Soar-SMem Tutorial

Soar Workshop 30

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Topics

- Big picture
- Demo
  - WordNet
- Basic usage
- Additional resources

Semantic Memory

Concepts, facts, and relations, independent of how/when/where/why originally learned

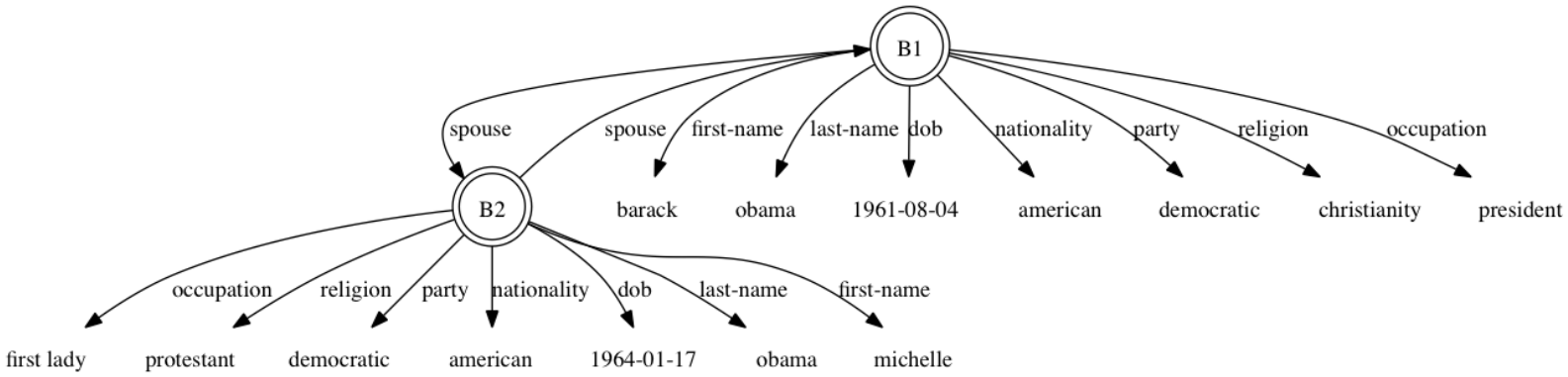
Memory	Knowledge
Semantic	*Who is the current President of the United States?*
vs.	
Episodic	*Where were you seated at the 2010 UM Spring Commencement?*

Semantic Memory in Soar

Hierarchical association of concepts

- Similar to chunks in ACT-R

Agent is able to retrieve concepts by identifier or a cue of features/relations

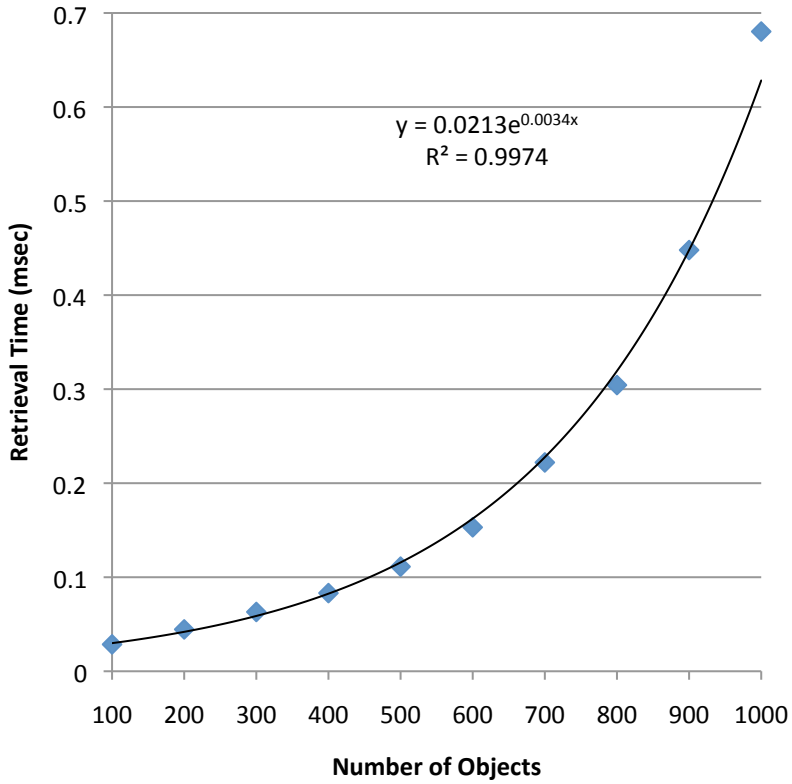


Why a Separate Module?

