Logic Learning Assistance Tool

Ali Altamimi
Christopher Brantley
Nadia Doudou
Harinder Badesha
Joshua Crotts

A Visual Improvement to the Pedagogy of Introductory Logic

Senior Capstone Project - Final Presentation

Why Did We Choose This?

- Formal logic is a tough subject for many students
  - Difficult and unfamiliar notation
  - Proof-based

- Few tools give students what they need
  - Online websites exist, but are few and far between
    - https://www.umsu.de/trees/
      - If the website *does* exist, it can be a bit daunting for an intro student
  - Textbooks may give examples, but practice makes perfect
  - Symbols and terminology vary from subject to subject and source to source
  - Want: a way to "combine" all notations and teach the underlying concepts

- Visual aids complement learning experience
  - Interaction is key when learning new subjects!

What Is The Project?

- A new and improved tool for students to learn propositional and first-order predicate logic
  - Material learned in CSC-350 (Chapters 6-7) and PHI-310 (Introduction to Formal Logic)
  - *Logic Learning Assistance Tool (LLAT - pronounced /L/-LÆT)*
- Design and construct truth tables, truth trees, examine well-formed formulas, and more
  - Complements the traditional lecture(s) with definitions and examples of all symbols
- Aimed at college students, but may also be used by high-schoolers, teachers, and professors
  - Exportable as LaTeX and PDF *(Other formats are planned in future versions)*

