

Improving Clojure Usability for Introductory Course

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Table of contents

- 1 Introduction to the Project
- 2 Error Handling
- 3 Clojure's Graphical Library

Goals

- Integrate Clojure into an introductory CSci class
- Currently use Racket
 - Limited teaching language
 - Difficult to make complex projects
 - Students hitting performance issues

What is Clojure?

- Clojure is a programming language
- Built on top of the Java programming language
- Designed by Rich Hickey in 2007
- Functional (composition of functions)
- Built for concurrency (simultaneous computation)

Why use Clojure?

- Used in industry (real life)
- Better on resume
- Many programmers enjoy using Clojure
- Large community and excellent resources
- Large number of libraries (data processing, image recognition, graphical, musical)

Issues with Clojure

- Confusing error messages
- Missing graphics libraries for students

Error Messages

- Computers are literal
- Primary means of communication
- Inherently difficult to create

Henry: Post office

Current Error Messages

- Incredibly awful
- Use strange terminology
- Meaningless to most people
- Extremely bulky

New Error Messages

- Interpret old errors
- Replace with new message
- Terminology that is friendly to novices
- Consistency within error messages

Future Work

- Look into integrating this with an IDE [Henry: Explain](#)
- Spin off our utilities into separate libraries
-

What is Quil?

- Graphical Library for Clojure
- It can:
 - Draw shapes and images
 - Move objects on the screen
 - Make games, pictures, ect..

super-fun-mode

^

fun-mode

^

Quil

^

Clojure

^

Java

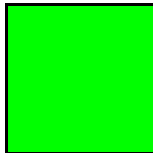
How does Quil work?

- Quil takes draw commands
- What you type: `(q/rect 500 500 200 200)`
- What Quil sees: Draw a rectangle at (500, 500) and make it 200 pixels wide and 200 pixels tall

Quil's fun-mode isn't enough

- Quil ONLY takes draw commands
- Quil doesn't separate the model from the view
- Quil code can get confusing and long

```
(q/fill 80 255 80)
(q/rect 100 100 50 50)
(q/no-fill)
(q/no-stroke)
```



- versus

```
(def lime-rect
  (create-rect 50 50 :lime))
(ds lime-rect 100 100)
```

Designing super-fun-mode

- Built on top of Quil
- Gives students functions, colors, images, ect..
- Allows for easy complex shapes

How super-fun-mode works

- You start by creating a shape

```
(def red-square  
  (create-rect 50 50 :red))
```
- Note that creating a shape does not draw it
- From there, you can draw the shape

```
(ds red-square 500 500)
```



How super-fun-mode works

- You can put shapes together to make complex shapes

```
(def rainbow  
  (above red-square  
         orange-square  
         yellow-square  
         green-square  
         blue-square  
         violet-square))
```



Six Squares

- Especially when you draw more things, such as complex shapes



Quil Code

```
(let [x 100
      num 6
      dist (+ 100 (* (\ num 2) 50))]  
(q/fill 80 255 80)  
(q/rect (- dist (* 1 50)) 100 50 50)  
(q/rect (- dist (* 2 50)) 100 50 50)  
(q/rect (- dist (* 3 50)) 100 50 50)  
(q/rect (- dist (* 4 50)) 100 50 50)  
(q/rect (- dist (* 5 50)) 100 50 50)  
(q/rect (- dist (* 6 50)) 100 50 50))  
(q/no-fill)  
(q/no-stroke)
```

Our Code

```
(def lime-rect
  (create-rect 50 50 :lime))

(def lime-rectangles
  (beside
    lime-rect lime-rect lime-rect
    lime-rect lime-rect lime-rect))

(ds lime-rectangles 100 100)
```

How super-fun-mode works

- You can modify the size and orientation of the shape

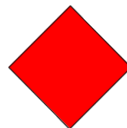
```
(ds (rotate-shape red-square 45)  
    500 500)
```



```
(ds (scale-shape red-square 2 2)  
    500 500)
```



```
(ds (rotate-shape  
    (scale-shape red-square 2 2)  
    45)  
    500 500)
```



Our Direction

- Less paintbrush, more collage
- Create shapes, not just draw them
- Easier student code
- Give students an idea of how good software should be built

A Few Examples

Please Enjoy a Few Live Examples

Future Work

- Fill out more functionality
 - Rotate more complex shapes
 - Pixel-detail Overlay and Overlay-Align
 - More seamless integration with Quil fun-mode

Acknowledgments

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Thank you!
Any questions?