Smart-M3 hands on training

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Training Contents

- Overview of M3 concept
- Overview of different communities
- Hello world example and demo
- Q & A
- Hands-on session
  - I will participate in the conference also on Thursday, feel free to ask questions also after this training

Smart-M3 basics

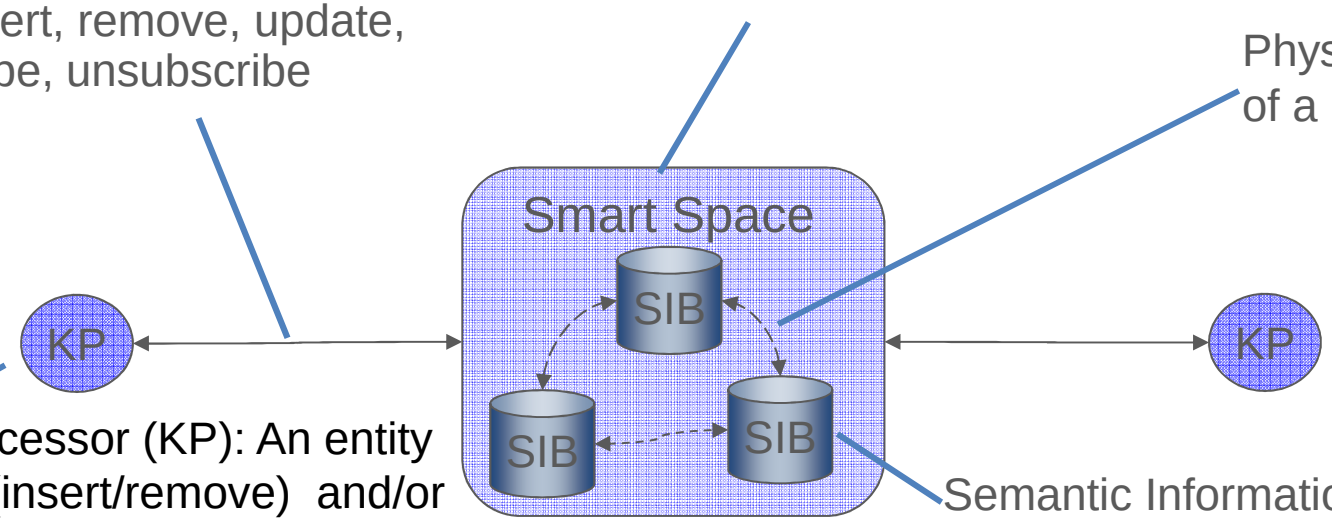
- A Blackboard like system to store and share information between processes
- Two key components
  - Semantic Information Broker (SIB): stores the information
  - Knowledge processors (KPs): accesses and modifies the information
- Information is stored in RDF
  - RDF triples constituting a graph
- Operations to modify and query the information
  - Insert: insert a graph to smart space
  - Remove: remove a graph from smart space
  - Update: update (remove and insert) a graph in a smart space
  - Query: query for information in a smart space
  - Subscribe: set up a persistent query
- Open source (BSD license) implementation in sourceforge

Overview

Triple governance transactions using Smart Space Access Protocol (SSAP): join, leave, insert, remove, update, query, subscribe, unsubscribe

Smart Space: a named search extent of information

Physical distribution of a Smart Space



Knowledge Processor (KP): An entity contributing to (insert/remove) and/or reading (query/subscribe) content according to ontology relevant to its defined functionality. A KP needs one or more partner KPs for useful sharing of content, implying an agreed semantics for the used ontology

Semantic Information Broker (SIB): An entity performing triple governance in possible co-operation with other SIBs for one Smart Space. A SIB may be a concrete or virtual entity.

The Big Picture

Several communities have been established to use & improve the M3 concept:

- http://www.fruct.org/smart
- http://www.open-m3.org/
- http://www.sofia-community.eu/
- http://sourceforge.net/projects/smart-m3/
  - Several related projects also in sourceforge

There is obviously some overlap...

