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SILK: Efficiently Building Systems with Complex Behaviors and Varieties

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Outline

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- SILK Introduction
- SILK Advantages
  - Note: SILK syntax is (mildly) simplified for presentation
- Demonstration – Policy Modeling
- Questions and Discussion

SILK Introduction

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- Semantic Inferencing on Large Knowledge (SILK)
- A "logic programming" language and engine
  - UI, API (implemented in Java)
  - Flora2 + XSB Prolog back-end reasoner (impl. in C)
- Advanced research component of Vulcan Inc.'s Project Halo
  - Intelligent agents answer AP Biology questions
- In development by BBN and others, with rights for government use

Features of SILK

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- "Declarative" = system state and behavior expressed as accessible facts and rules – easier for non-programmers to work with
- Capabilities beyond OWL and other rule languages
  - object-oriented + ontological syntax
  - defaults & exceptions
  - contradiction handling
  - easy to express minor variations
- Formal foundations = long-term stability
- Synthesis of existing Semantic Web standards and cutting edge LP research

Why SILK?

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low-level languages (Java, .NET, XML, protocols)

- Flexible
  - supremely flexible
- Accessible
  - opaque to non-developers
- Ontological
  - code yes, world no
- Business logic
  - none
- Agile
  - far too low-level





Why SILK?

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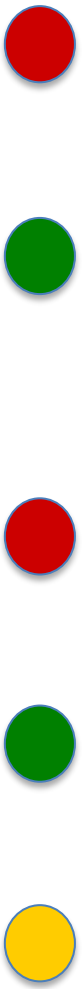
business processes (BPMN, BPEL)

- Flexible
  - inflexible, baked
- Accessible
  - intuitive shared representation for managers/developers/machines
- Ontological
  - no
- Business logic
  - yes
- Agile
  - modeling is quick
  - hard to define exceptions



Why SILK?

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OWL+RIF

```
DisjointClasses(
unionOf(a:animal
restriction(a:part_of
someValuesFrom
(a:animal)))
unionOf(a:plant
restriction(a:part_of
someValuesFrom
(a:plant))))
```

- Flexible
  - flexible
- Accessible
  - declarative, but unintuitive
- Ontological
  - yes
- Business logic
  - none
- Agile
  - modeling is quick
  - can't say what's NOT true
  - hard to define exceptions

Why SILK?

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SILK

- Flexible
  - supremely flexible
- Accessible
  - intuitive shared representation for managers/developers/machines
- Ontological
  - yes – built-in syntax
- Business logic
  - can model these and beyond
- Agile
  - can say what's NOT true
  - easy, succinct exceptions
  - graceful contradiction handling

Why SILK?

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	low-level languages (Java, .NET, XML, protocols)	business processes (BPMN, BPEL)	OWL+RIF	SILK
Flexible				
Accessible				
Ontological				
Business Logic				
Agile				

Mix other approaches, or just use SILK?

Representing variations and exceptions

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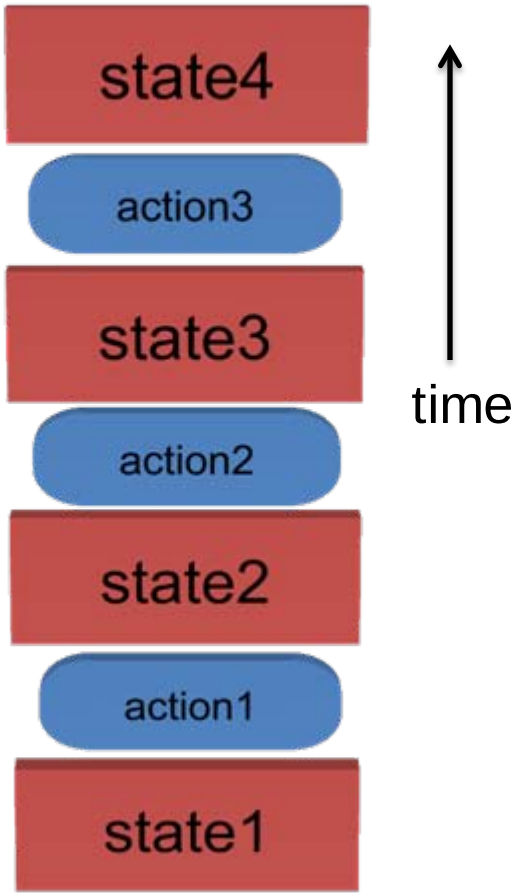
- SILK can represent variations of complex rules/structures/processes:
  - easily
  - intuitively
  - concisely – only the differences
- Consider a simple process:
  - a series of actions
  - each action produces a new state
- Obviously, this is a simplification



Representing variations and exceptions

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SILK is the preferred method for developing ontologies/varieties of complex phenomena

- like processes!

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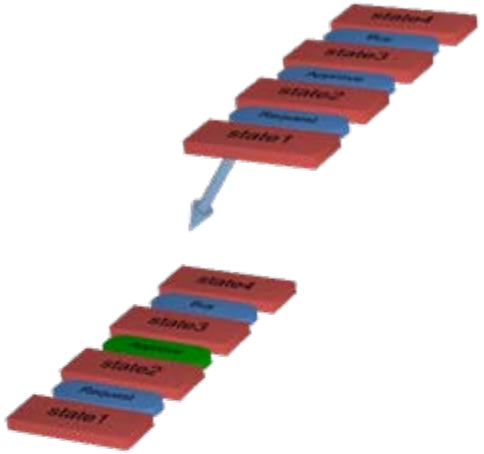

- …where each child is a subtle variation of its parent

SILK is the preferred method for developing ontologies/varieties of complex phenomena

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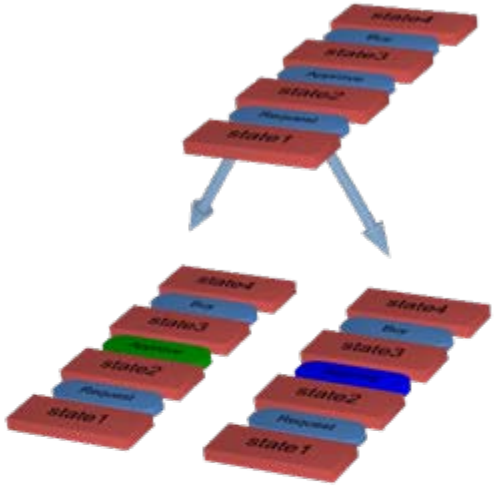

