Making Microworlds: A Framework for Making Sense by Making Things

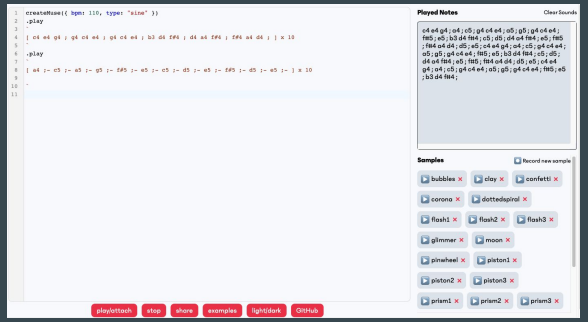
•••

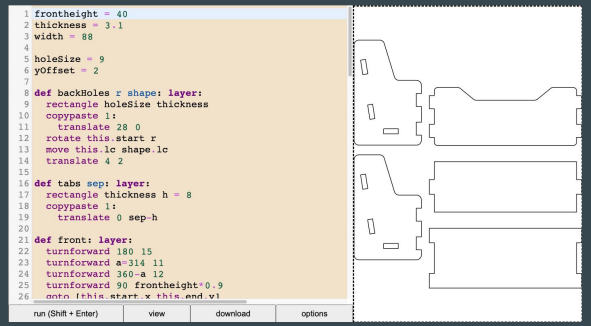
Leo McElroy
April 14, 2022

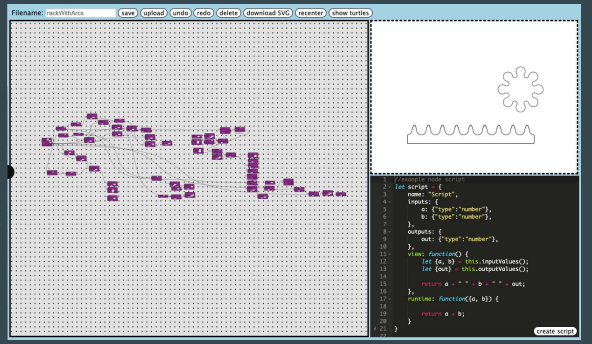
People learn best by making things they care about, which they share with others.

