Funicular

A Browser App Framework
Powered by PicoRuby.WASM

hasumikin

RubyKaigi 2026

22nd April #rubykaigiA

self.inspect

- Hitoshi HASUMI @hasumikin (GitHub and Twitter)
- Creator of PicoRuby
- Committer of mruby and mruby/c
  (Committer of CRuby IRB and Reline)
- Working with ANDPAD: Local Meals Sponsor

- Today, I'll be handing out **Lucky Pierrot Burger** 🍔

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Today's Topic

Chapter 1. PicoRuby.WASM

Chapter 2. Funicular on PicoRuby.WASM

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Chapter 1

PicoRuby.WASM

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PicoRuby consists of

- PicoRuby compiler using Prism
- mruby VM + Task scheduler (mruby-task mgem)
- A lot of libraries (Picogems)
- Microcontroller integration: Raspi Picos and ESP32
- Browser-based runtime: **PicoRuby.WASM ←[new!]**

How to Use PicoRuby.WASM

```
<script src="https://cdn.jsdelivr.net/npm/@picoruby/
wasm-wasi@latest/dist/init.iife.js"></script>

<!-- Embedded Ruby Script -->
<script type="text/ruby">
  puts "Hello, World!"
</script>

<!-- Remote Ruby Script file (.rb) -->
<script type="text/ruby" src="hello.rb"></script>

<!-- Remote Precompiled Ruby VM Code file (.mrb) -->
<script type="application/x-mrb" src="hello.mrb"></script>
```

When It Comes to PicoRuby,

L-chika 

(LED blinking)

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Words from Ancient Izumo Folklore

L-chika is aesthetic/emotional education.
Lチカは情操教育

If you love your kid, let them L-chika.
かわいい子にはLチカをさせろ

We're talking about the browser..?

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Demo : L-chika in browser

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L-chika in Ruby (microcontroller)

```ruby
led = LED.new(id: 'red')

while true
  led.on
  sleep 1
  led.off
  sleep 1
end
```

In JavaScript

```
const led = new LED({ id: 'red' });

setInterval(() => {
  led.on();
  setTimeout(() => {
    led.off();
  }, 1000);
}, 2000);
```

Or... (I don't know if it works)

```
const led = new LED({ id: 'red' });

function sleep(ms) {
  return new Promise(resolve => setTimeout(resolve, ms));
}

(async () => {
  while (true) {
    led.on();
    await sleep(1000);
    led.off();
    await sleep(1000);
  }
})();
```

sleep🤔

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Demo : sleep in CRuby.WASM

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sleep in PicoRuby.WASM

Claude Code:
“sleep doesn’t work on browser, let me investigate how PicoRuby.wasm manages setTimeout()...”

Me:
“PicoRuby.wasm’s sleep doesn’t block browser UI”

`Kernel#sleep` in *Ruby.WASM

- CRuby essentially depends on the OS
  →**`Kernel#sleep`** doesn't work on CRuby.WASM
- PicoRuby basically does NOT depend on the OS
  →PicoRuby.WASM supports **`sleep`**

But How?

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Hitoshi HASUMI

@hasumikin

Creator of PicoRuby and PRK Firmware.

JA

MicroRuby: True Microcontroller Ruby

PicoRuby's VM is mruby/c. While it has the advantage of being memory-saving, it also has disadvantages such as a lack of Ruby language specifications and the inability to call Ruby methods from C.

By integrating the mruby VM into PicoRuby's features of memory-saving runtime compilation and a practical development ecosystem, MicroRuby brings ISO/IEC 30170-compliant Ruby to microcontroller programming and expands the scope of application development. In this session, I will provide a detailed explanation of the technical barriers that this project has overcome.

https://rubykaigi.org/2025/presentations/hasumikin.html

PicoRuby.WASM's main loop

```
Module.picorubyRun = function() {
  const MRB_TICK_UNIT = 4;       // Must match the value in build_config/picoruby-wasm.rb
  const BATCH_DURATION = 16;     // ~1 frame (16.67ms) at 60 fps
  const MAX_CATCHUP_TICKS = 10; // Cap to avoid freeze when tab returns from background
  let lastTick = performance.now();
  function run() {
    const now = performance.now();
    let tickCount = 0;
    while (now - lastTick >= MRB_TICK_UNIT && tickCount < MAX_CATCHUP_TICKS) {
      Module._mrb_tick_wasm();
      lastTick += MRB_TICK_UNIT;
      tickCount++;
    }
    if (now - lastTick >= MRB_TICK_UNIT) {
      lastTick = now;
    }
    const sliceStart = performance.now();
    while (performance.now() - sliceStart < BATCH_DURATION) {
      const result = Module._mrb_run_step();
      if (result < 0) {
        console.error('mrb_run_step returned', result, '- scheduler continues');
      }
    }
    setTimeout(run, 0);
  }
  run();
};
```