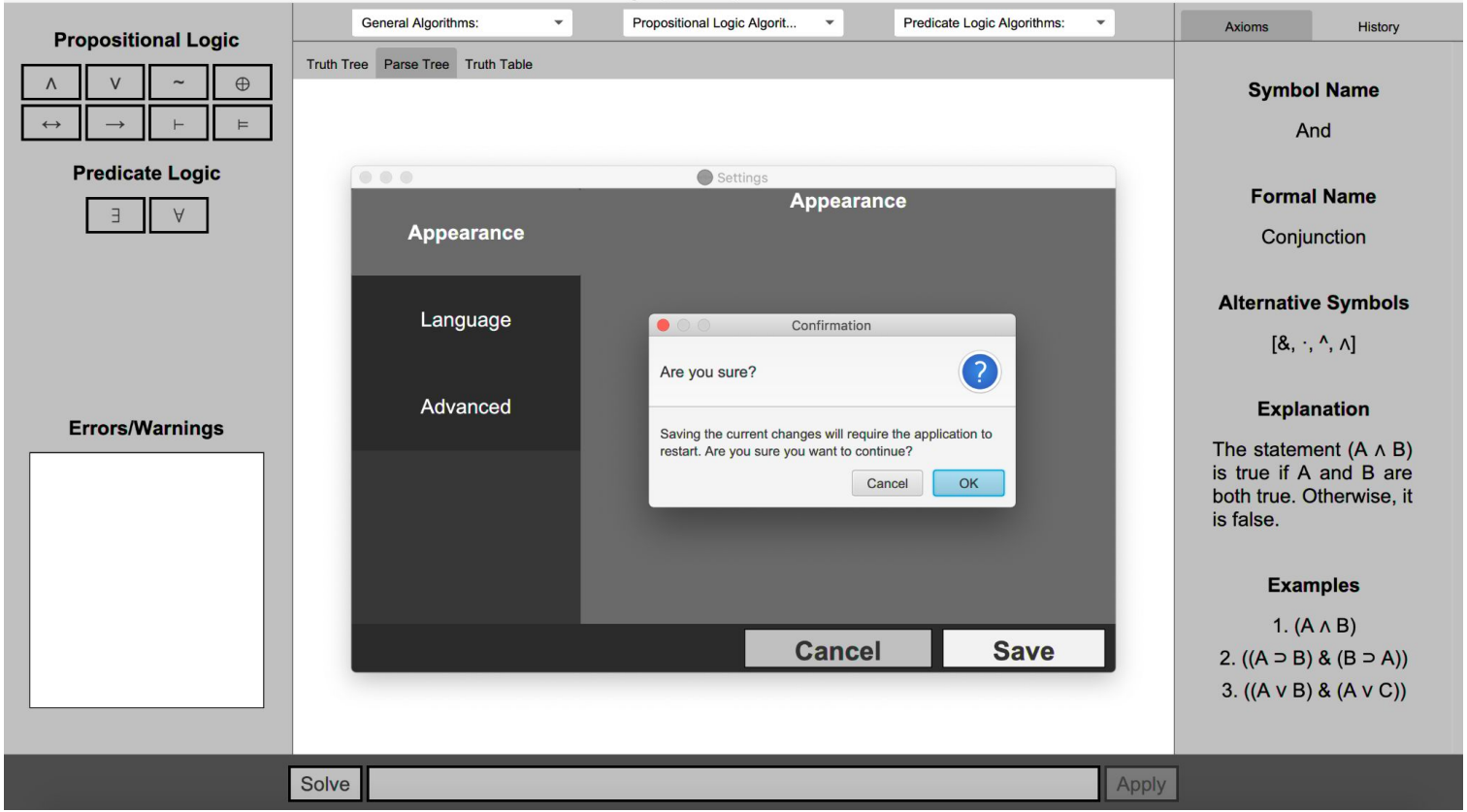
Frontend

- Constructed with JavaFX and follows MVC design
  - Application utilizes BorderPane (top, right, bottom, left, center)
  - Sections were constructed piece by piece and then joined
- Application view takes in wff's and outputs results in appropriate formats, and provides helpful information.
  - Truth tree(Abego library), parse tree(Abego library), truth table
  - Tooltips, rules, and examples
- Connecting views and models
  - Communication between views done with an event bus
    - Each view gets a listener which implements procedures
  - Views and models connected through the controller
    - Controller contains models, view accesses controller

