Visual Code Annotations for Cyberphysical Programming

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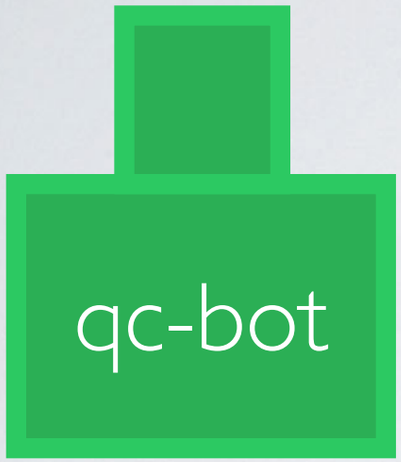
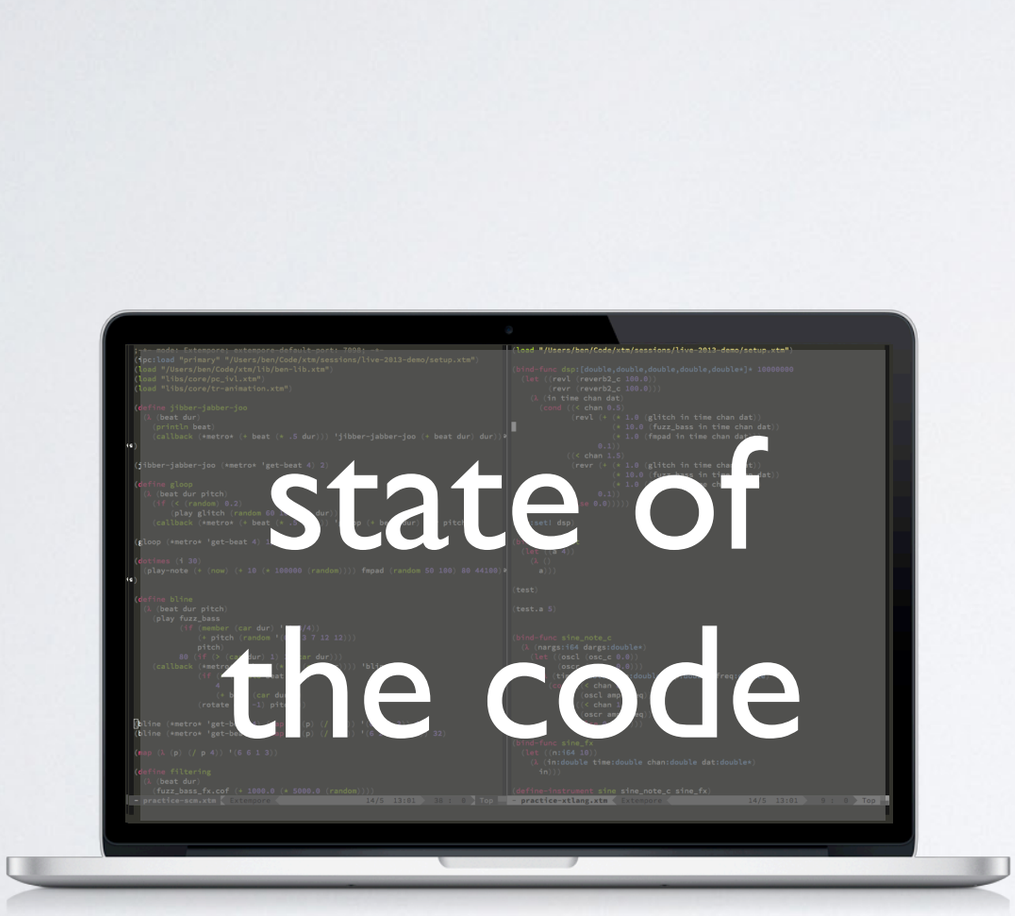
widget factory

