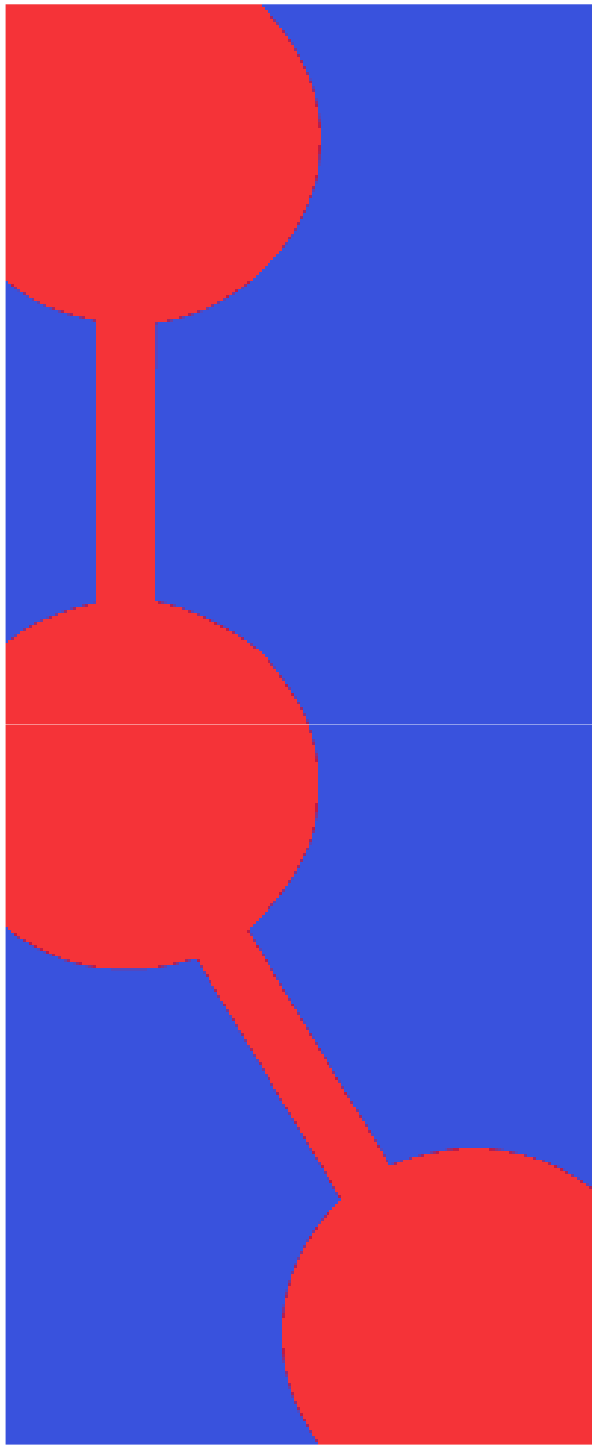

DynaLearn, una herramienta de razonamiento cualitativo

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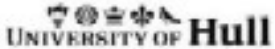
Asignatura de "Modelos de Razonamiento", Noviembre 2011

Outline

1. Introduction
2. Qualitative Reasoning modelling
3. Semantic Technologies
4. Semantic Grounding
5. Semantic Feedback
6. Research and in-use questions

Introduction



"Engaging and informed tools for learning conceptual system knowledge"

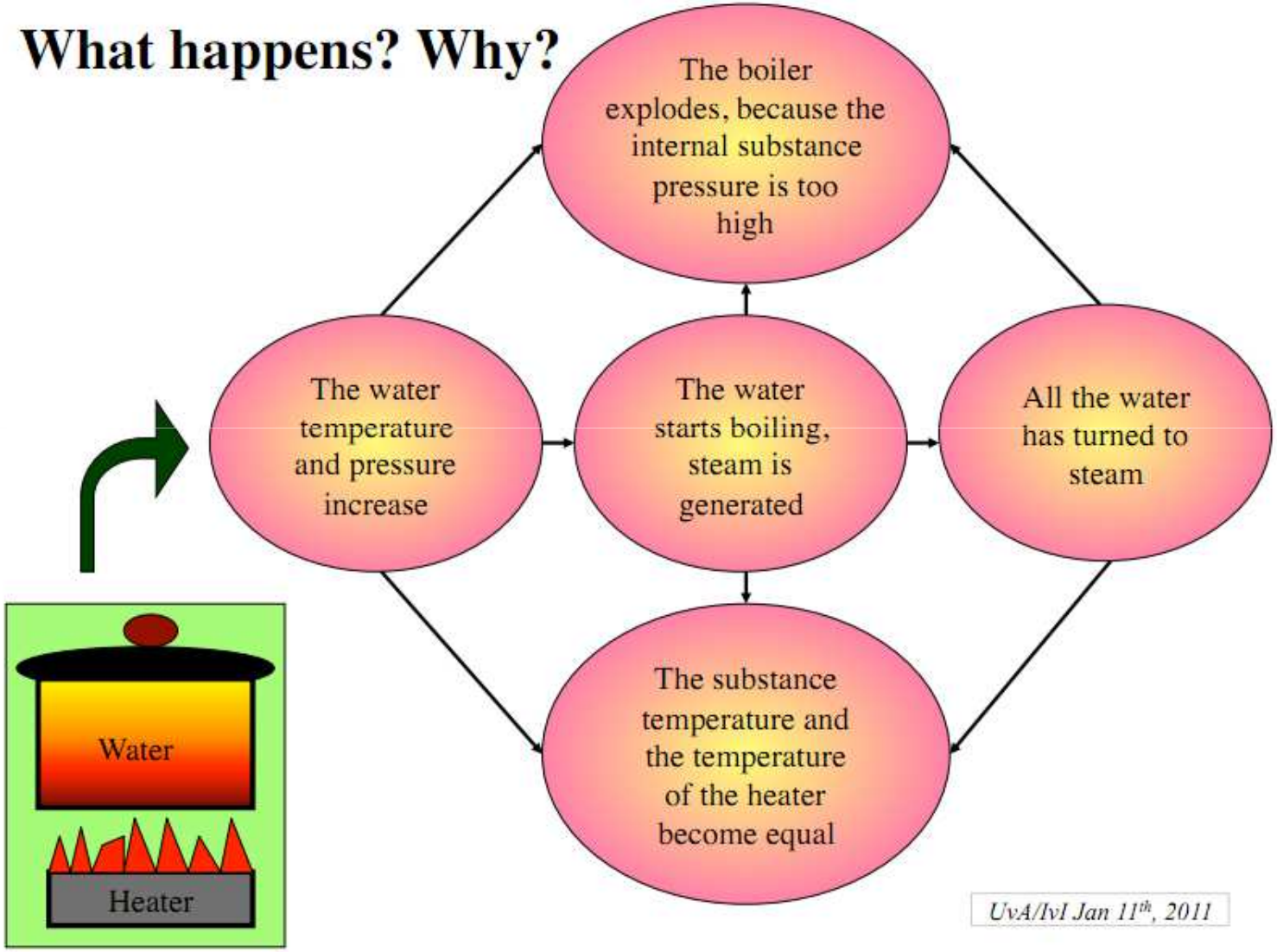
QUALITATIVE REASONING

- Trata de capturar la interpretación humana de la realidad
- Representa sistemas físicos mediante modelos
- Estudia su comportamiento mediante simulación
- Enfocado en las variables cualitativas de los sistemas (ej.: cierto árbol es de tamaño “grande”, la población de cierta especie “aumenta”, etc.) más que en variables numéricas

APPLICATION TO LEARNING OF ENVIRONMENTAL SCIENCES

- Idea: aprendizaje basado en construir modelos (“Learning by modelling”)
- Herramientas para el aprendizaje:
  - Definición de terminología apropiada
  - Interacción con el modelo
  - Predicción de su comportamiento
- Ejemplos:
  - *“Estudiar la evolución de la población de una especie cuando se introduce otra en su mismo ecosistema”*
  - *“Estudiar el efecto de los agentes contaminantes en un rio”*
  - ....

