-like.

I wish java interop was easier, Rich Hickey tried it before writing Clojure.

I think external-program, streaming,&msg-passing can get around some of the/se tighter/(more radical) ways of getting interop.

Remember your freedom to choose which (set of) language(s) to use should be increased (both in server& distributed programming, given this looser (stream/msg-passing/..) coupling.

Can also interact w/AWS ..

Can get to S3 storage w/: www.xach.com/lisp/zs3/ get-string/put-string &share w/other apps, via: common-lisp.net/project/cl-json/ strings

or

Simple Command-Line Access to Amazon EC2 and Amazon S3, via:

common-lisp.net/project/trivial-shell/ to aws.amazon.com/developertools/739 AWS shell tool.

NoSQL fast front-end use by putting the json to www.cliki.net/cl-mongo &can make use of: cliki.net/cl-redis too.

Had considered being able to take avro (self-describing) inputs.

It has a json header that describes the binary encoded stream.

can even mix w/hadoop-streaming, but be sure that it is faster than a multi-step process, which could be organized&run by oozie

Though for some tasks you might just be able to use *casalog*, in clojure which allows for tighter Hadoop/Java integration, &for more real-time streaming work a clojure hadoop like system called *storm* which uses MQ, though possibly rewritable in Lisp.

New: will look at: <https://github.com/lookis/service-monitor>

Example use: bit.ly/hurricanehackers-gdoc tasks using logd.tw.rpi.edu linked-open-govt/etc data

#HurricaneHackers

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Reasons for triples describing large arrays vs. a triple_{per} #:
few extra orders of magnitude by directing data to right tools

Plenty of large numeric needs:

sensor-nets, large-science (weather/satellite-imagery..)
machine-learning, query over huge multi-dim arrays

HPC techniques&tools for store/moving&processing
these volumes very quickly.

HDF5 w/parallel (msg-passing) IO &tools that use it.

Links: www.sbcl.org or ccl.closure.com & www.quicklisp.org

www.cs.utexas.edu/~mfkb/km [KnRepr&Reasoning/Qry](#)

www.dist-systems.bbn.com/people/krohloff/shard.shtml

also see the Lisp: (pay): <http://franz.com/agraph/> (&free:) <https://github.com/kraison/vivace-graph-v2.git>

Data: code.google.com/p/cl-protobuf/ or avro.apache.org/ in lisp w/cl-json &a decent cl binary pkg *I'd like semantics for*

Store: www.hdfgroup.org/HDF5/ git://gitorious.org/dh-misc/hdf5.git github.com/filonenko-mikhail/cl-scidb.git <- *petabytes,*

[_ parallel/dist/msg-passing:](#) lparallel.com cl-pvm/lpvm www.cliki.net/cl-mpi www.csm.ornl.gov/pvm/PVMvsMPI.ps

&miss: http://en.wikipedia.org/wiki/*Lisp 's pvars: auto-spread vects among processors

some Lisp(likes): en.wikipedia.org/wiki/CLIPS (has CLOS) [RuleBased-Shell](#)

In CL there is: <http://lisa.sf.net/> .. [gui: protege.stanford.edu/](http://gui.protege.stanford.edu/)

Streaming SPARQL: github.com/aaltodsg/instans

ML: code.google.com/p/malecoli/ github.com/mathematical-systems/clml.git <http://quickdocs.org/mgl/>

en.wikipedia.org/wiki/XLispStat or in CL: github.com/blindglobe/common-lisp-stat

www.visualstats.org lush.sf.net common-lisp.net/project/rc1 [to R](#) which has

or cliiki.net/Mathematics

R+pvm: cran.r-project.org/web/packages/rpvm/index.html

common-lisp.net/project/cl-octave &for py pkgs github.com/franzinc/cl-python.git to octave.sf.net

ipython is allowing mixing R/etc, & parallel execution, *sage* mixes python &maxima in Lisp

new: <https://github.com/Paradigm4/SciDBR> &v7: <https://github.com/openlink/virtuoso-opensource> *more

github.com/nathanmarz [cascalog](#) [storm](#) in Clojure

Cascalog is a replacement for tools like Pig,Hive,&Cascading.

Storm is a distributed, reliable,&fault-tolerant stream processing system.

MsgPassing:PVM (a more simple MPI)

We are seeing HPC *msg-passing* libs like MPI being brought into new Hadoop like packages; to allow for *orders of magnitude improvements* (via tighter-loops) for applications like *Machine-Learning*

