PHIL 473 Final Project Proposal

“Modal Logic Playground open-source contribution:
Epistemic Logic Playground”

1 Project Description

1.1 Motivation

During the PHIL 473 course, I made great use of the
Modal Logic Playground as an intuitive learning method and a place to test formulas while writing assignments. This resource made Modal Logic, and the logics that build on-top of it more easily understandable.

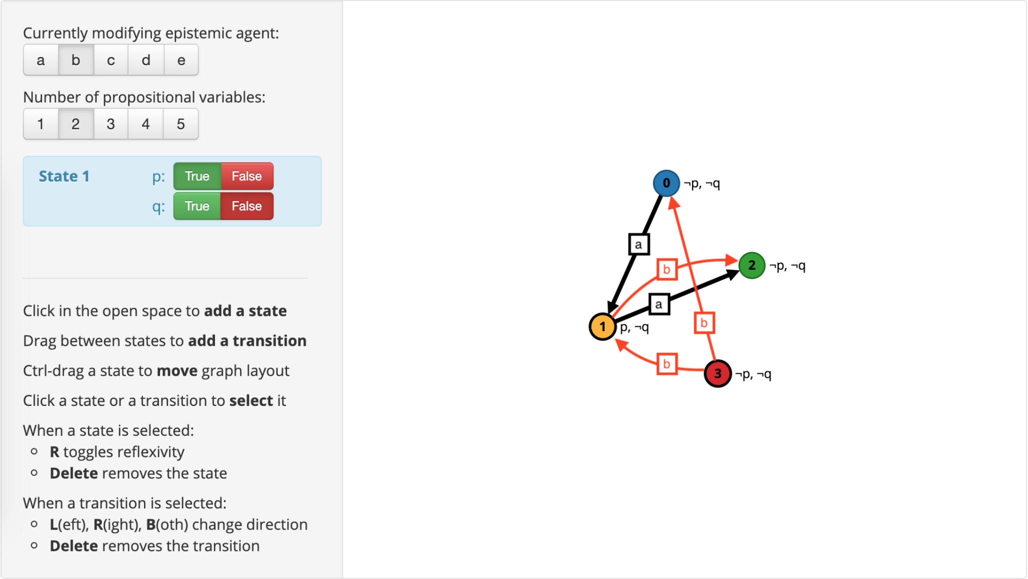
During the Epistemic Logic week of the course, I wished that there was a version of the Modal Logic Playground that supported multiple agents and the knowledge operator *K* from Epistemic Logic.
It would have also been nice to have Temporal Logic and Intuitionistic Logic playgrounds, but it is possible, and quite simple, to convert temporal and modal intuitionistic logic formulas into modal logic formulas so I was able to use the Modal Logic Playground for these logics as well. So in the interest of making this project achievable and novel, Temporal Logic and Intuitionistic Logic are out of the scope of this project.

Other students agree that an Epistemic Logic Playground would be nice:
One said ” I also remember thinking during the course that it’d be cool to have a modal logic playground for epistemic logic. Something where you can add agents and their accessibility relations.”

I am confident that an Epistemic Logic Playground will be a creative and novel contribution that can be used by non-classical logic learners.

1.2 Objectives

My high level objectives are to contribute code to the open source Modal Logic Playground, adding Epistemic Logic functionality. My goal is to make Epistemic Logic interactive, approachable, and intuitive.



Currently modifying epistemic agent:

a | b | c | d | e

Number of propositional variables:

1 | 2 | 3 | 4 | 5

State 1 p: True False q: True False

Click in the open space to **add a state**

Drag between states to **add a transition**

Ctrl-drag a state to **move** graph layout

Click a state or a transition to **select** it

When a state is selected:

- **R** toggles reflexivity
- **Delete** removes the state

When a transition is selected:

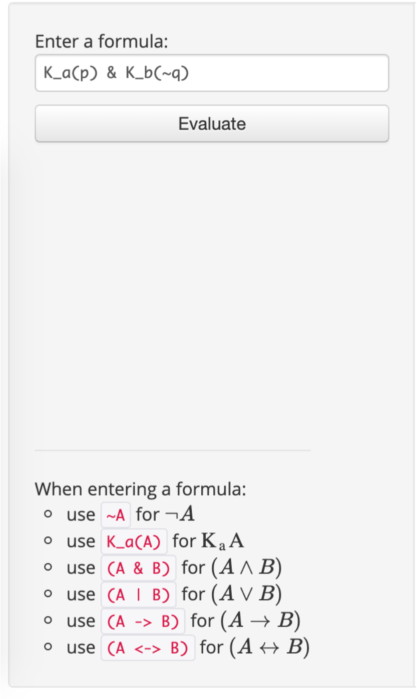
- **L**(eft), **R**(ight), **B**(oth) change direction
- **Delete** removes the transition

Figure 1: A mock-up of the Epistemic Logic Playground. Notice the buttons for selecting a epistemic agent to modify in the top left, and the different colors of labelled arrows representing different agent's accessibility relations.