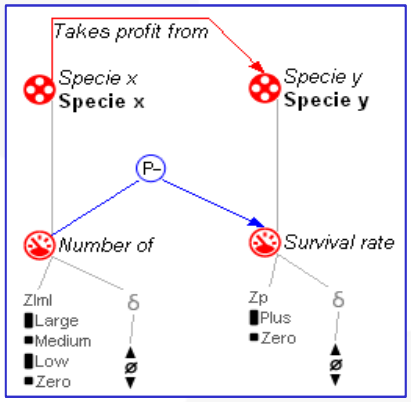
What happens? Why?

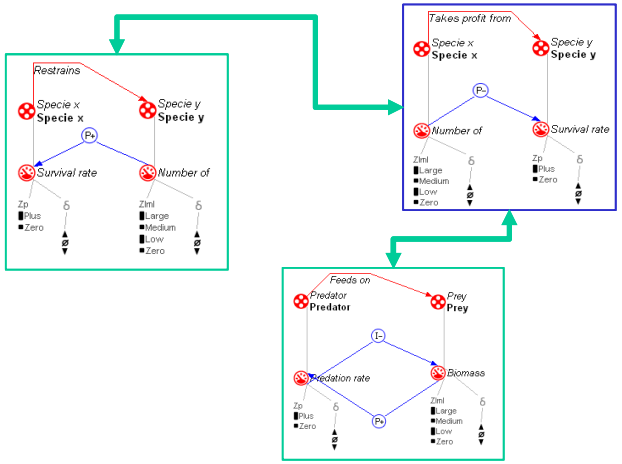


UvA/IvI Jan 11th, 2011

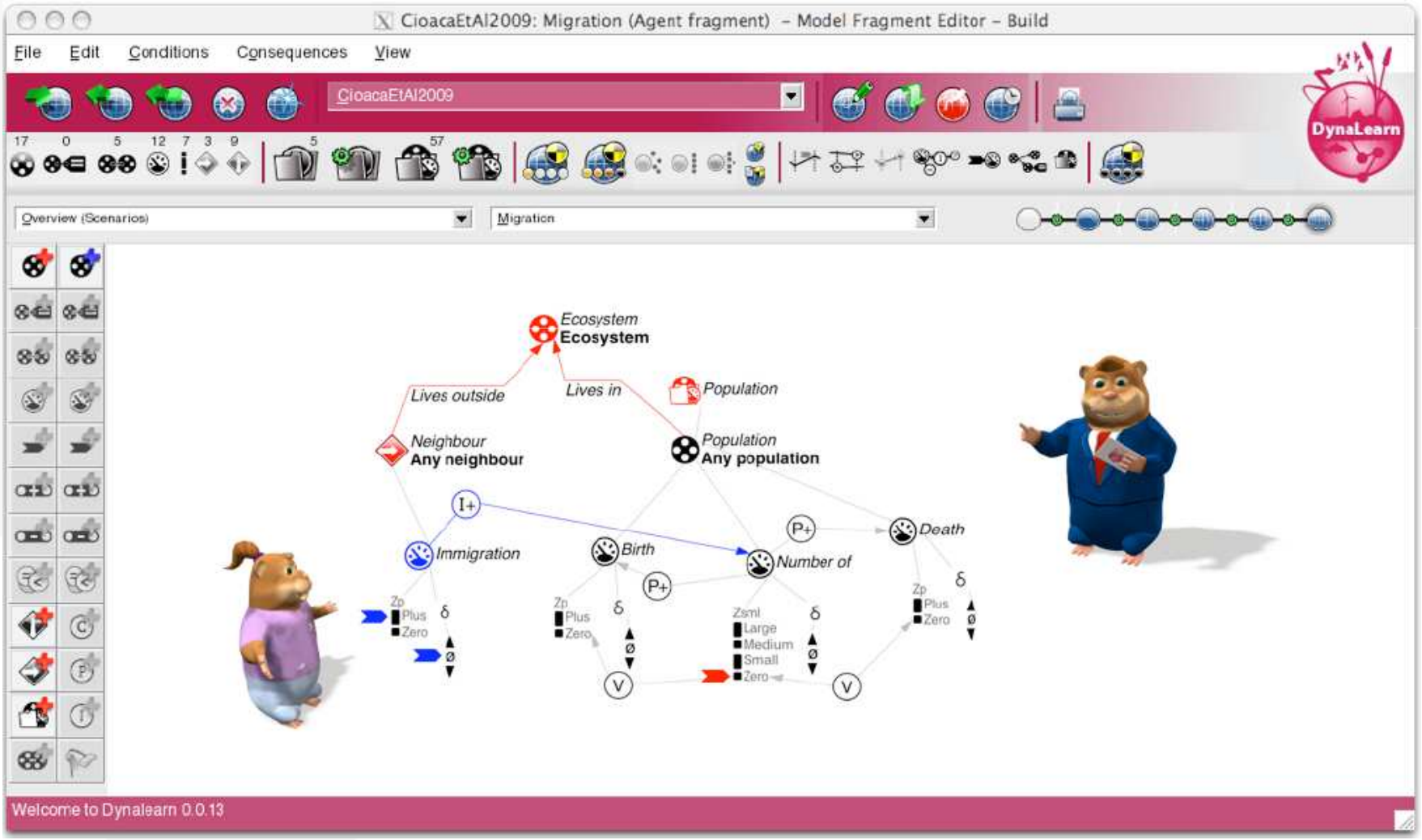
DYNALEARN

- "*Sistema para la adquisición de conocimiento conceptual en el contexto de la enseñanza de ciencias medioambientales*". Combina:
  - Construcción de modelos representando un sistema
  - Técnicas semánticas para relacionar distintos modelos de alumnos y profesores
  - Uso de avatares para interaccionar con el sistema

