MondriΛn

A Visual Programming Language Based on the Lambda Calculus

Students

Mona Panchaud

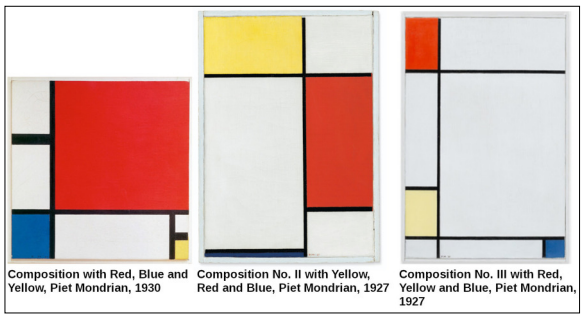
Anja Friedrich

Introduction: A core part of every functional programming class is the lambda calculus as it forms the basis for functional programming. However, students often find it difficult to grasp, especially the process of beta reduction. Hence, representing lambda terms and the beta reduction process visually could improve its comprehensibility to students. Additionally, allowing experimentation with lambda terms in a visual way could fascinate and, therefore, motivate students to learn more about the subject. Furthermore, visual functional programming languages are an interesting concept, which is not yet well explored.

Objective: The goal is to design a visual language for the representation of lambda terms which can aid students' understanding of lambda terms. In addition, the language aims to be visually pleasing, simple to draw and reason about on paper, and straightforward to read for humans.
A proof of concept application should be created to ensure that the implementation of this language is feasible.

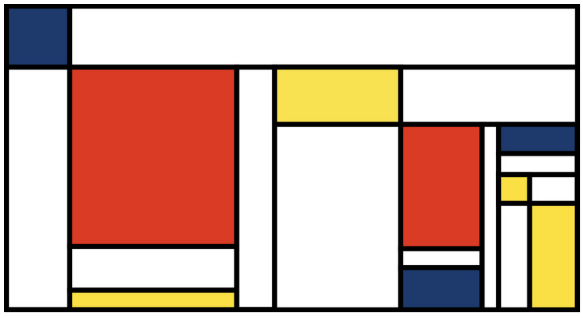
Result: MondriΛn uses coloured rectangles and their relative positions to represent lambda terms. This design was inspired by the Dutch painter Piet Mondrian, who was one of the pioneers of 20th century abstract art. Furthermore, the visual language is able to represent all lambda terms up to the limit of how many colours can be represented by a screen. The proof of concept application is implemented as a command line tool and supports generating images from lambda terms, determining the lambda term contained within an existing image and performing beta reduction on them. This proves that it is possible to implement the language we envisioned. The application is implemented using Haskell and the visual representation is stored in SVG format. To be more useful for students and artists alike, additional development (e.g. a web frontend) is required to realise the full potential of MondriΛn. Moreover, the effectiveness of the visual representations in improving students' understanding of lambda calculus needs to be evaluated.

Selection of Piet Mondrian paintings
Wikimedia Commons

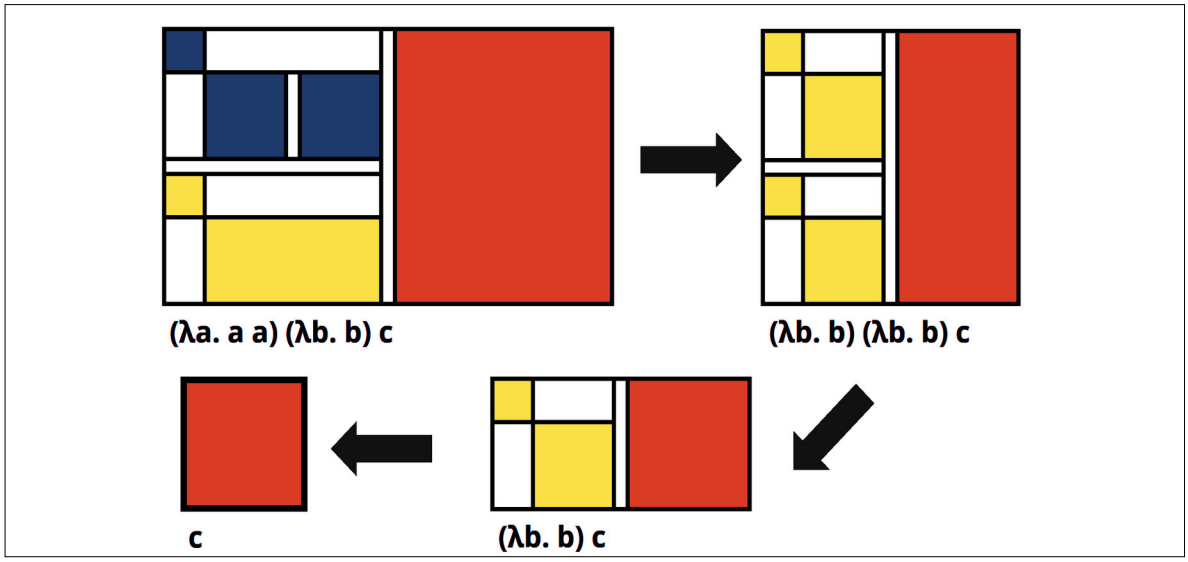


Composition with Red, Blue and Yellow, Piet Mondrian, 1930 | Composition No. II with Yellow, Red and Blue, Piet Mondrian, 1927 | Composition No. III with Red, Yellow and Blue, Piet Mondrian, 1927

Visual representation of the term λa. b c (λd. b a (a (λc. c)))
Own presentment



Beta reduction process of the term (λa. a a) (λb. b) c
Own presentment



Advisor
Prof. Dr. Farhad D. Mehta

Subject Area
Software