1. Open an issue on the Modal Logic Playground Repository on Github. Merging my code is outside the scope of this project because it depends on the owner's availability and willingness to review and accept my code, but I will start the process by opening an issue.

2. Add the ability to interactively define multiple agent's binary accessibility relations using the existing model editing UI. Each agent will be associated with a different color arrow, with labels for accessibility. See figure 1.

3. Add the ability to use the agent knowledge K_a operator in the "Evaluate Formula" tab. See figure 2.



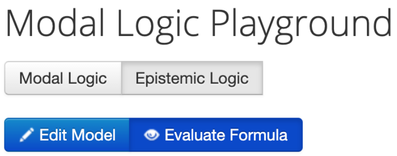
Enter a formula:

K_a(p) & K_b(~q)

When entering a formula:

- use `~A` for $\neg A$
- use `K_a(A)` for $\mathrm{K_a A}$
- use `(A & B)` for $(A \wedge B)$
- use `(A | B)` for $(A \vee B)$
- use `(A -> B)` for $(A \rightarrow B)$
- use `(A <-> B)` for $(A \leftrightarrow B)$

Figure 2: Proposed syntax for the textual representation of the Epistemic Logic agent knowledge operator K_a, as well as an explanation of the syntax at the bottom of the image.



Modal Logic Playground

Figure 3: Buttons for switching between Modal Logic and Epistemic Logic functionality.

4. include information on the site explaining how to use the Epistemic Logic Features.

5. Add the ability to switch between normal Modal Logic and Epistemic Logic modes. See figure 3.

Note that: the common knowledge operator will not be included, in pursuit of simplicity of implementation, explanation, and use.
Also note that: Existing modal logic operator parsing and evaluation code can be reused, so I only need to implement the knowledge operator K_a.

1.3 Outcome and how it will be shared

My version of the code is accessible online at https://github.com/vezwork/modallogic and my interactive version of the modal logic playground is available at https://vezwork.github.io/modallogic/. I will add Epistemic Logic features to this website over the course of this project (the next two weeks). By the end of the two weeks, anyone will be able to access the interactive Epistemic Logic Playground features at the above link. This will be useful for peer feedback. My contribution will be accessible and usable by all during and after the course.

2 Project Timeline

2.1 Course defined deadlines

- Sunday November 15 - This proposal is due
- Monday November 30 - Final project is due
- Sunday December 6 - Peer reviews complete

2.2 Suggested project deadlines

- Monday November 16 - Submit issue to modal logic repo
- Wednesday November 18 - Explore the interactive model editing user interface code and get an initial prototype of multicolored arrows working
- Friday November 20 - Implement multi agent accessibility relations in the existing model code and data structure
- Monday November 23 - Connect the multi-colored arrow interactive model editing user interface code with the multi agent model code
- Wednesday November 25 - Implement parsing for formulas containing the K_a operator. Parsing involved converting the text representation of a formula into a data structure representing the semantics of the formula

- Friday November 27 - Implement evaluation for formulas containing the Ka operator using the existing *MPL* code library
- Monday November 30 - Clean up the user interface. Add instructions for use of Epistemic Logic Playground features. Submit the assignment for peer review.

3 Resources

- The course textbook **"What If? An Open Introduction to Non-classical Logics"**. I will use the course textbook for a reference on the semantics of Epistemic Logic. I will specifically be looking at Definition 15.5 and related sections.
- Kripke models for modal logic (Stanford Encyclopedia of Philosophy). I will use this source as a publicly available reference for Epistemic Logic models. I will be able to share a link to this with the Modal Logic Playground Repository owner to help explain what I want to contribute, and I will be able to give this link as a resource for users of the Epistemic Logic Playground who want to learn more.
- MPL code library reference. This is the documentation for the code library used by the Modal Logic Playground for parsing and evaluating formulas. I will have to make use of this library to implement parsing and evaluation of formulas containing the K_a operator.
- Directed Graph Editor Source Code. This is the code for the interactive model editing user interface used by the Modal Logic Playground. I will reference and modify this code to implement multicolored arrows representing multi-agent accessibility relations.