World Modeling

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https://laramartin.net/interactive-fiction-class

Learning Objectives

Evaluate how world modeling has evolved through the years

Review: What is an ontology

Describes a domain

- concepts
- properties and attributes of those concepts
- constraints on properties and attributes
- individuals

Defines

- a common vocabulary
- a shared understanding

Can be used with reasoning agents

- to infer new facts from existing definitions

Review: Ontology basics (using OWL)

Axioms — Basic statements in an ontology. An ontology is a set of axioms

Entities — Used to refer to basic things in the domain of interest.

Class Expressions — Combinations of entities that form more complex descriptions out of simpler ones.

Axioms specify the relationships between entities and class expressions

Review: Defining classes

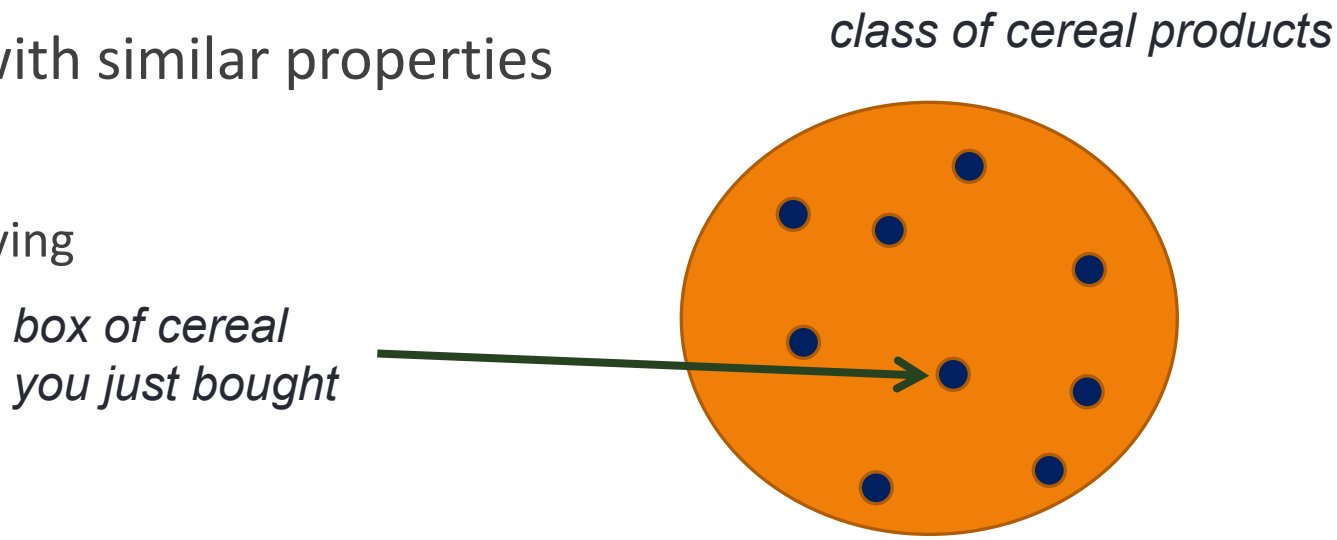
A class is a concept in the domain

- a class of products
- a class of ingredients
- a class of dairy products

A class is a set of elements with similar properties

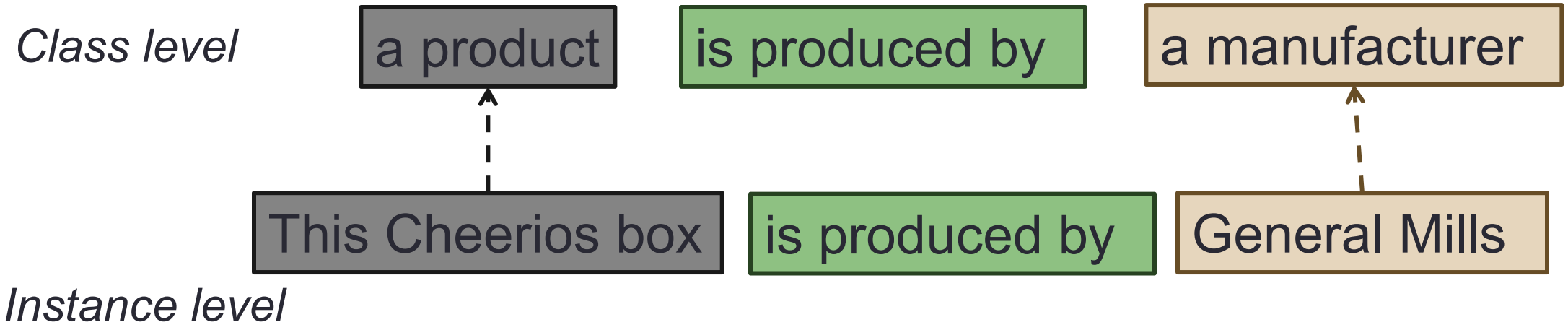
Instances of classes

- a box of cereal that you are buying

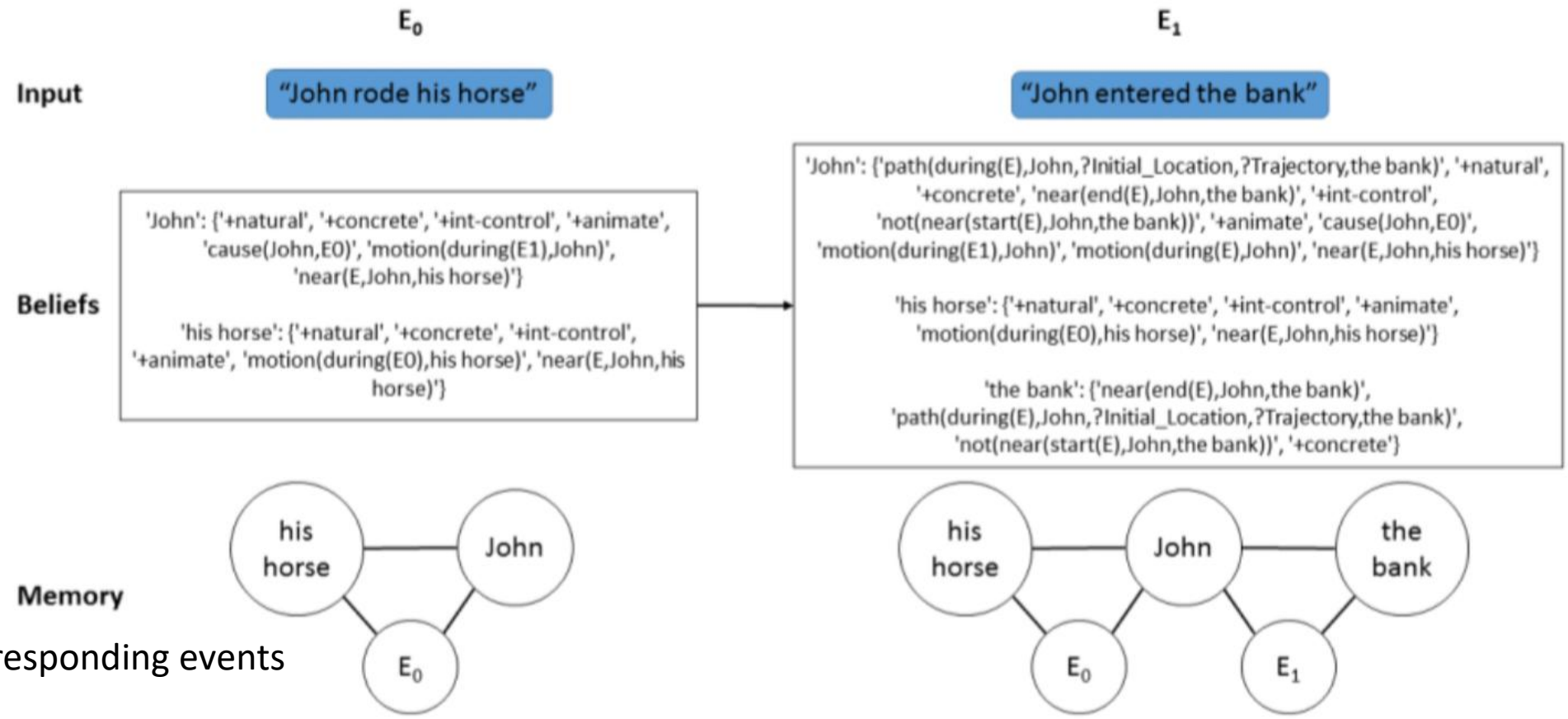


Review: Properties describe instances

Properties associated with a class describe the **attributes** and **relationships of the instances** of the class

