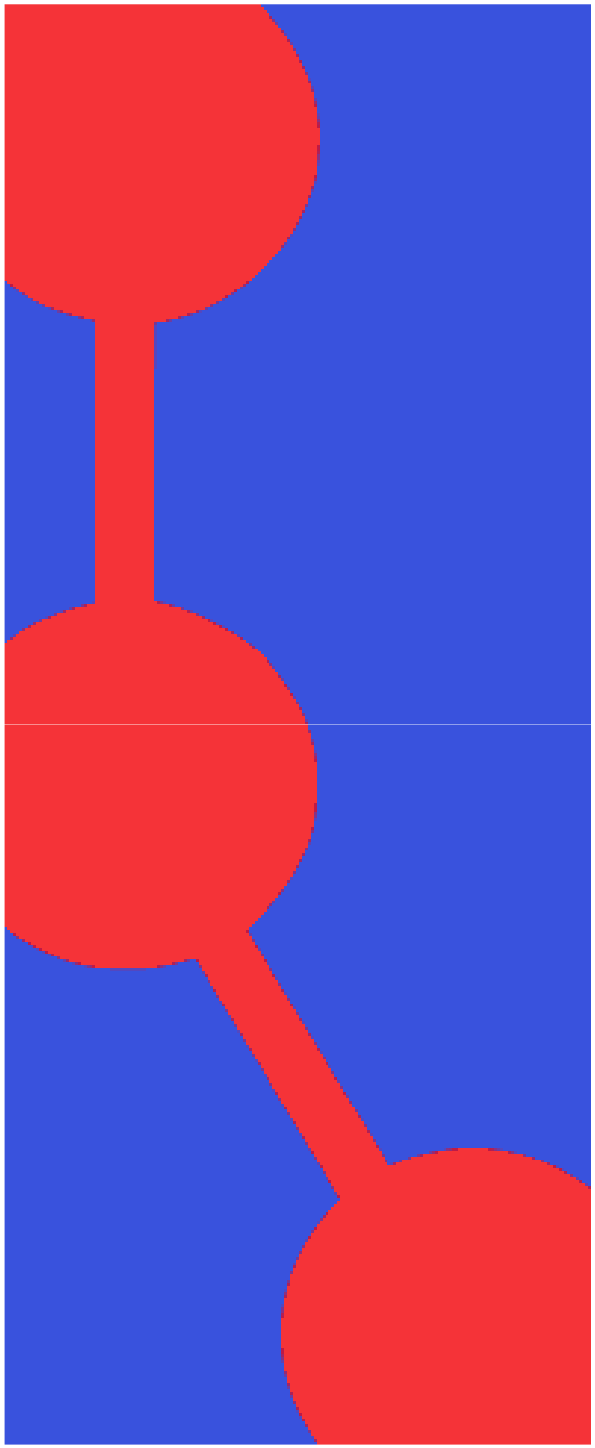

# Razonamiento Cualitativo con DynaLearn (introducción)

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**Asignatura de "Modelos de Razonamiento", Noviembre 2012**

# Outline

1. Introduction
2. What is Spacial/Temporal reasoning?
3. Qualitative reasoning: an example
4. Application Scenarios
5. QR modeling in DynaLearn
6. Semantic Techniques in DynaLearn

## 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

# Introduction

- "Qualitative reasoning is the area of AI which creates representations for continuous aspects of the world, such as space, time, and quantity, which support reasoning with very little information" [1]
- *"People draw useful and subtle conclusions* about the physical world without differential equations." [1]

# Introduction

- Qualitative representations. Key issues:
  - Resolution
    - Level of information detail
    - Low resolution is frequent but leads to ambiguity
  - Compositionality
    - Represent different aspects of a phenomenon or system and combine them to represent it as a whole
- Elements to be represented:
  - Quantities
  - Mathematical relations
  - Ontology
  - State, time, behaviour
  - Space, shape

# What is Spatial/Temporal Reasoning?

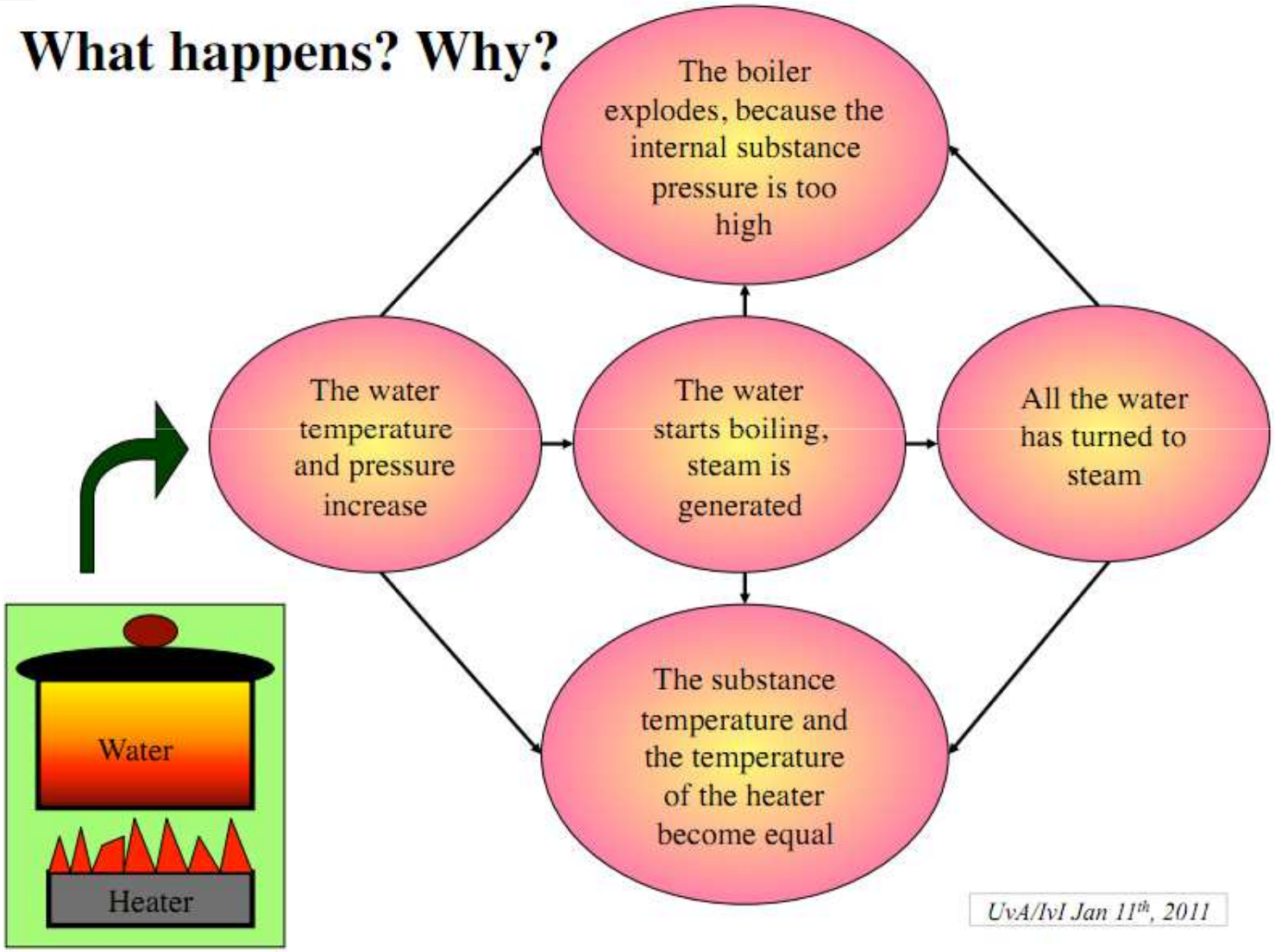
- Humans reason (and make decisions) about space and time through both quantitative and qualitative assertions and relationships
  - qualitative
    - “that object is closer to me than this object”
    - “I am inside this room”
    - “that event occurred a long time ago”
  - quantitative
    - “that event happened 6 minutes and 30 seconds ago”
    - “My current position is (23.2, 100.4)
    - “object B lies 6 meters closer to me than object C”

