SweetPH: Using the Process Handbook for Semantic Web Services

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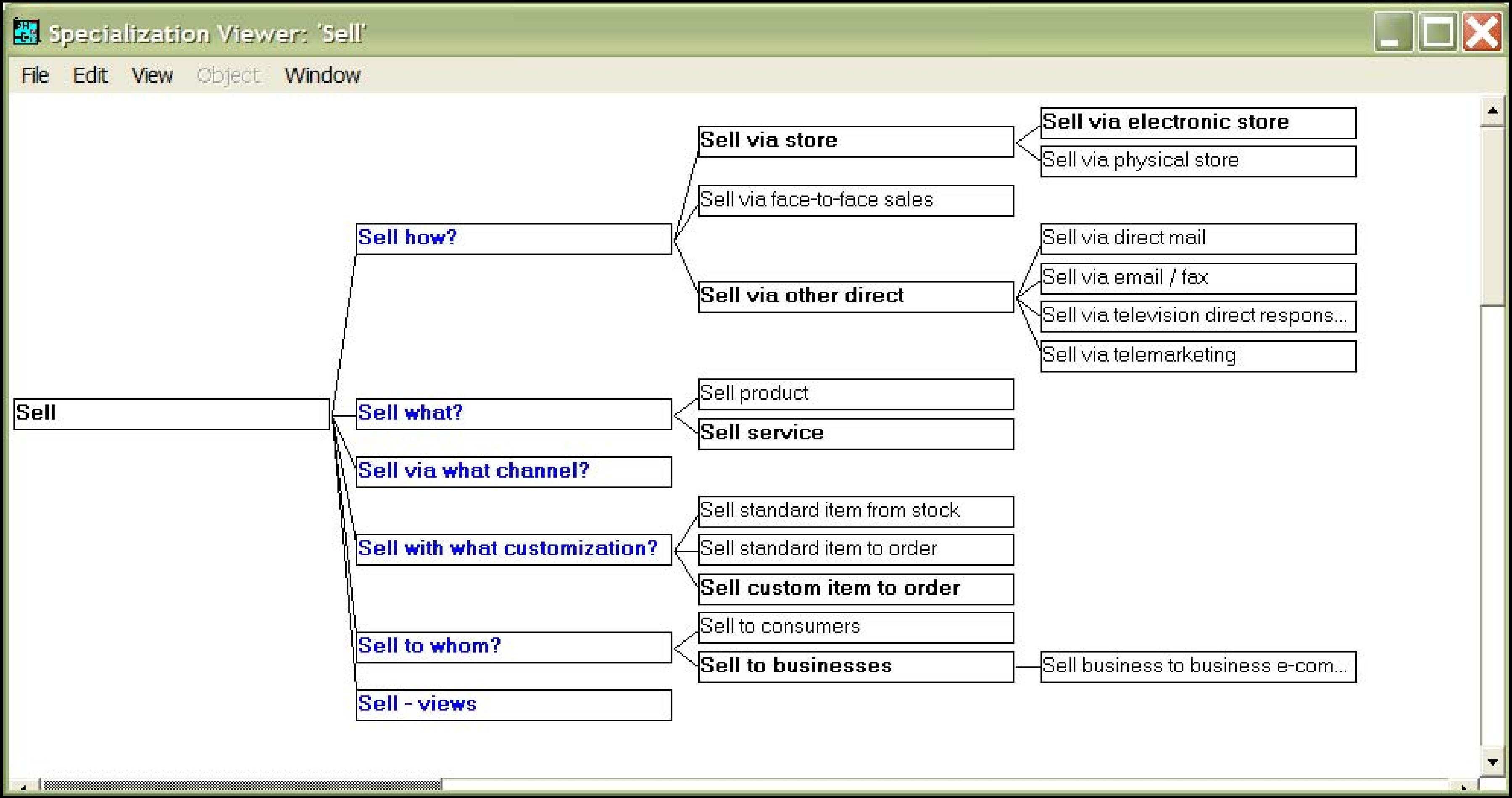
http://www.swsi.org