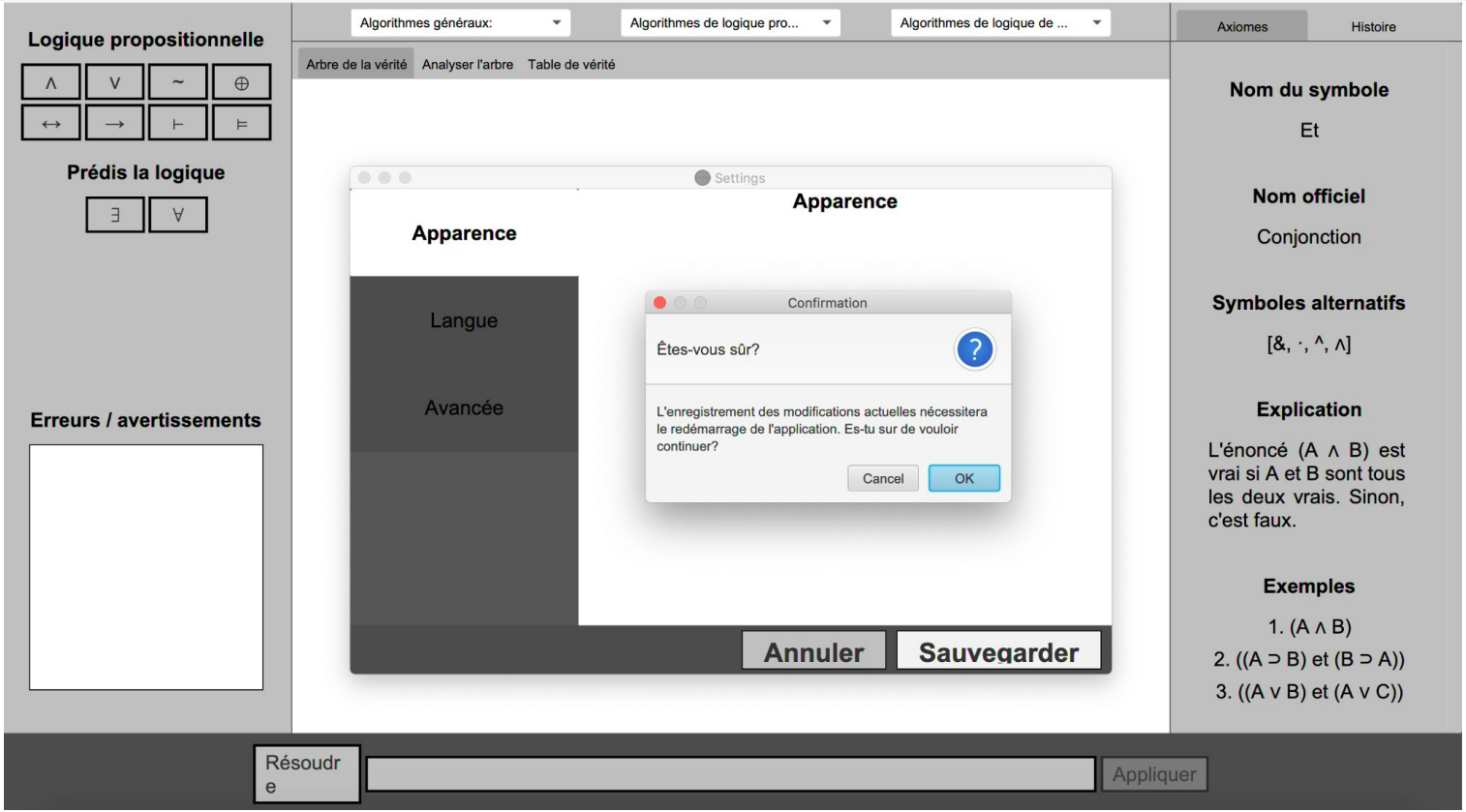
Language Translation API

- Google Translation API
  - Based on Java 8 and our project is using Java 15
    - *As a result, this API was not working!*
- Alternative: Google Script
  - A Google Script was created which is used as a simple API call
  - Works well for what we need (simpler than a “full API”)
  - Cons: performance
    - *Tried to multithread, but it didn’t work well…*