PicoRuby.WASM's main loop

```
function run() {
  (...)
  const sliceStart = performance.now();
  while (performance.now() - sliceStart < BATCH_DURATION) {
    const result = Module._mrb_run_step();
    (...)
  }
  setTimeout(run, 0);
}
run();
```

`setTimeout()` is called every 16ms (60fps)

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sleep in PicoRuby.WASM

- It is NOT **`setTimeout()`** wrapper
- PicoRuby runtime runs on a multi-task scheduler
- **`Kernel#sleep`** stops its task and returns to the scheduler
- In PicoRuby.WASM, JS main loop is the scheduler

`sleep` works like **yield**

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Yield == Give Way

- **`Kernel#sleep(n)`** suspends the task and gives way to other tasks
- After **`n`** sec, scheduler resumes the task

https://www.callbigmike.com/faqs/what-does-yield-mean-in-driving/

Yield == Give Way

Claude Code: “Now I understand full picture!”

———next session———

Claude Code: “sleep shouldn’t work on browser…
Me: “Hey!😡”

CRuby.WASM vs PicoRuby.WASM

	CRuby.WASM	PicoRuby.WASM
`Kernel#sleep`	❌	✅
Multithreading	No `Thread` support	`Task` support
Binary size (compressed)	17.2 MB (4.4 MB)	1.1 MB (470 KB)

Debugging

- Unfortunately, Opal is hard to debug
- You won’t use PicoRuby.WASM unless it’s debuggable

Demo : binding.irb in L-chika

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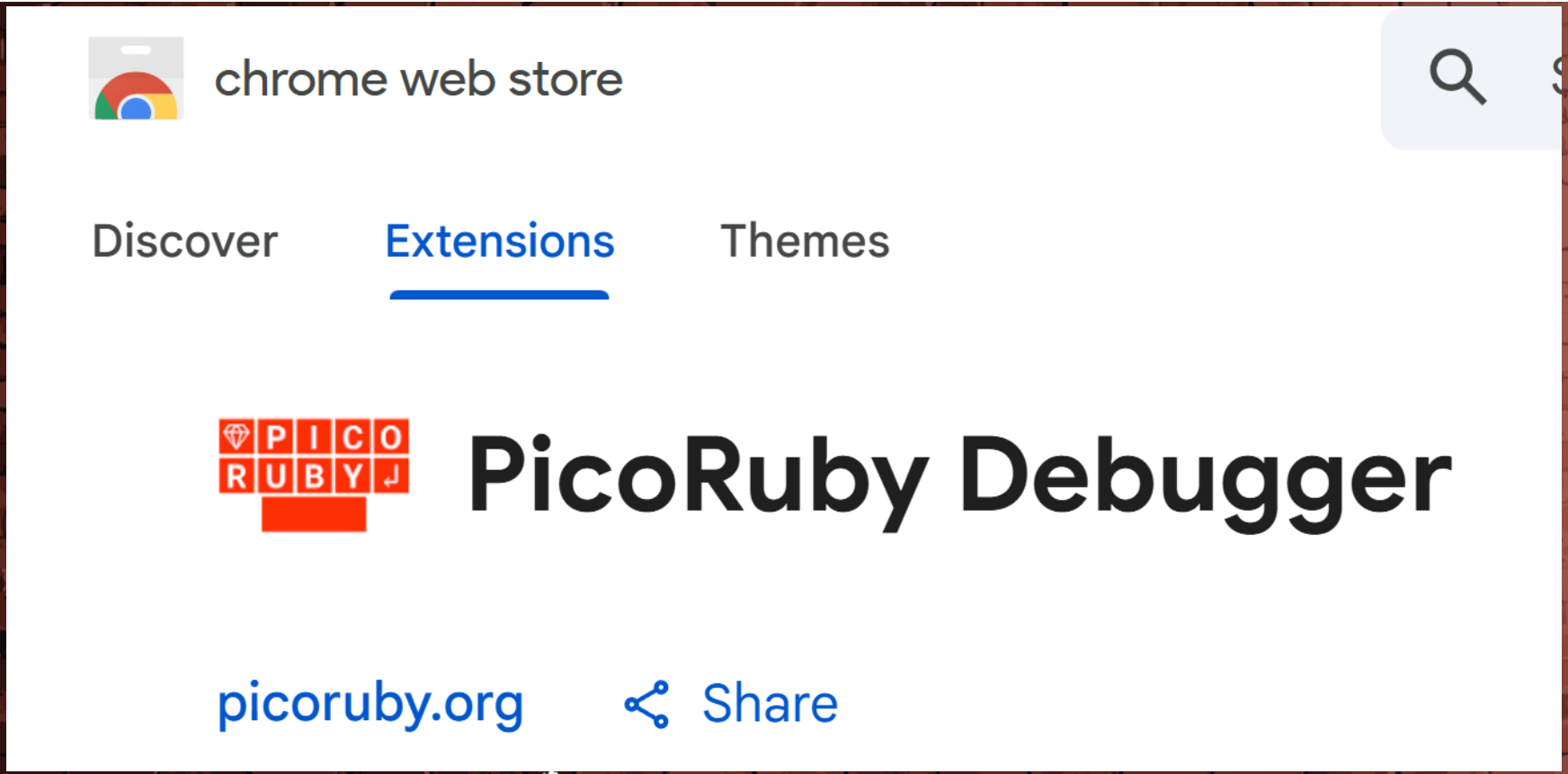
Chrome Web Store