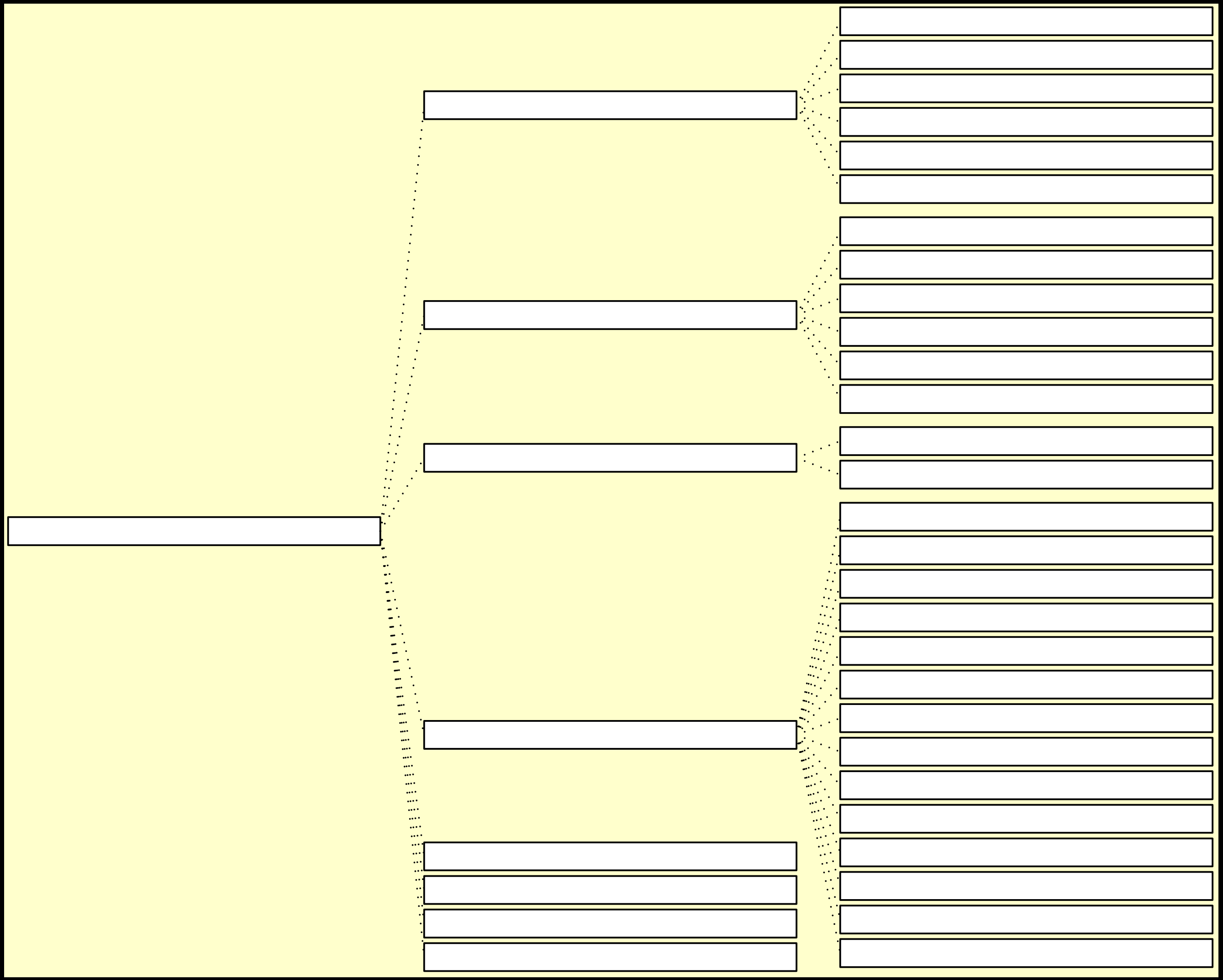
Opportunity for Process Handbook in SWS

- Need for Shared Knowledge Bases about Web Services / Business Processes
  - For Semantic Web Services, etc.
- Want to leverage legacy process knowledge content
  - Go where the knowledge already is
- Process Handbook (PH) as candidate nucleus for shared business process ontology for SWS
  - 5000+ business processes, + associated class/property concepts, as structured knowledge (http://ccs.mit.edu/ph)
  - E.g., used in SweetDeal E-Contracting prototype
- Concept: Use Semantic Web KR and standards to represent Object-Oriented framework knowledge:
  - class hierarchy, types, generalization-specialization, domain & range, properties/methods' association with classes

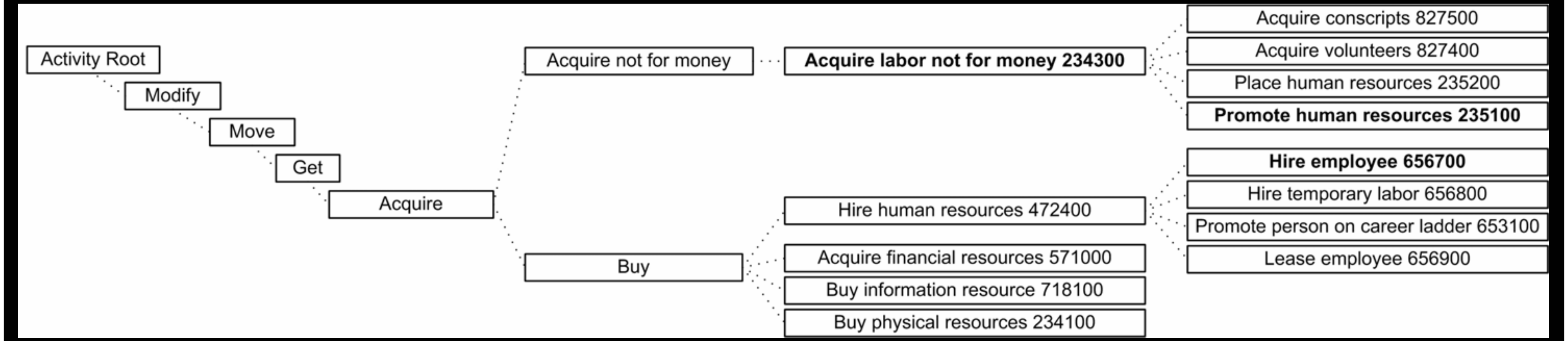
Some Specializations of "Sell" in the Process Handbook (PH)


Specialization Viewer: 'Sell'
File Edit View Object Window
Sell
Sell how?
Sell what?
Sell via what channel?
Sell with what customization?
Sell to whom?
Sell - views
Sell via store
Sell via face-to-face sales
Sell via other direct
Sell product
Sell service
Sell standard item from stock
Sell standard item to order
Sell custom item to order
Sell to consumers
Sell to businesses
Sell via electronic store
Sell via physical store
Sell via direct mail
Sell via email / fax
Sell via television direct respons...
Sell via telemarketing
Sell business to business e-com...

