Raspberry and Pharo

Pharo run on RaspberryPI

- ArmVM: http://files.pharo.org/vm/pharo-spur32/linux/armv6/latest.zip
  - JIT
  - FFI
  - OSProcess/OSSubprocess
    - https://github.com/marianopeck/OSSubprocess

Low level GPIO libraries

- WiringPI bindings from Jean Baptiste
  - http://smalltalkhub.com/#!/~Pharo/IoT
  - docs http://wiringpi.com
- Pigpio bindings from Tim Rowledge
  - http://www.squeaksource.com/HardwarePeripherals.html
  - docs http://abyz.co.uk/rpi/pigpio/
  - Required old compiler to install in Pharo

Remote development of Raspberry

1. Prepare Raspberry image

    - Download Pharo 6 and install server part of PharmIDE

```
Metacello new
        smalltalkhubUser: 'Pharo' project: ‘PharmDIE';
        configuration: 'PharmIDE';
        version: #stable;
        load: ‘Server’.
```

2. Save image with running server where IDE will connect

```
PrmRemoteUIManager registerOnPort: 40423
```

3. Or start image on Raspberry with command line option

```
pharo --headless Server.image  remotePharo --startServerOnPort=40423
```

Remote development of Raspberry

- Prepare development image:
  - Download Pharo 6 and install client part of PharmIDE

```
Metacello new
	smalltalkhubUser: 'Pharo' project: ‘PharmDIE';
	configuration: 'PharmIDE';
	version: #stable;
	load: ‘Client’.
```

- Connect to running Raspberry image from playground:

```
remotePharo := PrmRemoteIDE connectTo: (TCPAddress ip: #[193 51 236 167] port: 40423)
```

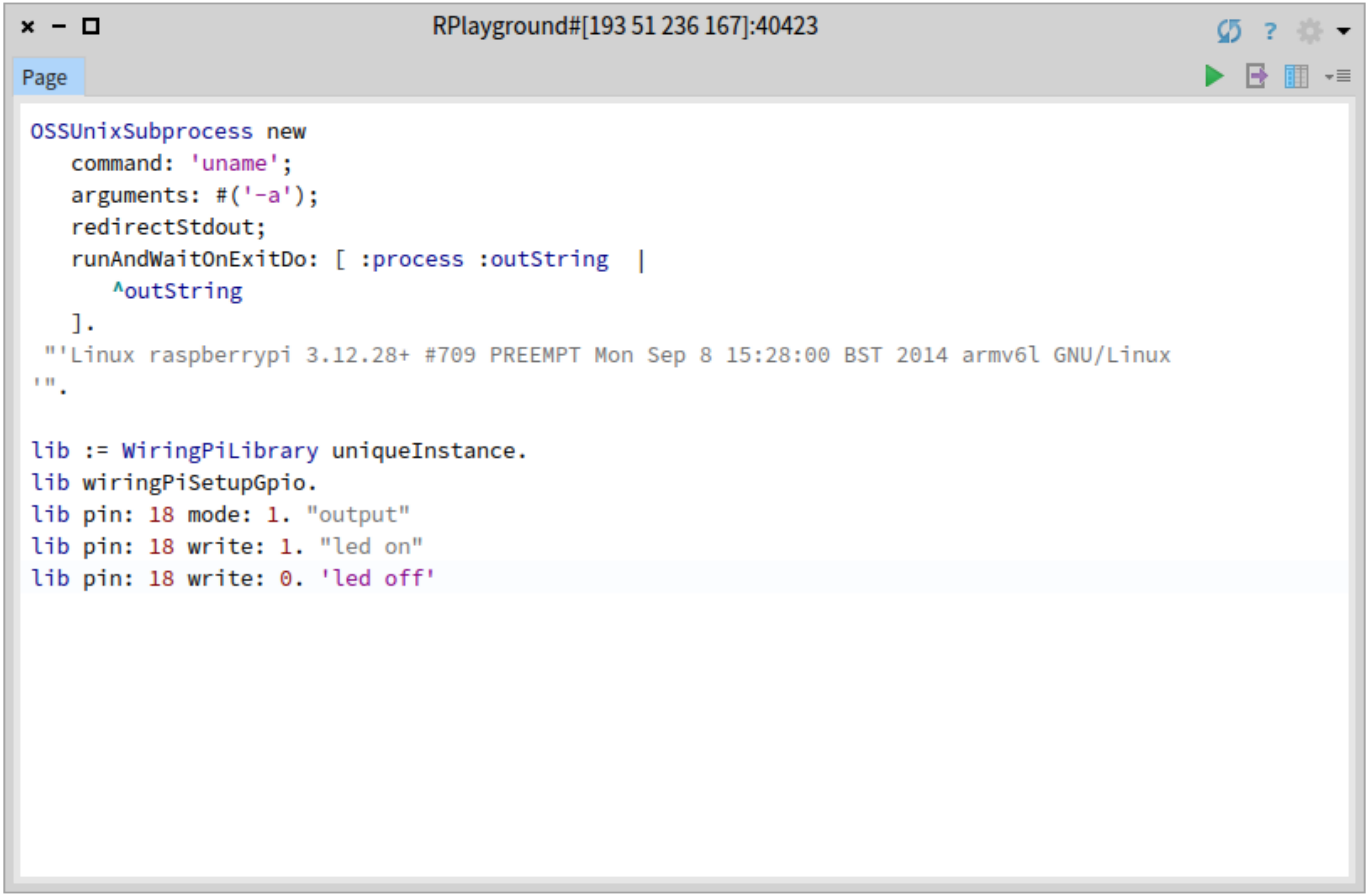
- Script Raspberry from remote playground:

```
remotePharo openPlayground
```