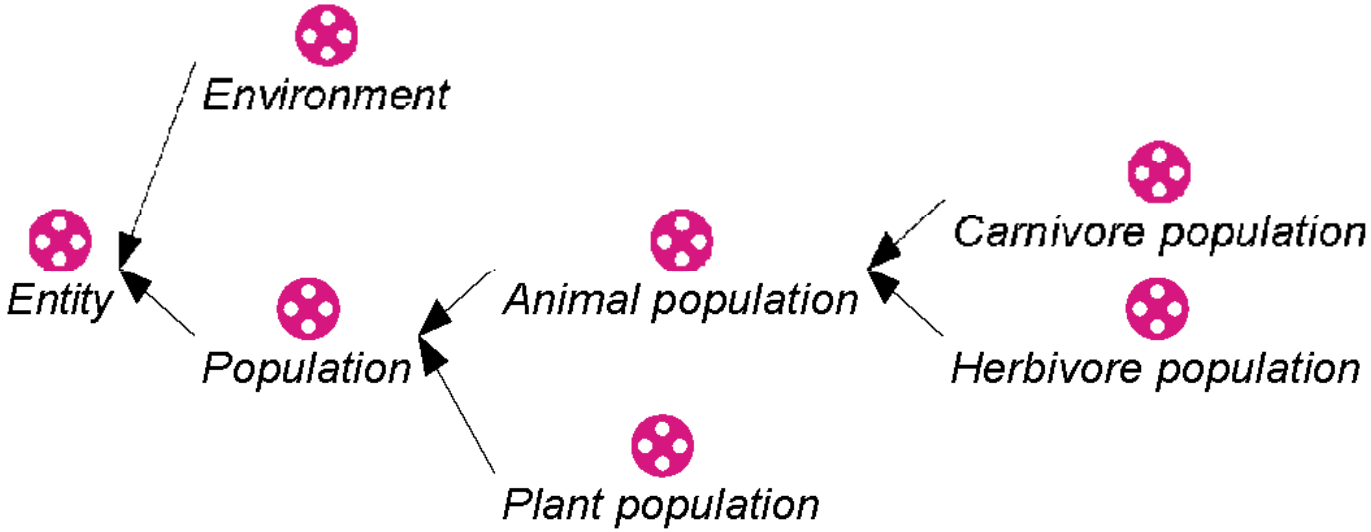




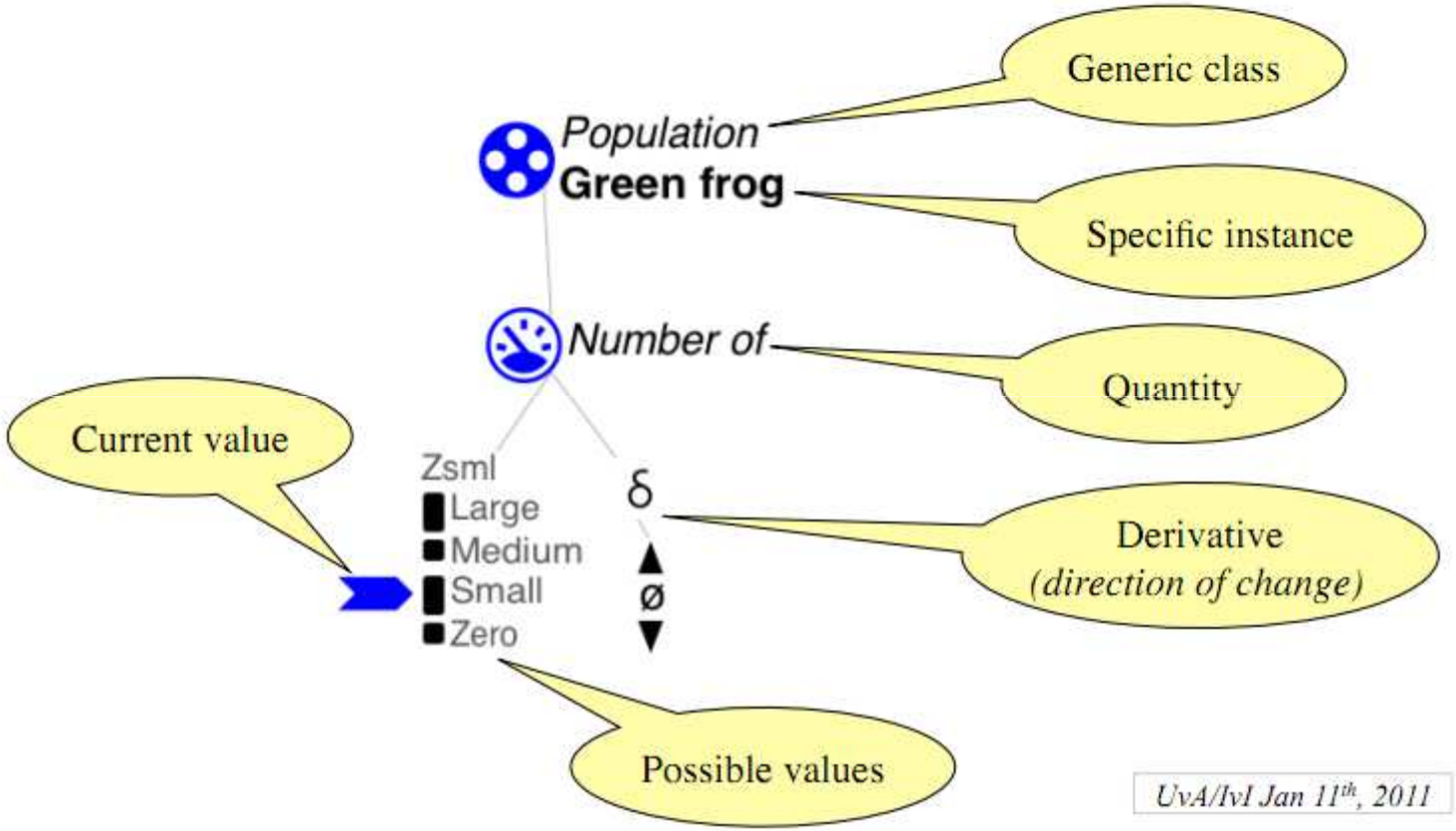
DYNALEARN


CioacaEtAl2009: Migration (Agent fragment) – Model Fragment Editor – Build
File
Edit
Conditions
Consequences
View
CioacaEtAl2009
DynaLearn
Overview (Scenarios)
Migration
Ecosystem
Ecosystem
Lives outside
Lives in
Population
Neighbour
Any neighbour
Population
Any population
I+
Immigration
Birth
P+
Number of
P+
Death
Zp
Plus
Zero
δ
Zsml
Large
Medium
Small
Zero
V
Welcome to Dynalearn 0.0.13