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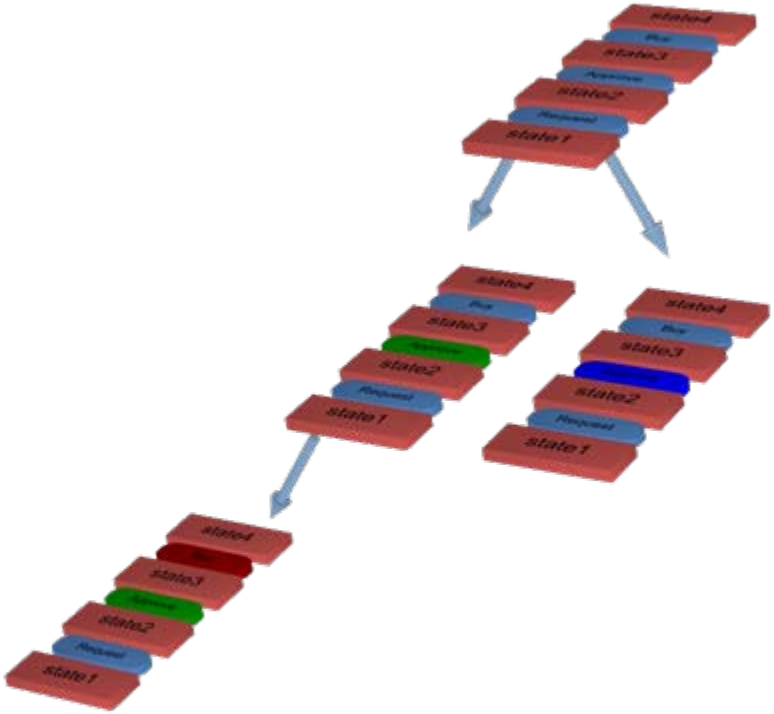

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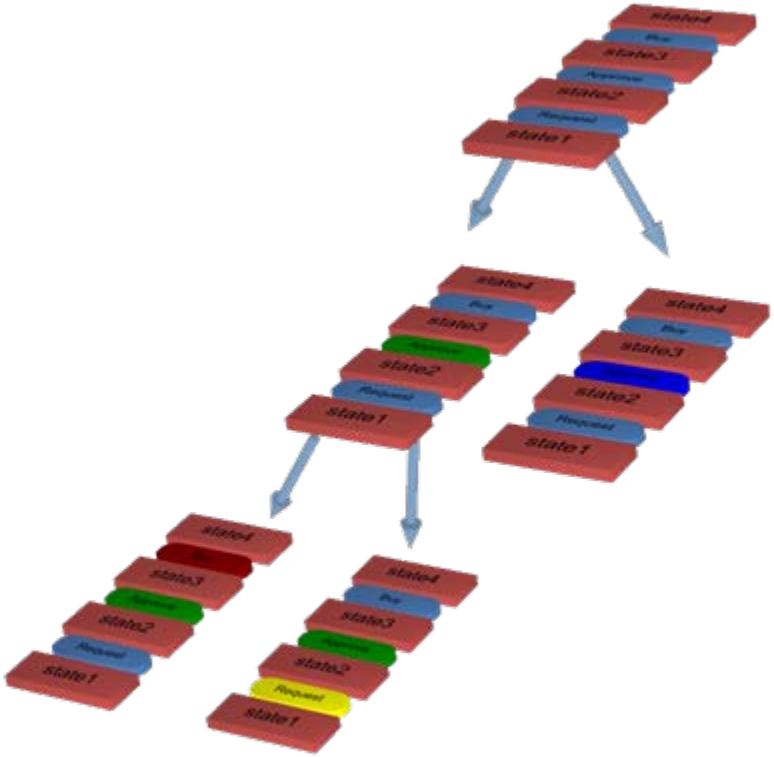

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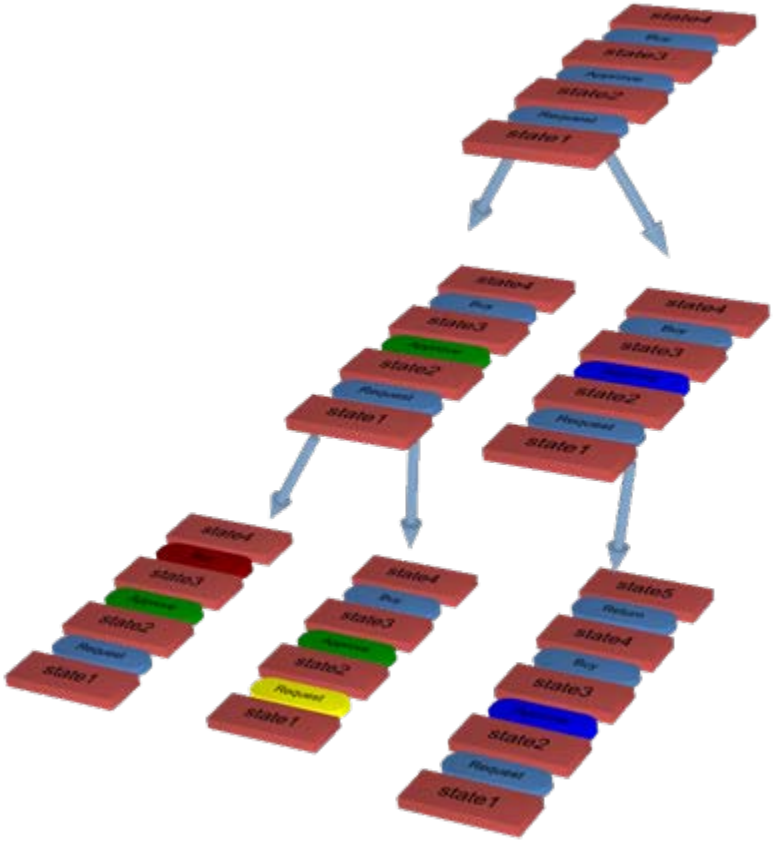