- Browse/edit Raspberry image from remote browser:

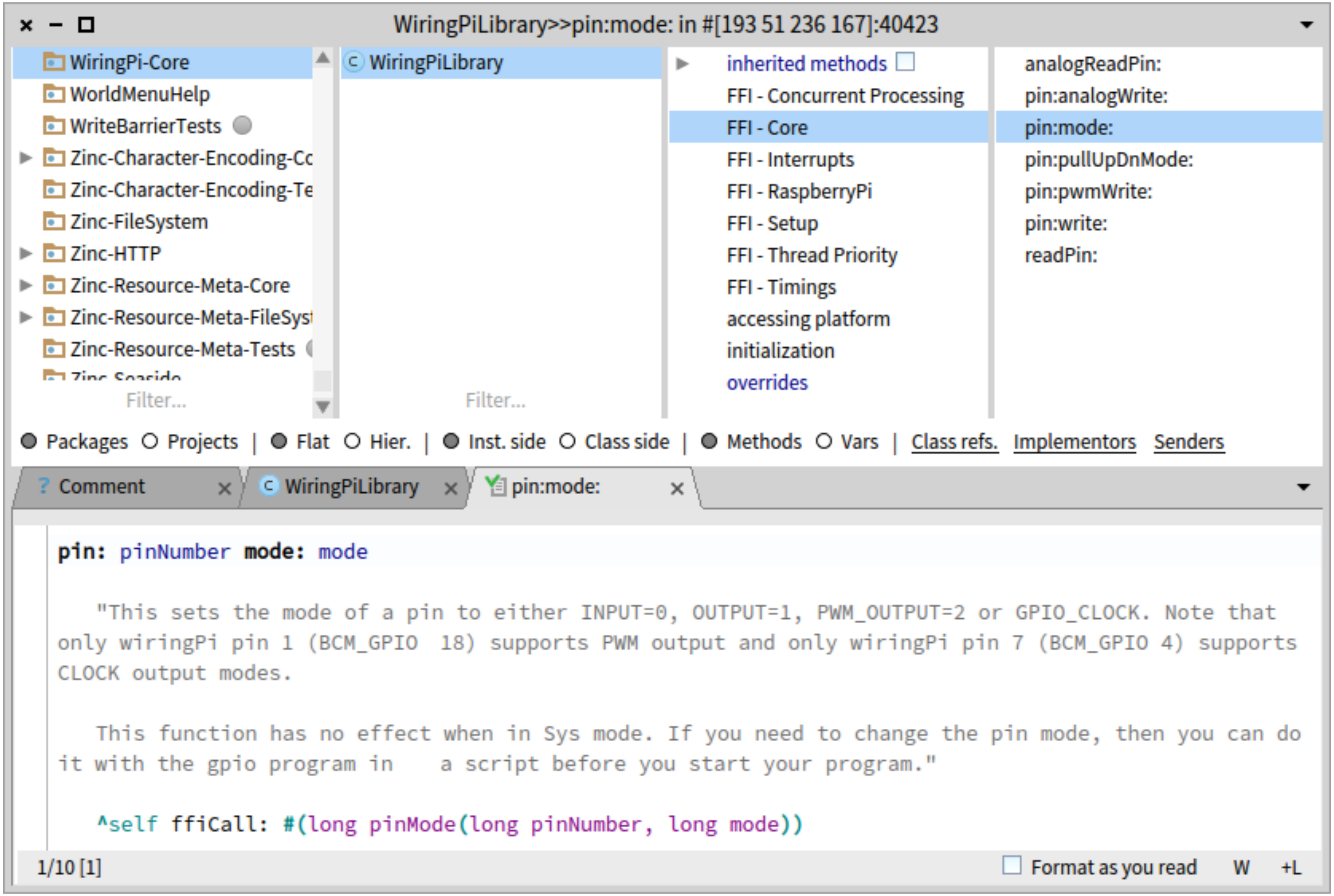
```
remotePharo openBrowser
```

Remote playground



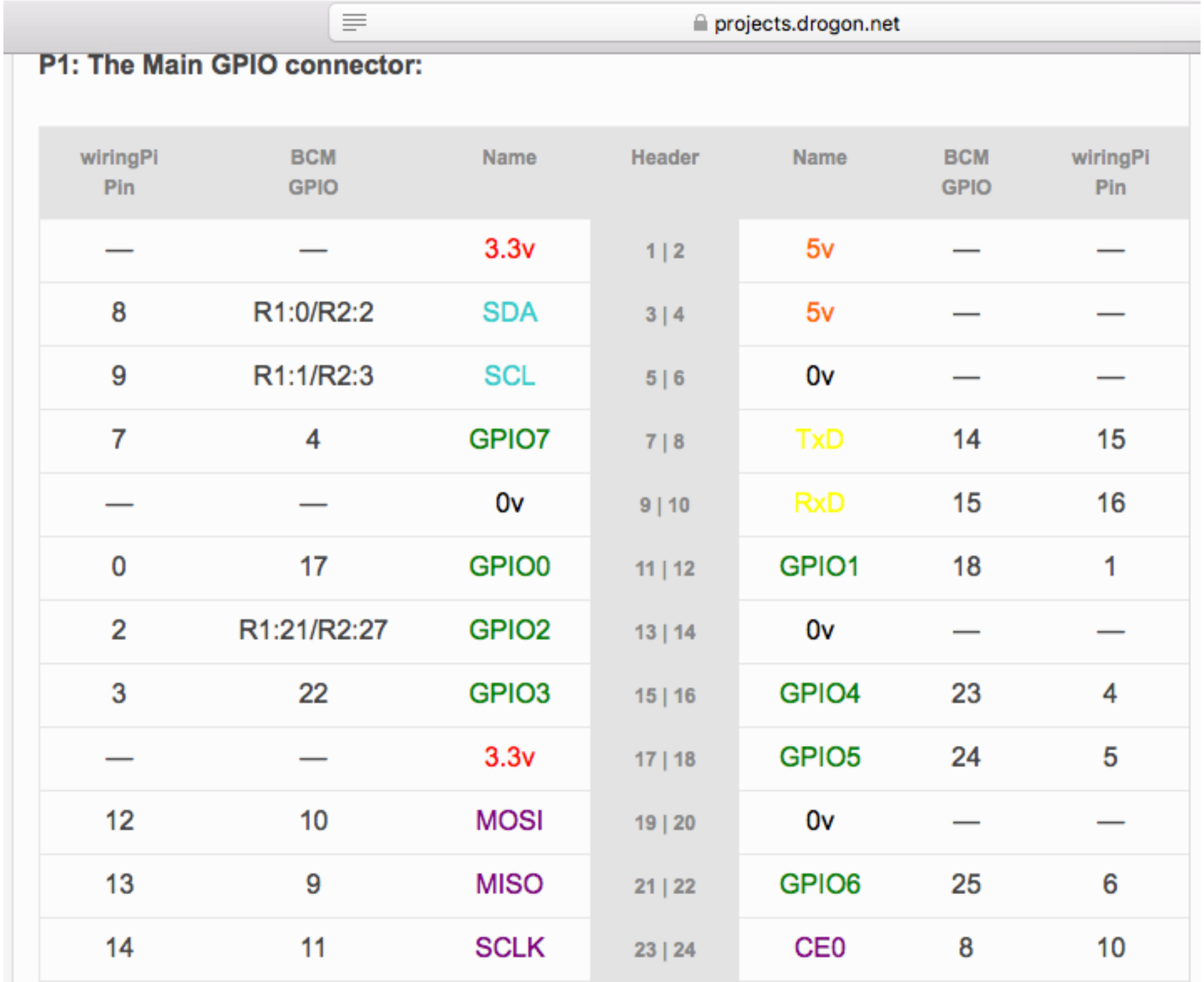
```
OSSUnixSubprocess new
   command: 'uname';
   arguments: #('-a');
   redirectStdout;
   runAndWaitOnExitDo: [ :process :outString  |
      ^outString
   ].
 "'Linux raspberrypi 3.12.28+ #709 PREEMPT Mon Sep 8 15:28:00 BST 2014 armv6l GNU/Linux
'".

lib := WiringPiLibrary uniqueInstance.
lib wiringPiSetupGpio.
lib pin: 18 mode: 1. "output"
lib pin: 18 write: 1. "led on"
lib pin: 18 write: 0. 'led off'
```

Remote browser



```
pin: pinNumber mode: mode

	"This sets the mode of a pin to either INPUT=0, OUTPUT=1, PWM_OUTPUT=2 or GPIO_CLOCK. Note that only wiringPi pin 1 (BCM_GPIO  18) supports PWM output and only wiringPi pin 7 (BCM_GPIO 4) supports CLOCK output modes.

	This function has no effect when in Sys mode. If you need to change the pin mode, then you can do it with the gpio program in 	a script before you start your program."

	^self ffiCall: #(long pinMode(long pinNumber, long mode))
```

Online docs on GPIO



P1: The Main GPIO connector:

wiringPi Pin	BCM GPIO	Name	Header	Name	BCM GPIO	wiringPi Pin
—	—	3.3v	1 | 2	5v	—	—
8	R1:0/R2:2	SDA	3 | 4	5v	—	—
9	R1:1/R2:3	SCL	5 | 6	0v	—	—
7	4	GPIO7	7 | 8	TxD	14	15
—	—	0v	9 | 10	RxD	15	16
0	17	GPIO0	11 | 12	GPIO1	18	1
2	R1:21/R2:27	GPIO2	13 | 14	0v	—	—
3	22	GPIO3	15 | 16	GPIO4	23	4
—	—	3.3v	17 | 18	GPIO5	24	5
12	10	MOSI	19 | 20	0v	—	—
13	9	MISO	21 | 22	GPIO6	25	6
14	11	SCLK	23 | 24	CE0	8	10