# What is Spatial/Temporal Reasoning?

- Spatio-temporal configurations can be described quantitatively by specifying the coordinates of the relevant objects:
  - At time point 10.0 object A is at position (11.0, 1.0, 23.7)
- Or qualitatively, with a finite vocabulary
  - Object A hit object B. Afterwards, object C arrived.
- Sometimes we want to reason with such descriptions
  - Object C was not close to object A when it hit object B.

  -> Qualitative spacial/temporal reasoning

# Qualitative Reasoning: example



# Application Scenarios

- Campos de aplicación
  - Aeroespacial (fault-aware systems)
  - Automóviles
  - Software de control (e.g., fotocopiadoras)
  - Educación
  - Ecología

## EJEMPLO: QR para el aprendizaje de ciencias medioambientales

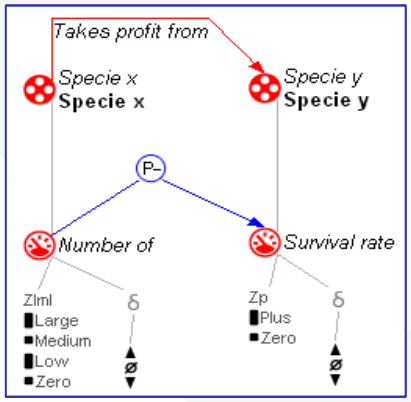
- Idea: aprendizaje basado en construir modelos (“Learning by modelling”)
- Herramientas para el aprendizaje:
  - Definición de terminología apropiada
  - Interacción con el modelo
  - Predicción de su comportamiento
- Ejemplos:
  - *“Estudiar la evolución de la población de una especie cuando se introduce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