Some Process Handbook Ontology

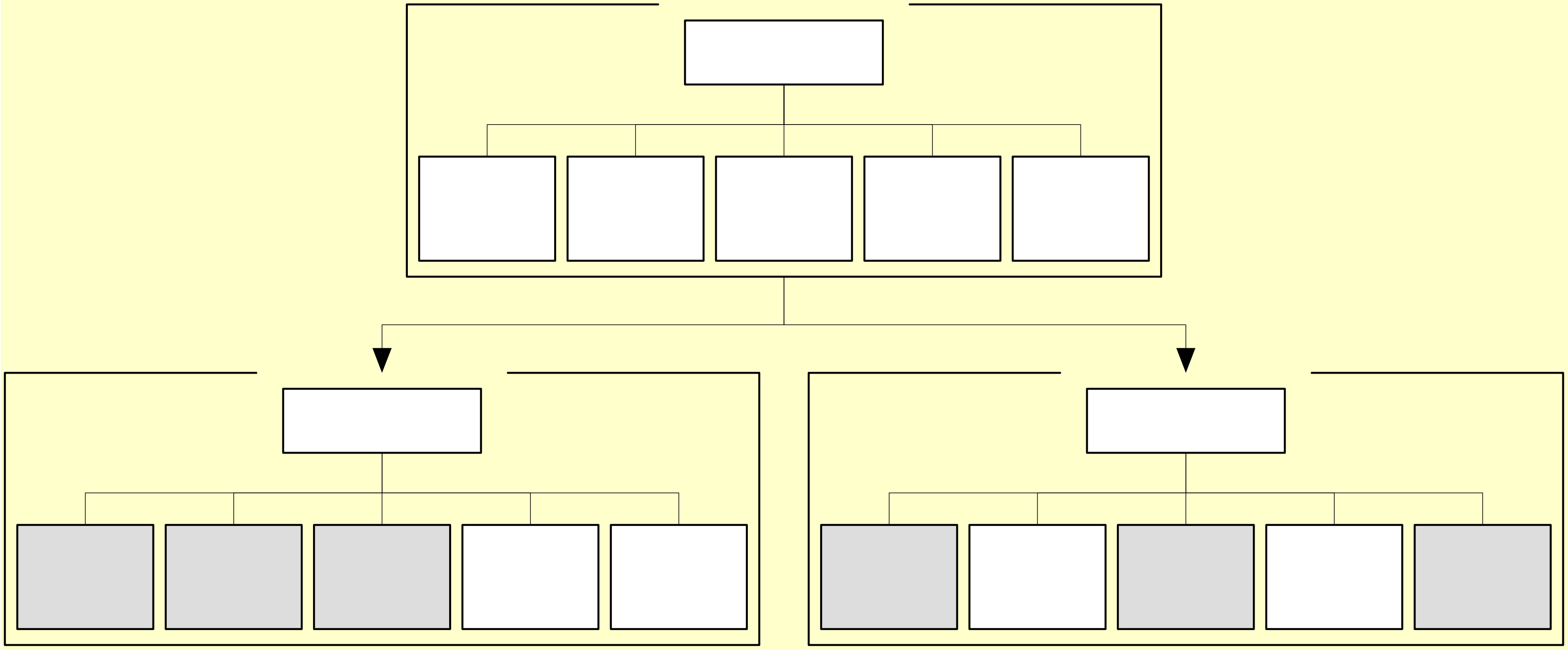


Some Process Handbook Ontology



Activity Root
Modify
Move
Get
Acquire
Acquire not for money
Buy
Acquire labor not for money 234300
Hire human resources 472400
Acquire financial resources 571000
Buy information resource 718100
Buy physical resources 234100
Acquire conscripts 827500
Acquire volunteers 827400
Place human resources 235200
Promote human resources 235100
Hire employee 656700
Hire temporary labor 656800
Promote person on career ladder 653100
Lease employee 656900

PH Example: Selling Processes



An activity (e.g., SellProduct) has sub-activities (steps).

Its specializations (e.g., SellByMailOrder) inherit its sub-activities by default.

Key: gray = modified (overridden). X = deleted (canceled).

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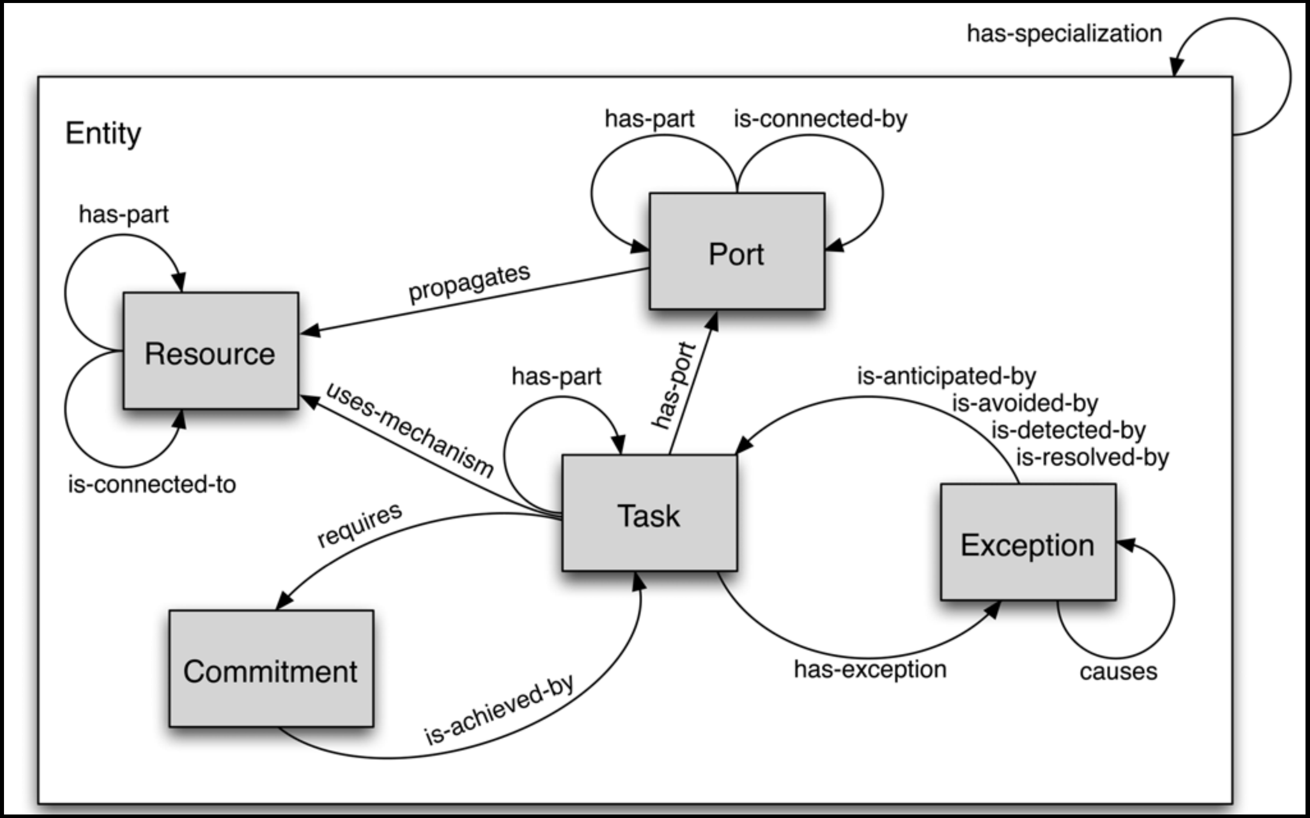
SweetPH's New Technical Approach: Courteous Inheritance for PH & OO