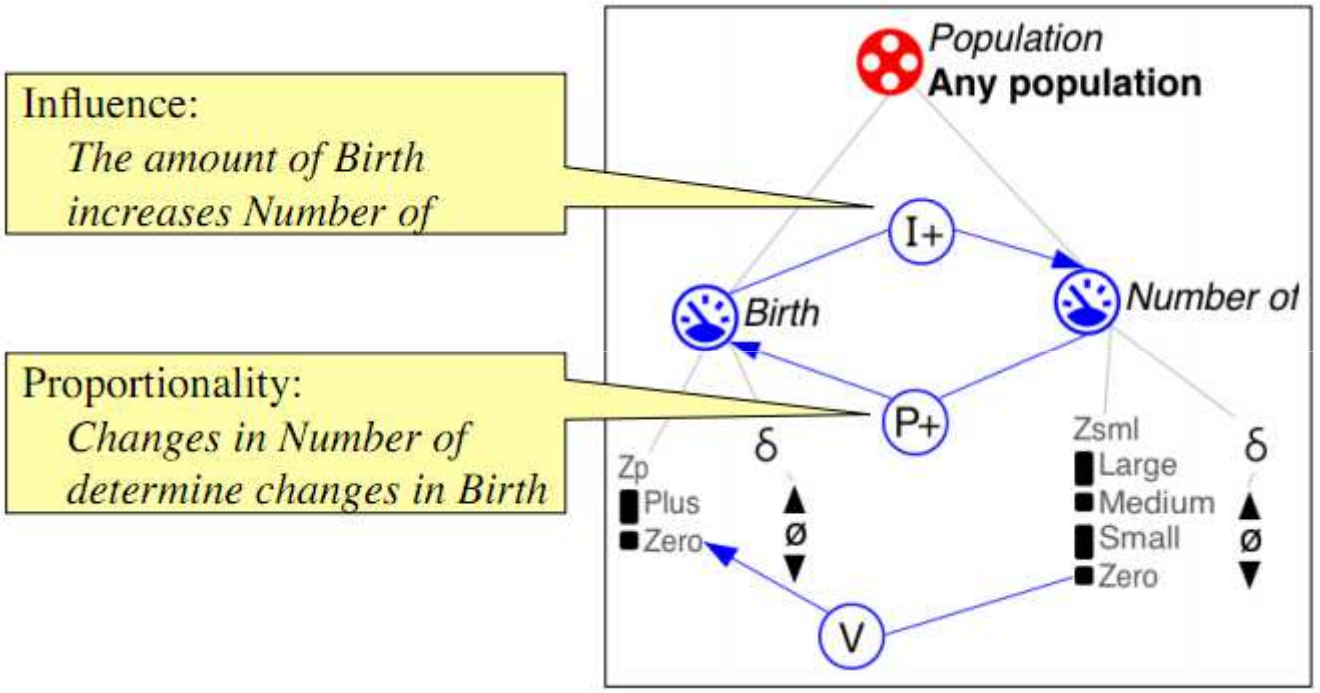
Entities


Environment
Entity
Population
Animal population
Carnivore population
Herbivore population
Plant population

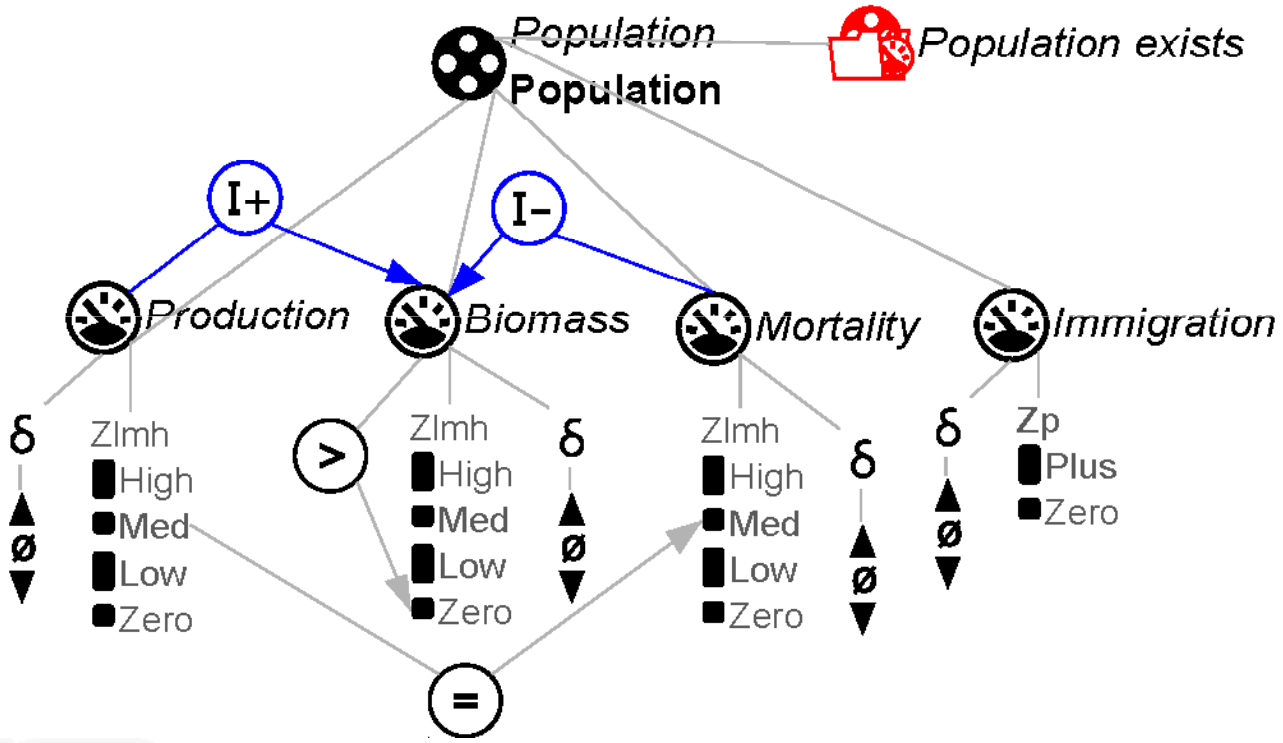
Scenarios *(starting situation)*



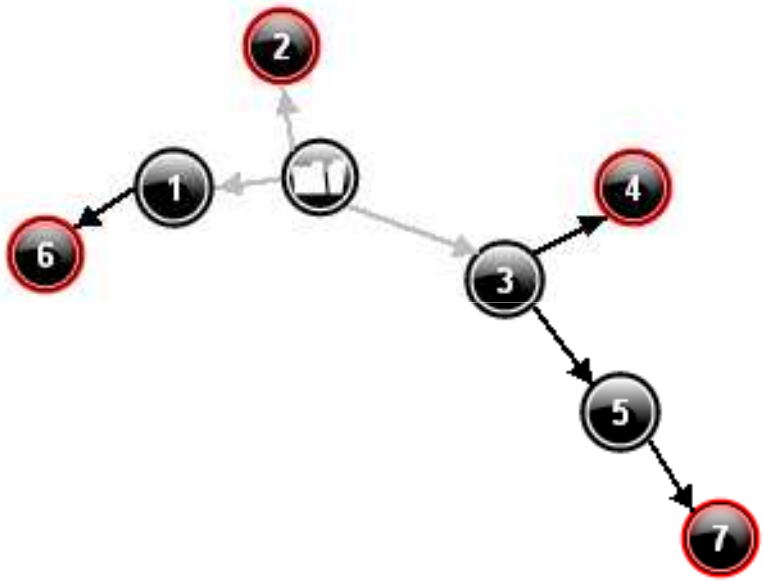
Model fragments *(capturing partial knowledge)*



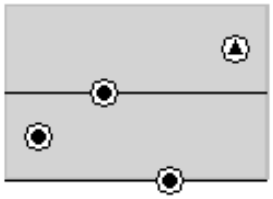
Model fragments *(capturing partial knowledge)*