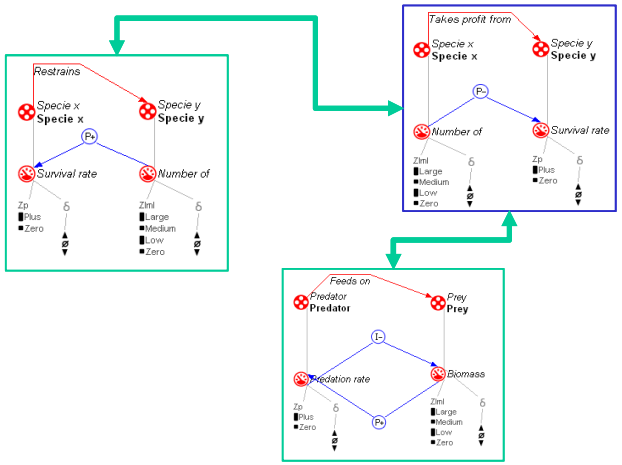
# QR modelling with DynaLearn


*"Engaging and informed tools for learning conceptual system knowledge"*

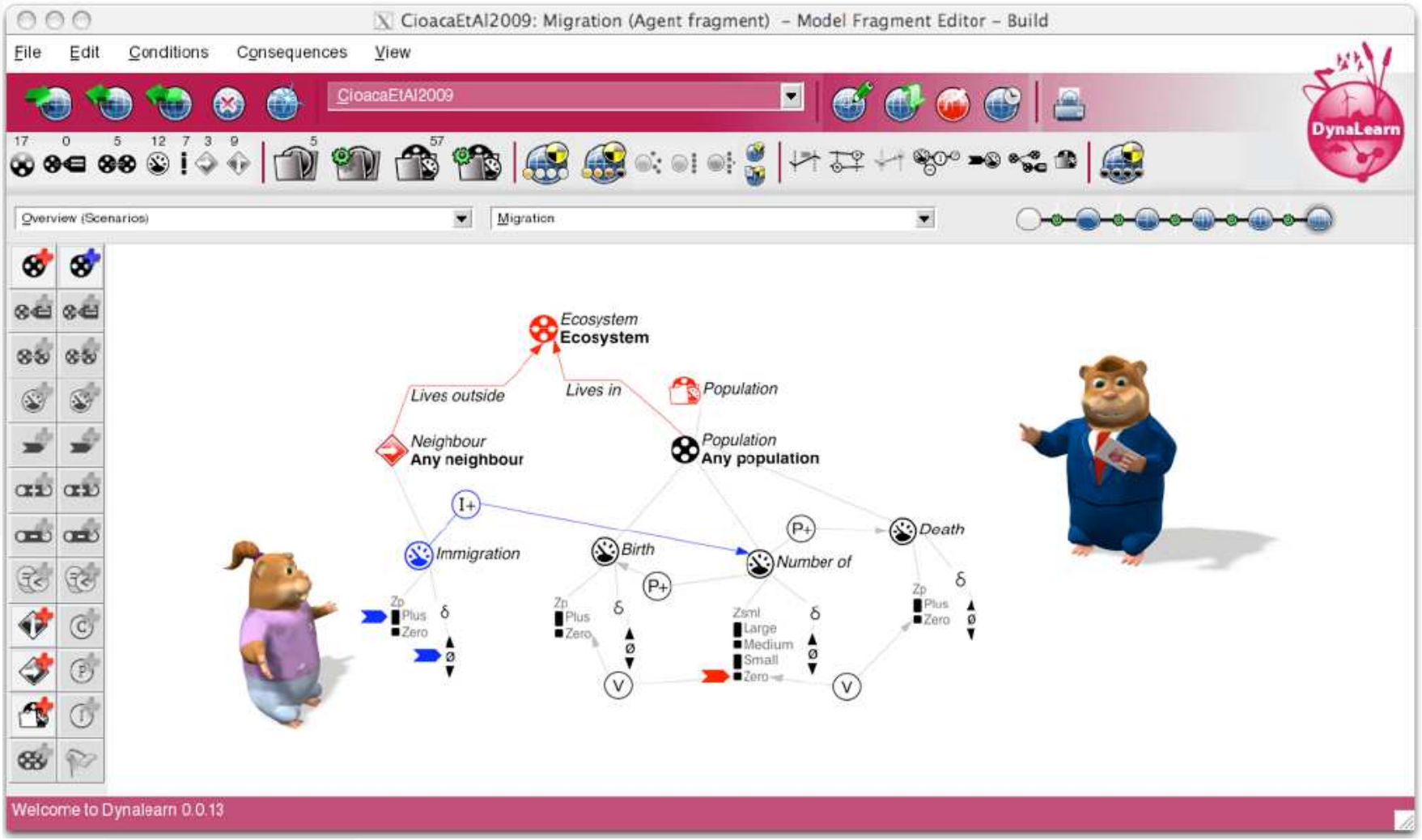
## DYNALEARN

- "*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

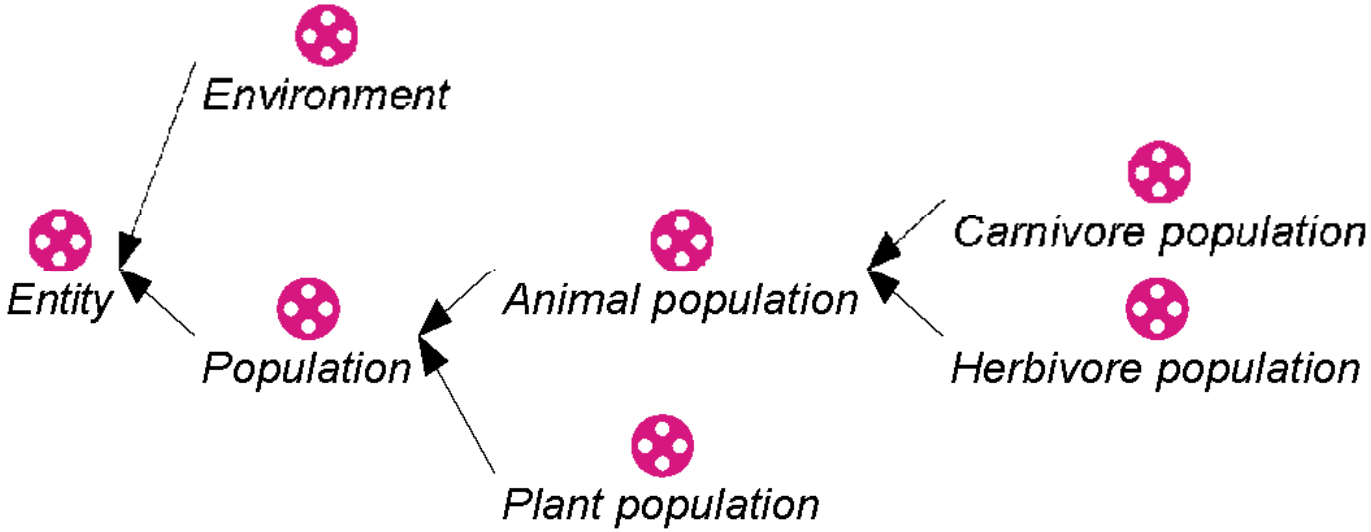