High level tools

- Low level libraries are not object based
- Pharo IoT project
  - Load to Raspberry image with:

```
Metacello new
	smalltalkhubUser: 'Pharo' project: 'IoT';
	configuration: 'IoT';
	version: #stable;
	load: 'RemoteToolsServer'.
```

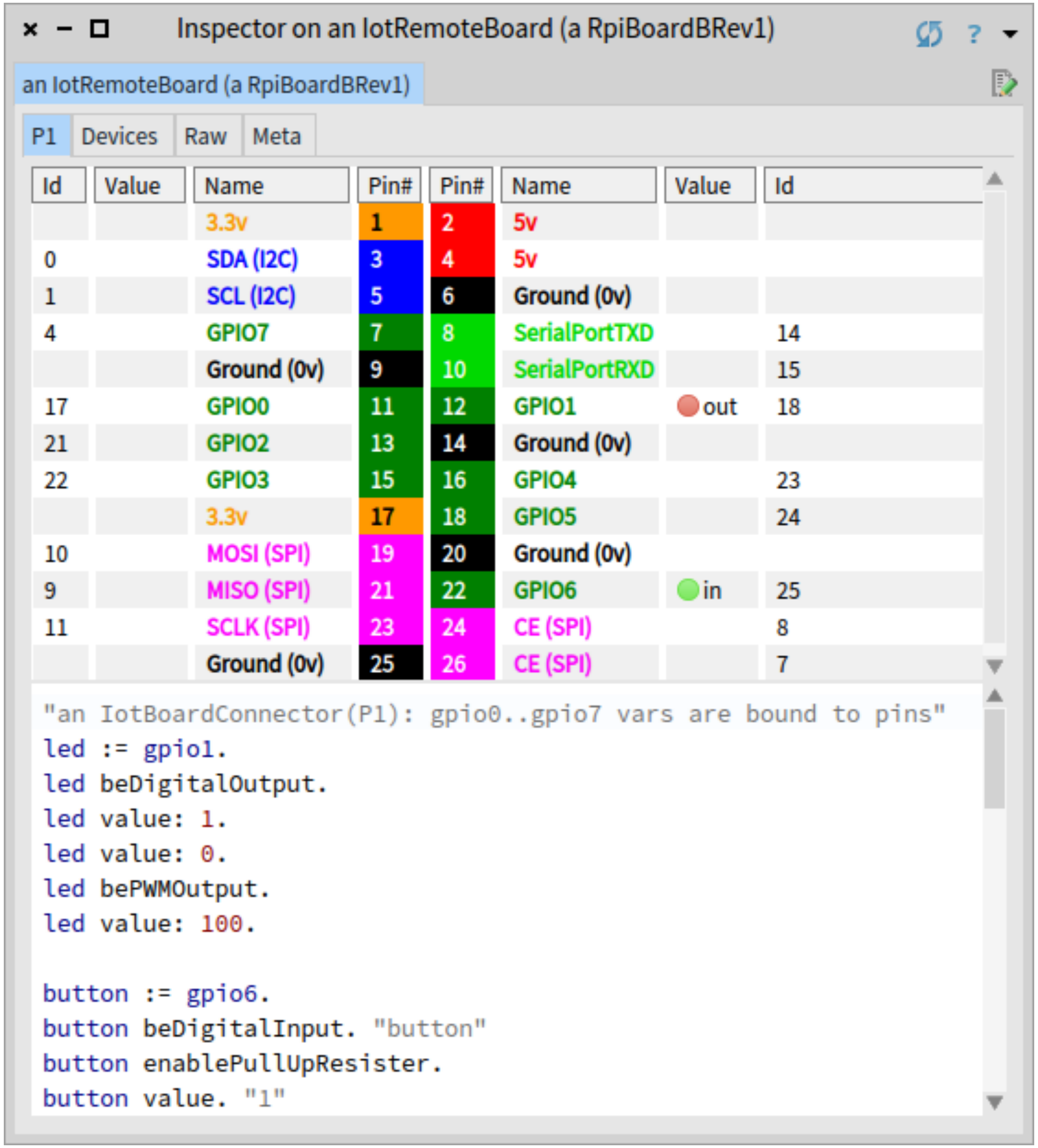
  - Load to client dev image with:

```
Metacello new
	smalltalkhubUser: 'Pharo' project: 'IoT';
	configuration: 'IoT';
	version: #stable;
	load: 'RemoteToolsClient'.
```

Pharo IoT project

- Includes remote development tools
- Simple object model for boards
    - pins are objects
    - hierarchy of boards with specific configuration of pins
        - RpiModelBRev1 with single connector P1
        - RpiModelBRev2 with two connectors P1 and P2
        - more in future
        - BeagleBoard’s in future
- Advanced tools to manage peripherals