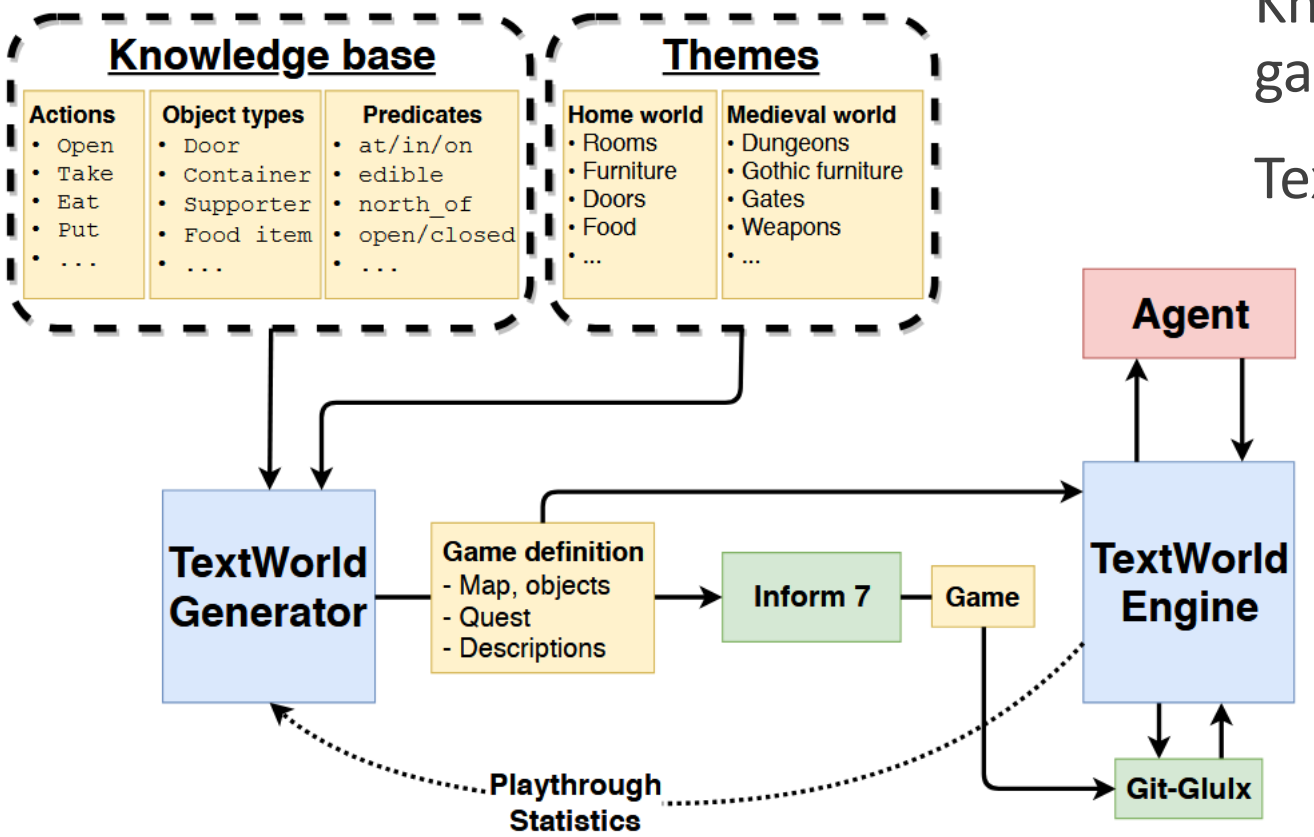


State Tracking Using VerbNet



Entities and corresponding events

TextWorld



Knowledge-guided building of text games

Text generation using a CFG

Côté, MA. *et al.* (2019). TextWorld: A Learning Environment for Text-Based Games. In: Cazenave, T., Saffidine, A., Sturtevant, N. (eds) Computer Games. CGW 2018. Communications in Computer and Information Science, vol 1017. Springer, Cham. https://doi.org/10.1007/978-3-030-24337-1_3

StoRM

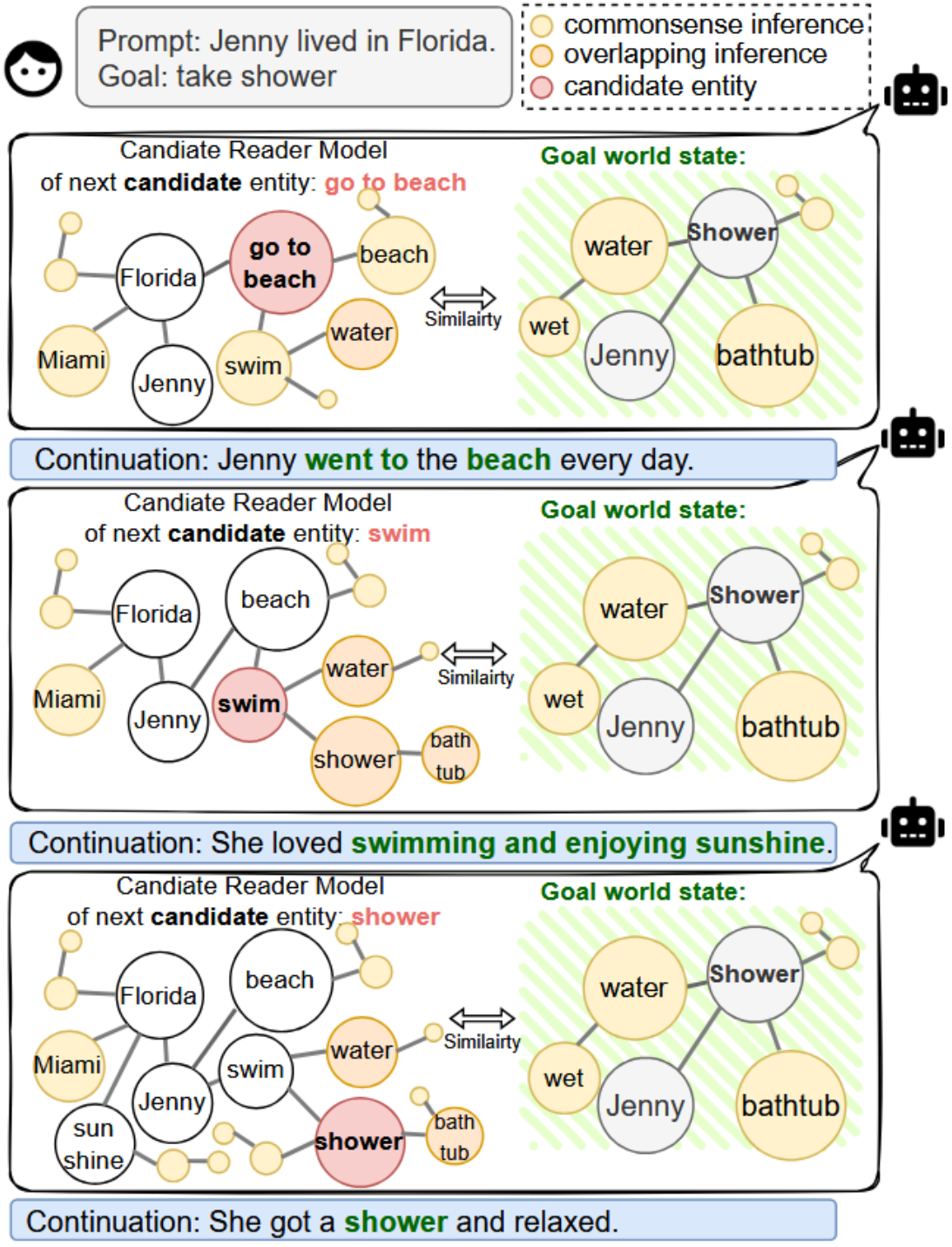
Reader model and goal world states compared