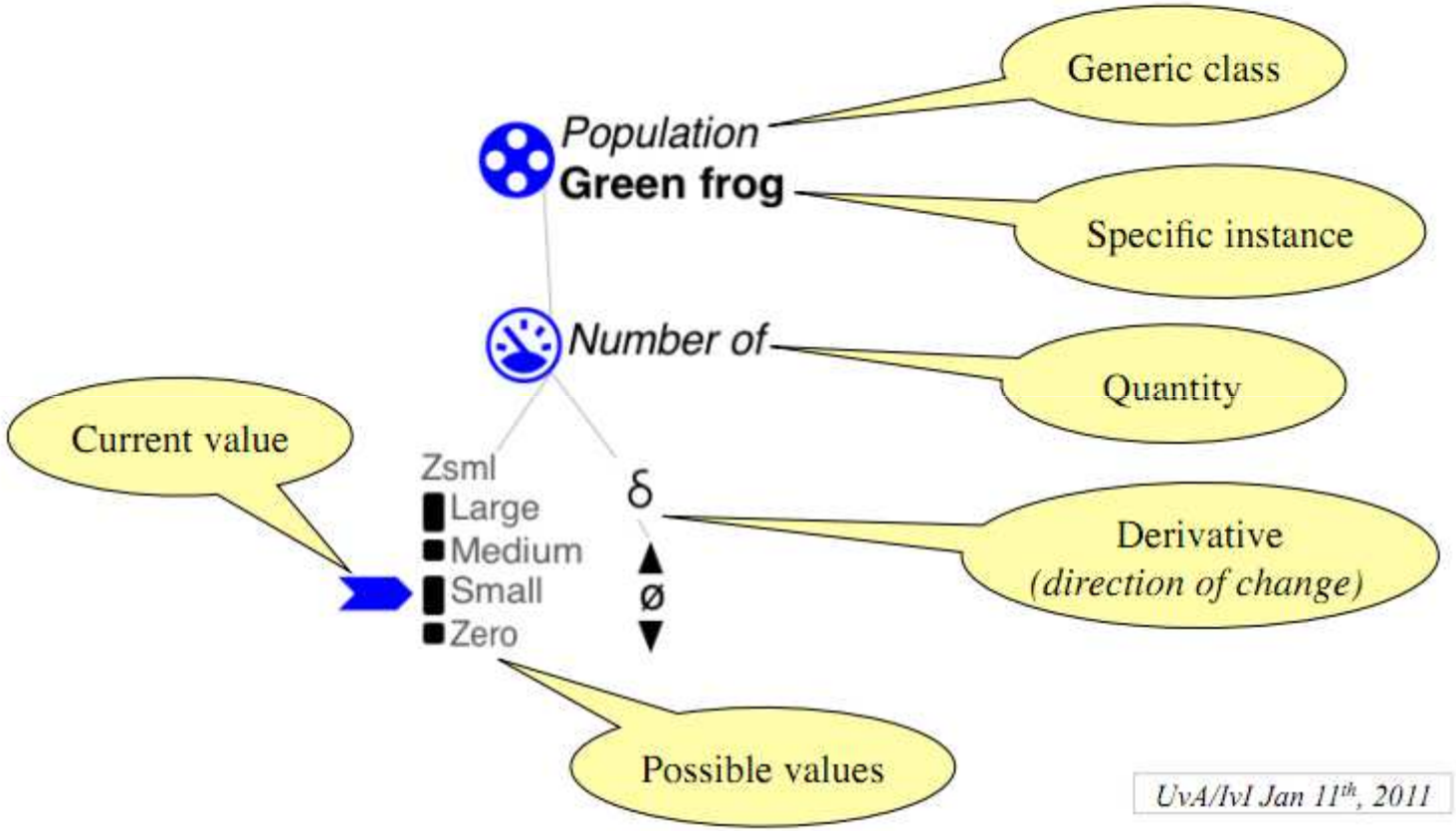

## DYNALEARN


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

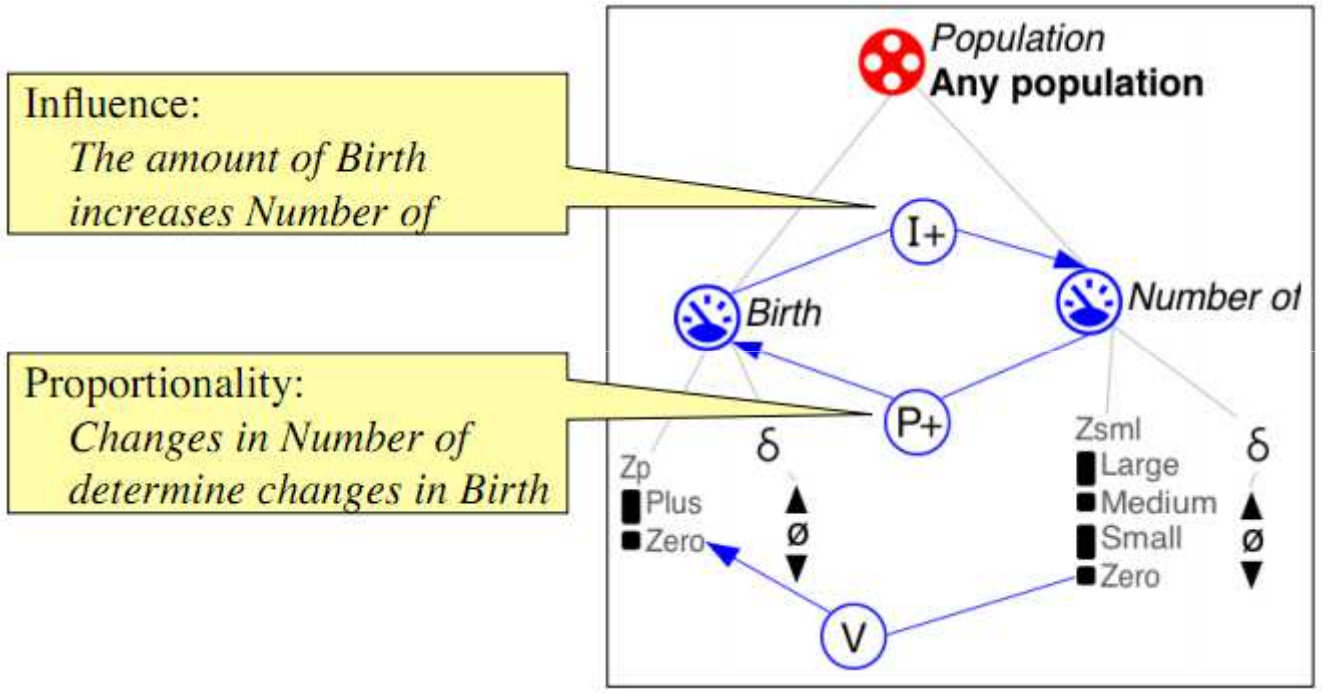
## Entities


Environment
Entity
Population
Animal population
Carnivore population
Herbivore population
Plant population