Encode in rules (data chunking)

-> Exponential rules

Encoding in Working Memory



Example KB: WordNet

English lexical database (>212.5K senses)

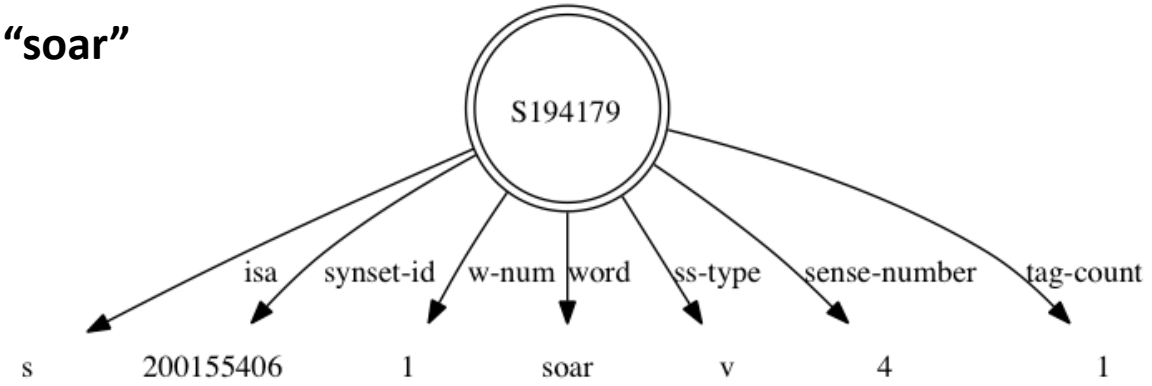
http://wordnetweb.princeton.edu

Includes information about

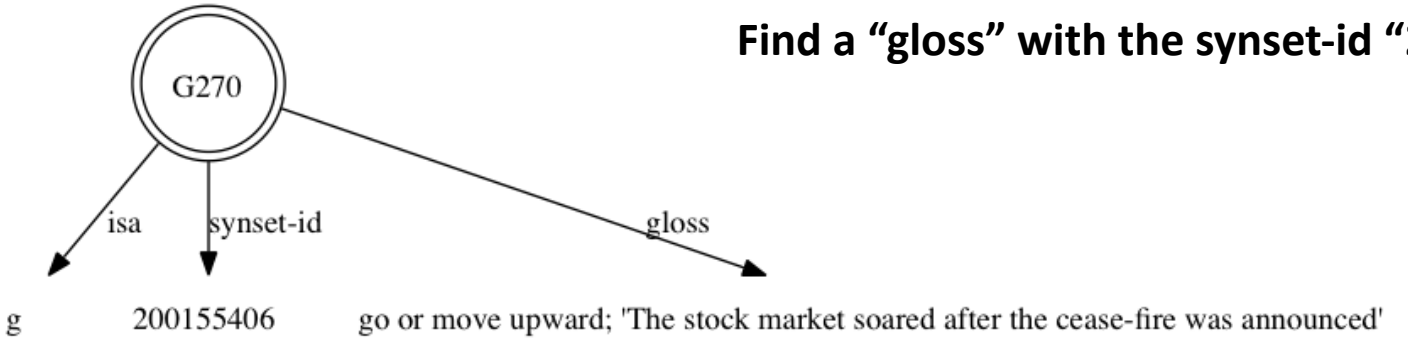
- word senses
- definitions (glosses)
- synonyms
- …