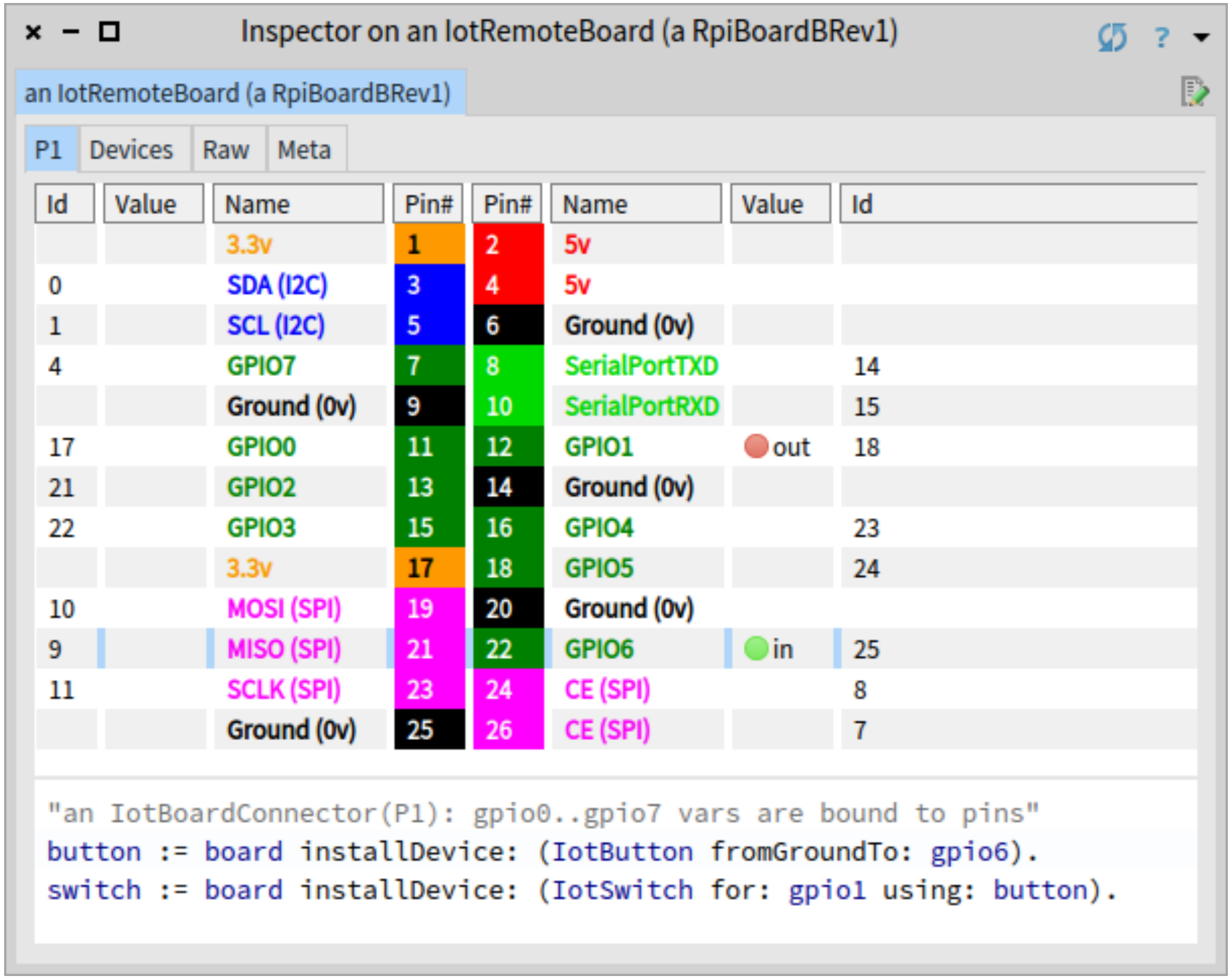
```
remoteBoard := remotePharo evaluate: [ RpiBoardBRev1 current].
remoteBoard inspect
```


Inspector on an IotRemoteBoard (a RpiBoardBRev1)
an IotRemoteBoard (a RpiBoardBRev1)
P1
Devices
Raw
Meta

Id	Value	Name	Pin#	Pin#	Name	Value	Id
		3.3v	1	2	5v		
0		SDA (I2C)	3	4	5v		
1		SCL (I2C)	5	6	Ground (0v)		
4		GPIO7	7	8	SerialPortTXD		14
		Ground (0v)	9	10	SerialPortRXD		15
17		GPIO0	11	12	GPIO1	● out	18
21		GPIO2	13	14	Ground (0v)		
22		GPIO3	15	16	GPIO4		23
		3.3v	17	18	GPIO5		24
10		MOSI (SPI)	19	20	Ground (0v)		
9		MISO (SPI)	21	22	GPIO6	● in	25
11		SCLK (SPI)	23	24	CE (SPI)		8
		Ground (0v)	25	26	CE (SPI)		7