Break by binding.irb

```
binding.irb (Ruby)
 │    struct wasm_debug_state g_gdb; // Global
 └─ mrb_binding_irb (C)
```

1. **`g_gdb.mode = WASM_DBG_PAUSED`**
2. **`g_gdb.binding = binding`** (save from GC)
3. Specify file & line by tracing back callstack
4. **`mrb_suspend_task()`** (like **`sleep`**)

Step and Next

```
mrb_debug_step() or mrb_debug_next()
```

1. **`g_gdb = WASM_DBG_STEP`** (or **`WASM_DBG_NEXT`**)
2. **`mrb->code_fetch_hook = wasm_hook`**
3. **`mrb_resume_task()`**

`wasm_hook()` checks line and ci (stack) on every OP code fetch

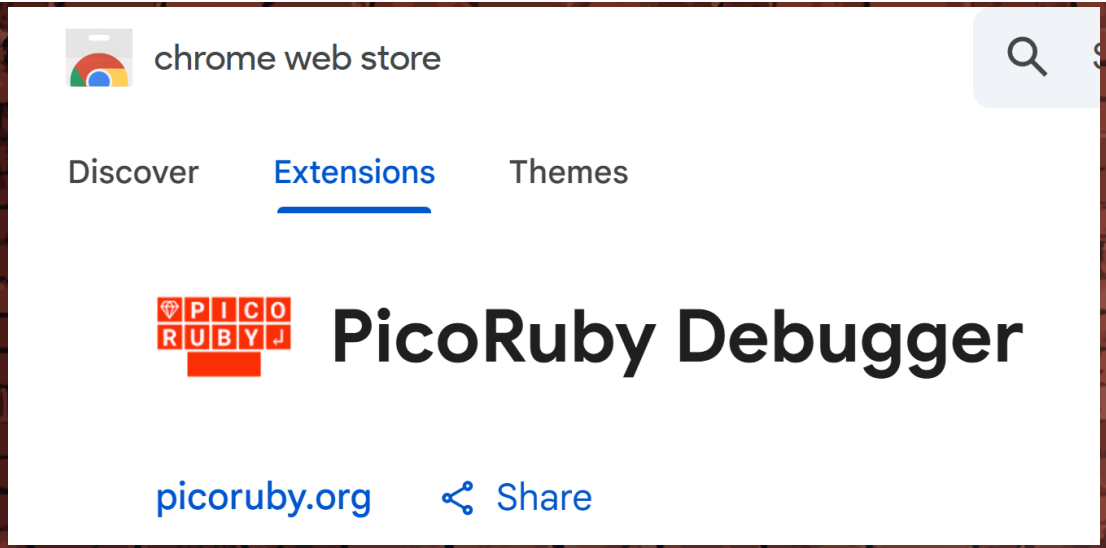
Eval

- Disable **`code_fetch_hook()`**
- **`debug_env_cxt_clear()`** to clear on-stack **`cxt`**

```
__b__ = $__debug_binding__
red  = __b__.local_variable_get(:red)
__r__ = (USER_CODE) # mrb_execute_proc_synchronously()
__b__.local_variable_set(:red, red)
__r__                  # `_` in IRB
```