Current State

- Smart-M3 only openly available implementation, Sofia ADK release in 1/2012
  - ADK is an eclipse plugin for developing M3 applications
  - ADK will be released in Sofia community
- Smart-M3 implementation needs work
  - Replacement for Piglet RDF store
  - Packaging of different components
  - Improving documentation
  - General improvements of different components

Applications / Demos

- Smart conferencing system done in FRUCT
- Several advanced demos done in Sofia
  - Building maintenance, car, smart lighting, ...
- Several demos done in DIEM
  - Greenhouse: http://youtu.be/2JtErnMt368
  - Dinetender: http://youtu.be/Bi1TEcI-nAE
  - Meeting Application: http://youtu.be/yFuiC75pZZA
  - Flowerstick: http://youtu.be/QBxqGpDYmw8
- No commercial deployments at the moment

ssls

- ssls is a ”smart-space shell” that offers a shell-like interface to contents of a SIB
- Downloadable from http://sourceforge.net/projects/ssls/
- Makes debugging M3 applications easier
- Integration with smodels reasoning engine
  - http://dl.acm.org/citation.cfm?id=1885832
- Written with python, thus easily portable

Outline

- Hello World
- Smart-M3 Python KP API
- Exercise Ontology
- Exercise 1:
  - Discover available SmartSpaces
  - Join/Leave
- Exercise 2:
  - Subscription
- Exercise 3:
  - Insert/remove information

Smart-M3 “Hello World” exercise

- Consists of three Knowledge Processors
  - Creator: inserts creatable things into the Space
  - Observer: observes which things exist and based on that information updates information whether the world exists or not
  - Greeter: monitors whether the world exists and says “Hello World”
- Exercise: Develop Observer KP application with using Python API
- Creator and Greeter KPs exist

Smart-M3 Python KP API

- m3_kp.py
  - Works on python 2.5 and 2.6, tested on linux, Maemo
- Pure python library that can be imported by python programs
- URI(Node), bNode(Node), Literal(Node) classes used to represent RDF nodes
- Triple class used to represent RDF triples
- KP class used to represent knowledge processors
  - methods for discovering SIBs, join/leave and instantiating/destroying transaction classes
- Transaction classes: Insert, Remove, Update, Query, Subscribe
  - Instances of these used to perform operations in SIB
- Exceptions for error handling
- Older version (Node.py) is deprecated
  - The old library contains many inconsistencies, retained for backwards compatibility

Python KP API Transaction methods

Insert

send([Triple] insert_graph)

Remove

remove([Triple] remove_graph)

Triple list may contain triples with wildcards

Update

update([Triple] insert_graph, [Triple] remove_graph)

Query

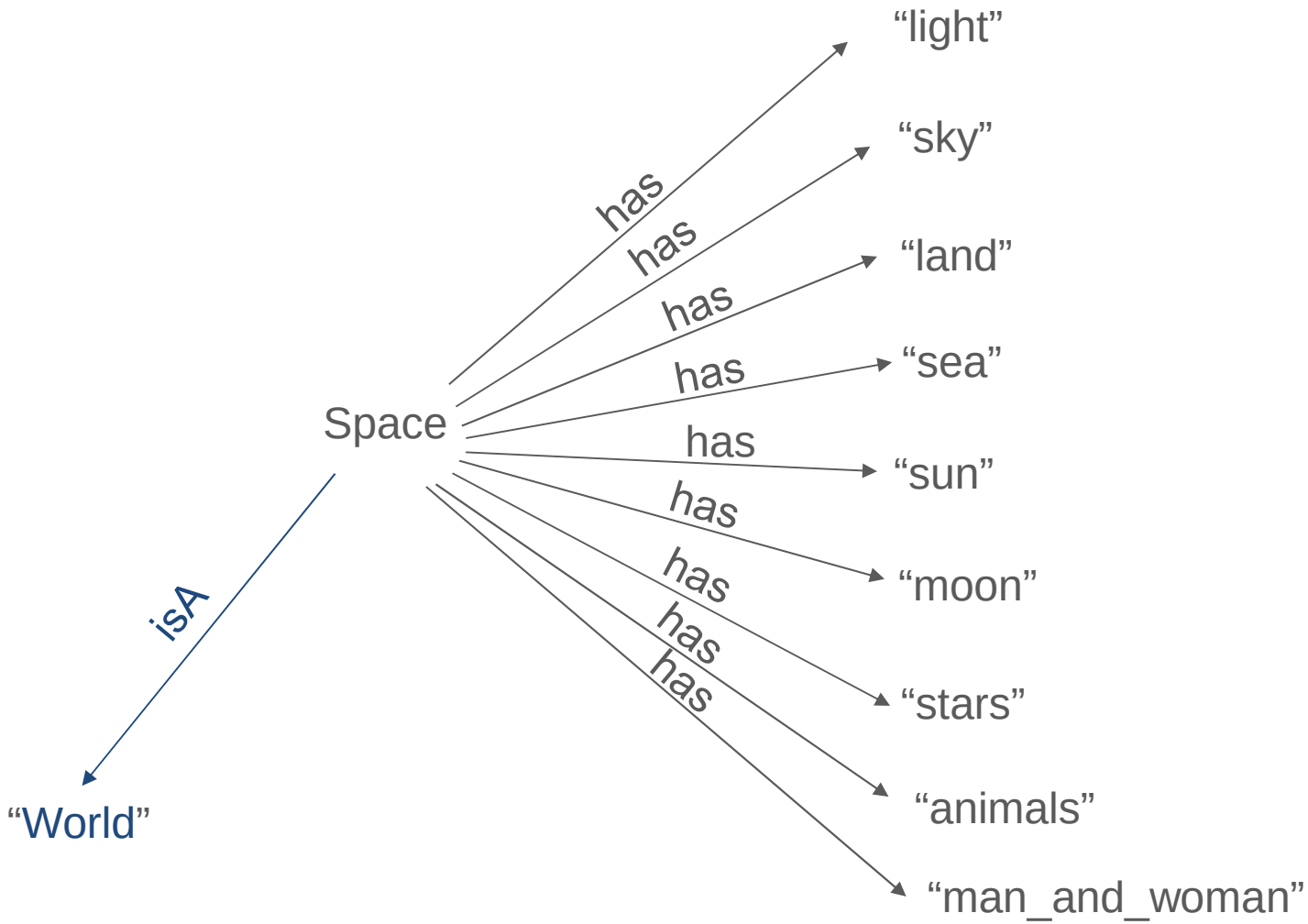
[Triple] ← triple_query([Triple])