Running simulations



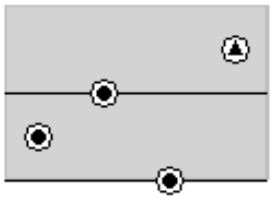
Green frog: Biomass



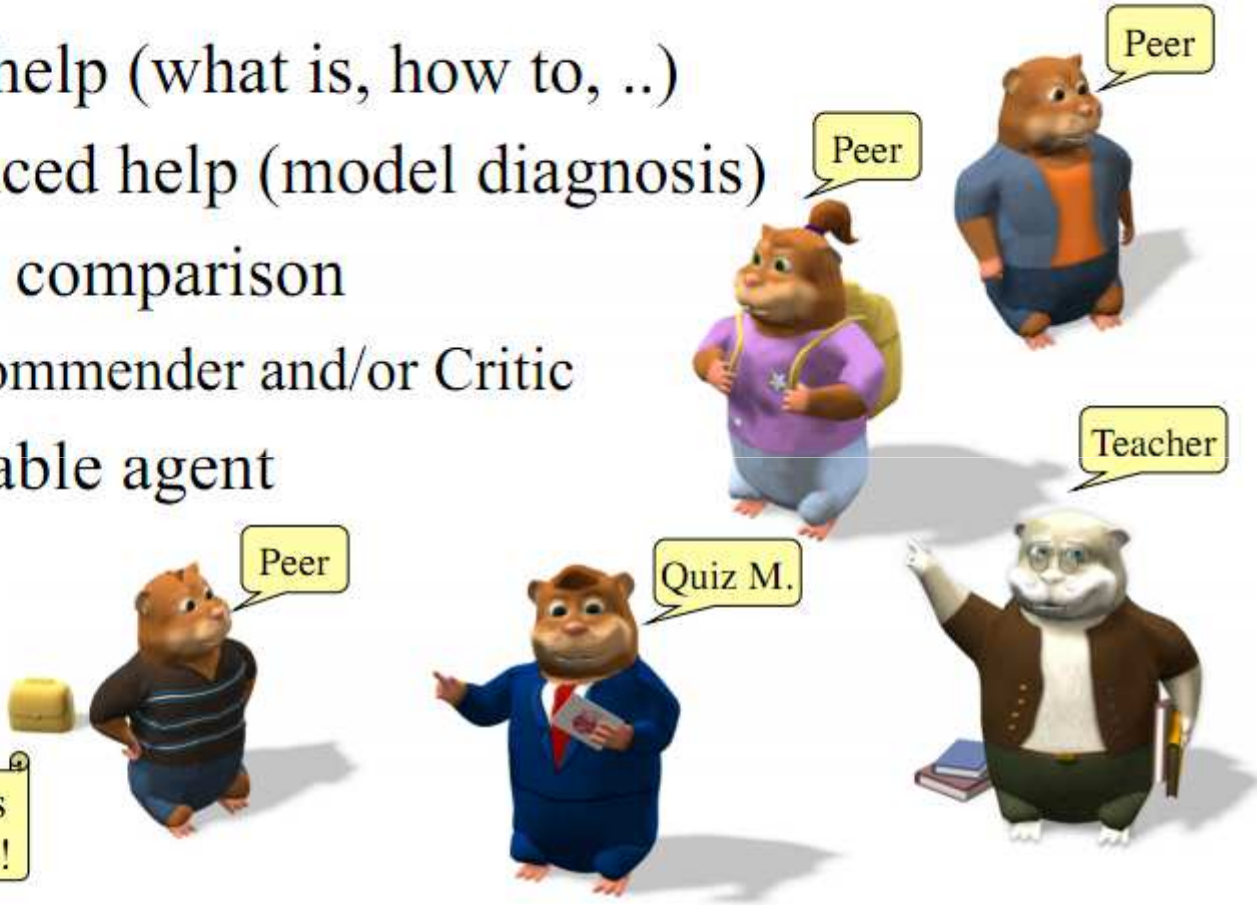
Green frog: Birth

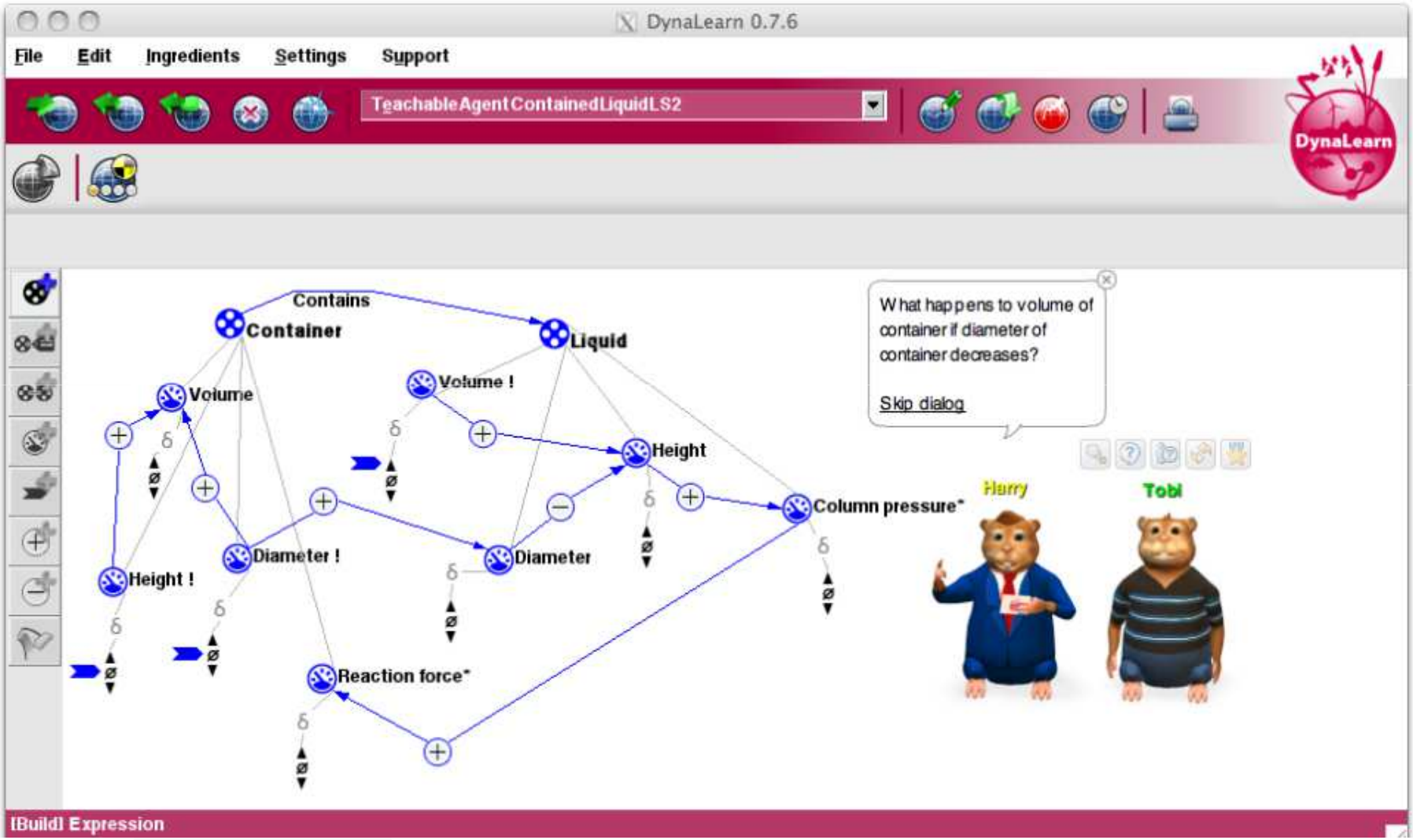
Green frog: Death

Green frog: Number of



- Basic help (what is, how to, ..)
- Advanced help (model diagnosis)
- Model comparison
  - Recommender and/or Critic
- Teachable agent
- Quiz