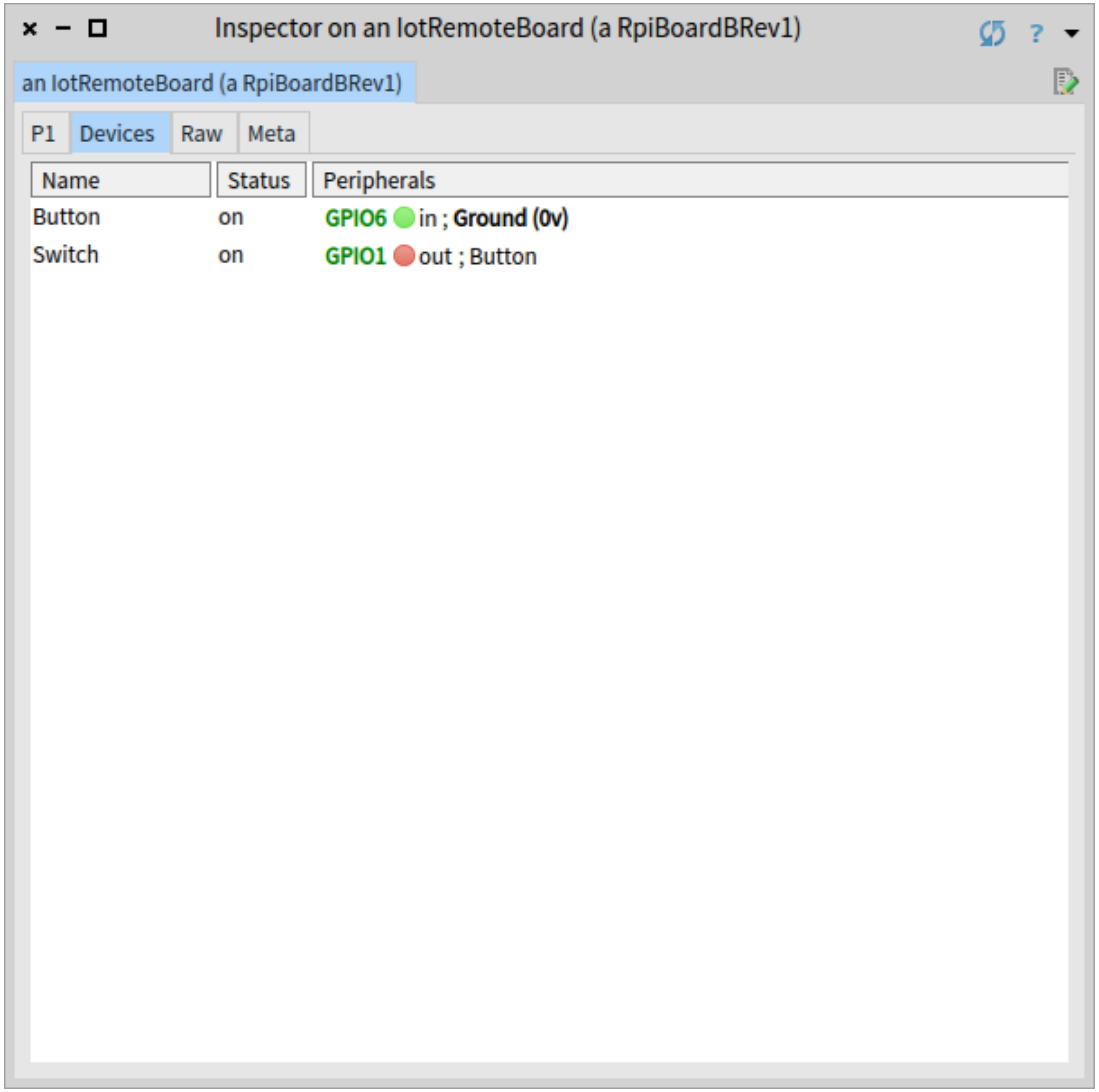
```
"an IotBoardConnector(P1): gpio0..gpio7 vars are bound to pins"
led := gpio1.
led beDigitalOutput.
led value: 1.
led value: 0.
led bePWMOutput.
led value: 100.

button := gpio6.
button beDigitalInput. "button"
button enablePullUpResister.
button value. "1"
```

Devices model to program physical things connected to board


Inspector on an IotRemoteBoard (a RpiBoardBRev1)
an IotRemoteBoard (a RpiBoardBRev1)
P1
Devices
Raw
Meta