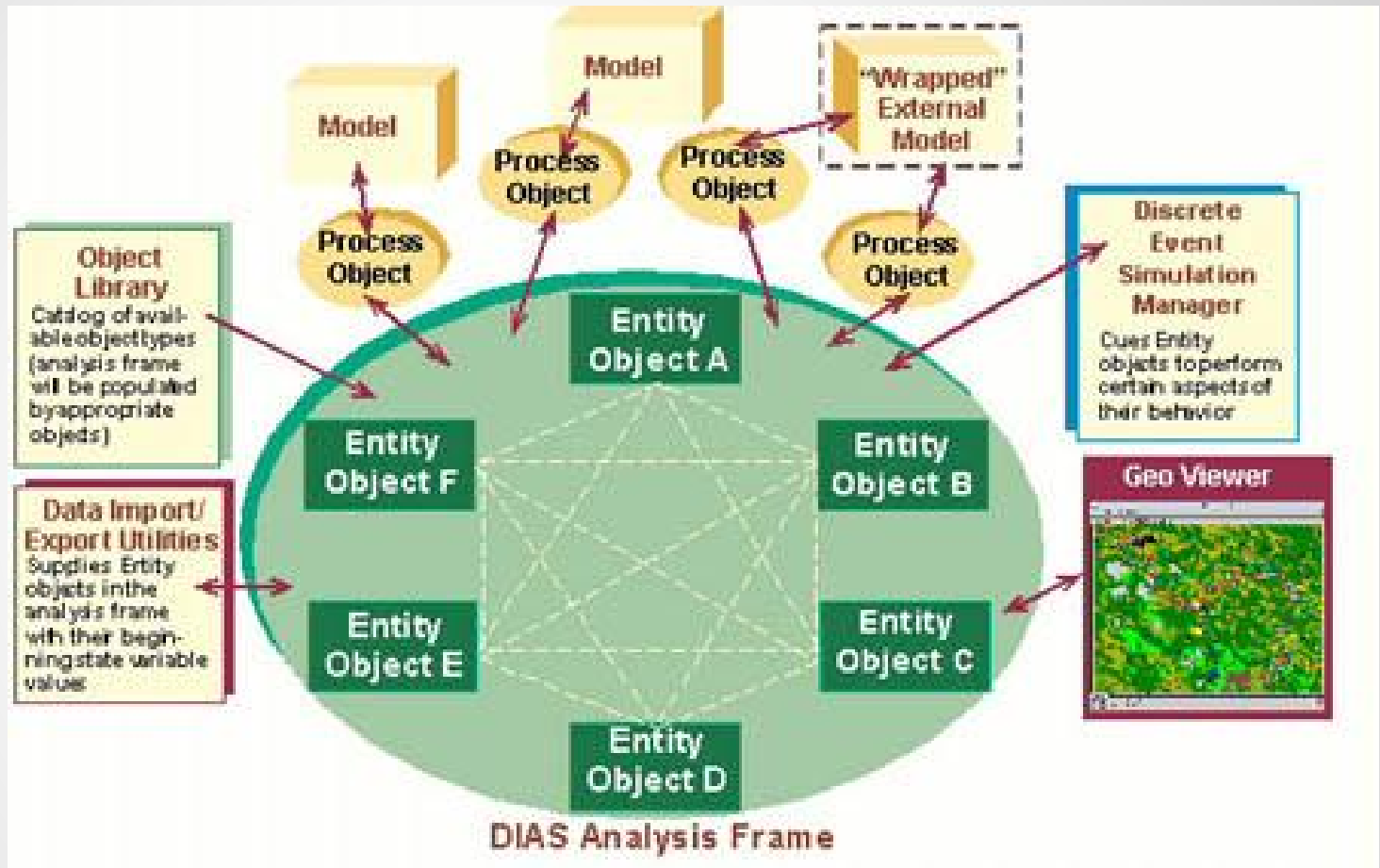
Having *distributed-objects* w/huge arrays in Lisp is very easy, as you have the ability to easily reflect during runtime; slot-names & associated msg-packing routines for all their slot-value types make it easy. The only trick was to start the obj-packed msg, w/a str, that could be eval'd to create an instance on the other side. Then assoc msg-unpacking methods for each of the slot/val pair comes into play. This can be a nice way to quickly share huge chunks of data between several different dynamic languages.

Even tighter coupling like in rcl&cl-octave can benefit from msg-passing; could maybe re-do w/pvm & (a link to the server version of) R&Octave's REPLs, or just `unpack&eval`.

I would also like to share lots of data w/xlispstat's vista, Lush, & Clojure

A live:data/goal-driven distrib-simulation

used in:



reasoning/comm

for Context/SimMgr at: <https://github.com/MBcode/CLIPSmsc/tree/master/clp-pvm>
cl-pvm also available, so I would write similar methods, so they could interoperate.

Semantic-Web/.. to aid Machine-Learning

Adding explicit model/structure, can aid in more causal/explanation/understanding/trust/usability/..

Now I would bring more KnShareingEffort like annotation around large data-sets and code(sim/analytics/etc), so they could more easily interoperate in a goal-based way. So extending old work, but doing it w/(hopefully)a better set of tools.

