A Web-based Environment for Developing and Utilizing Teaching Languages for Novice Computer Science Students

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C Spot Run

Student Development Environment

- Runs completely in the browser.
  - No compile server needed.
  - Can be hosted from static server.
- Incorporates Ace editor for features like
  - Syntax highlighting
  - Error annotations
  - Multiple cursors
  - Various color themes

Syntax

- Intuitive
  - Based on empirical research by Stefik and Siebert[1].
- Designed for teaching only (not for industry).
  - Limits complexity.
  - Overcomes objections to overloading = operator.

```
# Averages the number supplied by user interactively.

int iters = prompt "How many numbers?"
int nextNumber
int sum = 0

while i = 1 to iters
  let nextNumber = prompt "Enter a number: "
  let sum = sum + nextNumber
repeat

print "The average is " + (sum / iters)

```

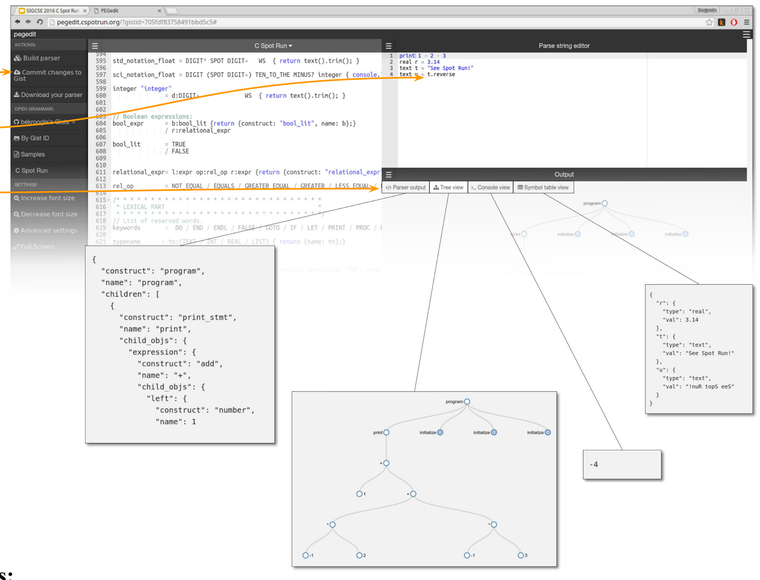
http://www.cspotrun.org

Language Development Toolkit

This site was built as an in-house tool to facilitate the development of the C Spot Run language and aid in debugging. The PEG.js Parsing Expression Grammar [2] is entered in the left editor. Some test code goes on the right. Next, simply build and run the parser to see the console output, a visualized syntax tree, and an audit of the symbol table's final state.

Features:

- Integrated with GitHub's Gist service.
- In-place testing.
- Multiple views for debugging.



Several ways to view results:

- Syntax tree in JSON format.
- Graphical tree using the D3.js visualization library.
  - With multiple modes (e.g. zoom, collapse).
- Console view for text output.
- Symbol table shows final values for variables.

http://pegedit.cspotrun.org

Roadmap

Student Development Environment

- Git-based data collecting to mine for common errors and issues with programming language syntax.
  - Inform syntax choices in language design.
  - Alert teachers when a change in pedagogy is needed.
- Assignment submission and file management.

Language Development Toolkit

- Add support for parser tracing (just added to PEG.js 0.9.0).
- Use web workers to allow infinite loops/recursion to be handled gracefully.
- Create a basic starter template for authoring a language for the system.
- Build automated language/library registry (à la NPM, Ruby GEM).
- Improve UI.
- Remove the need for the designer to use specific design patterns to access all features.

C Spot Run Language

- Add support for libraries (math, graphics web audio).
- Improve cryptic error messages.
- Give parser better awareness of the environment while generating tree.
- Implement proper type checking.

... and try the language in an actual classroom setting!

https://github.com/bekroogle

References and Acknowledgments

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The following authors and their works informed and influenced this project:

1. Andreas Stefik and Susanna Siebert. 2013. An Empirical Investigation into Programming Language Syntax. Trans. Comput. Educ. 13, 4, Article 19 (November 2013).
2. Bryan Ford. 2004. Parsing expression grammars: a recognition-based syntactic foundation. In Proceedings of the 31st ACM SIGPLAN-SIGACT symposium on Principles of programming languages (POPL '04). ACM, New York, NY, USA, 111-122.

These open source tools made this project possible:

- Ace (Ajax.org Cloud9 Editor)
  - https://ace.c9.io
- PEG.js parser generator for JavaScript
  - http://pegjs.org/
- D3.js Data-Driven Documents
  - https://d3js.org/