Tuples extracted from sentences are turned into knowledge graphs using semantic role labeling (i.e., filling in roles of frames)

KG expanded with COMET2020

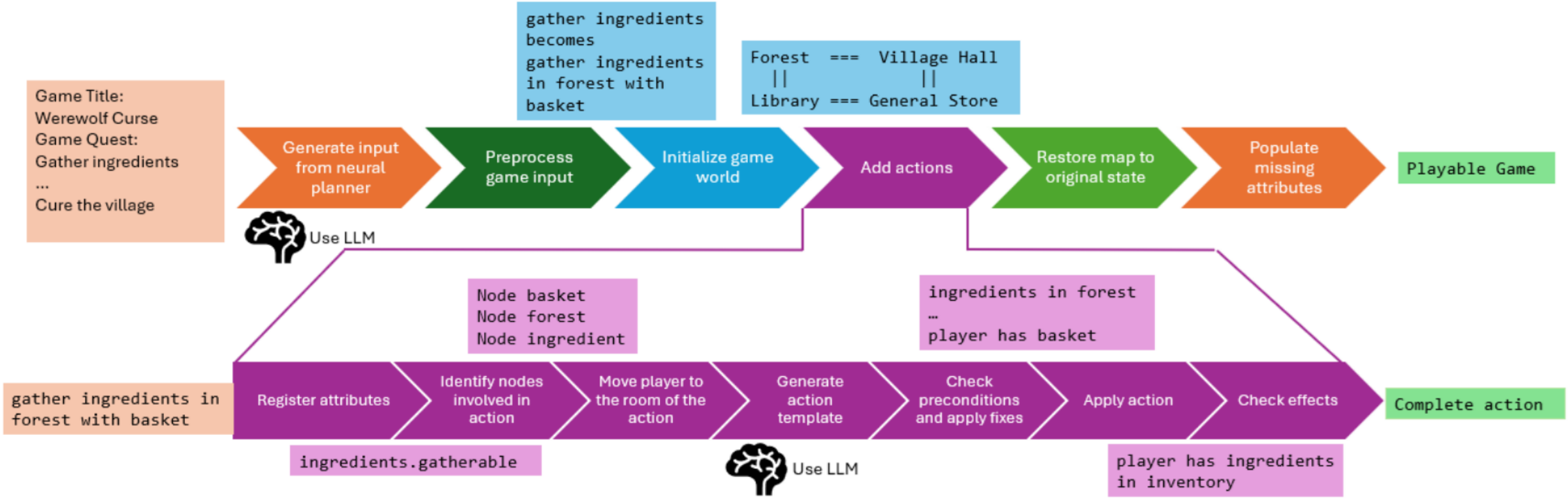
Templates were filled in with RoBERTa (infilling)

- `[subject] <mask> <mask> swim <mask>`



Guiding Neural Story Generation with Reader Models (Peng et al., Findings 2022)