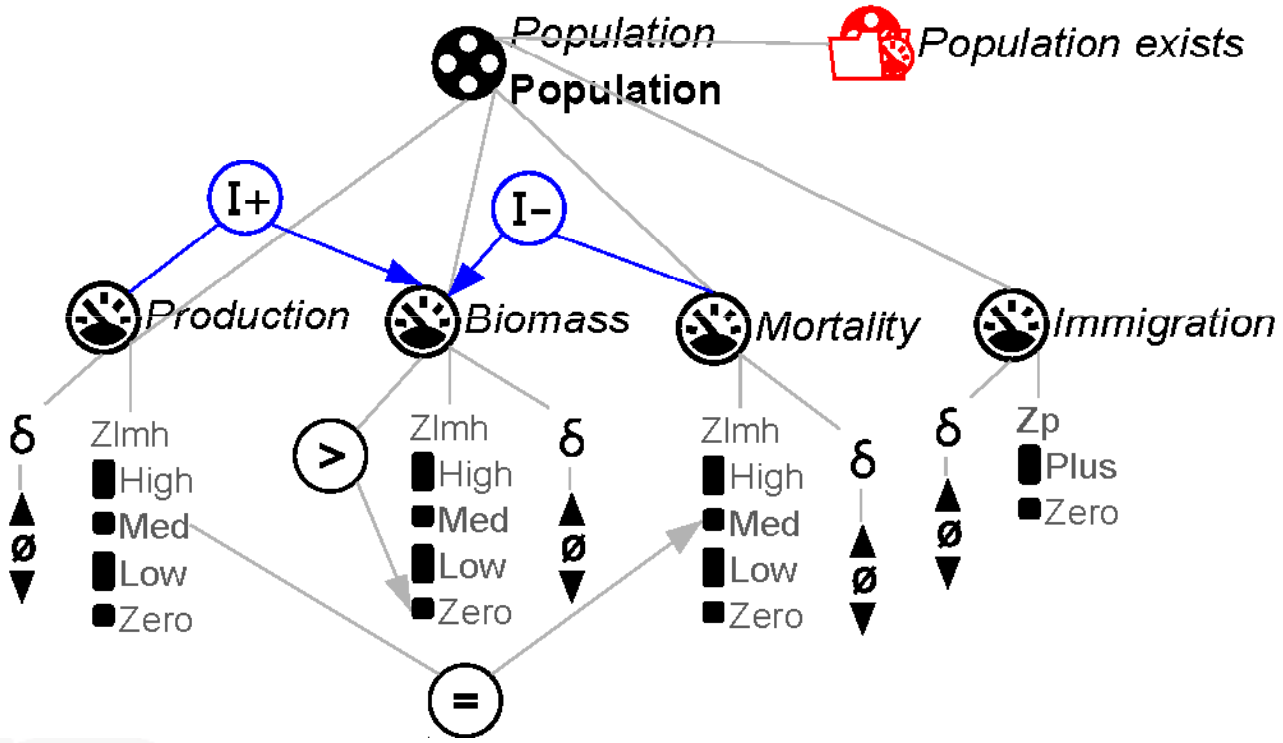
## Scenarios *(starting situation)*



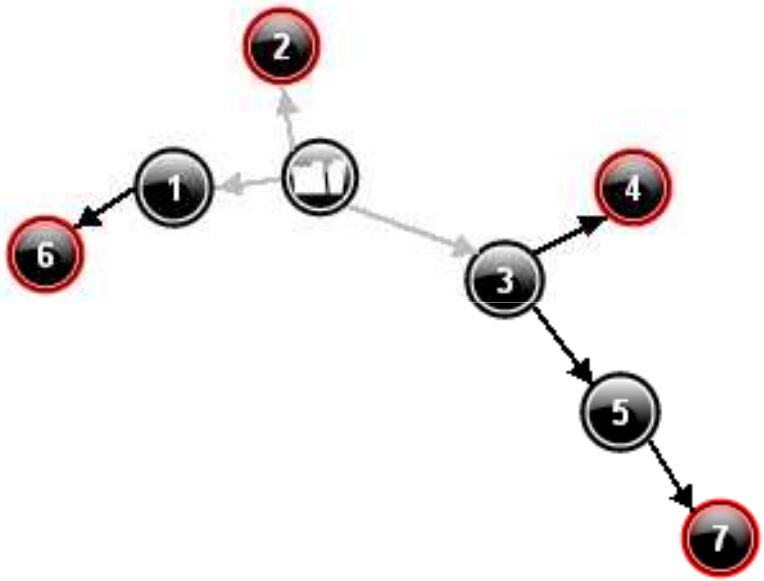
## Model fragments *(capturing partial knowledge)*



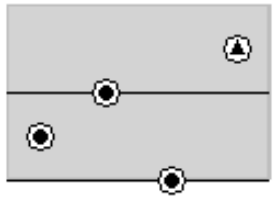
## Model fragments *(capturing partial knowledge)*