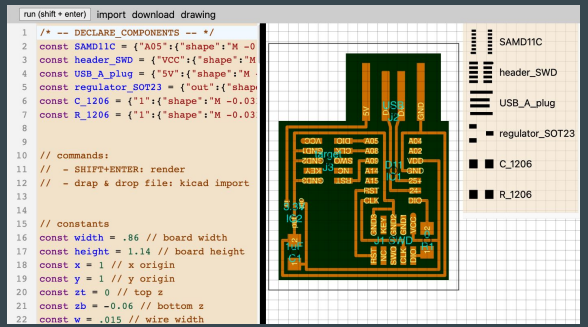
Physical Tools

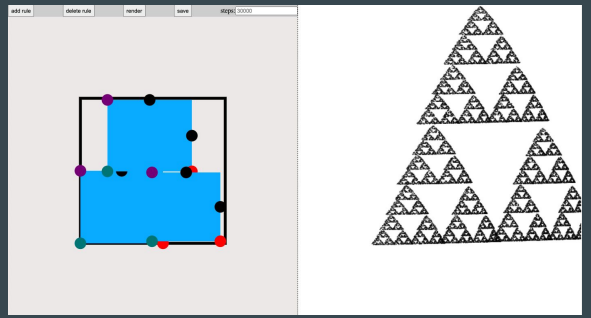
Digital Tools

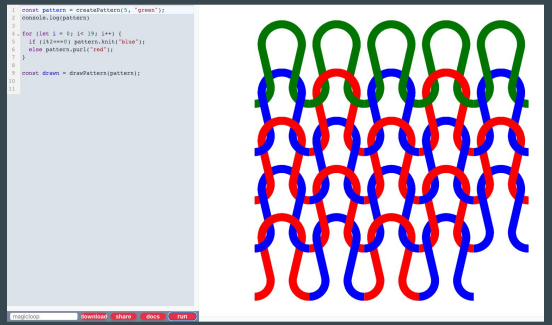












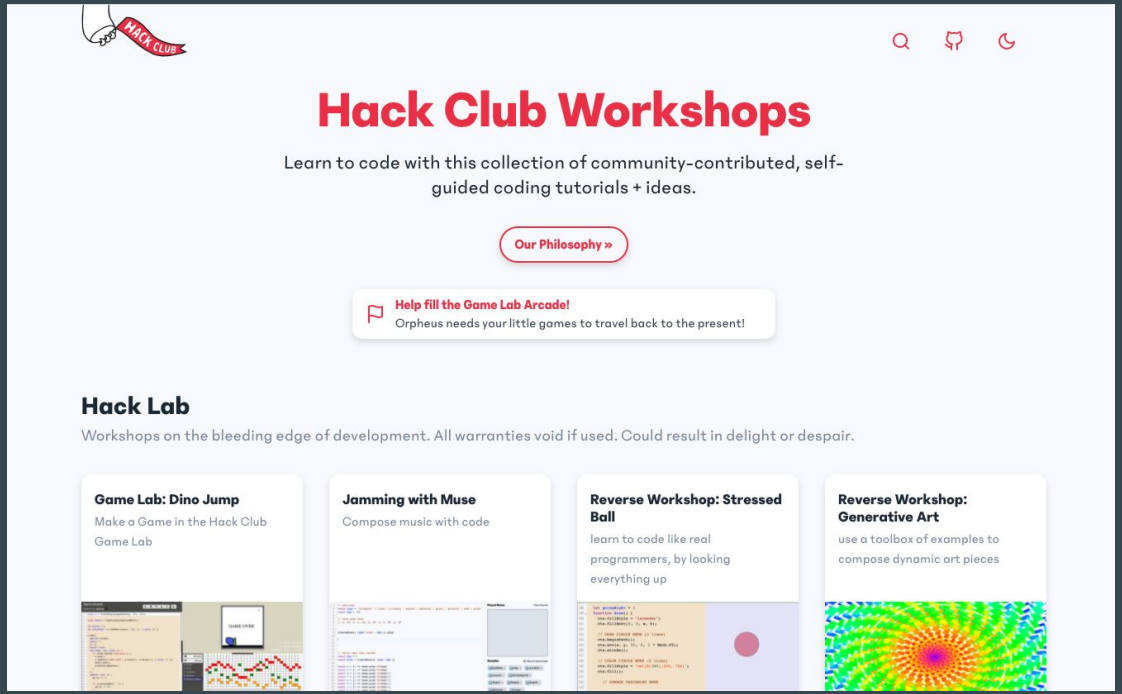
Some Guideposts

- The status quo: Hack Club Workshops
- Some history on Piaget, Papert, and microworlds
- A tour of microworlds
- Distill qualities of microworlds to help us make more