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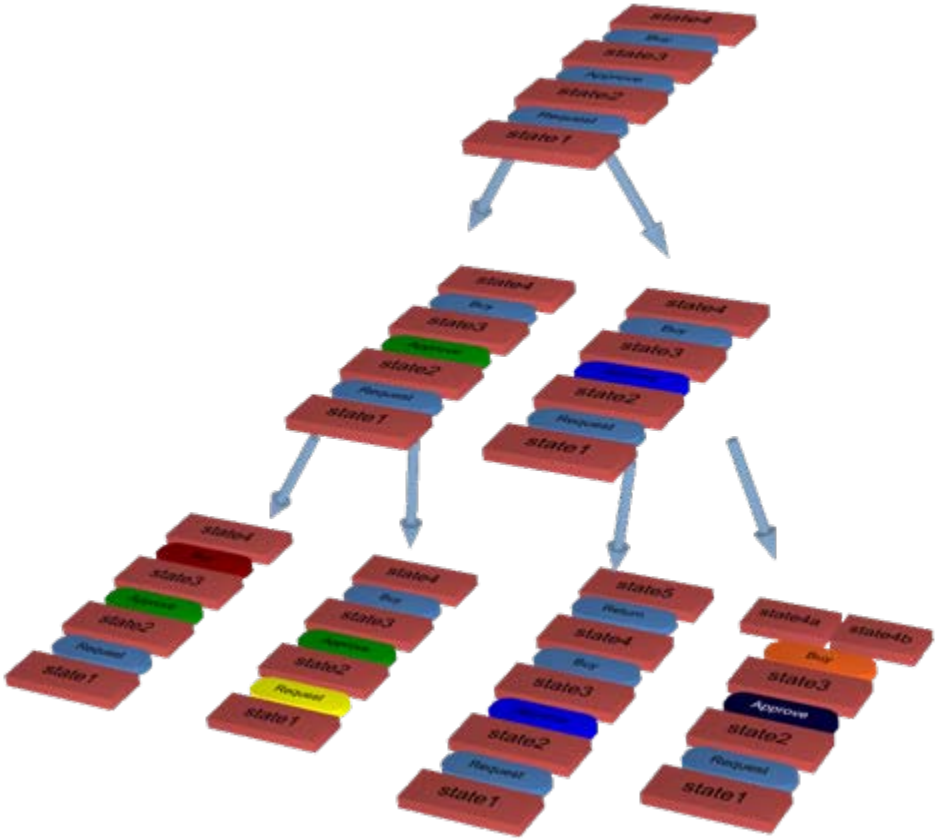

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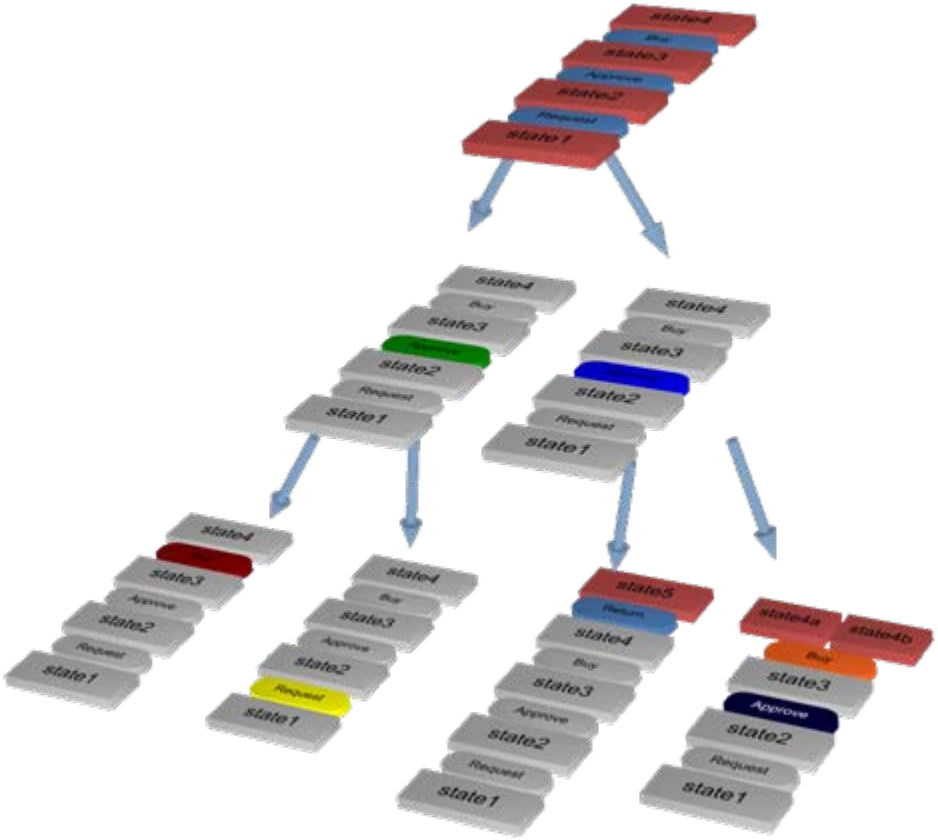
SILK is the preferred method for developing ontologies/varieties of complex phenomena

- like processes!

- …where each child is a subtle variation of its parent
- …where we only need to enter each child's differences from its parent