## Running simulations




Green frog: Biomass




2 4 6 7

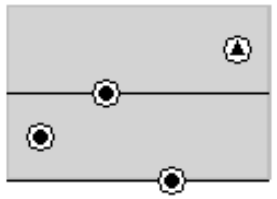
Green frog: Birth


2 4 6 7

Green frog: Death


2 4 6 7

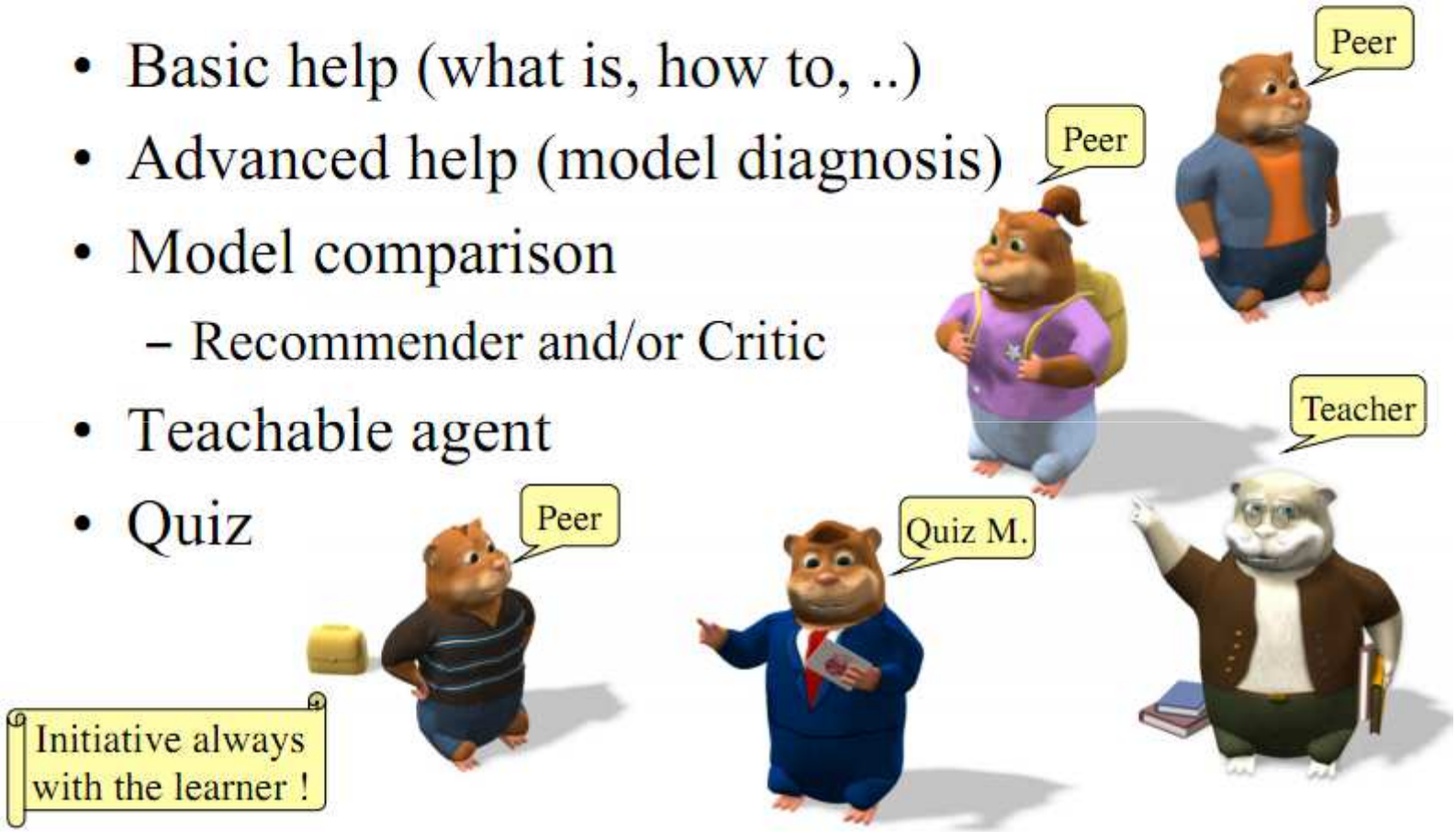
Green frog: Number of



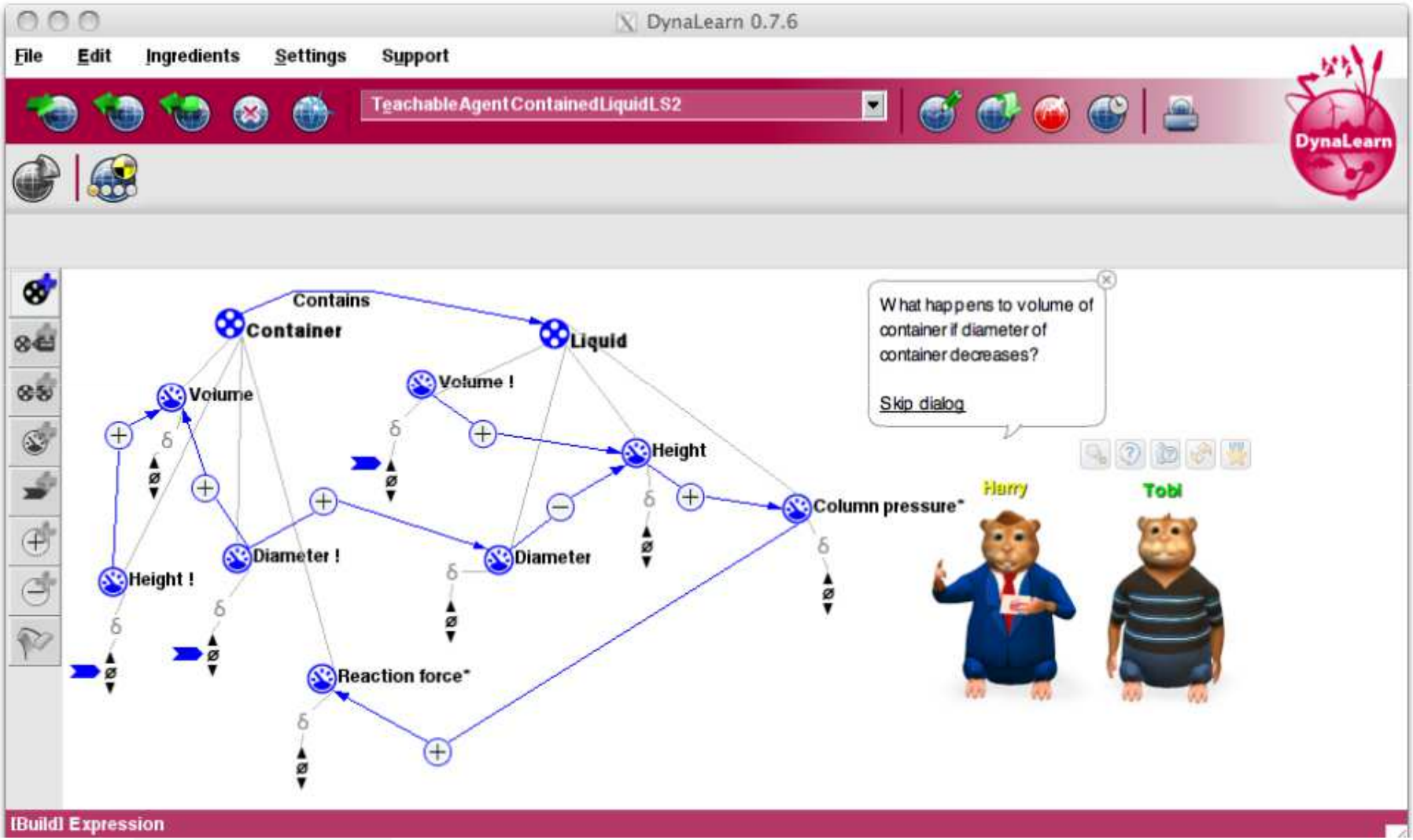

2 4 6 7

# QR modelling with DynaLearn

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



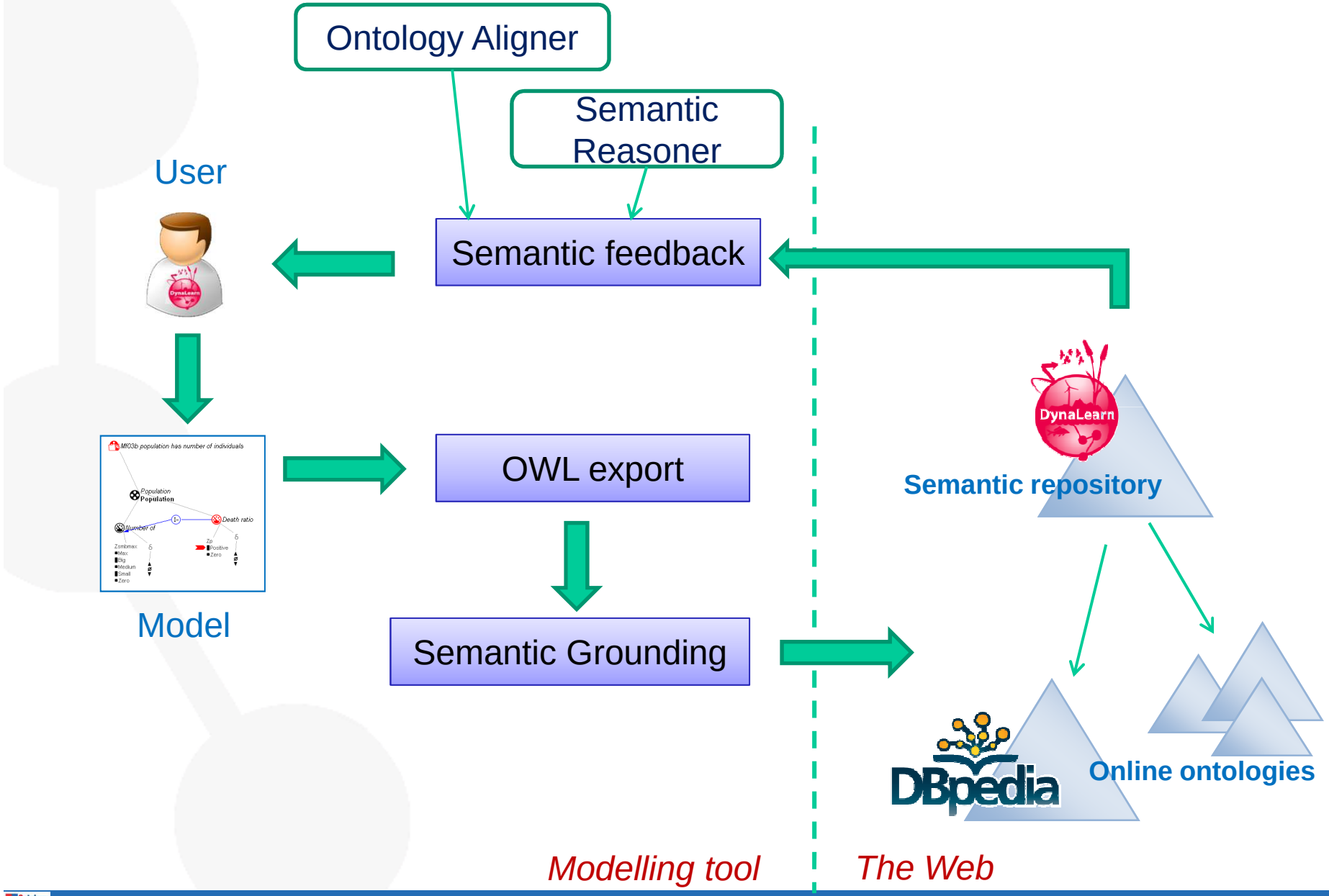
# QR modelling with DynaLearn



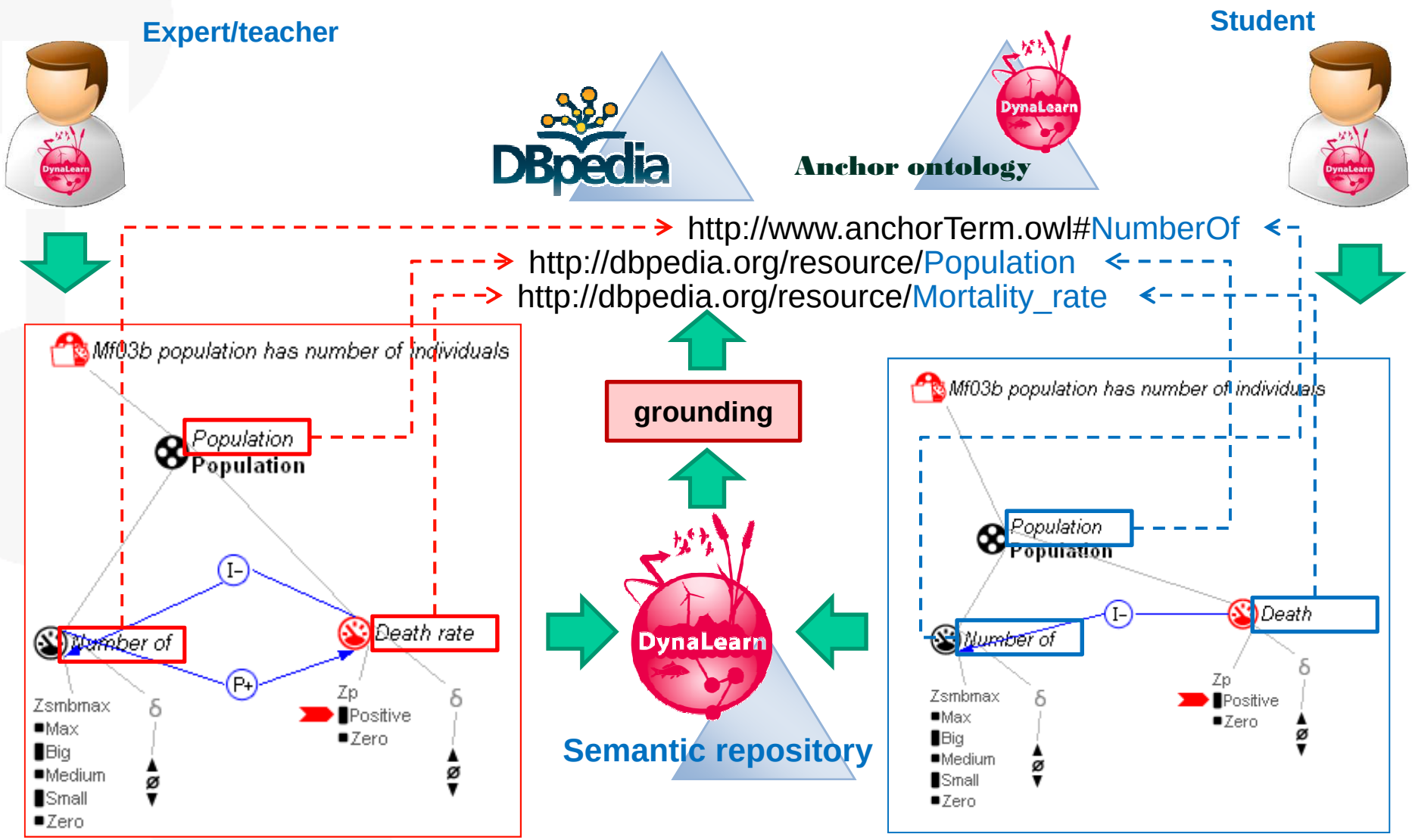