Example: “soar”

Find a “sense” of the word “soar”



Find a “gloss” with the synset-id “200155406”

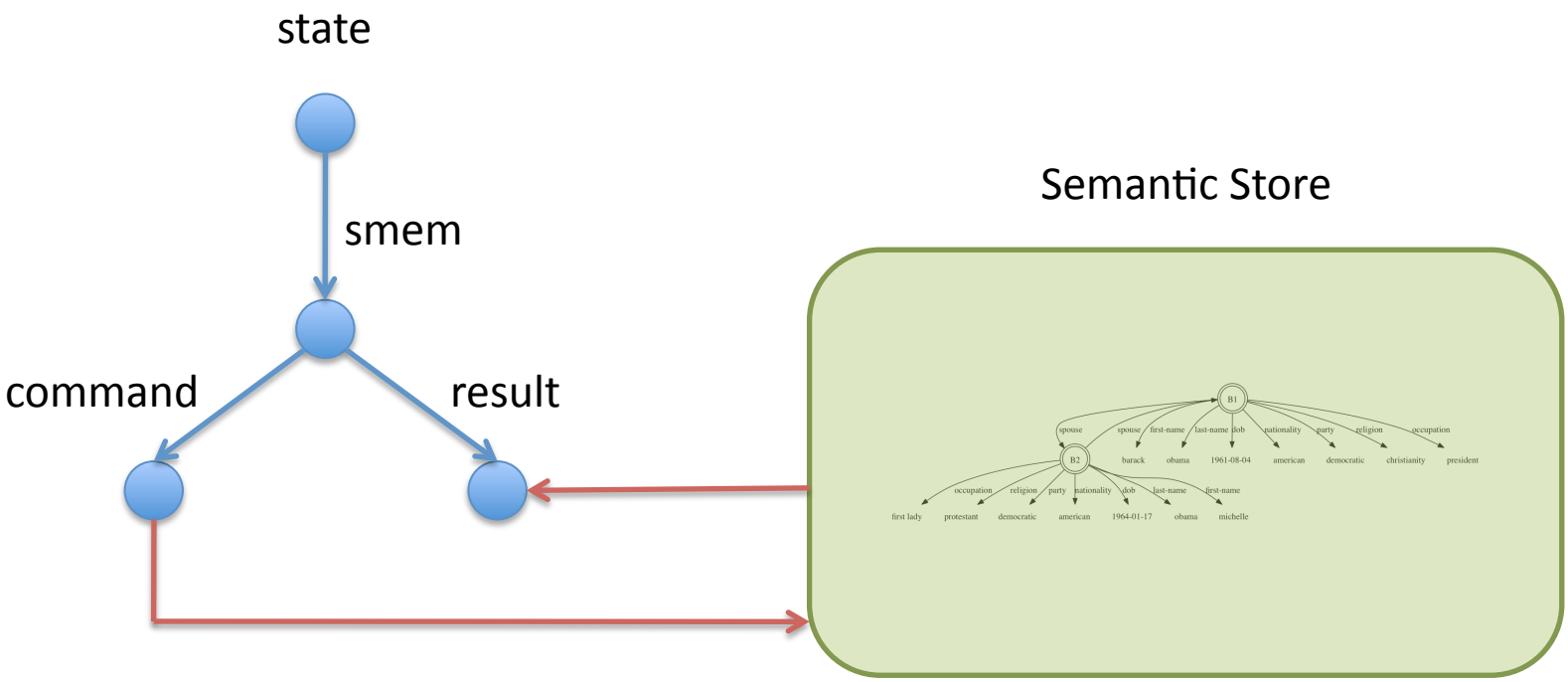


Basic Usage

- Working Memory structure
- Adding knowledge
- Retrieving knowledge

Working Memory Structure

Agents interact with an **smem** structure on each state



Adding Knowledge

Agent

`<state> ^smem.command.store <id1> <id2>…`

- Immediately stores all WMEs rooted at <id1>, <id2>, etc.
- Overwrites previous contents

