

# DSL3S - Domain Specific Language for Spatial Simulation Scenarios

## Beta-test and Evaluation Session

Luís de Sousa<sup>1 2</sup>

<sup>1</sup>Instituto Superior Técnico  
University of Lisbon

<sup>2</sup>Environmental Research and Innovation - ERIN  
Luxembourg Institute of Science and Technology

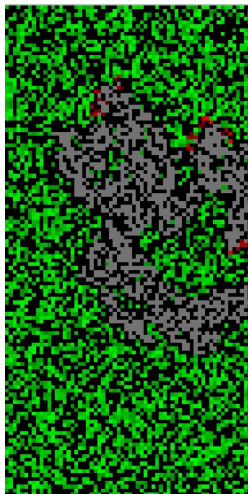
26<sup>th</sup> of May, 2015

# Outline

- 1 Introduction
- 2 Model-Driven Development
- 3 DSL3S
- 4 A Simple Exercise
- 5 Evaluation

# Introduction

- **Spatial Simulation** - the GIS sub-domain that explores the evolution of spatial features with time.
- Many tools exist providing support at different levels:
  - **Program-level:** code libraries with specialised classes and methods, ex.: RePAST, MASON, Swarm;
  - **Model-level:** pre-programmed models the user may parametrise, ex.: TELSA, LANDIS.

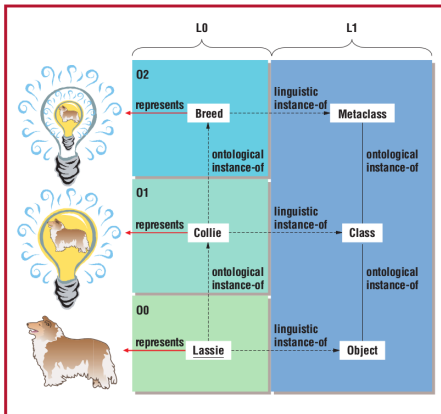


# Difficulties

- **Program level**
  - not accessible to analysts lacking advanced programming skill;
  - require a long learning process.
- **Model-level**
  - restrict the application scope;
  - poor integration with spatial data.
- **Domain Specific Languages (DSLs)** try to bridge between the two categories, but:
  - so far constrained to 4th generation paradigms;
  - user still need to learn keywords and how to compose instructions into a programme.

⇒ **DSL3S** is a new approach: a graphical modelling language.

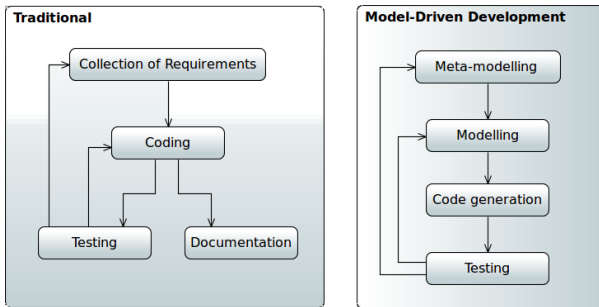
# Raising the level of abstraction



- Ontological modelling or meta-modelling.
- Beyond the entities of the system, identify its ontological concepts.

# Versus traditional software development

Aim: thoroughly include modelling in software engineering.



Code becomes a by-product of modelling.

# Model-Driven Architecture

The Object Management Group specified a Model-Driven Development infrastructure using UML:

- Language elements may be specialised with **stereotypes**;
- Specific **properties** can be added to stereotypes;
- Stereotypes can be gathered in a **UML Profile**:
  - used to develop models in a certain specific domain;
  - forming a context ontology, i.e.: a DSL.

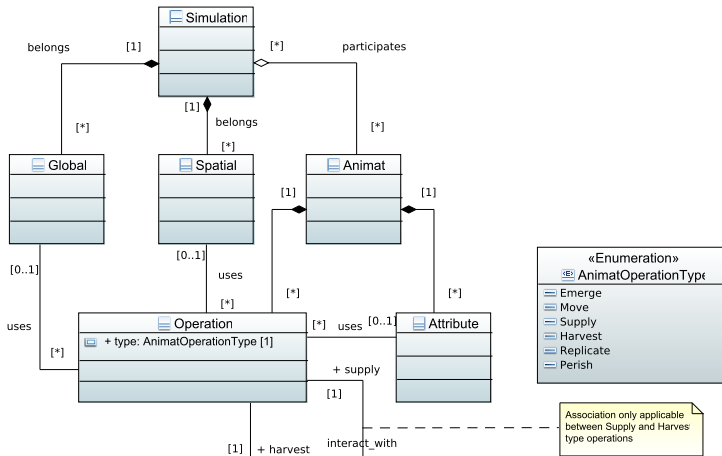
# Expected benefits

DSL3S is an MDD approach to Spatial Simulation.