SILK Expressiveness

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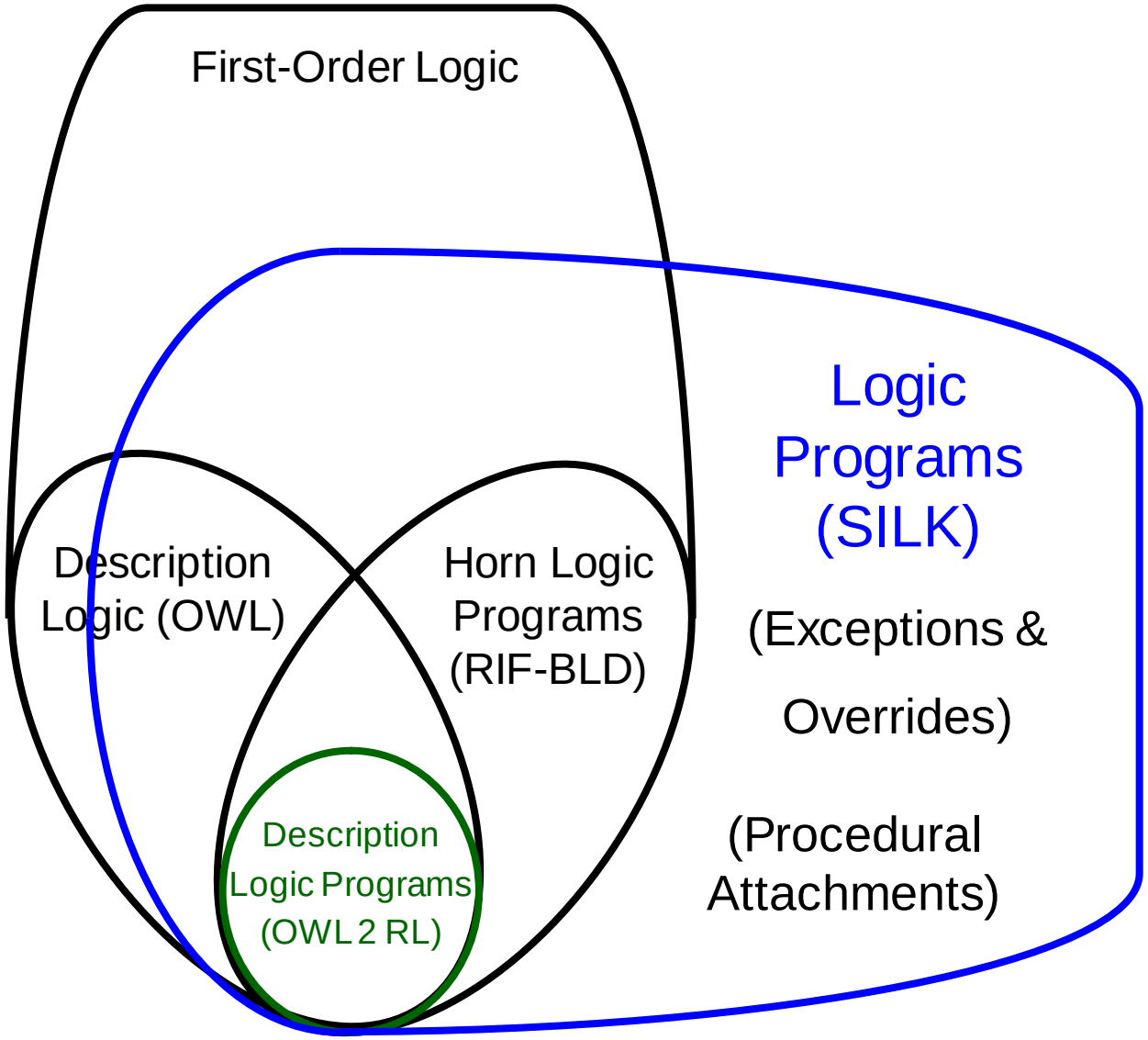

Image courtesy of Vulcan Inc., Benjamin Grosof, Mike Dean, and Michael Kifer.

SILK Builds Upon Standards

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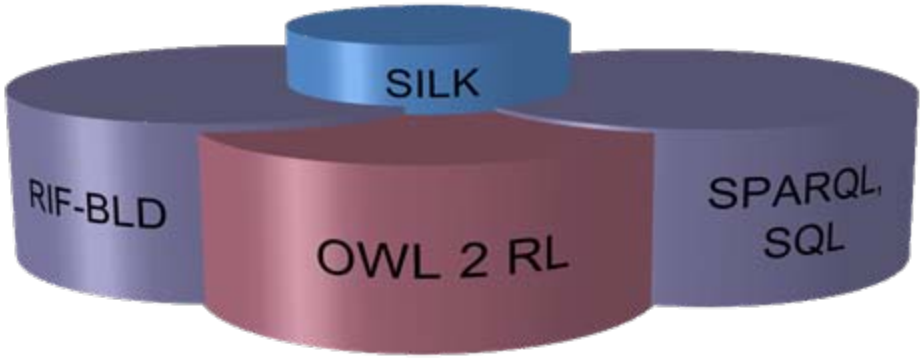
- SILK supports OWL 2 RL, RIF-BLD, RDFS imports & reasoning
- SILK supports federated data via remote SPARQL, SQL queries
- SILK is Sem Web friendly – supports URIs, XML Schema Datatypes, SPARQL



- Users can adhere to standards for the bulk of processing, accessing SILK's extra power only when necessary

How SILK (Logic Programming) Rules Work

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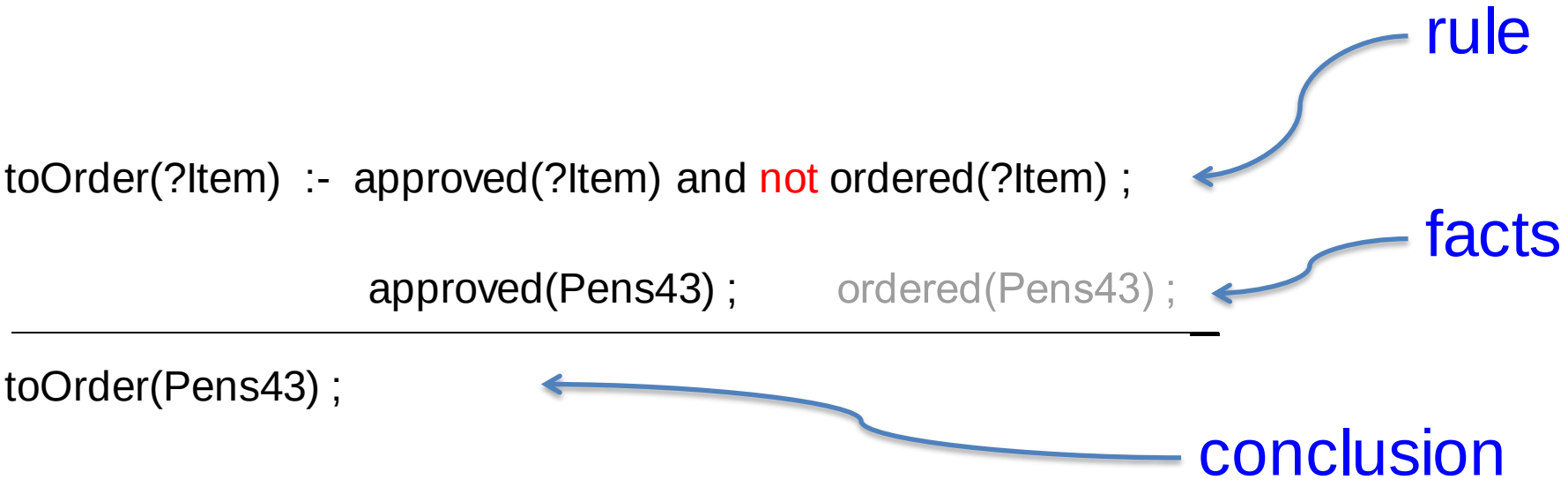
- SILK is akin to a "deductive" relational database
- Rules in the "knowledge base" (KB) allow us to conclude new facts