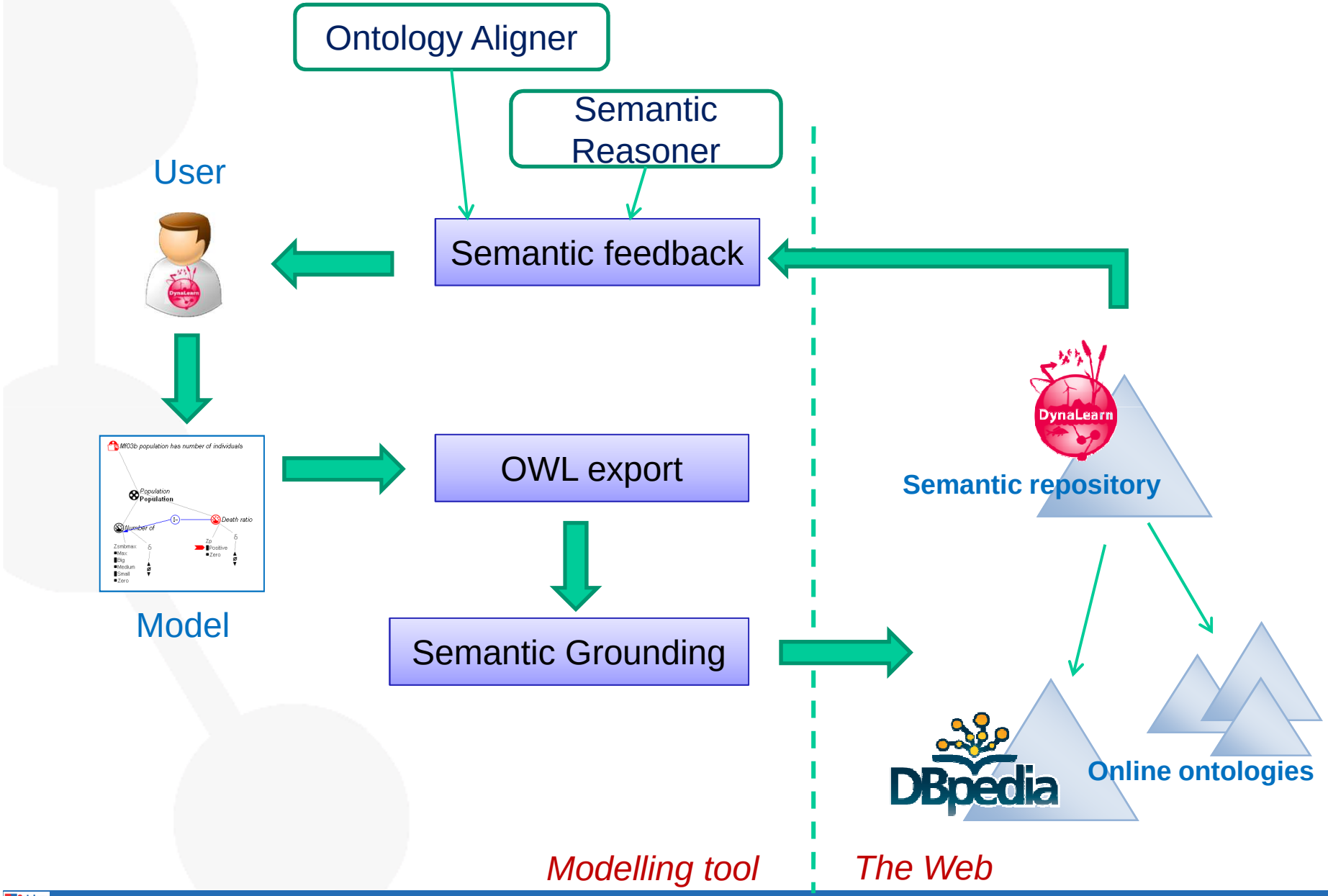



DynaLearn 0.7.6
File
Edit
Ingredients
Settings
Support
TeachableAgentContainedLiquidLS2
DynaLearn
Contains
Container
Liquid
Volume
Volume !
Height
Diameter !
Diameter
Height !
Column pressure*
Reaction force*
What happens to volume of container if diameter of container decreases?
Skip dialog
Harry
Tobi
[Build] Expression

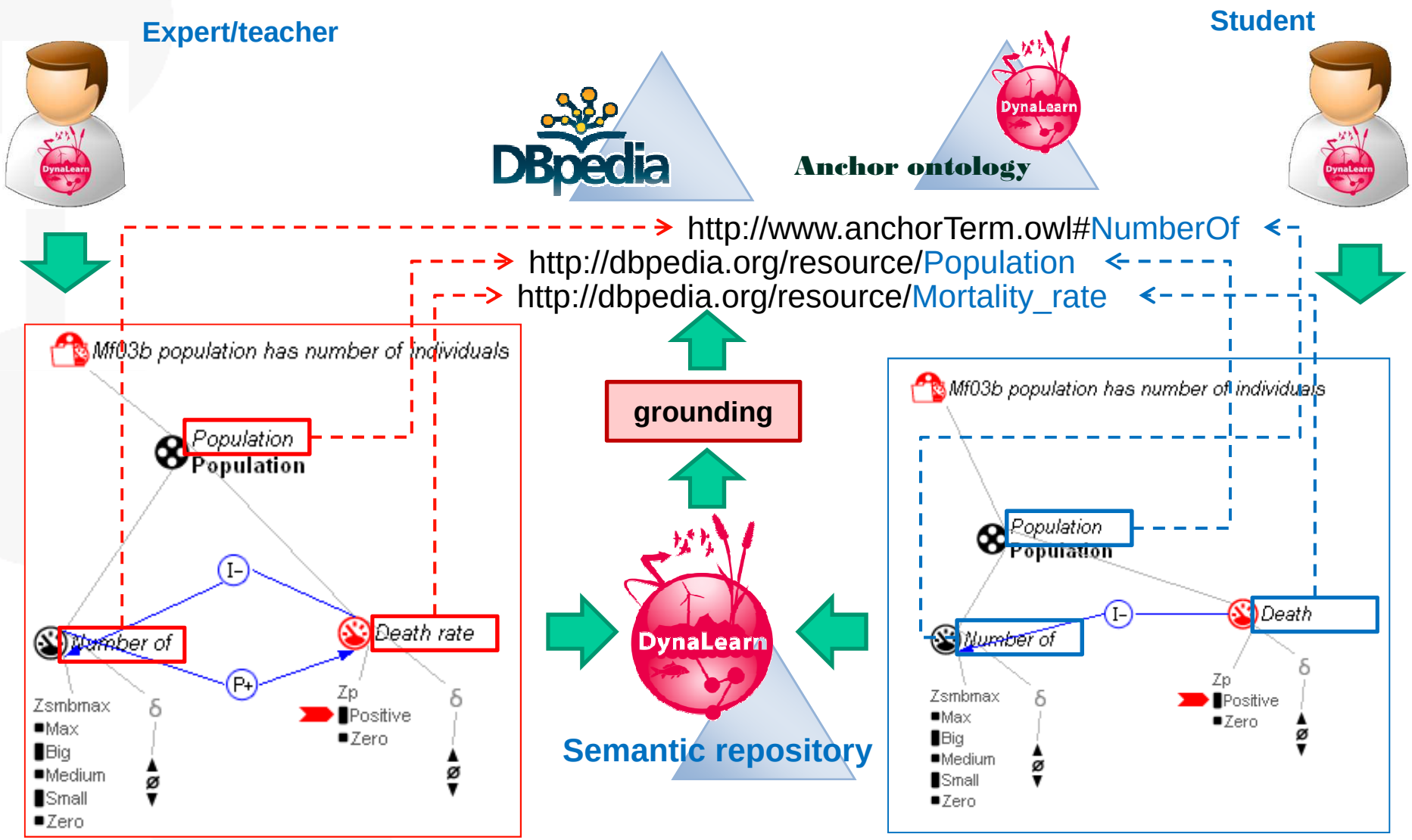
SEMANTIC TECHNIQUES

- To bridge the gap between the loosely and imprecise terminology used by a learner and the well-defined semantics of an ontology
- To put in relation to the QR models created by other learners or experts in order to automate the acquisition of feedback and recommendations from others

