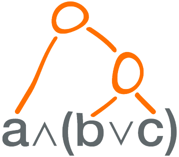
Nyāya for iPad

Interactive Environment with Bool+Tool



Alexander Maringele

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Supervisor: Dr. Georg Moser

Nyāya

Origin and meaning

- Sanskrit ny-āyá, literally “recursion” used in the sense of “syllogism, inference“.
- One of the schools of Hindu philosophy, specifically the school of logic.
- *“Obtaining valid knowledge is the only way to obtain release from suffering.”* (tenet)

Propositional Logic

Motivation

The aim of logic in computer science is to develop languages to model the situations we encounter as computer science professionals, in such way that we can reason about them formally.

- Rhyme: *If wishes were horses beggars would ride.*
- Modeling: if [wishes are horses] then [beggars ride]
- Model: $p \to q$
- Valuation: $v(p \to q) = v(p) \to v(q)$

BoolTool

Manipulation and evaluation of formulas in propositional logic

- BoolTool is powerful
  - It defines an input syntax for formulas
  - It derives normal forms
  - It computes truth tables and binary decision diagrams
  - It calculates satisfiability, tautologies and contradictions
- But it is not for beginners.
  - It does not motivate or explain much.
  - It does not use standard symbols of propositional logic.
  - It does not explain equivalence transformations.
  - It does not define normal forms.

Aim

Interactive learning environment

Allow the user to learn

- Formalism of propositional logic
- Separation of syntax and semantics
- Normal forms (NNF, CNF, DNF)
- Standard transformations of Boolean functions
- Coherence of different representations

in a self-explanatory environment.

Concept

Platform agnostic

Nyāya supports the most effective learning techniques – steadily learning and practice testing – with its combination of small bits of learning content and seemingly countless exercises.

- Tutorials for general concepts and definitions.
- Exercises to consolidate the learned concepts and definitions.
- A Playground to build and transform formulas.
- A Glossary of technical terms.
- Functionality of BoolTool.

Demo

- Tutorials
- Bool+Tool
- Playground

Choice of platform

iPad

- Most popular computing devices
  - Notebooks with mice or touch-pads and keyboards.
  - Phones with touch interfaces.
  - Tablets with touch interfaces.
- Immerse experience without distraction on tablets.
- Most popular development environments for tablets.
  - HTML5 with CSS3 and JavaScript – write once, run everywhere?
  - Tablets with Android and Java
  - iPad (mini) with iOS and Objective-C
- iPad has popoularized the usage of tablets.

Development

Toolchain

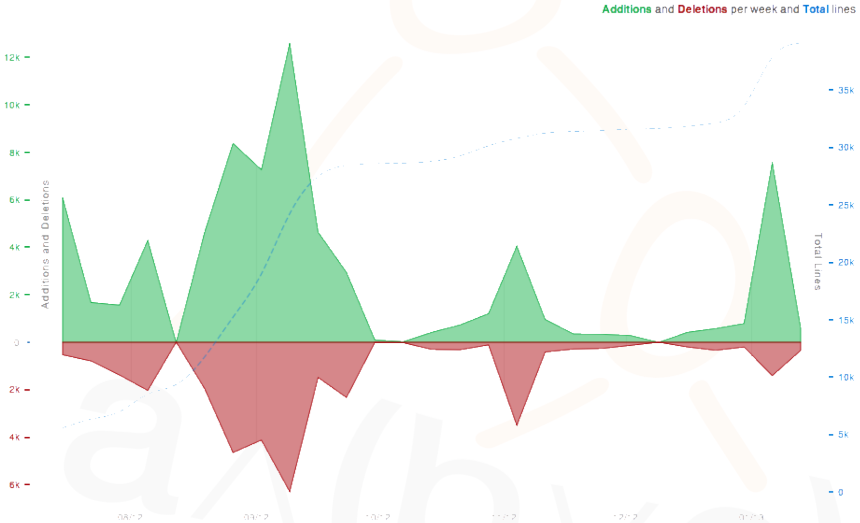
- Mac
- iPad
- Developer Portal
- IDs and Certificates
- Xcode
- Objective-C
- CocoaTouch
- Git
- GitHub

Project Execution

Priciples and Phases

- Principles
  - Fail Fast.
  - Test-driven.
  - Re-factoring.
  - Use cases.
- Phases
  - Exploring user interface possibilities.
  - Developing core components.
  - Adding content, controllers and configurations.
  - Finishing.

Commit history



Tutorials

Content and exercises

- Introduction
- Syntax
- Semantics
- Normal forms
- Binary decision diagrams

Random propositional formulas are generated for the exercises.

Playground

Syntax trees and equivalence transformations

- SyntaxTreeView
- Truth assignments and valuations.
- Free mode
- Locked mode.

Nyāya's BoolTool

Functionality of BoolTool

- Input
  - Propositional formulas
  - Binary expressions
  - Mixed
- Output
  - Validity
  - Satisfiability
  - Truth Table
  - ROBDD

Implementation

Model

- Scanner
  - Regex
  - Identifiers and operators with characters of all languages
- Parser
  - Recursive descendent
  - Associativity
  - Precedences
- Node
  - abstract superclass
  - factory mehtods
  - decorator

Retrospective

- Important Improvements
    - Independent content updates
    - Optimized valuation
    - Faster creation of BDDs.
    - Import and Export of formulas.
- Accessibility
    - Voice Over
    - Zoom
    - AssistiveTouch
- Internationalization and Localization

Outlook

- Additional Features
  - Creating and editing of BDDs.
  - Definition and using of Boolean functions $f(\ldots)$.
  - Export of syntax trees, BDDs and truth tables.
- Additional Platforms
  - Mac OS X
  - Android

Sources

- Huth and Ryan. **Logic in Computer Science**
- Middeldorp. **Logic**, Lecture
- Gamma, Helm, Johnson, Vlissides. **Design patterns: elements of reusable object-orientated software**
- Louden. **Compiler Construction: Principles and Practice**
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