- SILK elaborates upon this paradigm

SILK's Override Mechanism

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- SILK allows us to say things and later make exceptions

- All purchases need approval of a manager
- BUT - expensive purchases need VP approval
- Express this exception: the order>1K rule automatically "overrides" the order rule
- Result: purchases continue to only need manager approval UNLESS they are expensive, in which case VP approval is needed

```
@order doOrder(?Item) :- approvedMgr(?Item) ;

@order>1K not doOrder(?Item) :- cost(?Item) >
1000 and not approvedVP(?Item) ;

overrides(order>1K,order) ;

SILK>  ?- doOrder(Pens43) ;
TRUE

SILK>  ?- doOrder(DBSoftware11) ;
FALSE
```

SILK's Override Mechanism

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- This mechanism can also automatically detect conflicts/bugs

```
@order doOrder(?Item) :- approvedMgr(?Item) ;

@order>1K not doOrder(?Item) :- cost(?Item) >
1000 and not approvedVP(?Item) ;


overrides(order>1K,order) ;


SILK>  ?- doOrder(Pens43) ;
TRUE

SILK>  ?- doOrder(DBSoftware11) ;
ALARM!  CONTRADICTION!
```

Object-oriented/ontologies, but with exceptions

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- SILK has special syntax to express exceptions within ontologies

- Define Item and its subclass

```
Pens43 # Item ;
DBSoftware11  # ExpensiveItem ;
ExpensiveItem ## Item ;
```

- Define an (overridable) property. An Item is typically approved by a manager, but a subclass can override this

```
Item[approvedBy → Mgr] ;
ExpensiveItem[approvedBy → VP] ;
```

Object-oriented/ontologies, but with exceptions

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- SILK has special syntax to express exceptions within ontologies

- Define Item and its subclass

```
Pens43 instance-of Item ;
DBSoftware11 instance-of ExpensiveItem ;
ExpensiveItem subclass-of Item ;
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```
Item[approvedBy → Mgr] ;
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- Define an (overridable) property. An Item is typically approved by a manager, but a subclass can override this

```
Item[approvedBy → Mgr] ;
ExpensiveItem[approvedBy → VP] ;
```

- Similar to OO polymorphism, this kind of specialization is the way the world works – "every type has an exception".

```
SILK> ?- DBSoftware11[approvedBy → Mgr] ;
FALSE
```

- Intuitive; matches the way people think of exceptions