Manual

```
smem --add {
  (<id1> ^attr1 val1 val2 ^attr2 val1 … )
  (<id2> ^attr3 val4 … )
  …
}
```

Example Manual Storage

```
smem --add {
(<S-200155406-1> ^isa s
                 ^synset-id |200155406|
                 ^w-num 1
                 ^word |soar|
                 ^ss-type v
                 ^sense-number 4
                 ^tag-count 1)
}
```

Long-Term Identifiers

- All identifiers stored in semantic memory are *long-term*
- The letter-number pair (ex. S5 or C7) is permanently associated with the identifier
  - Retrievals will return this pair
- When printed, long-term identifiers are prefaced with the @ symbol (ex. @S5 or @C7)

Retrieving Knowledge

Command Types

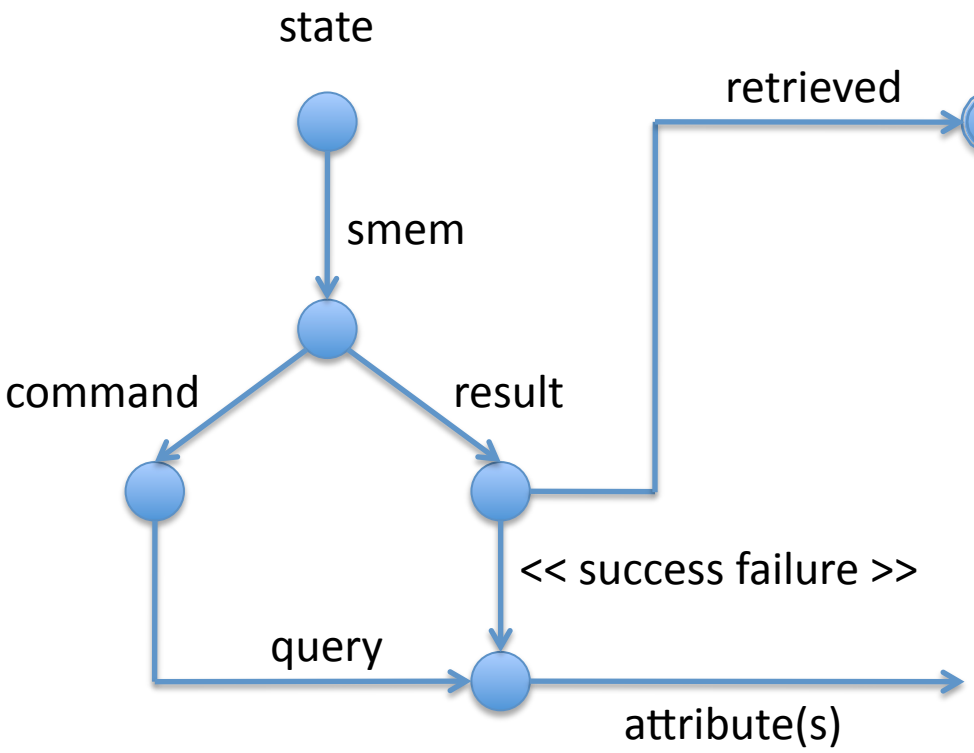
- Cue-Based (content-addressability)
- Non-Cue-Based (expand)

Notes

- Only one per state, per decision
- Commands processed during **output** phase
- Will not modify identifiers currently in WM
- If successful, retrieves WMEs rooted at a long-term identifier

Cue-Based Retrievals

WMEs rooted at a **query** identifier form hard constraint(s) (ties broken by access recency)