Language Translation API

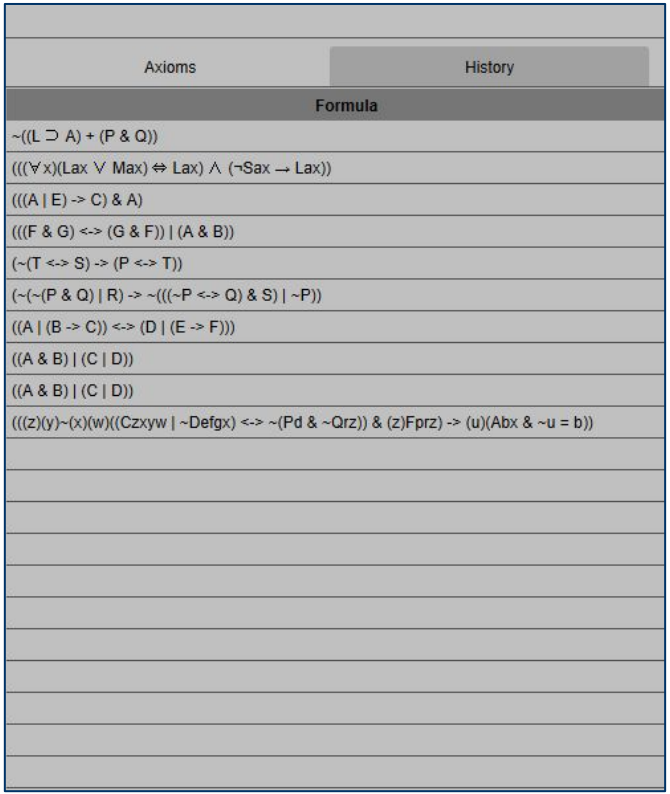


Language Translation API

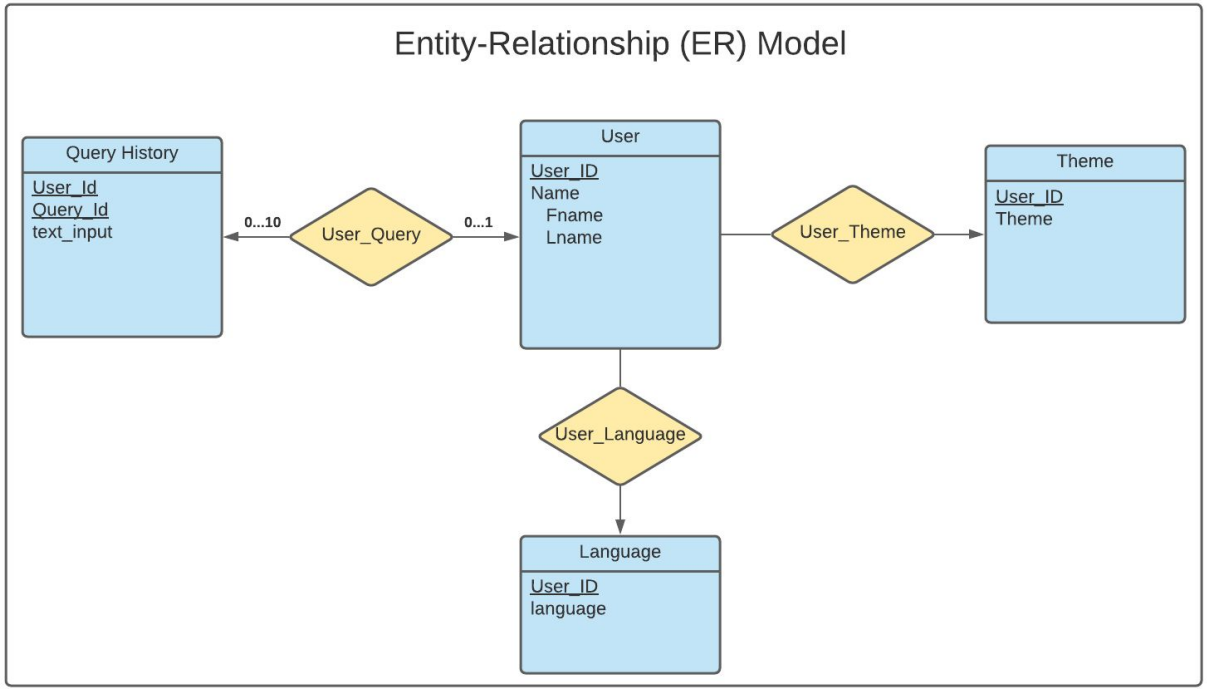


Database Subsystem

- Design and implementation of database
  - Database was designed with Amazon AWS database and MySQL
  - Database is used for user login credentials for registering and login an account, user input history, and user preference of theme and language
  - With this, user can have their preferred theme and language preselected for them automatically upon logging in and their history input

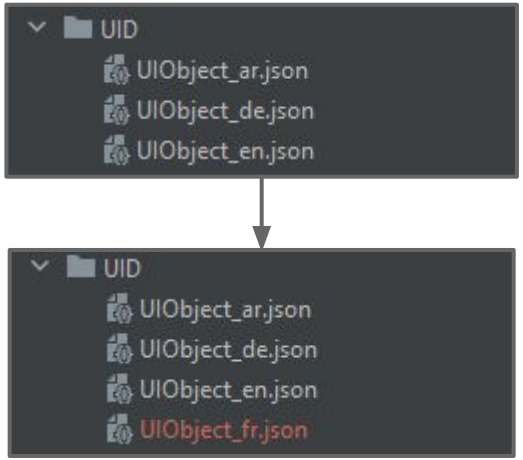


E-R Diagram

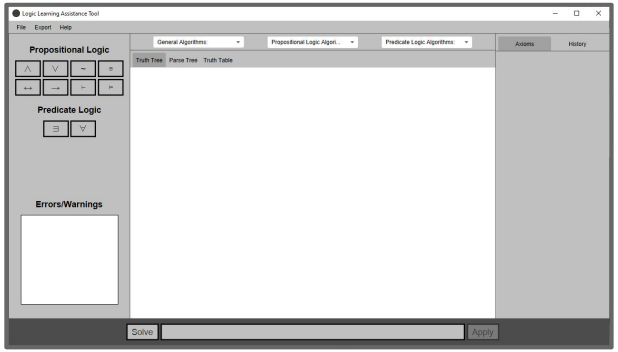

Entity-Relationship (ER) Model
Query History
User_Id
Query_Id
text_input
0...10
User_Query
0...1
User
User_ID
Name
Fname
Lname
User_Theme
Theme
User_ID
Theme
User_Language
Language
User_ID
language