Contract


qc-bot

cyberphysical programming



the **cyberphysical** programmer

Extempore

extempore.moso.com.au
github.com/digego/extempore


g: 0.0
Mercury g: 0.38
Venus g: 0.90
Earth g: 1.0
Mars g: 0.38
Jupiter g: 2.54


"I need our quality control bots online—**now!**"
CP

*"I need our quality control bots online—**now!**"*

```
;; cyberphysical programming in the widget factory
```

```
##            (c) 2010-2012            ##
##                                     ##
#########################################
     ###############################
          ######################
               ############
                    ##

---PortAudio---
Output Device    : Built-in Output
Input Device     :
SampleRate       : 44100
Channels Out     : 2
Channels In      : 0
Frames           : 128
Latency          : 0.0038322


Starting primary process
Trying to connect to 'localhost' on port 7099
New Client Connection
Successfully connected to remote process

Starting utility process
Trying to connect to 'localhost' on port 7098
New Client Connection
Successfully connected to remote process
New Client Connection
Starting OSC server on port: 7009 calling back to TR-anim-cl
ient-port
New Client Connection
Attempting to return a string from non-symbol obj ()
Trace: callback-adapter
```

```
- gig-scm.xtm  Extempore:7098(TCP)  15/5  17:52  3 : 0  All
* *extempore*  Shell:run  15/5  17:52  82 : 0  Bottom
```

qc-bot

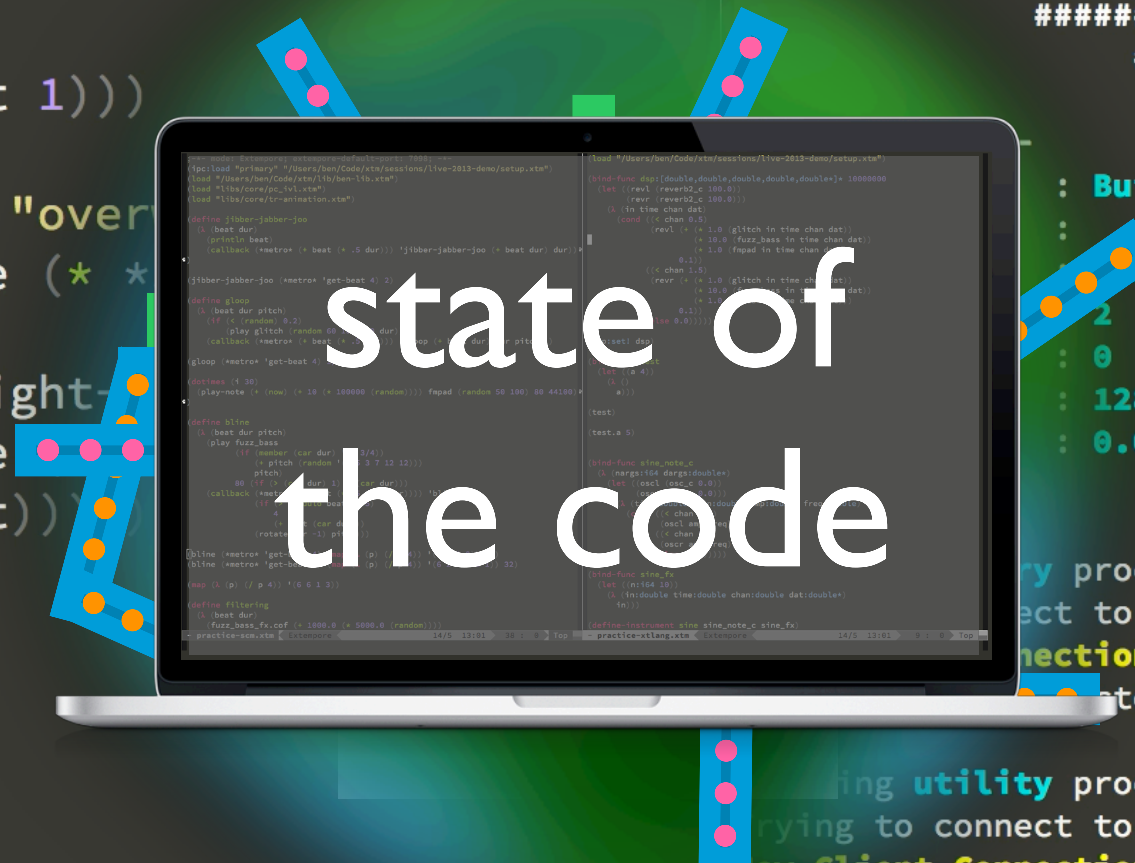
visual code annotations

- code-centric (inline)
- passive
- provide context about the *relationship* between the **code** and the **world**