```
SILK> ?- DBSoftware11[approvedBy → VP] ;
TRUE
```

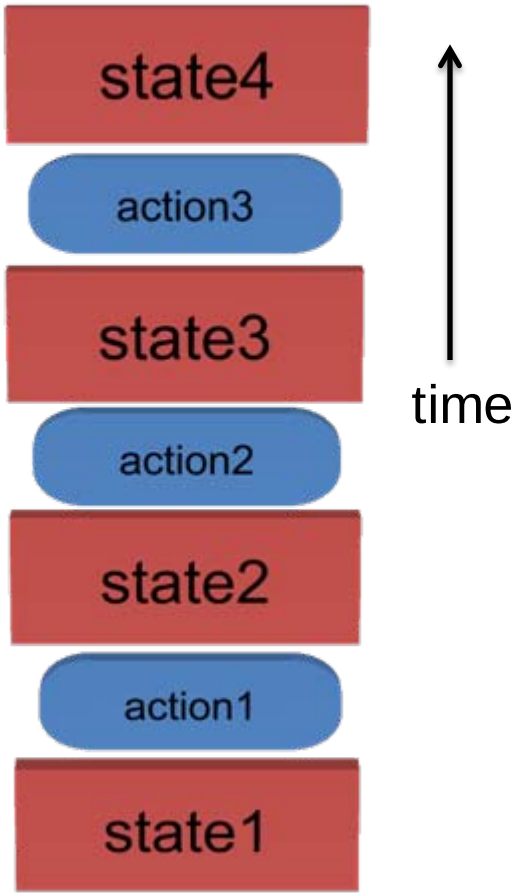
- Beyond OWL's powers

- SILK's syntax is also ideal for modeling complex business phenomena, such as processes

- Consider a simple process:
  - a series of actions
  - each action produces a new state

- Obviously, this is a simplification

- Policies can be thought of as constraints (on processes) – "the approved way to do something"



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It's easy(er) to model processes & policies using SILK's logical syntax:

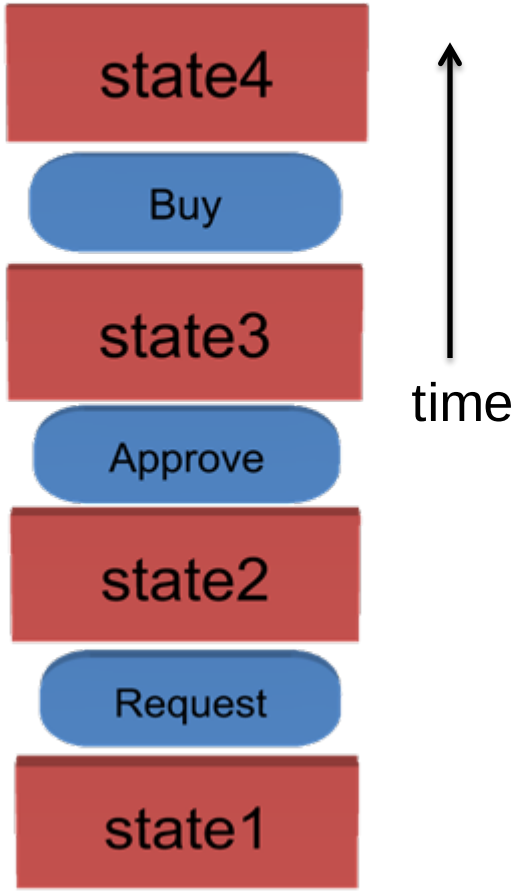
- e.g. actions:

"An Approval action cannot begin until a request to purchase the item is received."

"The action's effect is to approve the purchase of the item."

"Allow 3 days for approval."

Approve[object → ?Item,
pre → receivedRequest(?Item),
post → isApproved(buy(?Item)),
leadTime → 3 days]



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It's easy(er) to model processes & policies using SILK's logical syntax: especially exceptions!

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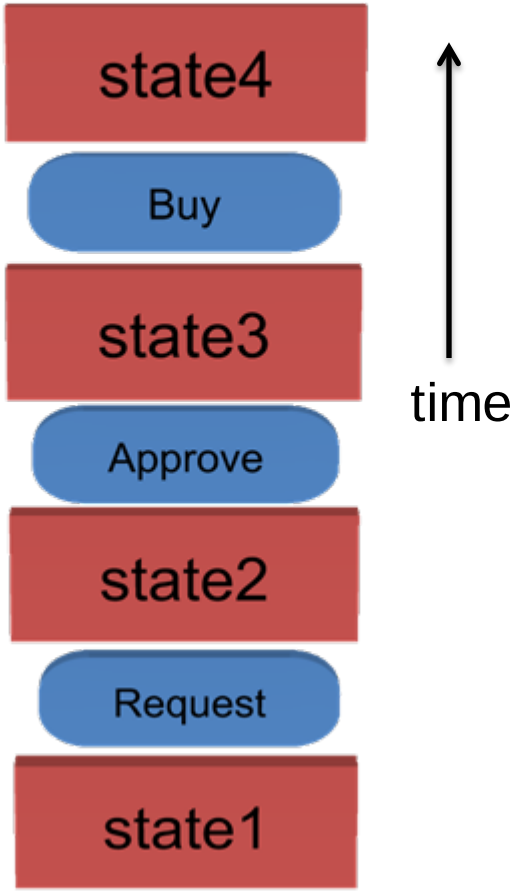