result ← wql_*_query(wql_expression) (see documentation)

Subscribe

As in query, callback subs_callback(added, removed) when results change

Hello world ontology



Exercise 1: Discovery and Join/Leave

SmartSpace discovery

- Import m3_kp
- Create a KP instance
- Discovery by KP.discover() method
  - Manual (default) method asks for smart space name and IP address
  - mDNS based method exists, but implementation is outdated (does not work with SIB)
- discover() returns a list of smart space handles, these can be used in join and other transactions

Joining to a discovered SmartSpace

- KP.join(ss_handle) will attempt to join to a smart space
- Currently no access control exists, thus join() should always succeed

Leaving a SmartSpace

- KP.leave()

Exercise 1 (cont.)

- Get a copy of all exercise files
- Skeleton file SS_HelloWorld_aggregator_1.py
  - Edit with favorite editor
- Running
  - Open three terminal windows
    - export PIGLET_HOME=‘pwd’; rm $PIGLET_HOME/X; sibd
      1) Runs the SIB
    - sib-tcp
      1) Runs TCP transport process for the SIB
    - python XXX.py

Exercise 2: Create subscription

- Subscription is a persistent query
- Subscribe to information what items Space has.
  - Create a triple with python value ‘None’ as a wildcard URI for the unknown field
    - `t = Triple(None, None, None) ~ (*, *, *)`
    - `The triple can be used as the query expression in Subscribe.subscribe_rdf()`
- Create instance of Subscription class
  - s = KP.CreateSubscribeTransaction() (use KP instance instead of KP)
- Initiate the subscription
  - s.subscribe_rdf(t, callback)
  - callback should be a class with method handle(self, added, removed)
  - returns a baseline result, callback will be a diff compared to last result

Exercise 2 (cont.)

Skeleton file SS_HelloWorld_aggregator_answer_1.py

In addition to Exercise 1 solution contains

- Subscription initialization
- Printing the baseline result
- printing additions / removals and the new result set

Test your subscription with hello_world/trunk/src/play_creator

Command line application to create/delete items that the world constitutes of

Run in a terminal window (sibd, sib-tcp, whiteboardd must be running)

Press enter to get list of SmartSpaces and select one of them

The application shows what items exist in the Space

- Use c1 c2 … to create items
- Use d3 d4 … to remove items

Exercise 3: Insert/Remove information

- Monitor the subscription results and check if all items that constitute the world exist
- Create a triple (<Space>, <isA>, “World”)
- Based on the information from subscription either insert or remove the triple from the smart space
- Testing
  - Use setup from Exercise 2
  - In addition, run SS_HelloWorld_world_observer.py in a terminal window
  - Use play_creator to modify the SmartSpace content
- Example answer in SS_HelloWorld_aggregator_answer_3.py