Hack Club

https://map.hackclub.com/

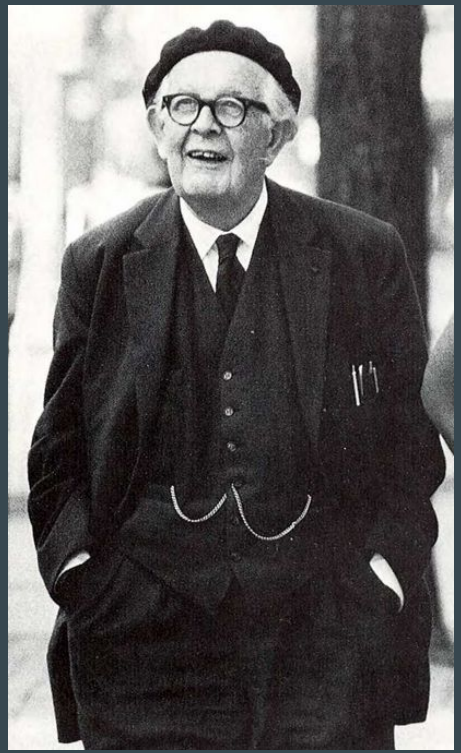
Status Quo: Hack Club Workshops



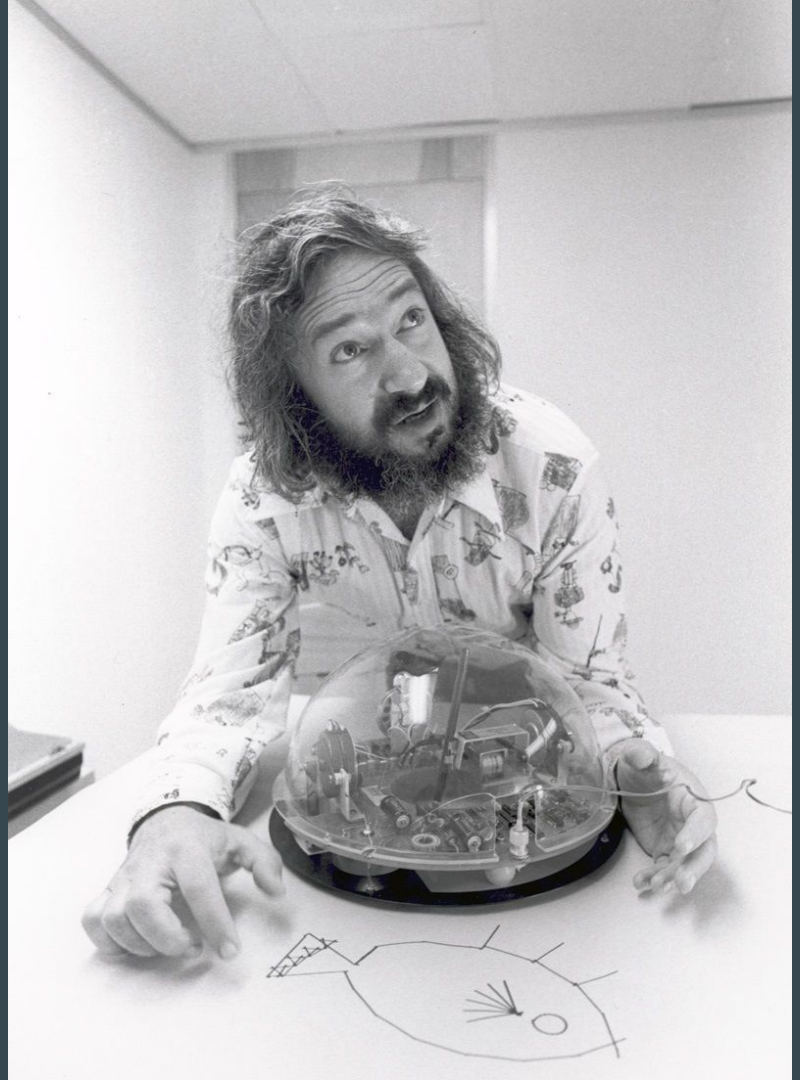
https://workshops.hackclub.com/

The Expository Model

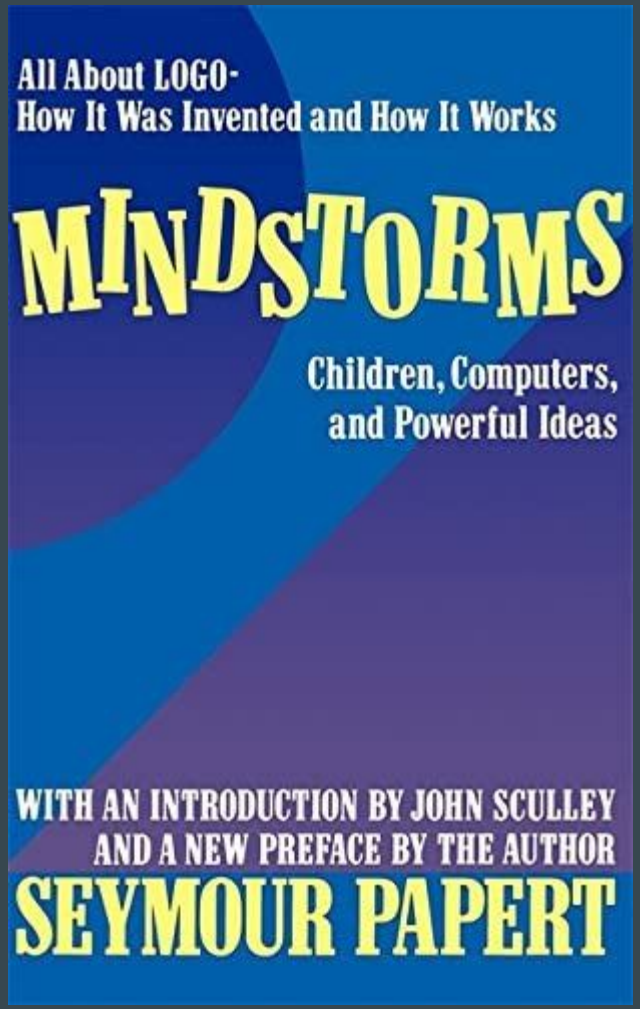
Piaget and the Bourbaki



Seymour Papert



Constructionism



Microworlds

“A growing place for a specific species of powerful idea or intellectual structure.”

