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# BloomingLeaf: A Formal Tool for Requirements Evolution over Time

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 evaluate the changes in the intentions or environment over time.
- **BloomingLeaf is a web-based tool** that uses precise semantics (with *Tropos*) to model goals and relationships that evolve over time. Simulation techniques are used to enable stakeholders to choose between design alternatives, **ask what-if questions**, and **plan for software evolution** in an ever-changing world.

Bike Lane Example

The City represented in the goal model below is considering adding bike lanes to a major street. The City is considering how different methods of constructing bike lanes would impact pedestrians, cyclists, and motor vehicles through the goal model. The City Stakeholders want to **satisfy**:

- Have Bike Lanes
- Cyclist Safety
- Access to Parking
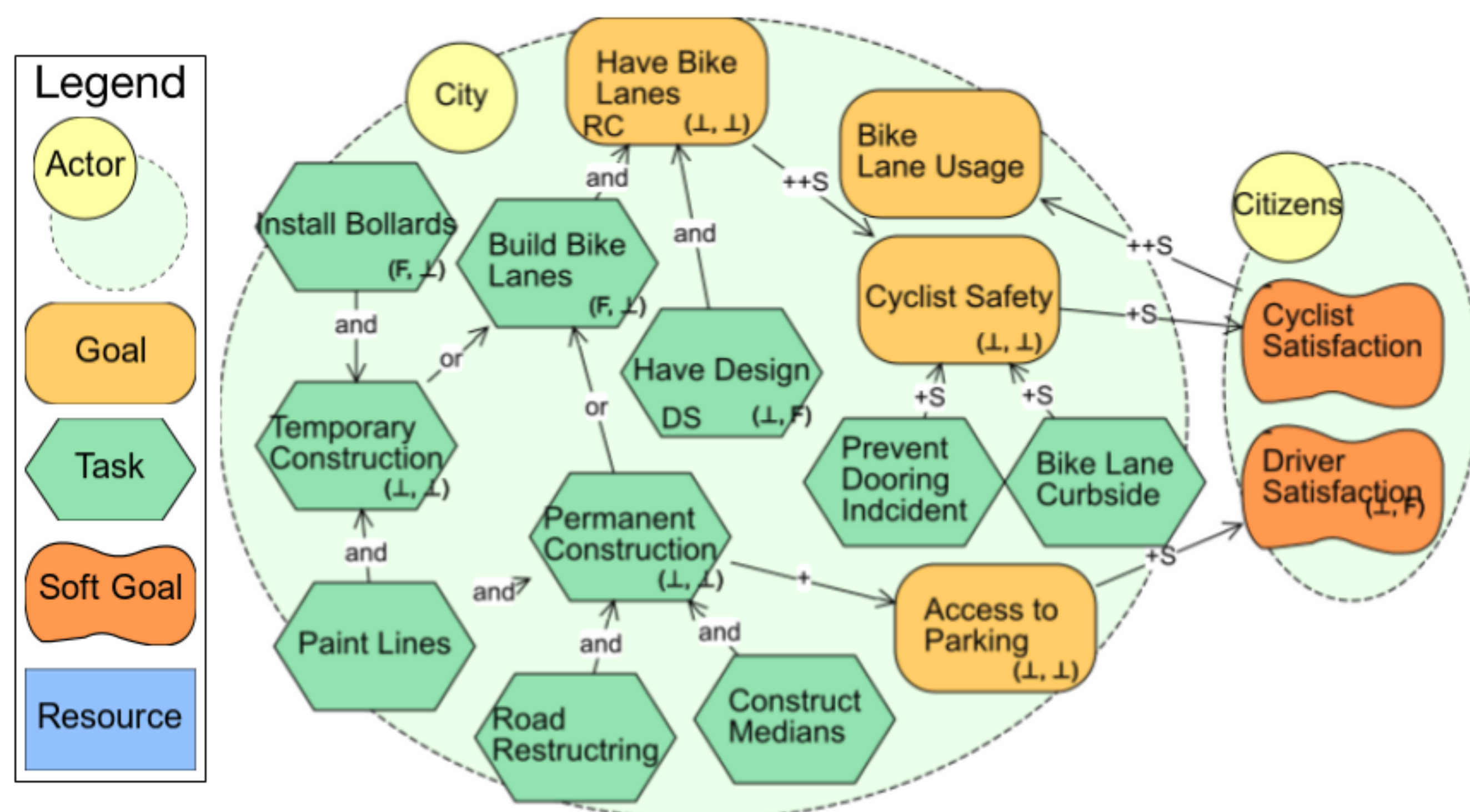
The City wants to understand how satisfaction values changing over time impact three **possible questions**:

1. Is a permanent solution or a temporary solution most appropriate, given possible changes to cyclist and vehicle traffic?
2. What are the one-month and one-year effects of each decision on Cyclist Satisfaction?
3. Can we eventually satisfy and maintain Cyclist Safety?