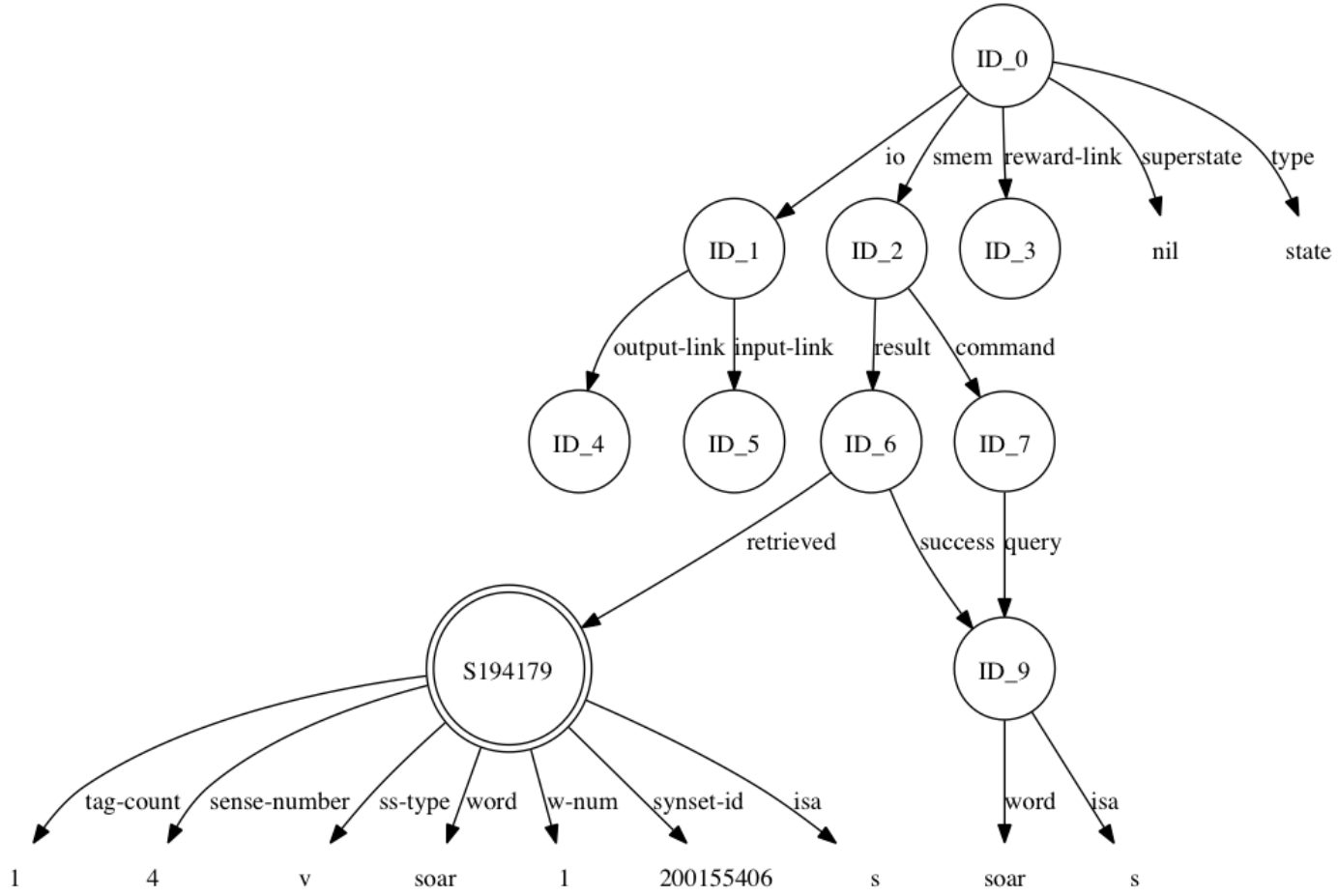
One or more…

Constant	Exact match
Long-Term ID	Exact match
Short-Term ID	Wildcard

Example Retrieval Rule

```
sp {query*sense
   (state <s>  ^superstate nil
               ^smem.command <cmd>)
-->
   (<cmd> ^query <q>)
   (<q>  ^isa s
         ^word |soar|)
}
```

Example Retrieval Result (1)



Example Retrieval Result (2)

