Computer Science
UNIVERSITY OF TORONTO

Alicia M. Grubb
amgrubb@cs.toronto.edu

Marsha Chechik
chechik@cs.toronto.edu

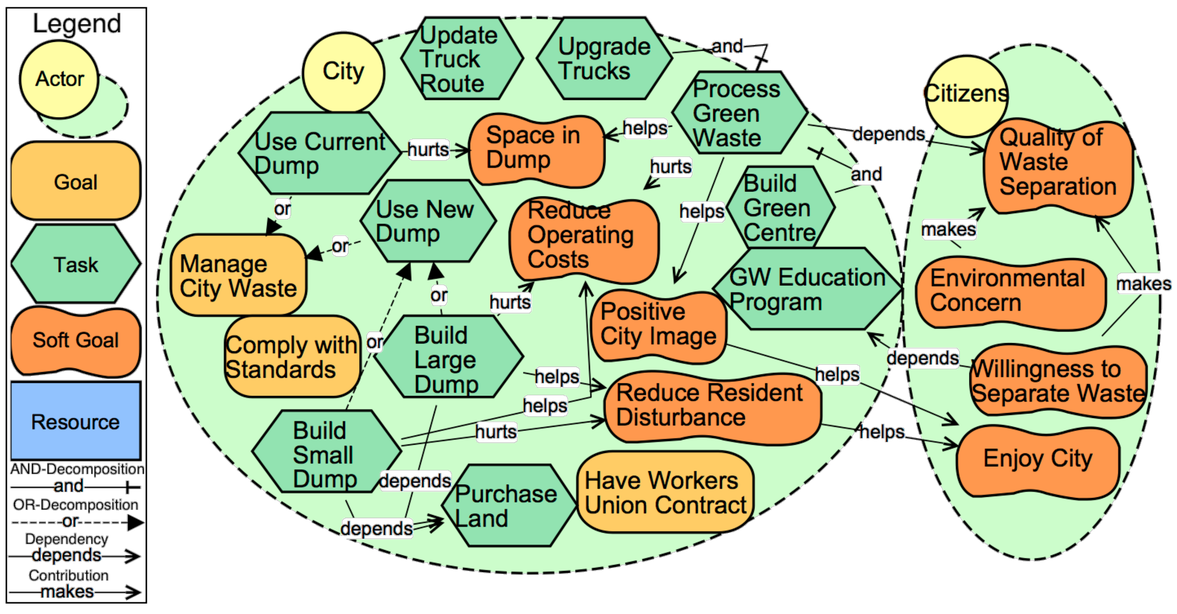
GrowingLeaf: Modeling and Analysis for Goals with Temporal Dynamics

Overview

- **Goal Models** for early phase requirements enable modelers to elicit stakeholders' intentions, analyze dependencies, and select preferred alternatives.
- Standard analysis techniques provide options for analysis of static goal models but do not consider the dynamic environment that the model represents and do not evaluate the intentions over time.
- **GrowingLeaf is a web-based tool** that uses explicit and symbolic simulation techniques to enable stakeholders to choose between design alternatives, **ask what-if questions**, and **plan for software evolution** in an ever-changing world.

Waste Management Example

The **City** represented in this *iStar Goal Model* [1] is considering **investing in building a new dump as well as a recycling and composting facility**. The city's current dump has not yet reached its capacity.



The City Stakeholders want to **satisfy**:

- Manage City Waste
- Comply with Standards
- Reduce Operating Costs
- Enjoy City

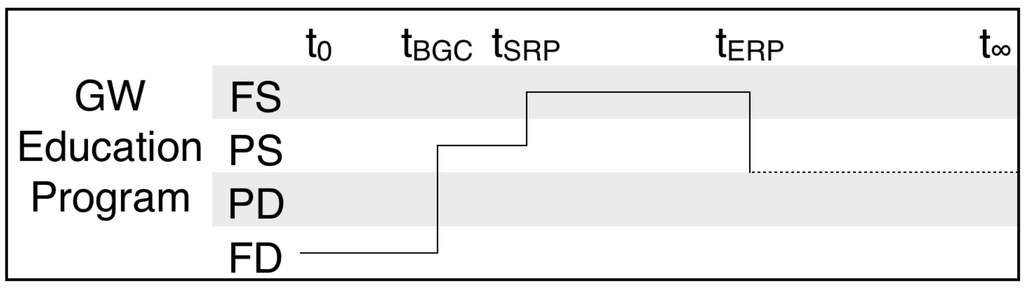
The City wants to understand how these goals changing over time impact **possible questions**:

1. Is it feasible to first *Build Green Centre* and then build another dump? (Does the order matter?)
2. Which possible scenarios always satisfy *Manage City Waste* even if *Space in Dump* becomes denied in the future?
3. How do changes in *Environmental Concern* effect the city's root-level goals over time?