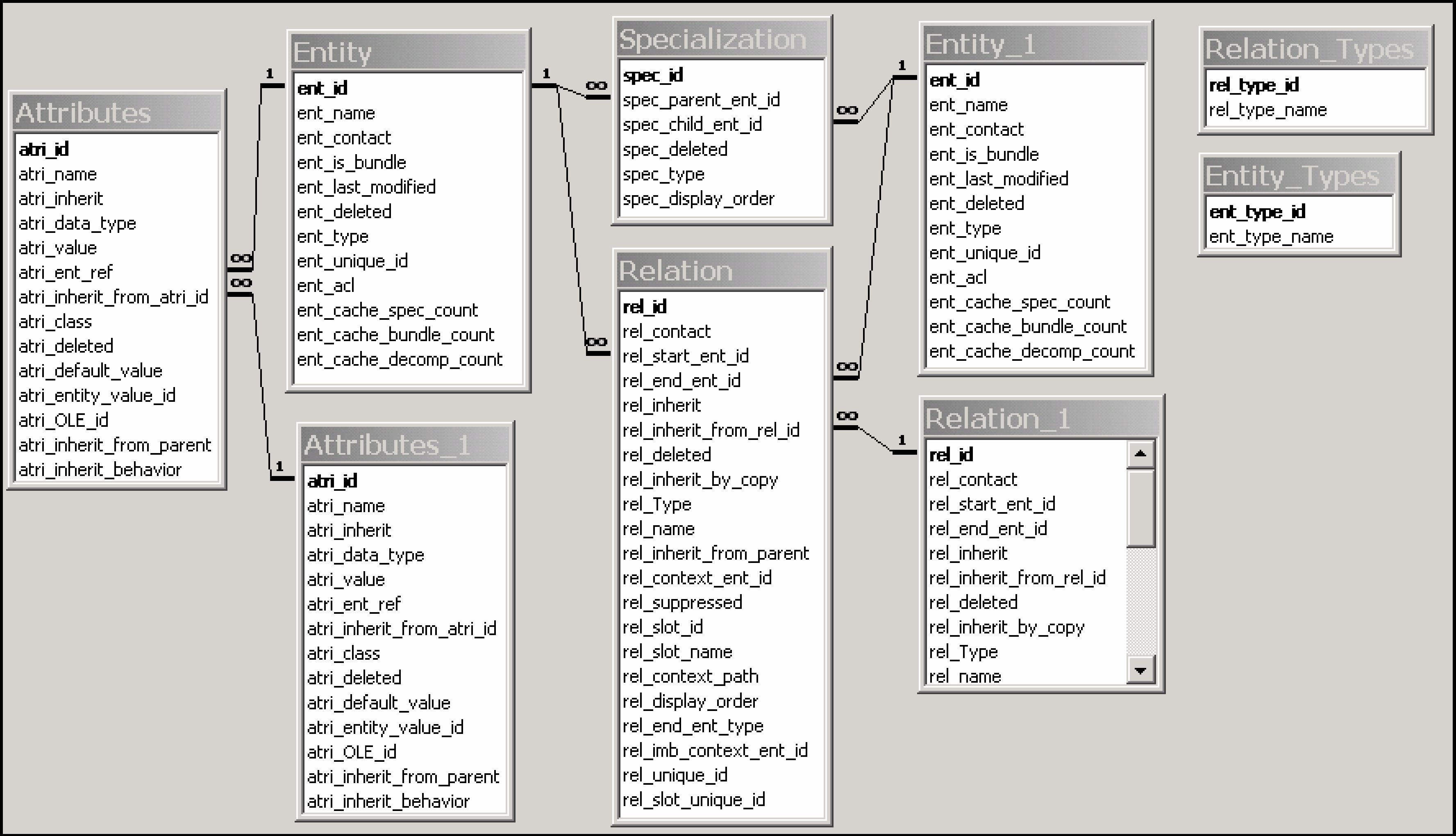
- Surprise: use SW *rule* language not the main SW *ontology* language! I.e., use (SCLP) RuleML not OWL.
  - OO inheritance is *default* ⇒ more reuse in ontologies
  - OWL/FOL cannot represent default inheritance
  - RuleML/nonmon-LP can
- Courteous Inheritance approach translates PH to SCLP KR
  - A few dozen background axioms. Linear-size translation. Inferencing is tractable computationally.
- PH becomes a SWS OO process ontology repository
- *In progress: open source version of PH content*
- *In progress: extend approach to OO ontologies generally*

The MIT Process Handbook

- Process repository (built for human consumption)
- Over 5000 processes, ~ 50000 assertions
  - Taxonomy of generic activity types
  - Case examples, on-line discussion forums



Original PH Data Base E-R Model



Attributes
atri_id
atri_name
atri_inherit
atri_data_type
atri_value
atri_ent_ref
atri_inherit_from_atri_id
atri_class
atri_deleted
atri_default_value
atri_entity_value_id
atri_OLE_id
atri_inherit_from_parent
atri_inherit_behavior