Semantic Techniques



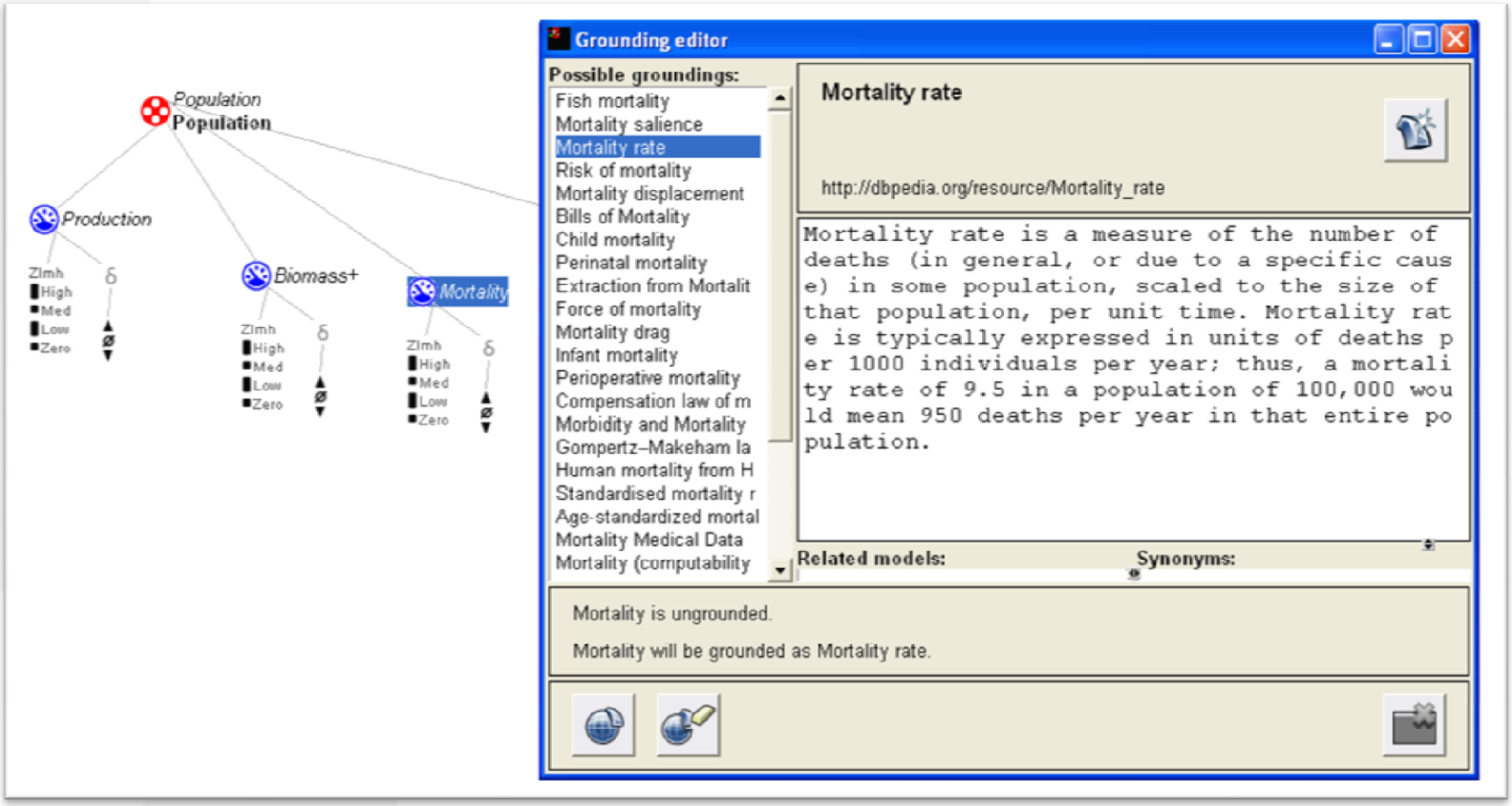
Semantic Grounding



Benefits of grounding

- Support the process of learning a domain vocabulary
- Ensure lexical and semantic correctness of terms
- Ensure the interoperability among models
- Extraction of a common domain knowledge
- Detection of inconsistencies and contradictions between models
- Inference of new, non declared, knowledge
- Assist the model construction with feedback and recommendations

Semantic Grounding

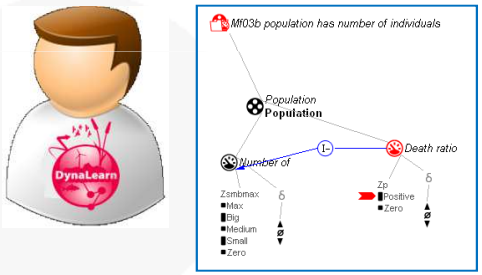


Semantic Feedback

e.g., "You can complete your model with a P+ proportionality"

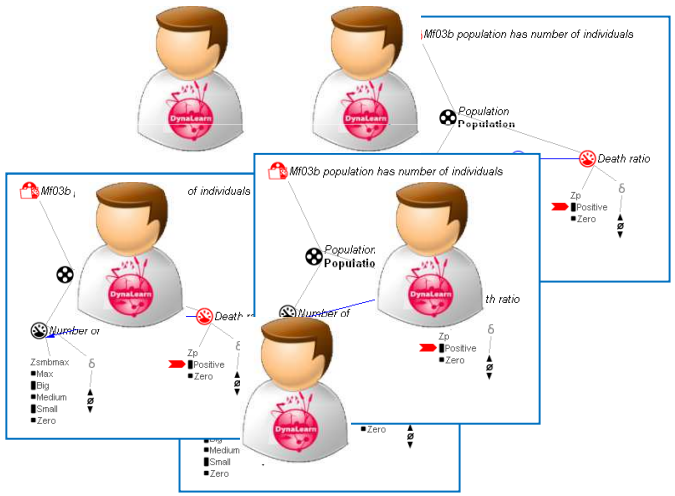
Feedback (assessments)