Papert's Microworld Criteria

- Relate ideas to something you know
- Give the tools to make those ideas your own
- Offer "the possibility of activities that make activity matter (games, music, etc.)"
- All needed concepts should be available within the experience of the microworld

The First Microworld: Turtle Geometry

https://microworlds.hackclub.dev/?file=turtle

Newton's Turtles

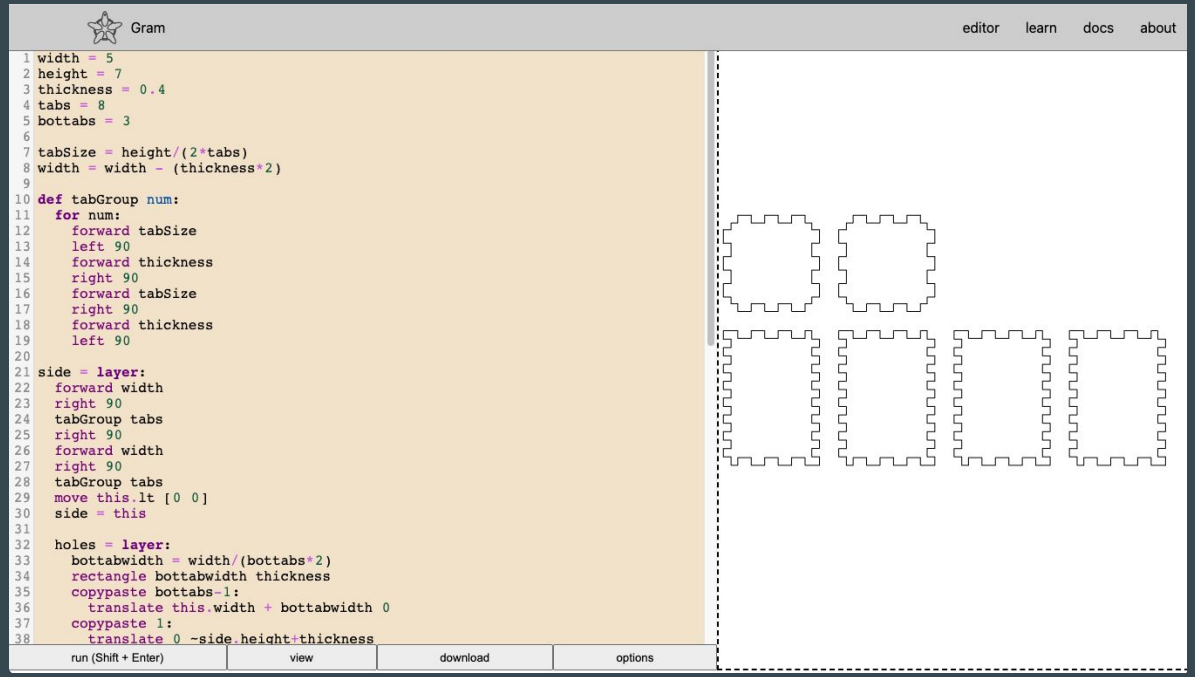
- Newton's Laws (2/3)
  - The Law of Inertia: a body remains at rest, or in motion at a constant speed in a straight line, unless acted upon by a force.
  - F = ma: when acted upon by a force the time rate of change of its momentum equals the force.
- Laws for our microworld
  - Every Turtle remains in its state of rest until compelled by a command to change that state.
  - The Turtle's speed can be modified only by commands to change speed by some quantity.