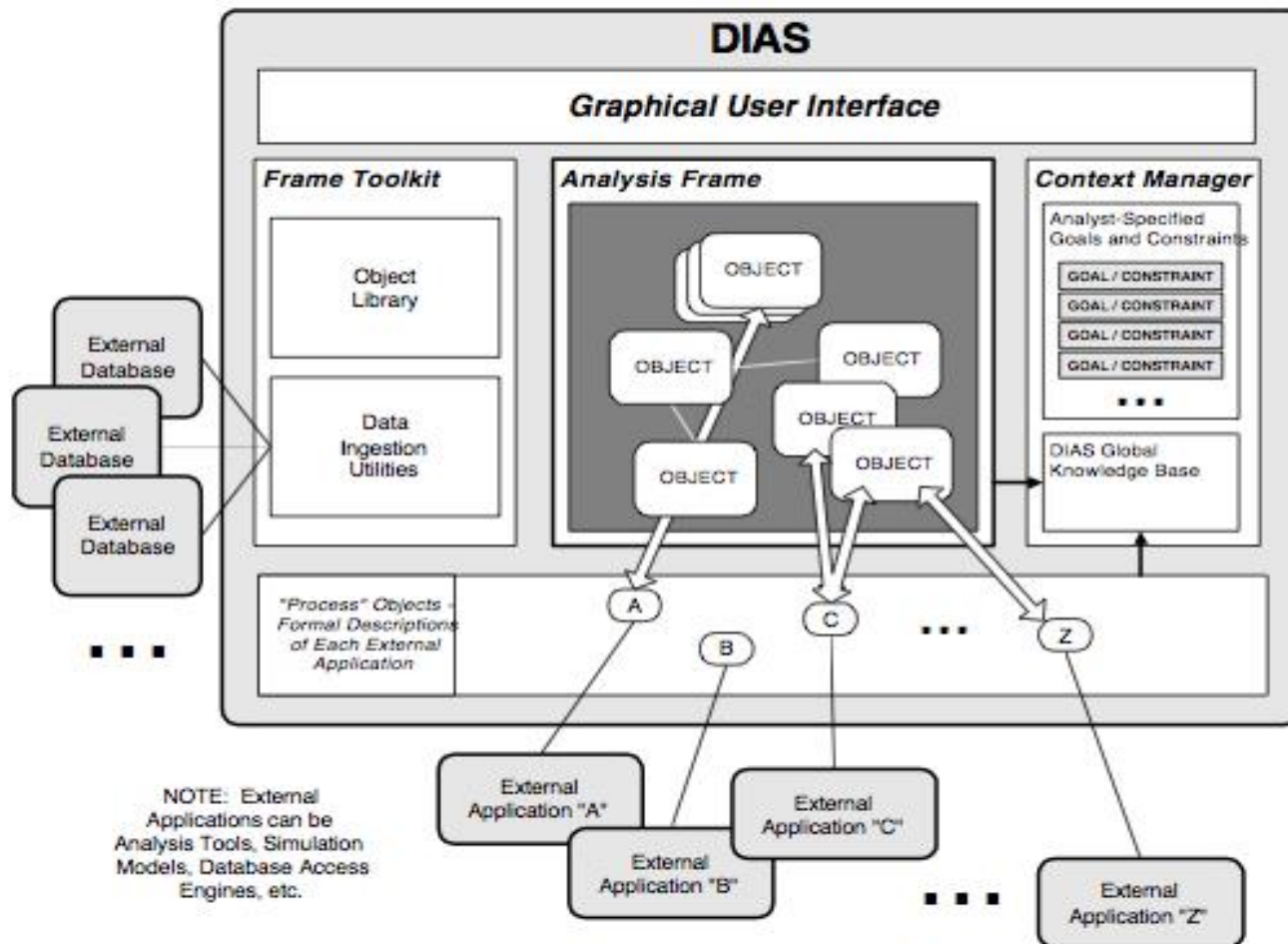


Figure 3. Representation of How DIAS Links User Goals and Constraints to DIAS Resources, Such as Objects, Applications, and Knowledge Bases

DIS/HLA allows simulation to be mixed with real-world activity

***more** I'll add a few more new links here:

Many can be found on my: <https://twitter.com/MBstream> & some others:

<http://thinkaurelius.com/2013/05/13/educating-the-planet-with-pearson/>

<http://www.openlinksw.com/dataspace/doc/oerling/weblog/Oerri%20Erling's%20Blog/1728>

http://www.franz.com/ps/services/conferences_seminars/semantic_technologies_v27.lhtml

from: http://www.franz.com/ps/services/conferences_seminars/ using: <http://www.franz.com/agraph/allegrograph/>

http://semanticweb.com/big-data-goes-to-the-ballpark-the-next-generation-of-moneyball-at-yarcdata_b37840

http://portal.utpa.edu/utpa_main/daa_home/coecs_home/provbase_home

Will try bits of this for the <http://lispinsummerprojects.org/> at: <https://github.com/MBcode/kme>

EDU: <http://linkedup-project.eu/>

NLP: <https://github.com/MBcode/km3> <http://www.cliki.net/natural%20language%20processing>

LinkedData: benchmark: <http://swat.cse.lehigh.edu/projects/lubm/>

another cloud triplestore: http://sqrrl.com/media/Rya_CloudI20121.pdf