Student



DynaLearn

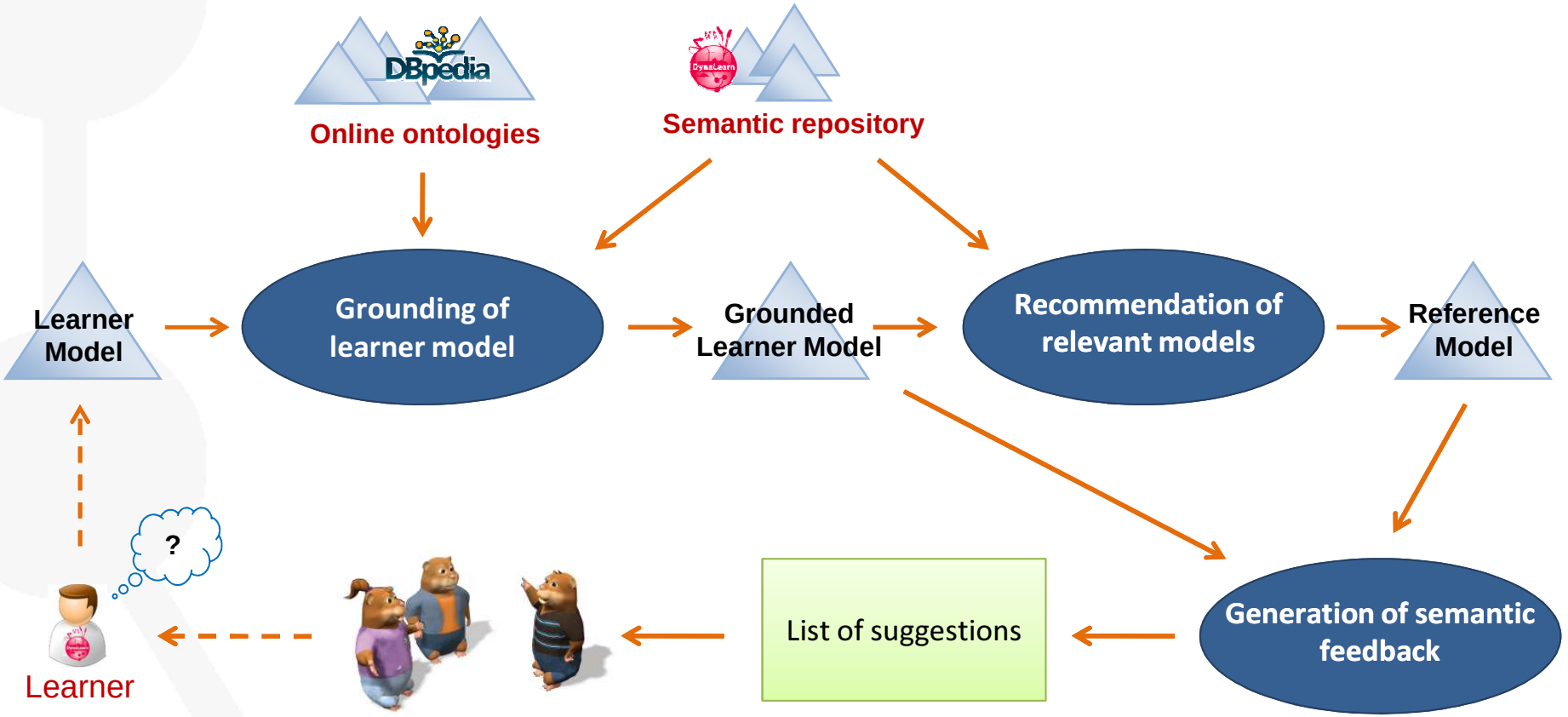
Community of users



e.g., "Users who modelled death also modelled birth"

Feedback (extensions)

Semantic Feedback



Semantic Feedback

- Collaborative filtering for (subjective) community-driven recommendation. E.g.:
  - *“Users who liked model X also liked model Y”*
  - *“Users who modeled X also modeled Y”*
- Model-based. Recommendations based on the properties of the model under an objective perspective. E.g.:
  - *“Find a model fragment with inverse behaviour to the current one”*
  - *“List all models which are more specific than the current one”*

SOME RESEARCH QUESTIONS

Q1. Which external knowledge source is the most suitable for grounding?

Q2. Are the proposed groundings suitable according to human opinion?

Q3. Are the state-of-the-art ontology matching tools suitable for the alignment of QR models?

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Coverage Study

Tested **1686** different English words coming from DynaLearn glossaries

Knowledge source	Coverage Ratio
DBpedia	**72%**
OpenCyc	69%
WordNet	45%
Watson	47%

Behaviour of Dbpedia in other **languages**?

Labels in other languages for the covered English terms:

Language	ratio
English	100%
German	72%
Spanish	64%
Dutch	61%
Portuguese	58%

Coverage Study

What if we fix spelling errors and suggest nearby terms?: *"fiter feeding"* → *"filter feeding"*

Knowledge source	Coverage Ratio
DBpedia + Yahoo Spelling Suggestion	**78%**

What if we combine several sources?:

Knowledge source	Coverage Ratio
DBpedia + OpenCyc	**87%**
DBpedia + Watson	**73%**
Dbpedia + WordNet	**72%**
Dbpedia + OpenCyc + WordNet + Watson	**88%**

SOME RESEARCH QUESTIONS

Q1. Which external knowledge source is the most suitable for grounding?

DBpedia (combined with OpenCyc for English)

Q2. Are the proposed groundings suitable according to human opinion?

Q2. Are the state-of-the-art ontology matching tools suitable for the alignment of QR models?

Q2 – human-based evaluation

HULL'S EXPERIMENT

- Tested 909 English labels covered by DBpedia, randomly selected from DynaLearn glossaries
- Asked 8 expert evaluators, each one evaluated between 200-300 groundings. Each grounding was double-evaluated
- Question*: For each grounded term, are all its relevant meanings contained in the set of grounding candidates? If yes, mark the relevant ones.*

Accuracy (Average)	precision@1st (Average)
83%	**76%**

Inter-evaluator Agreement Level (Average)		
Agreem.1 (chosen grounding)	Agreem.2 (existence of suitable grounding)	Cohen's Kappa
78%	85%	**0,47**

SOME RESEARCH QUESTIONS

Q1. Which external knowledge source is the most suitable for grounding?

Dbpedia (combined with OpenCyc for English)

Q2. Are the proposed groundings suitable according to human opinion?

Yes... (with an 83% accuracy)

Q3. Are the state-of-the-art ontology matching tools suitable for the alignment of QR models?

MODEL MATCHING EXPERIMENT

- Reference Alignments:

  Provided by experts, manually aligned:

  Case 1 - Social aspects of population growth, v1 vs. v2

  Case 2 - Soil contamination, v1 vs. v2

  Case 3 - Hervibory vs. Predation

  Case 4 - Amensalism vs. Commensalism

- Ontology alignment tools tested: CIDER, Falcon

Q4 - Ontology Matching

	CIDER			Falcon		
	Precision	**Recall**	**Time (s)**	**Precision**	**Recall**	**Time (s)**
Case 1 (pop.)	1.00	1.00	10.8	0.80	1.00	1.9
Case 2 (soil)	1.00	1.00	9.2	0.79	1.00	2.0
Case 3 (h./p.)	1.00	1.00	4.2	0.63	1.00	1.8
Case 4 (a./c.)	0.67	0.80	4.6	0.44	0.80	1.7
AVERAGE	**0.92**	**0.95**	7.2	0.67	0.95	1.9

SOME RESEARCH QUESTIONS

Q1. Which external knowledge source is the most suitable for grounding?

Dbpedia (combined with OpenCyc for English)

Q2. Are the proposed groundings suitable according to human opinion?

Yes... (with an 83% accuracy)

Q3. Are the state-of-the-art ontology matching tools suitable for the alignment of QR models?

Yes

Some references

[1] Bredeweg, B., Liem, J., Linnebank, F., Bühling, R., Wißner, M., Gracia, J., Salles, P., Beek, W. and Gómez Pérez, A. *DynaLearn: Architecture and Approach for Investigating Conceptual System Knowledge Acquisition*. In Intelligent Tutoring Systems 2010, Part II, pp. 272-274, LNCS 6095, Springer-Verlag.

[2] Gracia, J., Liem, J., Lozano, E., Corcho, O., Trna, M., Gómez-Pérez, A., and Bredeweg, B. (2010). *Semantic Techniques for Enabling Knowledge Reuse in Conceptual Modelling*. Proc. of 9th International Semantic Web Conference (ISWC2010), Shanghai (China), Springer, volume 6414, November 2010**. Nominated as best in-use paper**.

[3] DynaLearn web site, www.dynalearn.eu

Thanks for your attention!

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