Entity
ent_id
ent_name
ent_contact
ent_is_bundle
ent_last_modified
ent_deleted
ent_type
ent_unique_id
ent_acl
ent_cache_spec_count
ent_cache_bundle_count
ent_cache_decomp_count

Attributes_1
atri_id
atri_name
atri_inherit
atri_data_type
atri_value
atri_ent_ref
atri_inherit_from_atri_id
atri_class
atri_deleted
atri_default_value
atri_entity_value_id
atri_OLE_id
atri_inherit_from_parent
atri_inherit_behavior

Specialization
spec_id
spec_parent_ent_id
spec_child_ent_id
spec_deleted
spec_type
spec_display_order

Relation
rel_id
rel_contact
rel_start_ent_id
rel_end_ent_id
rel_inherit
rel_inherit_from_rel_id
rel_deleted
rel_inherit_by_copy
rel_Type
rel_name
rel_inherit_from_parent
rel_context_ent_id
rel_suppressed
rel_slot_id
rel_slot_name
rel_context_path
rel_display_order
rel_end_ent_type
rel_imb_context_ent_id
rel_unique_id
rel_slot_unique_id

Entity_1
ent_id
ent_name
ent_contact
ent_is_bundle
ent_last_modified
ent_deleted
ent_type
ent_unique_id
ent_acl
ent_cache_spec_count
ent_cache_bundle_count
ent_cache_decomp_count

Relation_1
rel_id
rel_contact
rel_start_ent_id
rel_end_ent_id
rel_inherit
rel_inherit_from_rel_id
rel_deleted
rel_inherit_by_copy
rel_Type
rel_name

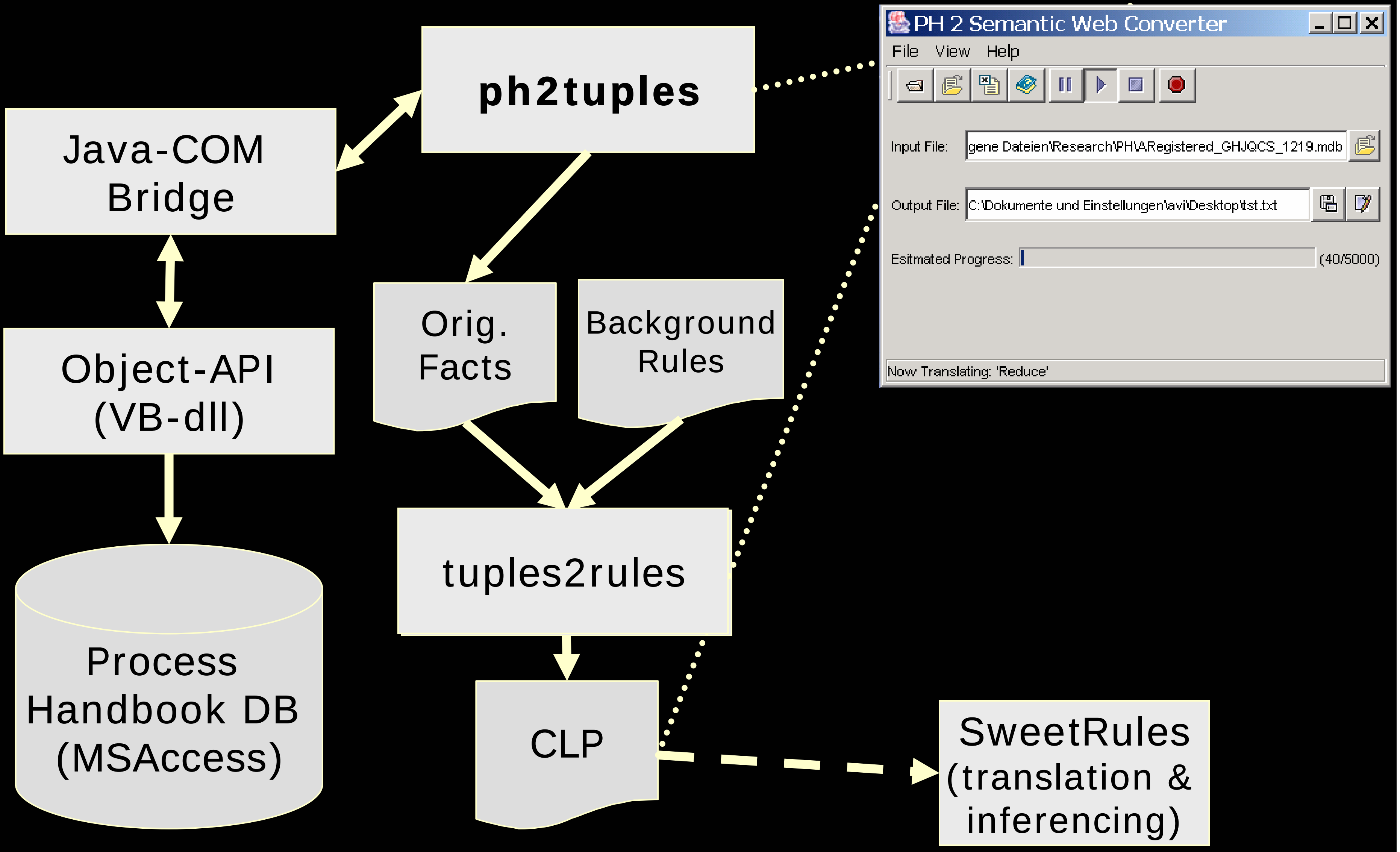
Relation_Types
rel_type_id
rel_type_name

Entity_Types
ent_type_id
ent_type_name

Hurdles Encountered when Translating the Process Handbook

- Nonmonotonic
  - FOL (including OWL) cannot represent
- Inheritance semantics hidden in code
  - Need to rationally reconstruct
- Only derived assertions are saved
  - Need to reconstruct premises
- Concept of slotted predicates
  - Use n-tuples
- Class as instance
  - *In-progress: combining with class as predicate*