"It's too strict—change it to a ***three strikes*** *QC policy!"*

```
;; cyberphysical programming in the widget factory

(define qc-weight-check
  (λ (time delta-t)
    (let ((w (sample-weight 1)))
      (if (> w 0.999)
          (stop-production "over
          (callback (+ time (* *
5)
                    'qc-weight-
                    (+ time
                    delta-t))

(qc-weight-check (now) 1)
```

```
##                                        ##
##########################################
################################
######################
############
##

: Built-in Output
:
00
2
: 0
: 128
: 0.0038322

y process
ect to 'localhost' on port 7099
nection
ted to remote process

ing utility process
rying to connect to 'localhost' on port 7098
New Client Connection
Successfully connected to remote process
New Client Connection
Starting OSC server on port: 7009 calling back to TR-anim-client-port
New Client Connection
Attempting to return a string from non-symbol obj ()
Trace: callback-adapter
"Stopping production due to overweight sample"
```




```
- gig-scm.xtm   Extempore:7098(TCP)   15/5 17:54   4 : 2   All   * *extempore*   Shell:run   15/5 17:54   83 : 0   Bottom
(No changes need to be saved)
```

*"We can't stop production for **one** overweight sample!"*

```
;; cyberphysical programming in the widget factory

(define qc-weight-check
  (let ((strikes))
  (λ (time delta-t)
    (let ((w (sample-weight 1)))
      (if (> w 0.999)
          (stop-production "overweight sample")
          (callback (+ time (* *second* delta-t) 0.
5)
                    'qc-weight-check
                    (+ time (* *second* delta-t))
                    delta-t)))))

(qc-weight-check (now) 1)
```

```
##                                          ##
############################################
     ################################
          ####################
               ############
                    ##

---PortAudio---
Output Device    : Built-in Output
Input Device     :
SampleRate       : 44100
Channels Out     : 2
Channels In      : 0
Frames           : 128
Latency          : 0.0038322


Starting primary process
Trying to connect to 'localhost' on port 7099
New Client Connection
Successfully connected to remote process

Starting utility process
Trying to connect to 'localhost' on port 7098
New Client Connection
Successfully connected to remote process
New Client Connection
Starting OSC server on port: 7009 calling back to TR-anim-cl
ient-port
New Client Connection
Attempting to return a string from non-symbol obj ()
Trace: callback-adapter
"Stopping production due to overweight sample"
```

particularly helpful when dealing with multiple concurrent ‘processes’ running in the world

```
(define qc-weight-check
  (let ((strikes 0))
    (λ (time delta-t)
      (let ((w (sample-weight 1)))
        (if (> w 0.9)
            (begin (set! strikes (+ strikes 1))
                   (println 'strikes= strikes)))
        (if (> strikes 20)
            (println "Overweight sample, stopping..."
                     'weight= w)
            (callback (+ time (* *second* delta-t) 0.5)
                      'qc-weight-check
                      (+ time (* *second* delta-t))
                      (* 2 (- 1 w)))))))))

(qc-weight-check (now) 1)

(define qc-size-check
  (λ (time delta-t)
    (if (< (random) 0.1)
        (println "Warning: size problem"))
    (callback (+ time (* *second* delta-t) 0.5)
              'qc-size-check
              (+ time (* *second* delta-t))
              delta-t))))

(qc-size-check (now) 0.5)

(define qc-colour-check
  (λ (time delta-t)
    (if (< (random) 0.1)
        (println "Warning: colour problem."))
    (callback (+ time (* *second* delta-t) 0.5)
```

```
* gig-scm.xtm  Extempore:7098(TCP)  15/5  16:33  23 : 0  13%
```

```
strikes= 15
"Warning: colour problem."
strikes= 16
"Warning: colour problem."
strikes= 17
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
strikes= 18
strikes= 19
strikes= 20
"Warning: size problem"
strikes= 21
"Overweight sample, stopping..." weight= 0.943653
"Warning: size problem"
"Warning: colour problem."
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
strikes= 1
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
strikes= 2
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
"Warning: size problem"
strikes= 3
"Warning: colour problem."
strikes= 4
```

```
* *extempore*  Shell:run  15/5  16:33  213 : 0  Bottom
```

lots more to say, but

the main point

the cyberphysical programmer has a complex (live) relationship to the world

visual code annotations may help them ‘manage’ this relationship

open questions

when are these annotations helpful?

which ones are most helpful?

how do we measure helpfulness?

cheers

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