## SEMANTIC TECHNIQUES

- 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 in DynaLearn



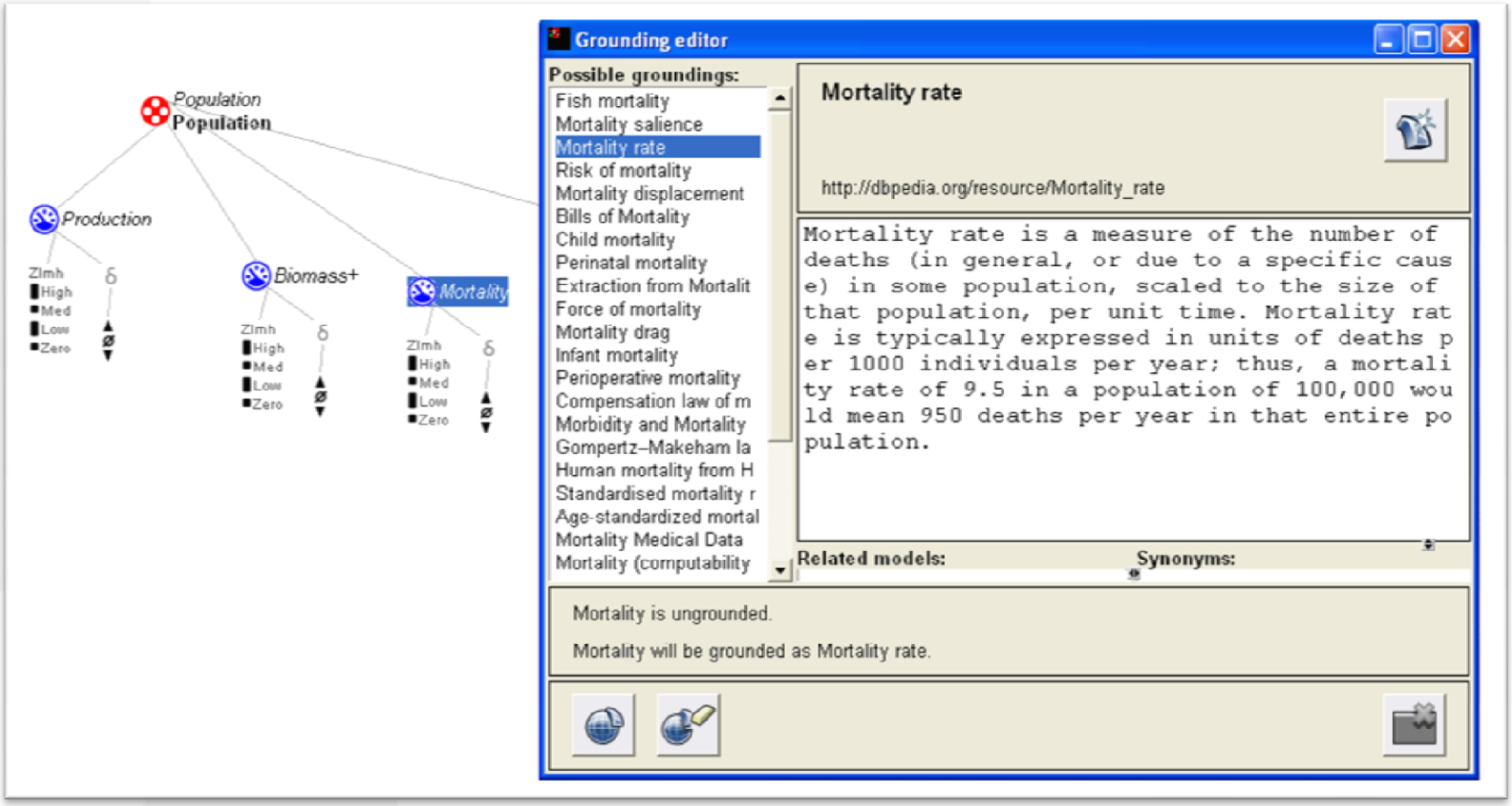
# Semantic Techniques in DynaLearn



## 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 Techniques in DynaLearn

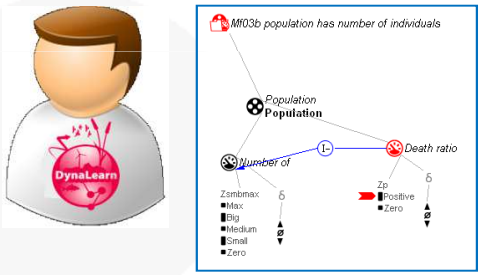


# Semantic Techniques in DynaLearn

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

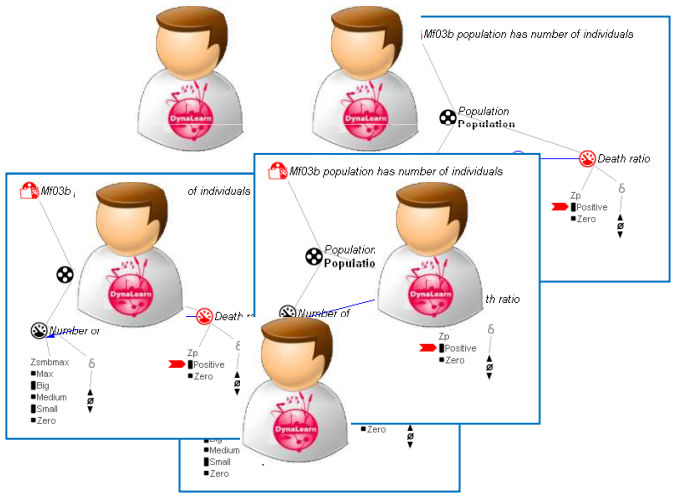
**Feedback (assessments)**

**Student**




DynaLearn

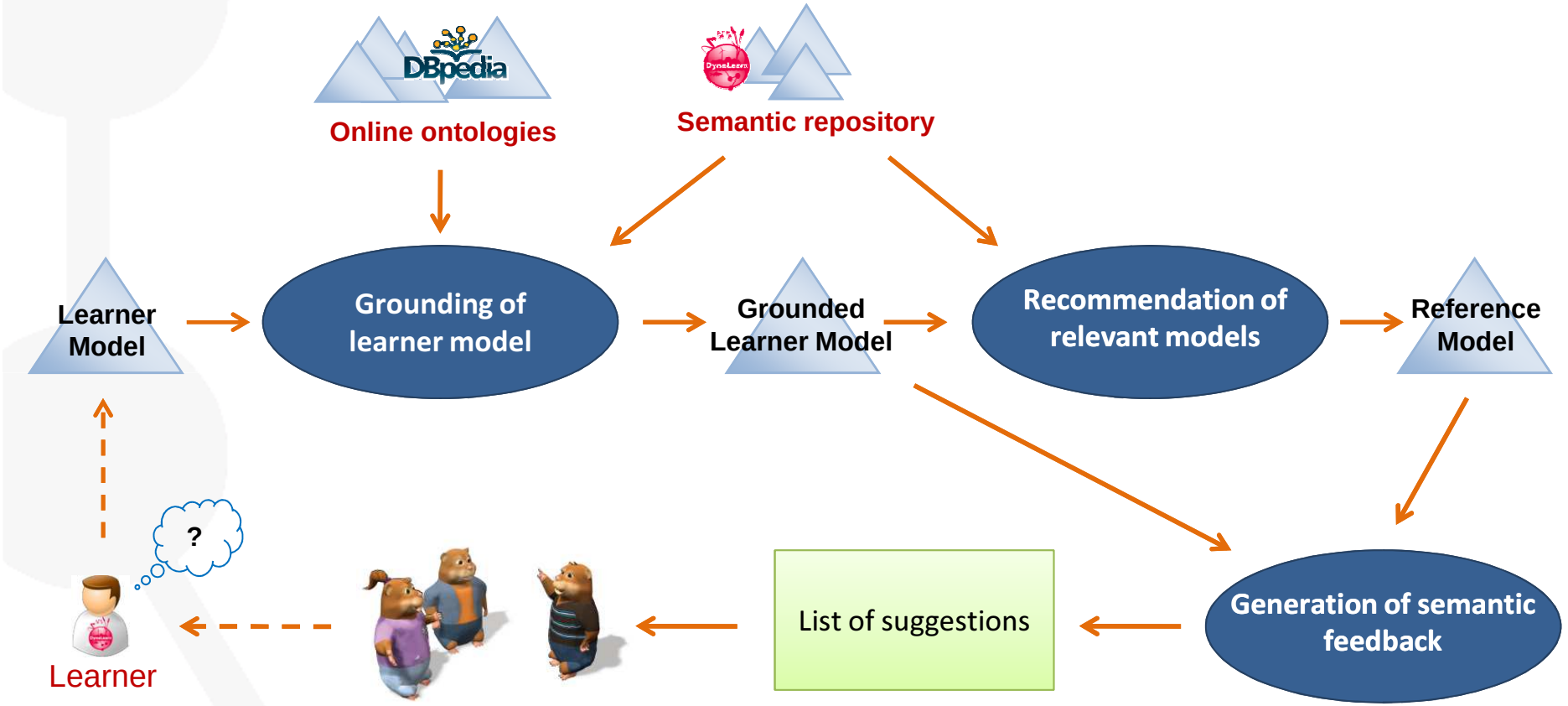
**Community of users**




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

**Feedback (extensions)**

# Semantic Techniques in DynaLearn



- 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 references


[1] Forbes, K., Qualitative Reasoning. CRC Handbook of Computer Science, 1996

[2] 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.

[3] 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**.

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

# Thanks for your attention!

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