Translation Processing Architecture



Input File: gene Dateien\Research\PH\ARegistered_GHJQCS_1219.mdb

Output File: C:\Dokumente und Einstellungen\avi\Desktop\tst.txt

Esitmated Progress: (40/5000)

Now Translating: 'Reduce'

Output
Background rules

- ~ 50 Background rules in CLP (~80 OLP)
- Transitivity of subclasses
- Domain and range for properties
- Partial functionality of slotted properties
- Axiomatization of inheritance prioritization partial order
- Default inheritance for properties

Output
Partial Output on Process “Sell” I

```
/* Declare subtype relationship 'Sell_263900' of 'Exchange_74000' */
                subclassof('Sell_263900, 'Exchange_74000);

/* Declare type 'Sell_263900' */
                class('Sell_263900);

/* Declare subtype relationship 'Sell_263900' of 'activity' */
                subclassof('Sell_263900, 'activity);

/* New value for 'has_attribute' at entity: Sell_263900 and slot: ph_Description */
<lb4987>
                pr(la4987, 'Sell_263900, 'has_attribute, 'ph_Description, "Selling implies an exchange of
      value from the customer to the seller for a product and/or service._cr_nl_cr_nlNote that the
      subactivities in 'sell' are the converse of 'buy'.");

/* New value for 'has_attribute' at entity: Sell_263900 and slot: ph_Name */
<lb4997>
                pr(la4997, 'Sell_263900, 'has_attribute, 'ph_Name, "Sell");

/* New value for 'has_attribute' at entity: Sell_263900 and slot: ph_PIFID */
<lb5003>
                pr(la5003, 'Sell_263900, 'has_attribute, 'ph_PIFID, "960823131555AB2639");
```

Output: Partial Output on Process "Sell" II

```
/* New value for 'has_task' at entity: Sell_263900 and slot:
    960823131555AB2639SL1367 */
<lb5008>
        pr(la5008, 'Sell_263900, 'has_task, '960823131555AB2639SL1367,
    'Identify_potential_customers_53400);

/* New value for 'has_task' at entity: Sell_263900 and slot:
    960823131555AB2639SL1369 */
<lb5009>
        pr(la5009, 'Sell_263900, 'has_task, '960823131555AB2639SL1369,
    'Identify_potential_customers'_needs_328100);

/* New value for 'has_task' at entity: Sell_263900 and slot:
    960823131555AB2639SL1368 */
<lb5010>
        pr(la5010, 'Sell_263900, 'has_task, '960823131555AB2639SL1368,
    'Inform_potential_customers_98400);
```

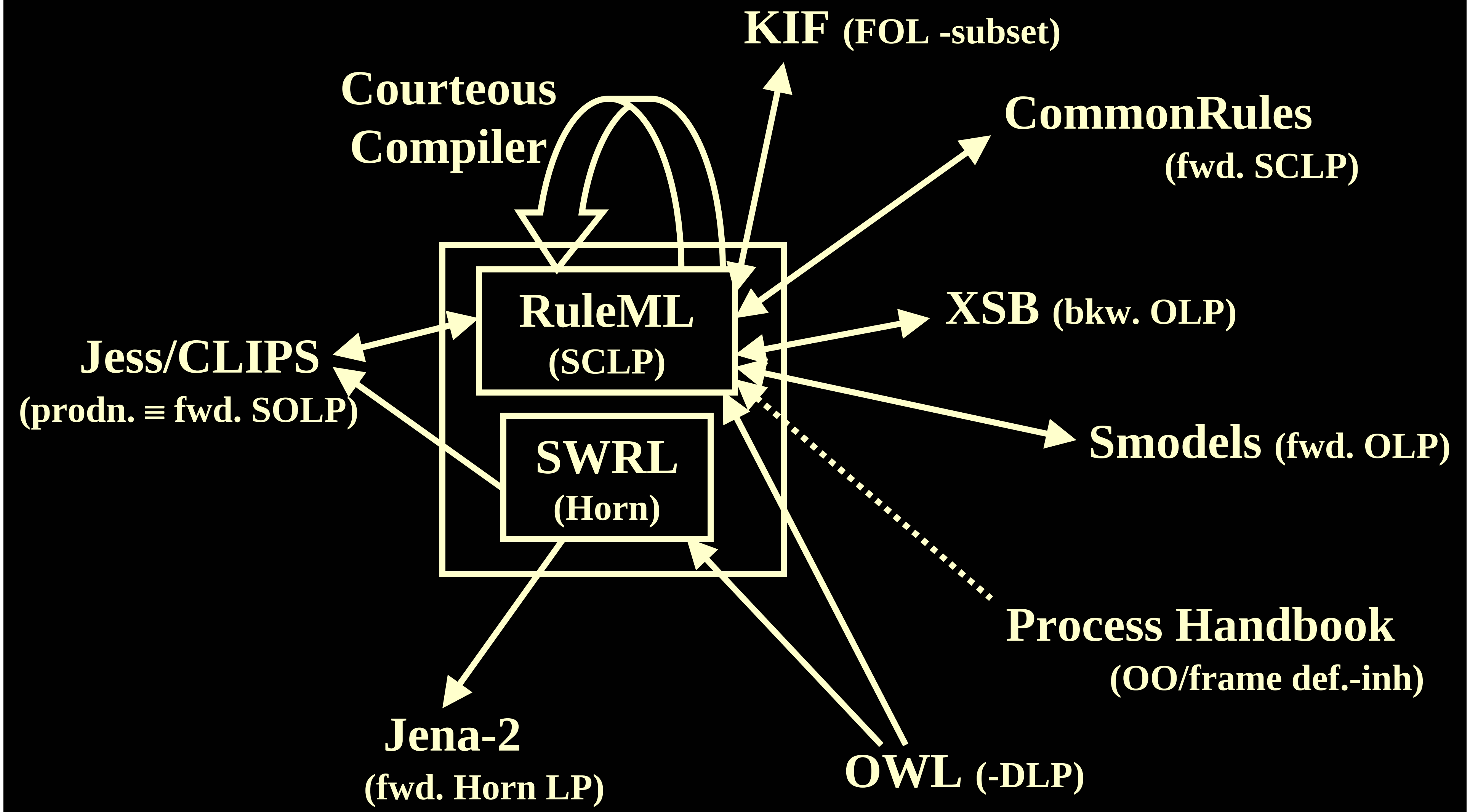
Output: Partial Output on Process “Sell” II

```
/* New value for 'has_task' at entity: Sell_263900 and slot: 960823131555AB2639SL1366 */
<lb5011>
        pr(la5011, 'Sell_263900, 'has_task, '960823131555AB2639SL1366,
   'Obtain_order_280400);

/* New value for 'has_task' at entity: Sell_263900 and slot: 960823131555AB2639SL1371 */
<lb5012>
        pr(la5012, 'Sell_263900, 'has_task, '960823131555AB2639SL1371,
   'Deliver_product_or_service_262300);

/* New value for 'has_task' at entity: Sell_263900 and slot: 960823131555AB2639SL1370 */
<lb5013>
        pr(la5013, 'Sell_263900, 'has_task, '960823131555AB2639SL1370,
   'Receive_payment_53800);

/* New value for 'has_task' at entity: Sell_263900 and slot: 960823131555AB2639SL3867 */
<lb5014>
        pr(la5014, 'Sell_263900, 'has_task, '960823131555AB2639SL3867,
   'Manage_customer_relationships_267400);
```