It's easy(er) to model processes & policies using SILK's logical syntax: especially exceptions!

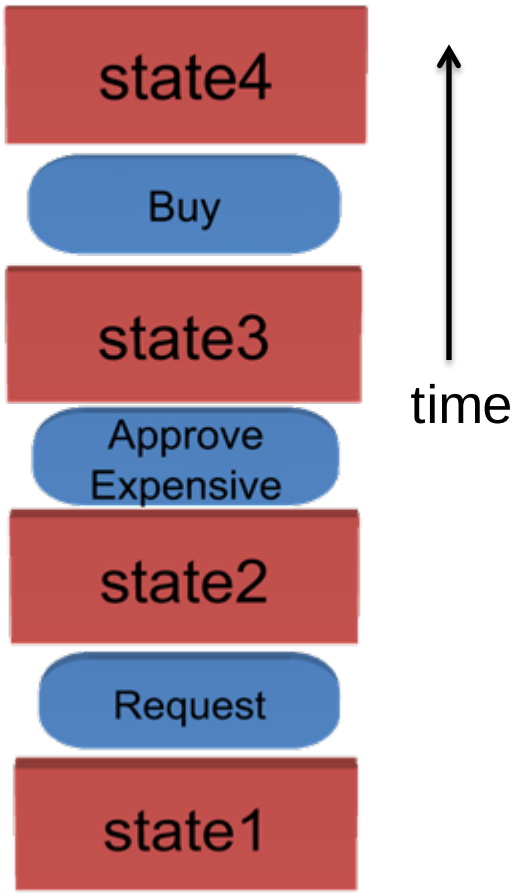
- an expensive ?Item:

"An Approval action cannot begin until a request to purchase the item is received."

"The action's effect is to submit a request for purchase to the VP."

"Allow 5 days for approval."

ApproveExpensive[object → ?Item,
pre → receivedRequest(?Item),
post → submitRequest(?Item,VP),
leadTime → 5 days]



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It's easy(er) to model processes & policies using SILK's logical syntax: especially exceptions!

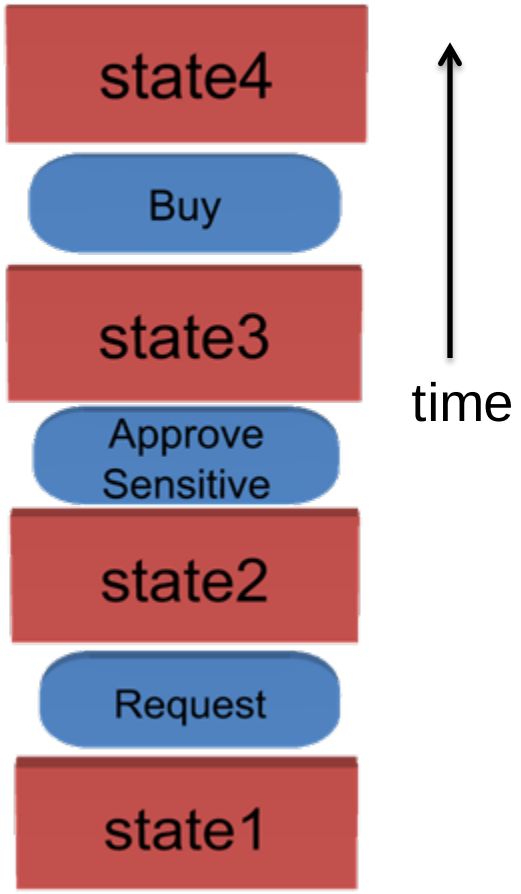
- an ?Item requiring special handling

"An Approval action cannot begin until a request to purchase the item is received in triplicate."

"The action's effect is to approve the purchase of the item."

"Allow 3 days for approval."

ApproveSensitive[object → ?Item,
pre → receivedRequestX3(?Item),
post → isApproved(buy(?Item)),
leadTime → 3 days]



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The best part is – you only have to say what's different.