- **`debug_env_cxt_restore()`** to restore **`cxt`**
- Enable **`code_fetch_hook()`**

Chrome Extension




```
<script src="https://cdn.jsdelivr.net/npm/@picoruby/
wasm-wasi@debug/dist/init.iife.js"></script>
<!--                ^^^^^ You need to use @debug -->
```

Chapter 2

Funicular on PicoRuby.WASM

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Demo : Tic-Tac-Toe (ReactJS)

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Demo : Tic-Tac-Toe on Funicular

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Funicular

- Single-Page Application framework
- Virtual DOM + Diffing
- Class-based Components
- Ruby DSL with no JavaScript
- Routing, State Management, etc.

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Demo : TODO APP

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How to Write Funicular: e.g. TODO APP

```ruby
class TodoApp < Funicular::Component
  def initialize_state
    { todos: [], input: "" }
  end

  def handle_input(event) # Update state
    patch(input: event.target[:value])
  end

  def handle_add(event) # Add new TODO
    new_todo = { id: Time.now.to_i, text: state.input, done: false }
    patch(todos: state.todos + [new_todo], input: "")
  end

  def render
    div do
      h1 { "Todo List" }
      input(value: state.input, oninput: :handle_input)
      button(onclick: :handle_add) { "Add" }
      state.todos.each do |todo|
        div(key: todo[:id]) { todo[:text] }
      end
    end
  end
end

Funicular.start(TodoApp, container: 'app')
```

How to Patch

```
Component#patch
  └─ Component#component_will_update # If callback exists
     @state.merge(normalized_state)
     Component#re_render
       └─ patches = VDOM::Differ.diff(@vdom, new_vdom)
          VDOM::Patcher.new.apply(@dom_element, patches)
     Component#component_updated     # If callback exists
```

(Nothing special)

Funicular is implemented in pure Ruby

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Funicular: When to Use?

Funicular: When NOT to Use?

- Need performance: WASM overhead
- Large scale with complex state management:
  We still don’t have the best practice
- Reliability required: Nobody uses it yet
- SEO critical: No SSR support (for now...but...)

Finally, We Have

Truly Practical Full-Stack Ruby

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Ruby for Server?

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Demo : Keyboard

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Server: PicoRuby on Keyboard

```ruby
kb = Keyboard.new([12,11,10,9,8], [7,6,5,4,3,2]) # GPIO matrix
kb.add_layer { ... } # Set keymap

pixels = Array.new(NUM_LEDS, 0) # LED color

Task.new do # Expose `pixels` via dRuby over WebSocket
  DRb.start_service('ws://0.0.0.0:9090', pixels)
  DRb.thread.join
end

kb.on_tick do |_kb| # Callback from the main loop
  # Light LEDs according to the pixels
end

kb.start do |event| # Main loop
  USB::HID.keyboard_send(event[:modifier], event[:keycode])
end
```

Client: PicoRuby on Browser

```
pixels = DRb::DRbObject.new_with_uri("ws://#{ip}:9090")
new_pixels = [...] # 30 Integer
pixels.replace(new_pixels)
```

Both PicoRuby (microcontroller) and PicoRuby.WASM support **dRuby!!**

(via WebSocket in this case)

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Keyboard is Essentially Ruby

Second time since 2021

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Ideas for Full-Stack Ruby

- CRuby for AWS Lambda function
- PicoRuby for IoT device (Pi Pico and ESP32)
  - Supports WebSocket & MQTT w/ TLS and BLE
  - You can expose config via dRuby for development
  - PicoRuby.WASM for browser configurator

“Funicular” 🤔

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Funiculí-funiculá funiculí-funiculá

https://ja.wikipedia.org/wiki/ヴェスヴィオ

Funicular is a Cable-Driven Railway

- Obviously targeting 
- But RubyKaigi talks aren’t supposed to be about 

Demo : Chat APP

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I’ve Been Workin’ on the Railroad 

-  integration: Initializer and Asset pipilne
- Object-REST Mapper: **`Funicular::Model`**
- ActionCable-compatible WebSocket
-  -like form builder
- Debugging mode vs Production mode

To Be Continued


Kaigi on

(if accepted)

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Stargaze at 🌟

github.com/picoruby/picoruby

Tic-Tac-Toe in depth 👀

picoruby.org/wasm

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