Acknowledgements: We would like to thank Gary Song and Jake Fear for their contributions to our tool and poster.
References: [1] E. Yu, "Towards Modeling and Reasoning Support for Early Phase Requirements Engineering," in Proc. of RE'97, 1997, pp. 226–235.

Goal Dynamics

Over a time interval (Epoch), the satisfaction of a goal can *Increase*, *Decrease*, remain *Constant*, or have a *Stochastic* pattern. We define **dynamic functions** over multiple epochs, such as *Monotonic Positive* where the value increases until its maximum value and then remains constant. Users can also define their own step-wise functions (as shown below).



Scale: Denied (FD), Partially Denied (PD), Partially Satisfied (PS), and Satisfied (FS).

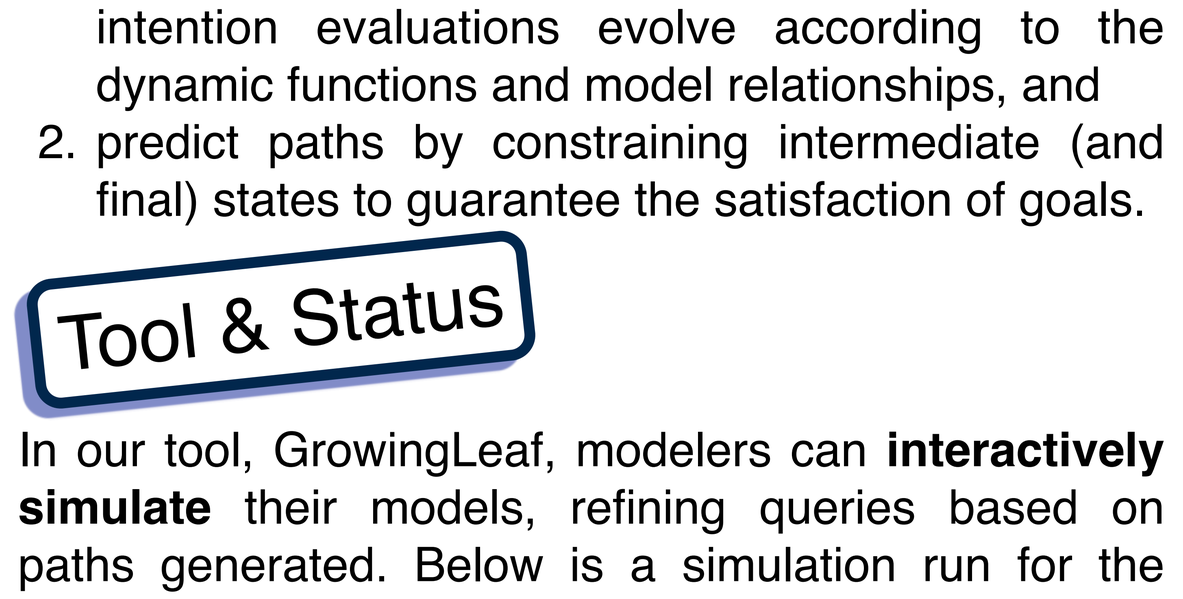
Simulation

Our analysis techniques can:

1. simulate the path that a goal model takes as the intention evaluations evolve according to the dynamic functions and model relationships, and
2. predict paths by constraining intermediate (and final) states to guarantee the satisfaction of goals.

Tool & Status

In our tool, GrowingLeaf, modelers can **interactively simulate** their models, refining queries based on paths generated. Below is a simulation run for the waste management example. This scenario shows how the model evolves if the City decides to *Build* a *Small Dump*, which doesn't satisfy the City's long-term goals. **Try out our tool to find the answers to the other questions…**



We are in the midst of our first public release cycle and have validated our analysis on large examples. **We are seeking external partners** and hope to offer partners long-term planning insights into their project evolution and in turn validate our approach.