Newton's Turtles

https://microworlds.hackclub.dev/?file=newts

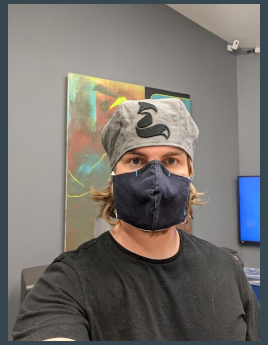
Using code to make things people want and understand.

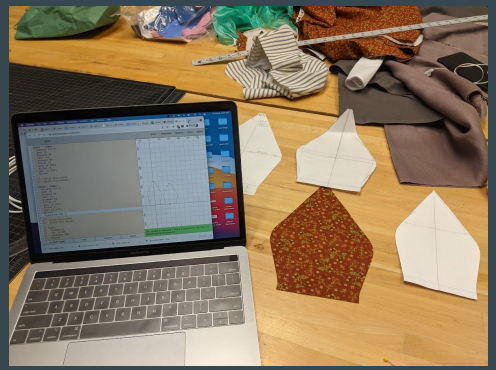
Gram Language



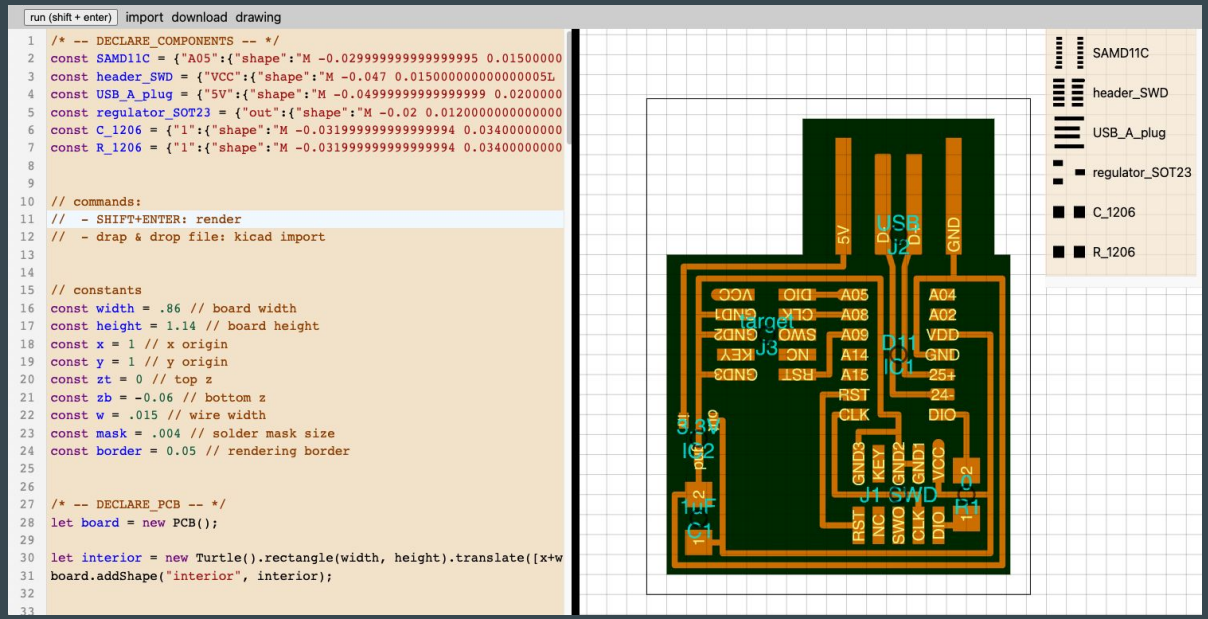