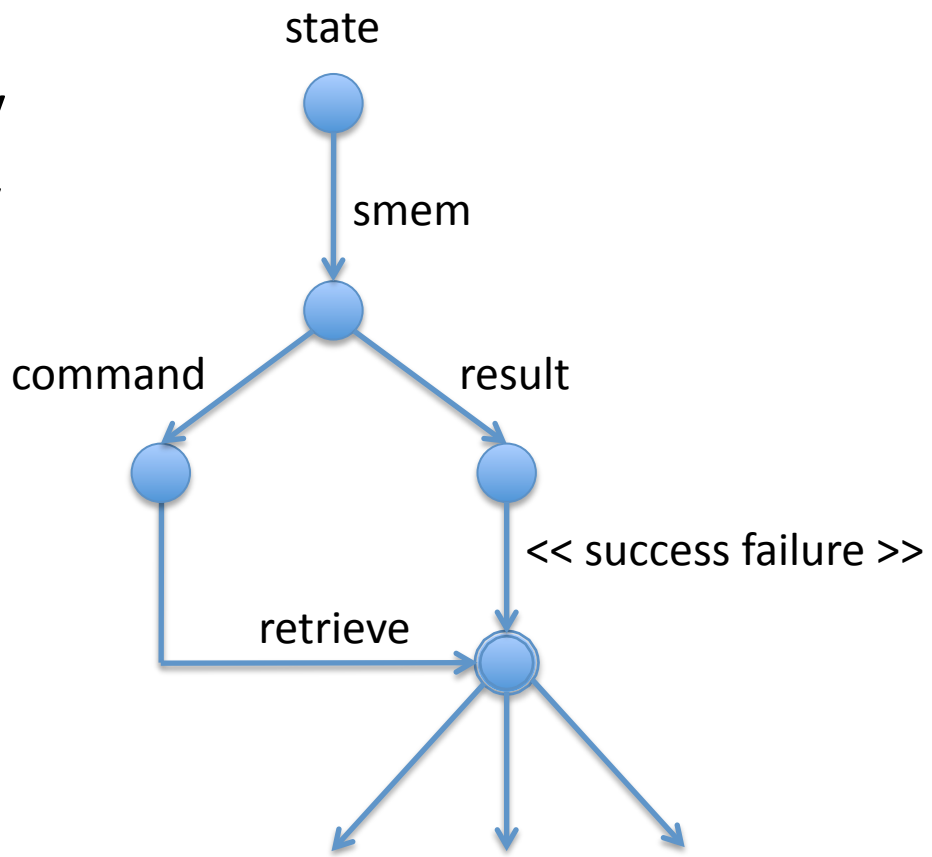
```
> print --depth 10 S2

(S2 ^command C2 ^result R3)
(C2 ^query Q1)
(Q1 ^isa s ^word soar)
(R3 ^retrieved @S194179 ^success Q1)
(@S194179 ^isa s
          ^sense-number 4
          ^ss-type v
          ^synset-id |200155406|
          ^tag-count 1
          ^w-num 1
          ^word soar)
```

Non-Cue-Based Retrievals

Reasons

- Working vs. semantic memory
- Episodic vs. semantic memory
- Expand semantic retrieval



Useful Commands

Enable SMem

```
> smem --set learning on
```

Graphviz

```
> smem [-v|--viz] <lt id> <depth>
```

Save semantic store to disk (SQLite3)

```
> smem --set path /path/to/file.db
```

Additional Resources

- Soar-SMem Documentation
- Soar-SMem Demos
- Readings

Soar-SMem Documentation

Manual

$SOAR_HOME/share/soar/Documentation

Topics

- Additional storage/retrieval details
- Performance
- Integration with other learning mechanisms
- Usage: commands, parameters, statistics, etc.

Soar-SMem Demos

Arithmetic

$SOAR_HOME/share/soar/Demos

– Can store (agent-based or manual) and retrieve addition/subtraction facts from semantic store

WordNet

http://code.google.com/p/soar/wiki/WordNet

– Download and conversion of WN-LEXICAL dataset for ACT-R

Readings

2006

- Integrating Semantic Memory into a Cognitive Architecture

  Yongjia Wang, John E. Laird (Technical Report)

2010

- Extending Soar with Dissociated Symbolic Memories

  Nate Derbinsky, John E. Laird (AISB)

More to come…