Local Storage Subsystem

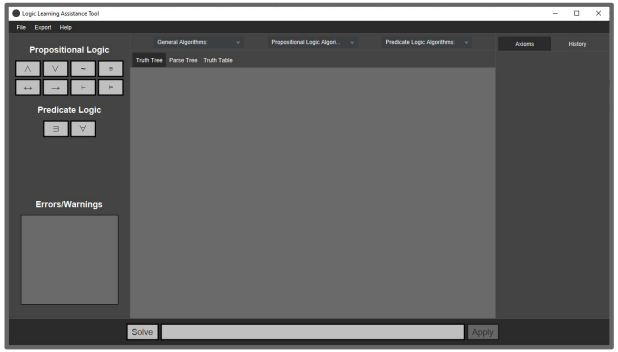
- User Interface Descriptions (UID)
  - Holds all the labels and descriptions of the application.
  - Generate JSON file that holds the missing language
- Settings
  - Holds the changes that the makes in the settings
    - Preferred theme and language
- Credentials
  - Holds user account information when signed in



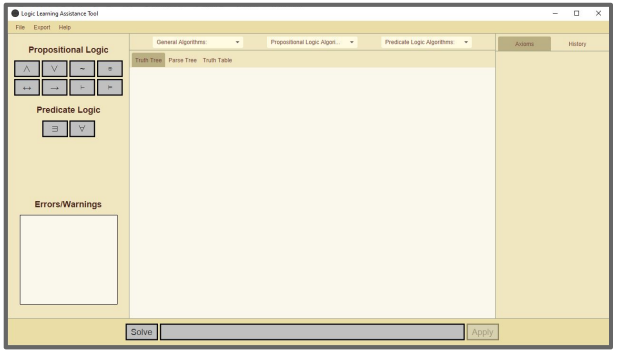
Different Theme Selection



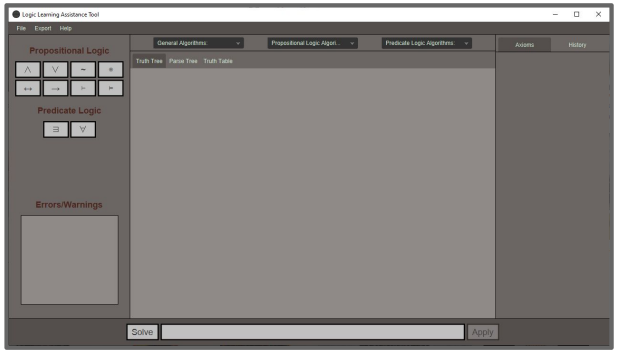
Default



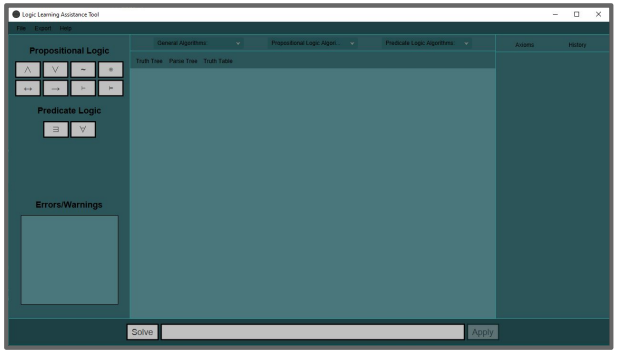
Dark



Tan



Sepia



Teal

Future Work

- Some of the algorithms we have are *very* complex
  - NP-Complete: SAT
  - co-NP-Complete: Theorem proving
- As a result, we want to find approximations or faster algorithms
  - Truth tables have an atom limit
  - First-order predicate logic is already *semi-decidable*...
- Practice *does* make perfect, but...
  - Our random PL and FOPL formula generators are arbitrary and sometimes undecidable
    - No good research available, hopefully we can improve its efficacy
- Better error messages and solution steps