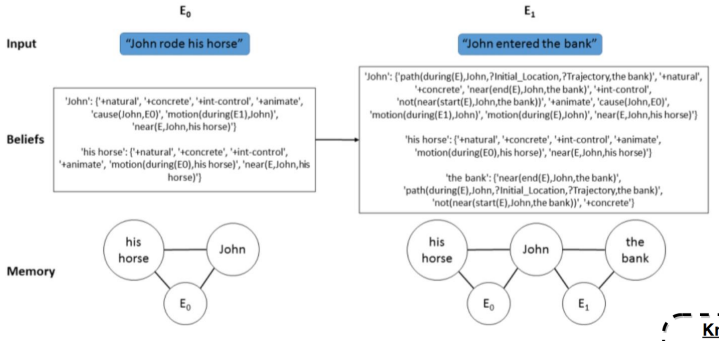
Story2Game


Game Title:
Werewolf Curse
Game Quest:
Gather ingredients
...
Cure the village
gather ingredients becomes gather ingredients in forest with basket
Forest === Village Hall
|| ||
Library === General Store
Generate input from neural planner
Preprocess game input
Initialize game world
Add actions
Restore map to original state
Populate missing attributes
Playable Game
Use LLM
Node basket
Node forest
Node ingredient
ingredients in forest
…
player has basket
gather ingredients in forest with basket
Register attributes
Identify nodes involved in action
Move player to the room of the action
Generate action template
Check preconditions and apply fixes
Apply action
Check effects
Complete action
ingredients.gatherable
Use LLM
player has ingredients in inventory

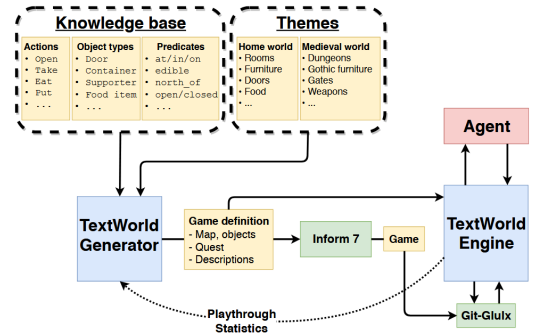
Think-Pair-Share

How has the way we track world states or modeled worlds changed over the years?

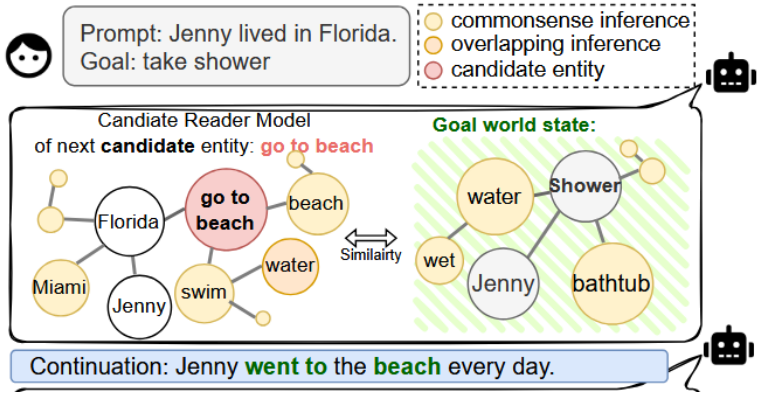
What has stayed the same?



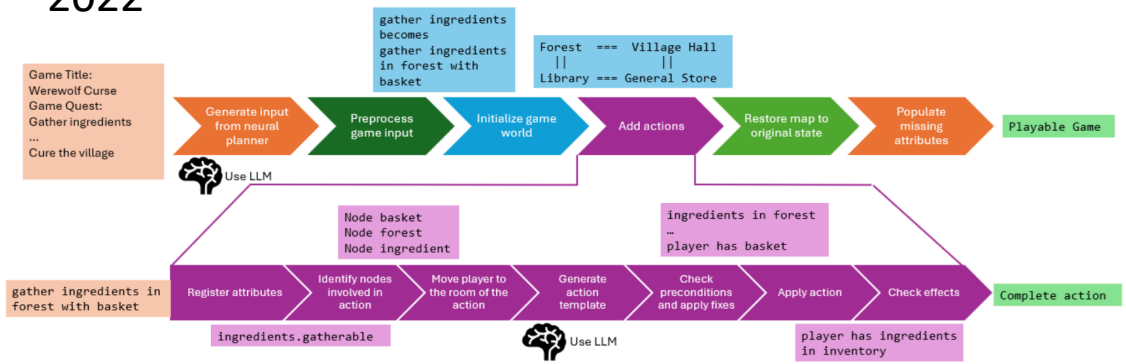
2016



2018



2022



2025