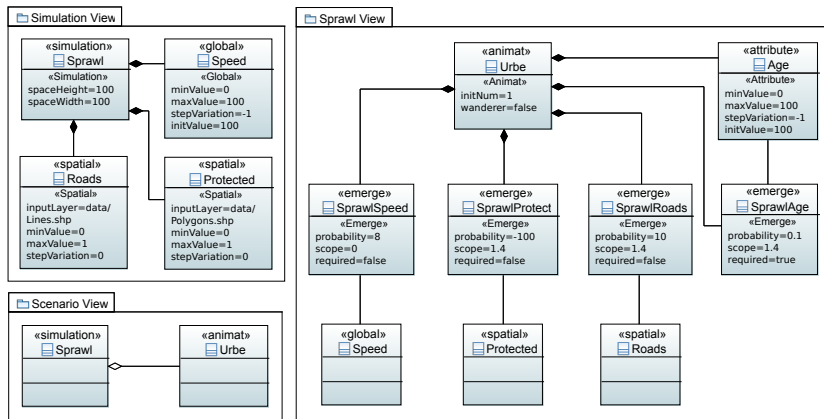
- simplify **communication** between analysts and stakeholders.
- allow **prototyping** by non-programmers, detaching model development from specific technologies or platforms;
- improve **interoperability** with geo-spatial data, generating *ad hoc* code as required;
- may lay the foundations for a **standard language** in the domain, as successful efforts in parallel fields have proved (e.g. *SysML*, *ModelicaML*).



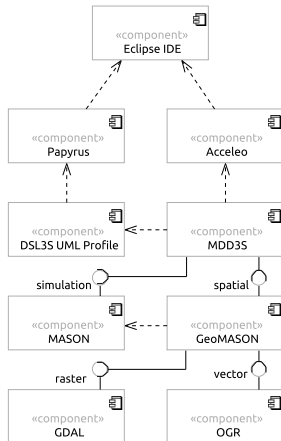
# Abstract Syntax



# An Example



# Tools

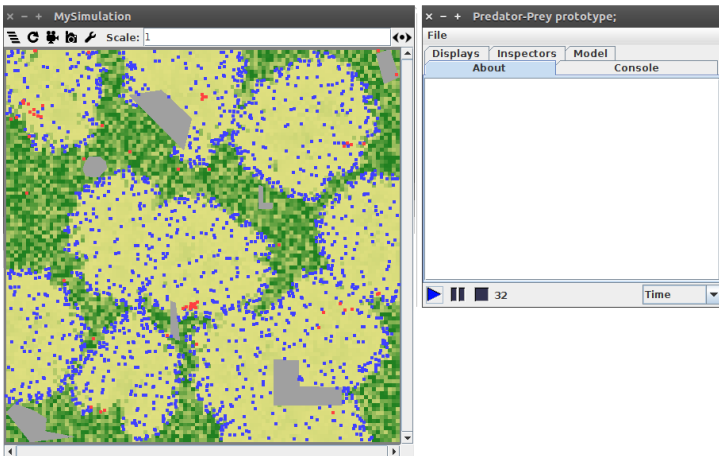


- Papyrus and Acceleo - MDD plugins for Eclipse.
- MASON and GeoMASON - spatial simulation libraries.
- DSL3S UML Profile and MDD3S - *ad hoc* Eclipse plugins.

# A Predator-Prey simulation

- **Pasture** - feedstock that slowly replenishes with time (a raster dataset).
- **Prey** - wonder around grazing the available pasture (a vector dataset).
  - Can replicate when harvested **Energy** reaches a certain amount.
  - Dies off if energy drops down to zero.
- **Predator** - seeks and feeds off prey (created randomly).
  - Can replicate when harvested **Energy** reaches a certain amount.
  - Dies off if energy drops down to zero.
- **Inaccessible** - areas where prey can not enter (a vector dataset).

# End result



# Evaluation

Please, fill the DSL3S Questionnaire available online:

<http://goo.gl/forms/LQMCIXU834>

# Thank you for participating!