Improving the Usability of MondriΛn, a Visual Esoteric Functional Programming Language

Students

Timo Strolz

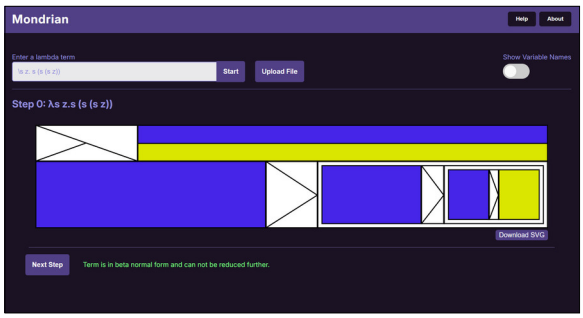
Sven Elvedi

Objective: The aim of this project is to make the lambda calculus more accessible through interactive visualization. A previous project developed MondriΛn as a proof of concept CLI application that generates MondriΛn images from lambda terms and vice versa. This project builds on the initial proof of concept by re-developing it as an interactive web application (MondriΛn+). Improved aspects are the visual representation of nested abstractions and parenthesized terms. Additional features include customizable visualizations, an α-conversion equivalent transformation for the images, an interactive web interface and an enhanced language specification for the images.

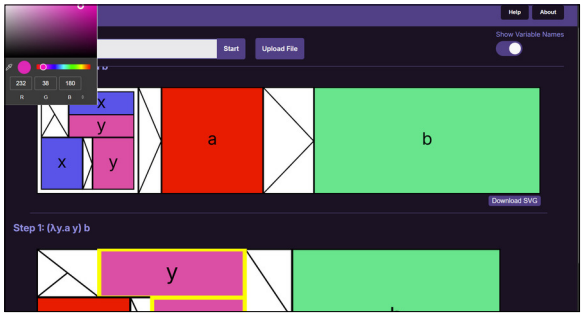
Approach / Technology: MondriΛn+ is written in Haskell and uses Nix in combination with Cabal as its build tool. The production code gets compiled to WebAssembly. This enables the development of a type safe and reactive UI with reproducible builds and high portability. The MondriΛn language specification was redesigned to enable greater customization, stronger invariants, and an improved user experience. Among the evaluated Haskell web frameworks, Miso was chosen for its simplicity and existing documentation. The core concept of the application remains the pure lambda calculus with an extended intermediate representation containing visual information on how to render the resulting images.

Result: MondriΛn+ can generate images from textual lambda calculus terms and vice versa. The application can perform β-reduction on MondriΛn+ images and on their corresponding textual representations. It supports α-conversion equivalent transformations on images, implemented as color changes. Users can either customize MondriΛn+ images implicitly by the way they enter textual terms and explicitly by resizing individual elements. The application can be used to teach and learn the lambda calculus in an interactive and visually appealing way. The current version of MondriΛn+ has potential for further development. Ideas for additional features include for example animations of β-reduction or scanning printed versions of MondriΛn+ images.

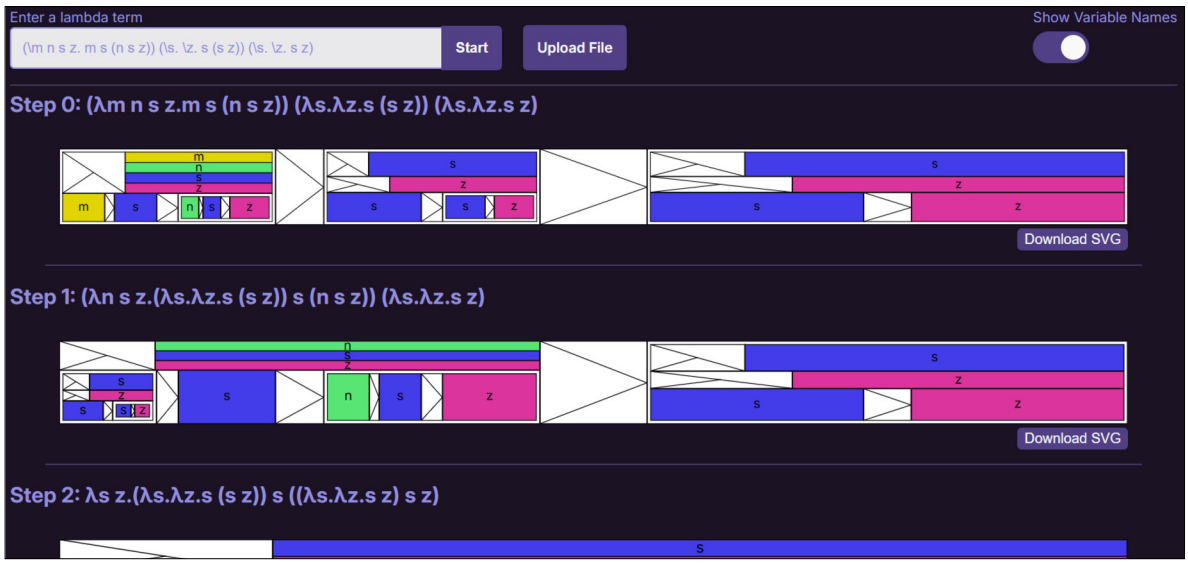
Visual representation of the Church Numeral 3
Own presentment



Example of an α-conversion equivalent transformation implemented as colour changes on the individual SVG elements
Own presentment



Scrollable view of the β-reduction process of 2+1=3 in Church Numerals with both curried and uncurried abstractions
Own presentment



Advisor

Prof. Dr. Farhad D. Mehta

Subject Area

Software