Sample Conclusion

```
/* Sell_by_mail_order has subactivity
   Deliver_product.

   This is inherited by default from Sell_Product.
  */
        h('Sell_by_mail_order,
          'has_task,
           960823131555AB2639SL1371,
           'Deliver_product).
```

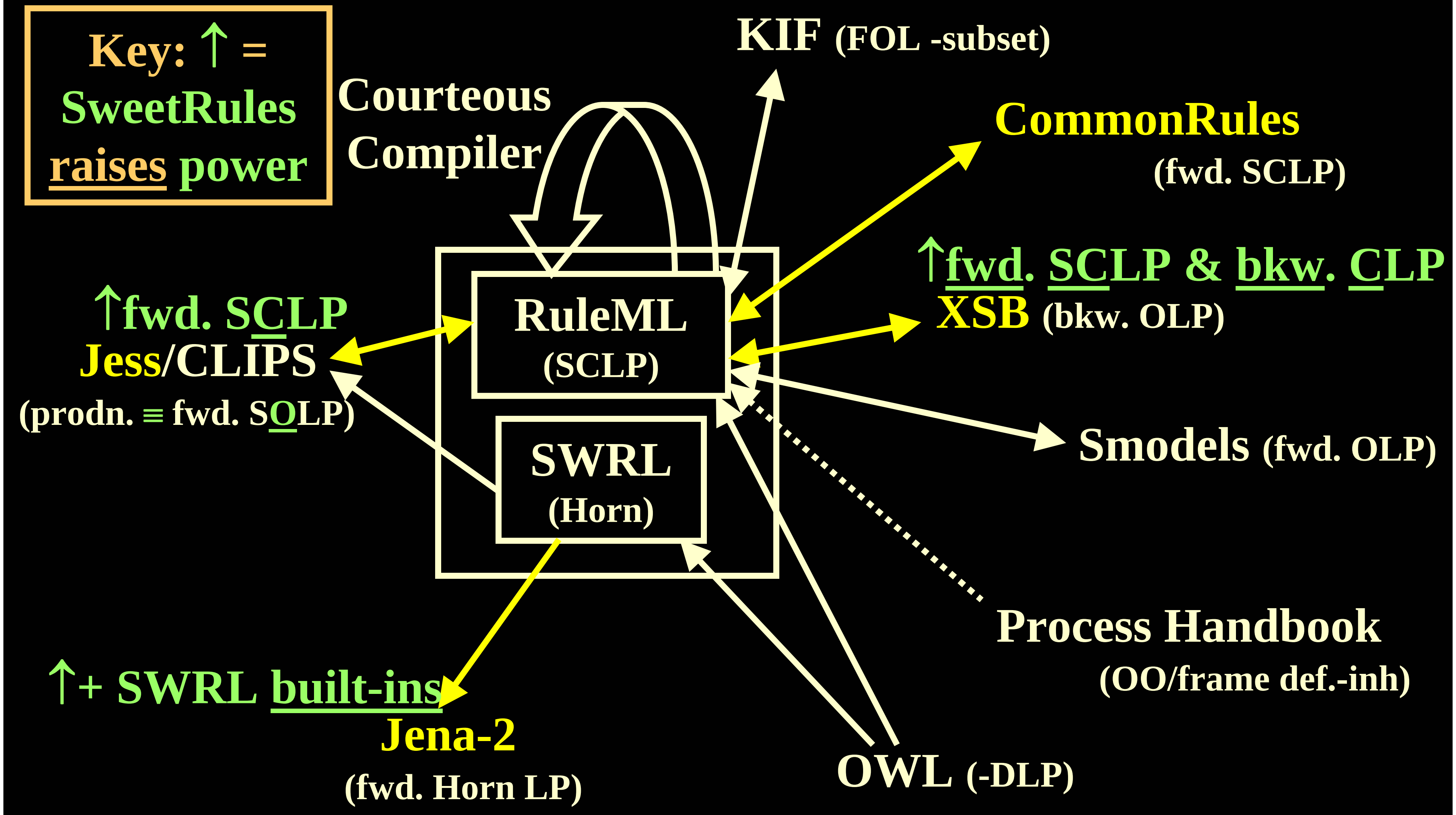
SweetRules Today: Translators Graph



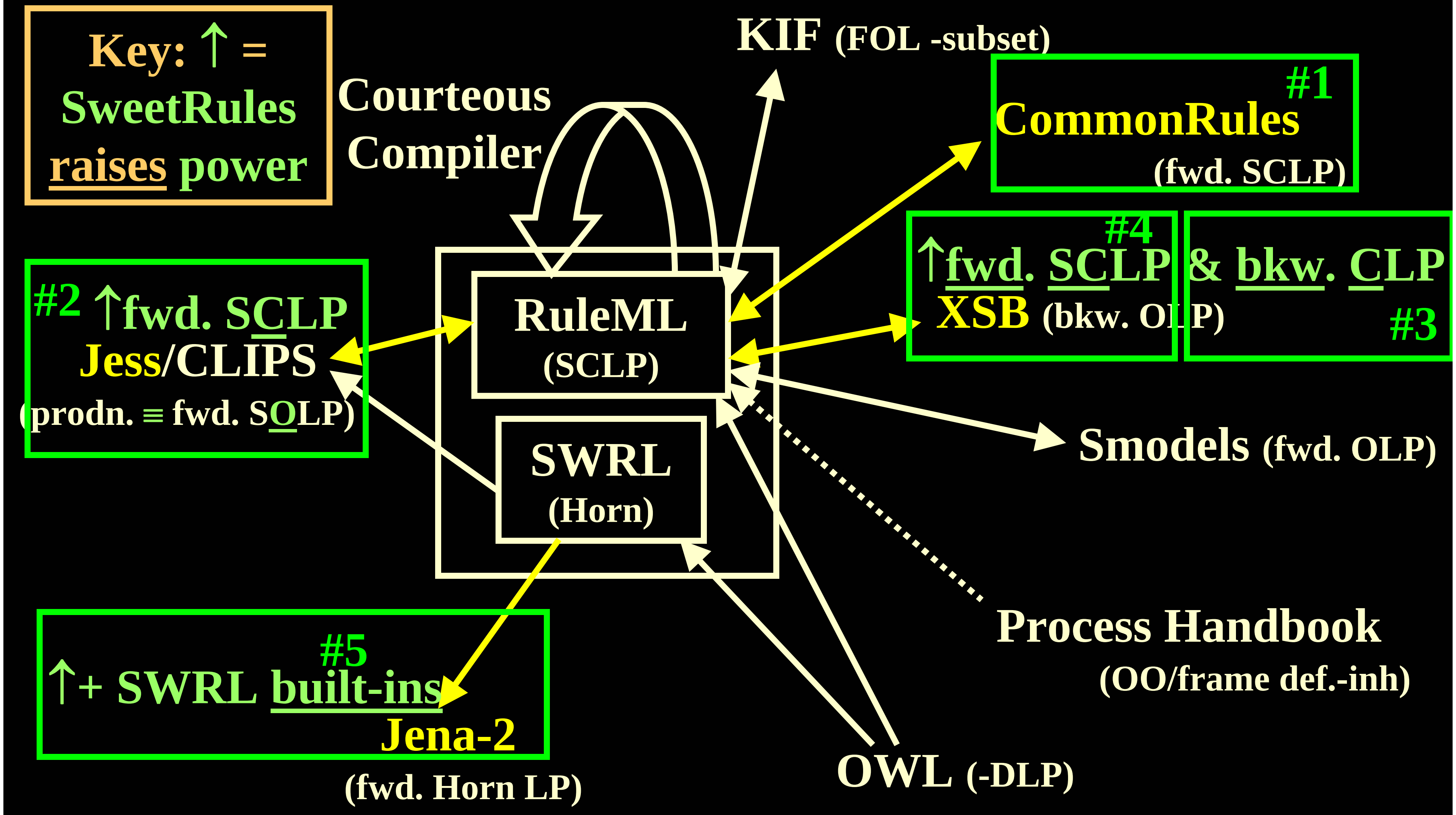
SweetRules Inferencing Capabilities Today: Overview

- Inferencing engines in RuleML/SWRL via translation:
  - Indirect inferencing:
    1. translate to another rule system, e.g., {XSB, Jess, CommonRules, or Jena}
    2. run inferencing in that system's engine
    3. translate back
  - Can use composite translators

SweetRules V2.0: Indirect Inferencing Engines



SweetRules V2.0 New Inferencing Engines



Key: ↑ = SweetRules raises power
Courteous Compiler
KIF (FOL -subset)
#1 CommonRules (fwd. SCLP)
#2 ↑fwd. SCLP Jess/CLIPS (prodn. ≡ fwd. SOLP)
RuleML (SCLP)
SWRL (Horn)
#4 ↑fwd. SCLP XSB (bkw. OLP)
& bkw. CLP #3
Smodels (fwd. OLP)
Process Handbook (OO/frame def.-inh)
#5 ↑+ SWRL built-ins Jena-2 (fwd. Horn LP)
OWL (-DLP)

SweetRules Components Today

- Some components have distinct names (for packaging or historical reasons): E.g.,
  - SweetCR translation & inferencing   RuleML ↔ CommonRules
  - SweetXSB translation & inferencing   RuleML ↔ XSB
  - SweetJess translation & inferencing   RuleML ↔ Jess
  - SweetOnto translation   {RuleML, SWRL} ← OWL + RDF-facts
  - SweetJena translation & inferencing   SWRL → Jena-2
- Other Project Components: (separate codebases for licensing or other reasons)
  - SWRL Built-Ins library   *Currently:* for Jena-2
  - SweetPH translation   RuleML ← Process Handbook (OO/frame ontologies)
    - *Currently V1.2 is running. Separately downloadable V2 is in progress.*
  - Protégé OWL Plug-in authoring SWRL rules (Horn, referencing OWL)
    - Enhancement providing SWRL Rules authoring is part of the Plug-In.
  - SWRL Validator