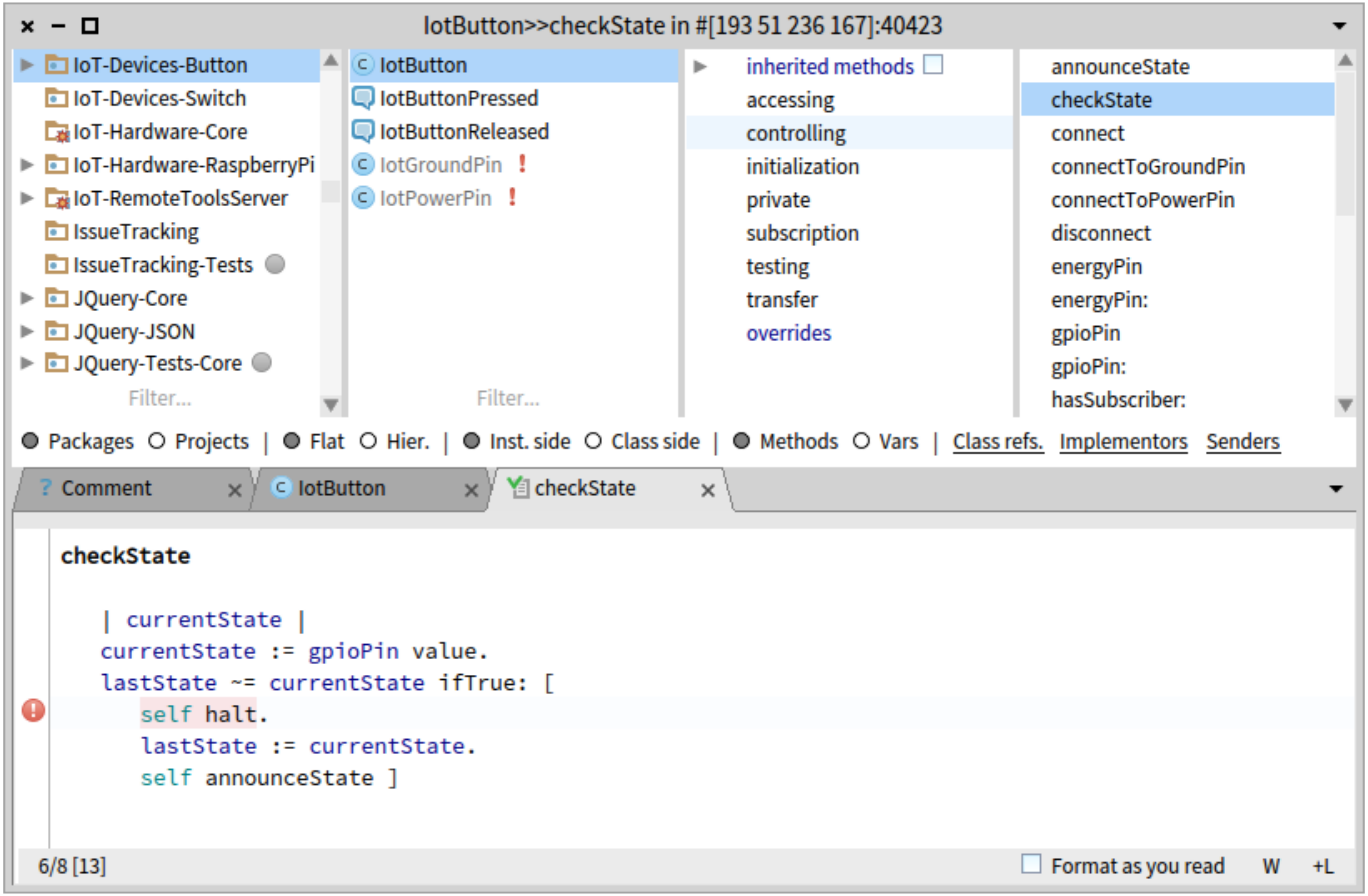
Id	Value	Name	Pin#	Pin#	Name	Value	Id
		3.3v	1	2	5v		
0		SDA (I2C)	3	4	5v		
1		SCL (I2C)	5	6	Ground (0v)		
4		GPIO7	7	8	SerialPortTXD		14
		Ground (0v)	9	10	SerialPortRXD		15
17		GPIO0	11	12	GPIO1	● out	18
21		GPIO2	13	14	Ground (0v)		
22		GPIO3	15	16	GPIO4		23
		3.3v	17	18	GPIO5		24
10		MOSI (SPI)	19	20	Ground (0v)		
9		MISO (SPI)	21	22	GPIO6	● in	25
11		SCLK (SPI)	23	24	CE (SPI)		8
		Ground (0v)	25	26	CE (SPI)		7

```
"an IotBoardConnector(P1): gpio0..gpio7 vars are bound to pins"
button := board installDevice: (IotButton fromGroundTo: gpio6).
switch := board installDevice: (IotSwitch for: gpio1 using: button).
```


Inspector on an IotRemoteBoard (a RpiBoardBRev1)
an IotRemoteBoard (a RpiBoardBRev1)
P1
Devices
Raw
Meta