Evolving Intentions

Over a time interval, the satisfaction of a goal can *Increase*, *Decrease*, remain *Constant*, or have a *Stochastic* pattern. We define **evolving functions** over multiple time intervals, 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. Below is an example of a step-wise function to model Bike Lane Usage over changing seasons.
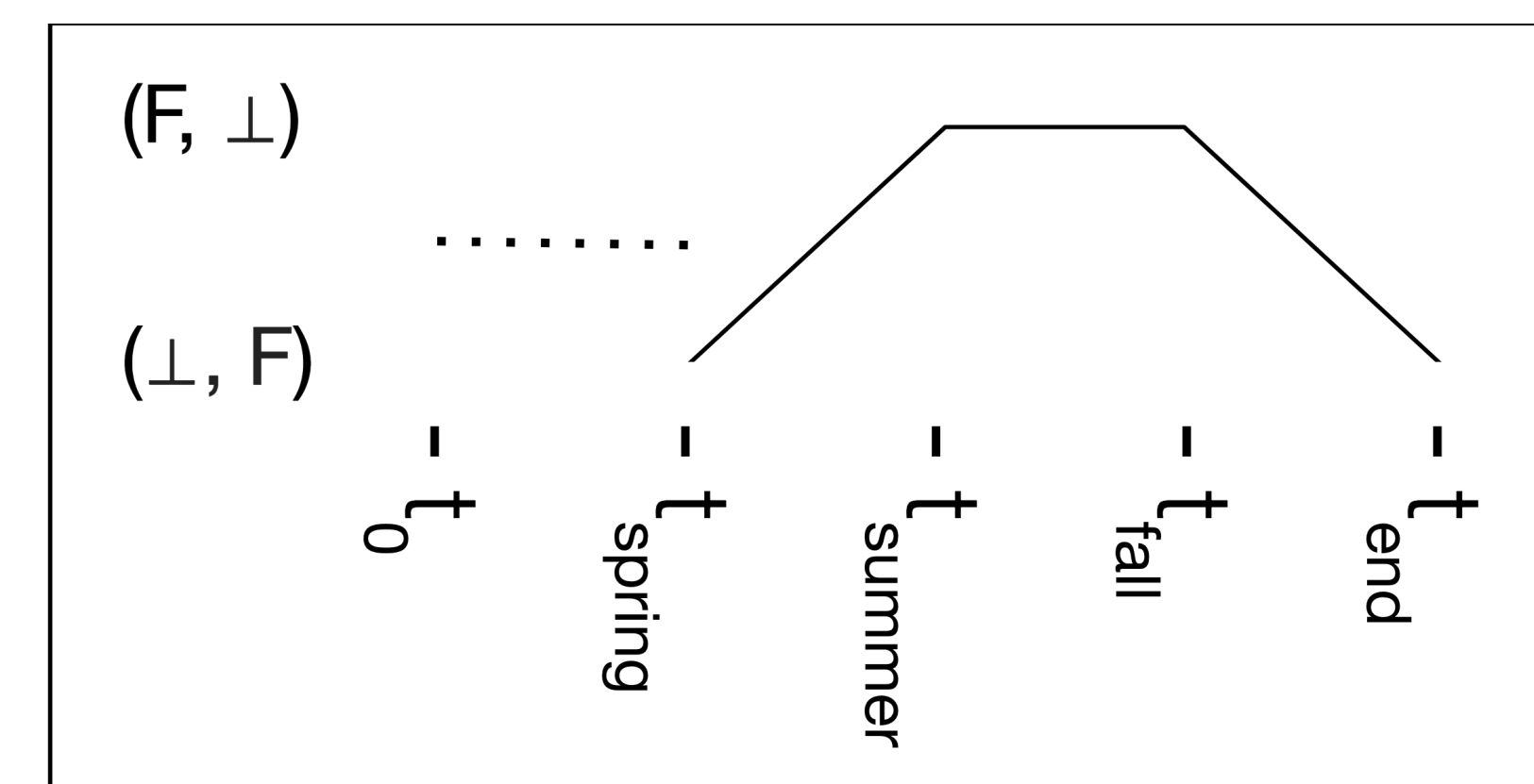
Simulation

Our analysis performs two functions:

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

Tool & Status

In BloomingLeaf, modelers can **interactively simulate** and analyze their models. Below is a simulation result for the Bike Lane Example. This scenario shows how the model evolves if the City decides to construct temporary bike lanes, which doesn't satisfy all of the City's long-term goals. **Try out our tool to find the answers to the other questions…**

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