"An Approval action cannot begin until a request to purchase the item is received in triplicate."

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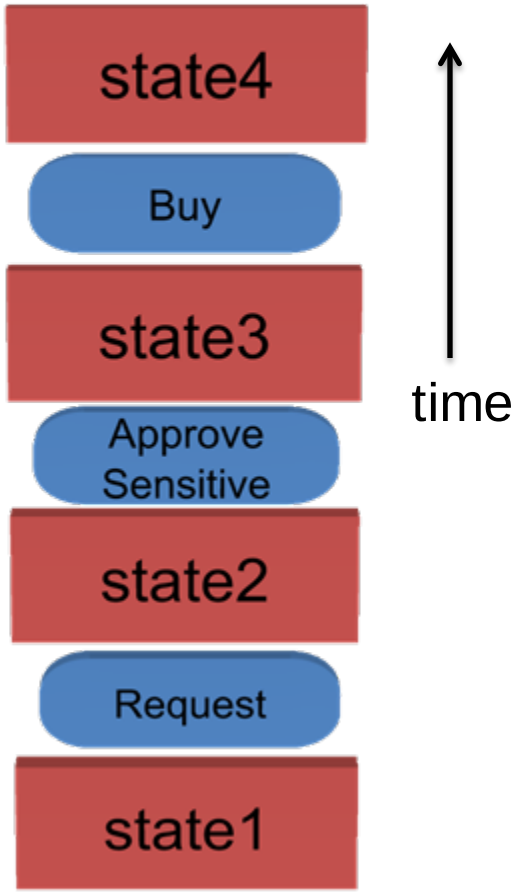
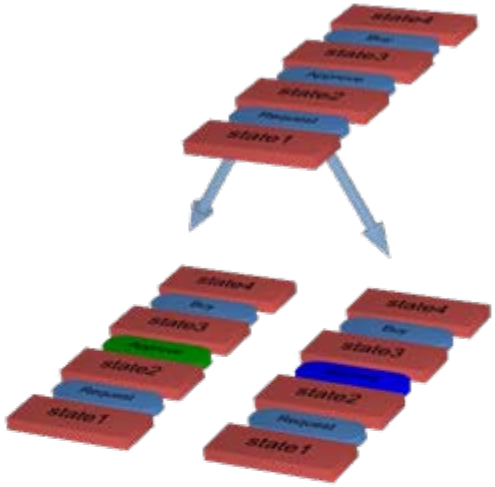
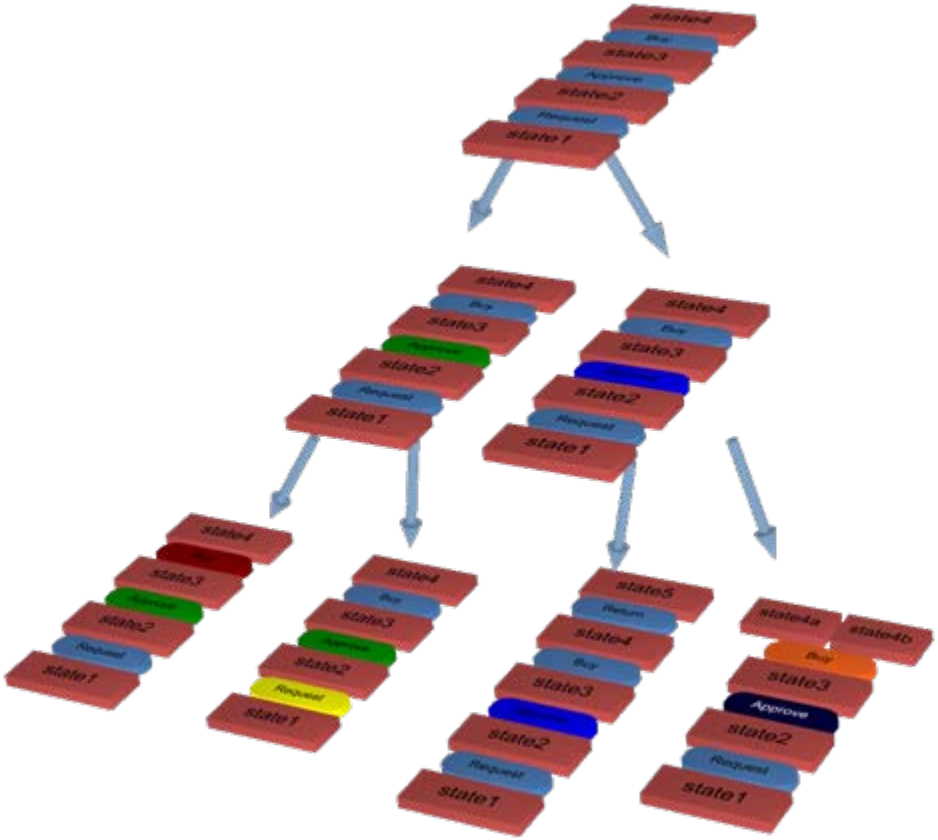


We can use this approach to develop ontologies of processes/policies



We can use this approach to develop ontologies of processes/policies

- …where each child is a subtle variation of its parent



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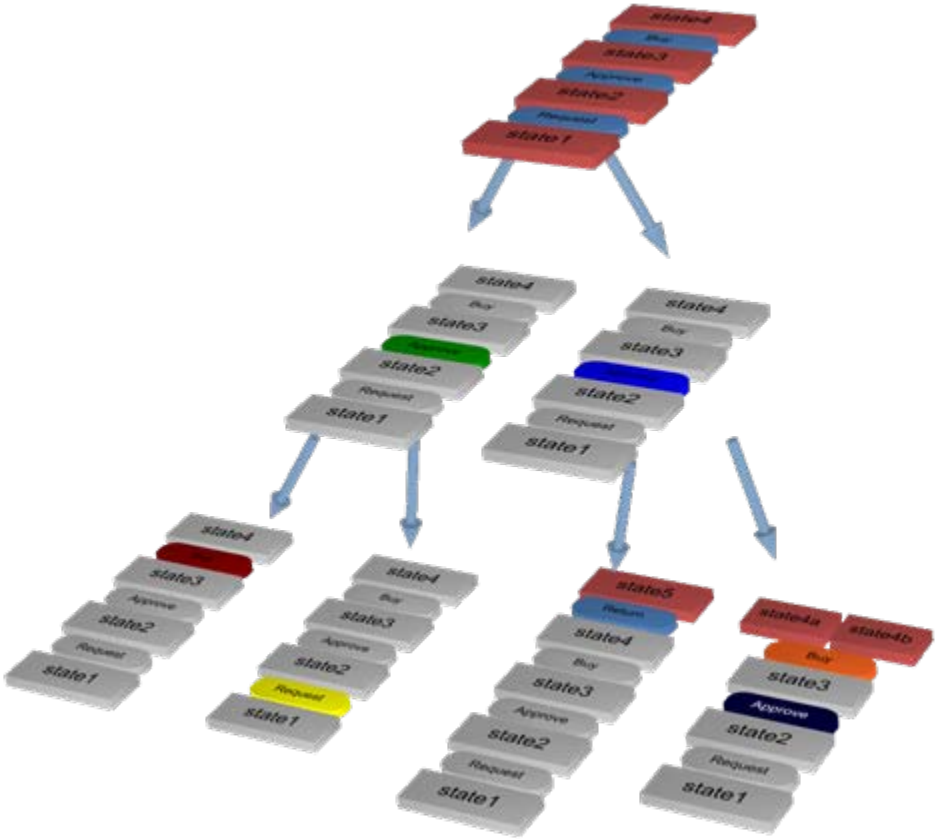

Demonstration of Policy Modeling

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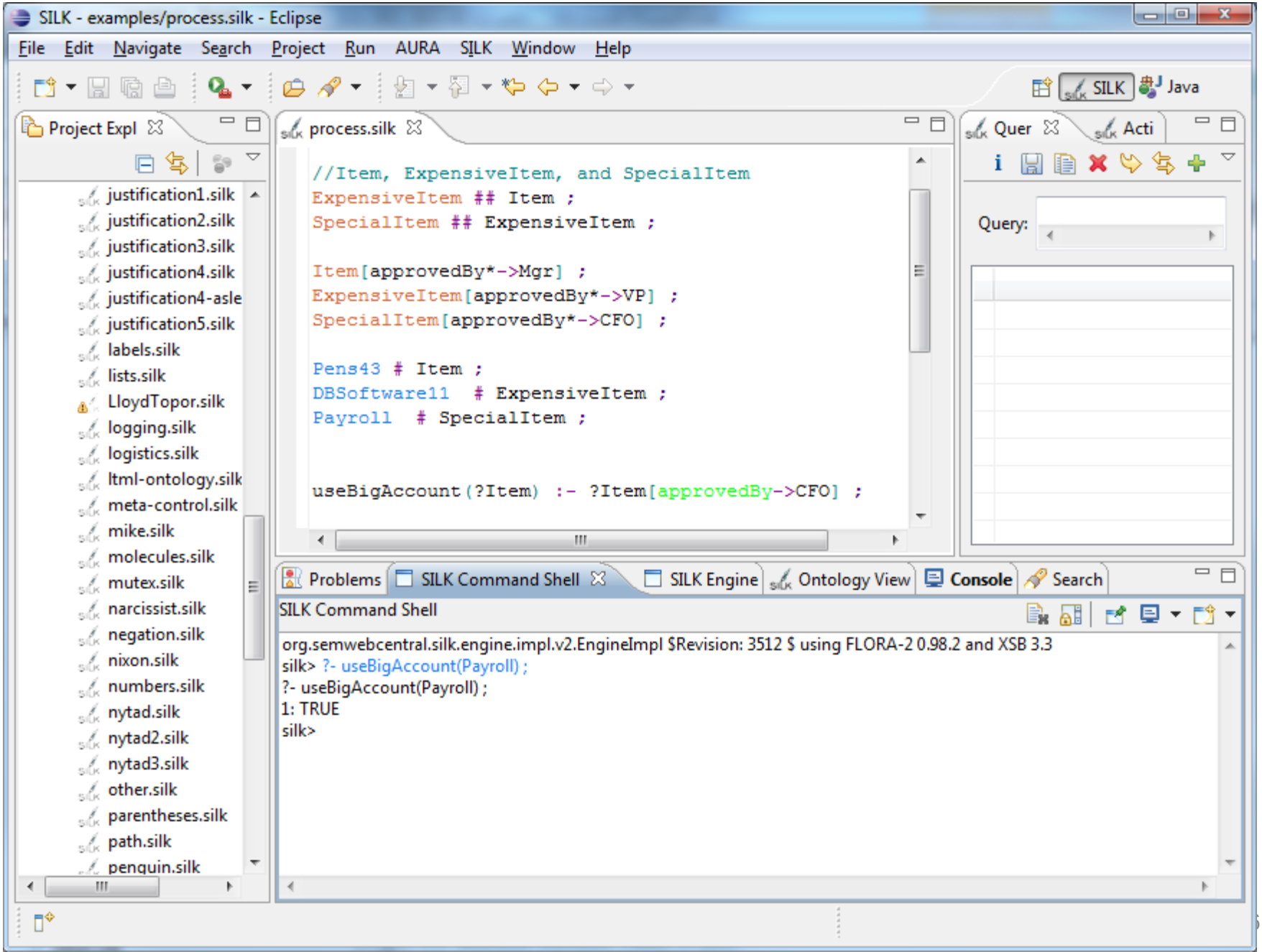

Additional Information

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- http://silk.semwebcentral.org
  - Public SILK site
  - Presentations and conference papers
  - RIF SILK dialect
- http://www.mit.edu/~bgrosof/paps/talk-iswc2010-rules-tutorial.pdf
  - Grosof/Dean/Kifer Web rules tutorial
  - 219 slides with theoretical and application details

Thanks! Questions?