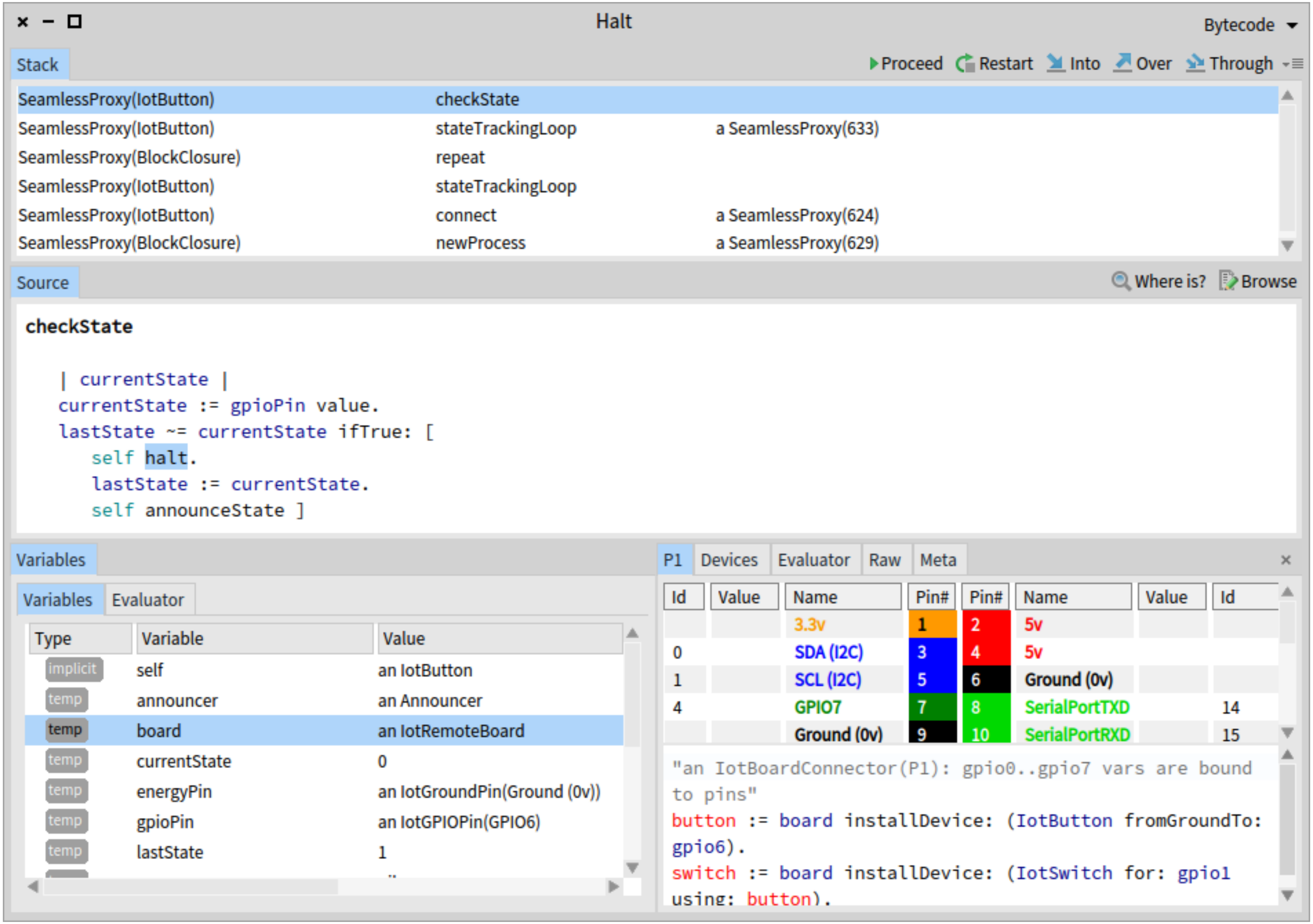
Name	Status	Peripherals
Button	on	GPIO6 🟢 in ; **Ground (0v)**
Switch	on	GPIO1 🔴 out ; Button

Remote debugger



IotButton>>checkState in #[193 51 236 167]:40423

```
checkState

   | currentState |
   currentState := gpioPin value.
   lastState ~= currentState ifTrue: [
      self halt.
      lastState := currentState.
      self announceState ]
```



SeamlessProxy(IotButton)	checkState	
SeamlessProxy(IotButton)	stateTrackingLoop	a SeamlessProxy(633)
SeamlessProxy(BlockClosure)	repeat	
SeamlessProxy(IotButton)	stateTrackingLoop	
SeamlessProxy(IotButton)	connect	a SeamlessProxy(624)
SeamlessProxy(BlockClosure)	newProcess	a SeamlessProxy(629)

```
checkState

    | currentState |
   currentState := gpioPin value.
   lastState ~= currentState ifTrue: [
      self halt.
      lastState := currentState.
      self announceState ]
```

Type	Variable	Value
implicit	self	an IotButton
temp	announcer	an Announcer
temp	board	an IotRemoteBoard
temp	currentState	0
temp	energyPin	an IotGroundPin(Ground (0v))
temp	gpioPin	an IotGPIOPin(GPIO6)
temp	lastState	1

Id	Value	Name	Pin#	Pin#	Name	Value	Id
		3.3v	1	2	5v		
0		SDA (I2C)	3	4	5v		
1		SCL (I2C)	5	6	Ground (0v)		
4		GPIO7	7	8	SerialPortTXD		14
		Ground (0v)	9	10	SerialPortRXD		15

```
"an IotBoardConnector(P1): gpio0..gpio7 vars are bound
to pins"
button := board installDevice: (IotButton fromGroundTo:
gpio6).
switch := board installDevice: (IotSwitch for: gpio1
using: button).
```

Deploy

- Save image at the end

```
remotePharo saveImage
```

- On start up all board state is recovered
- Set up image as service with Linux tools

Future

- More RaspberryPI models
- Beaglebone models
- Deploying as service from image
- Zeroconf for armVM+IoT
- Improve code management
- General evolution of PharmIDE
    - Automatic detection of running images in network
    - Remote refactoring
    - Security
    - many other things

The end