https://gramlanguage.com/#/home

Gram Language: Projects



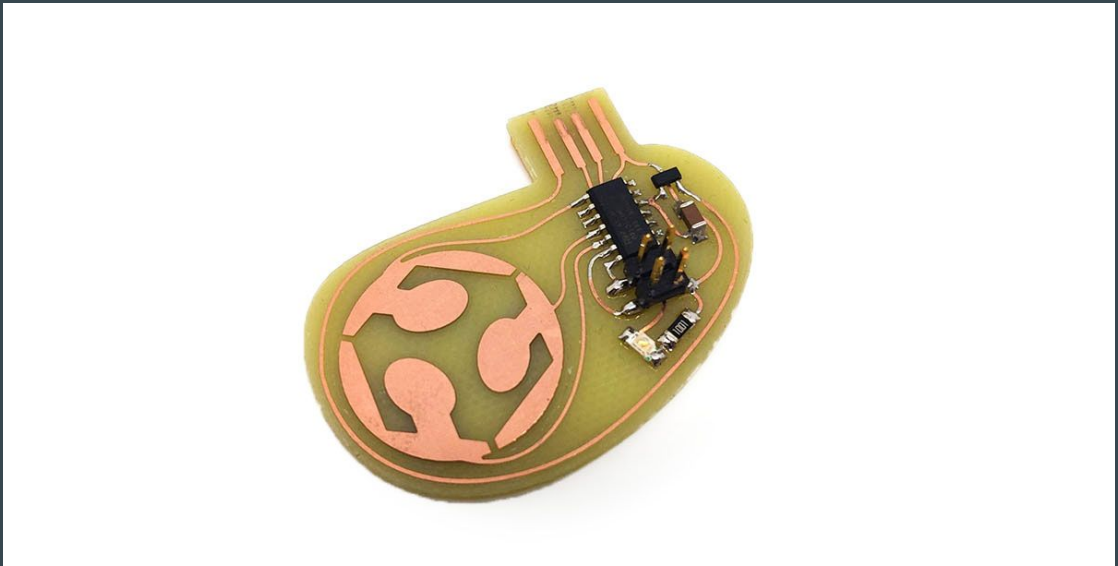


SVG PCB

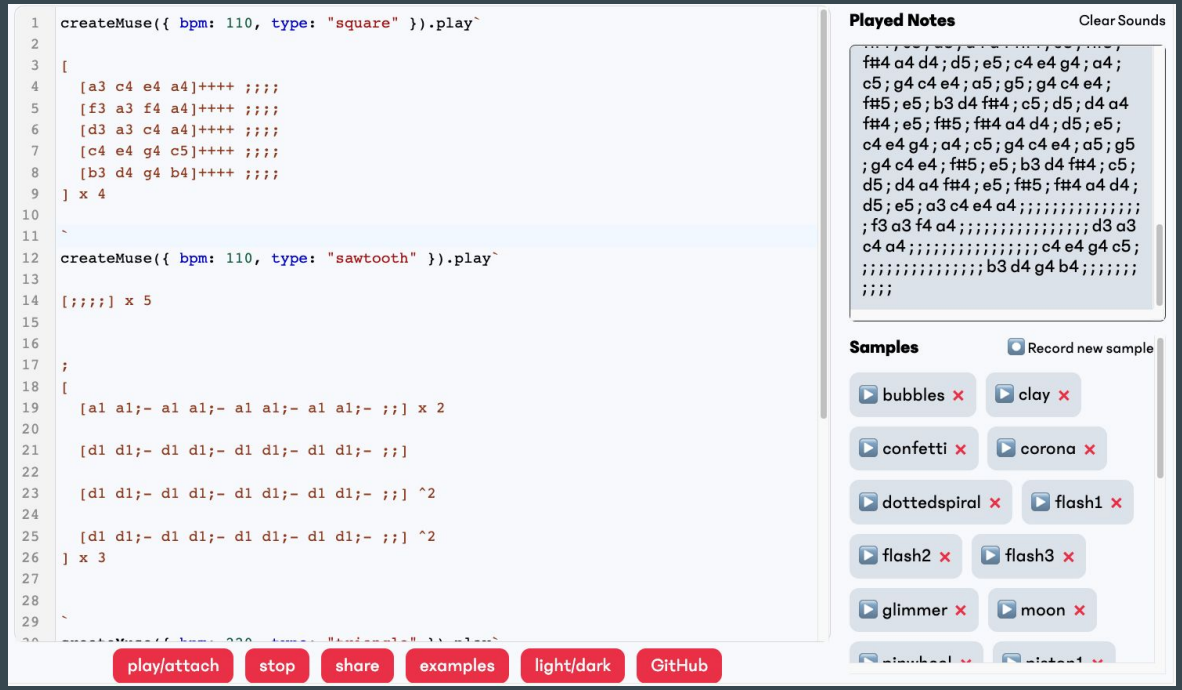


https://leomcelroy.com/svg-pcb-website/#/home

SVG PCB: Projects



Muse Language

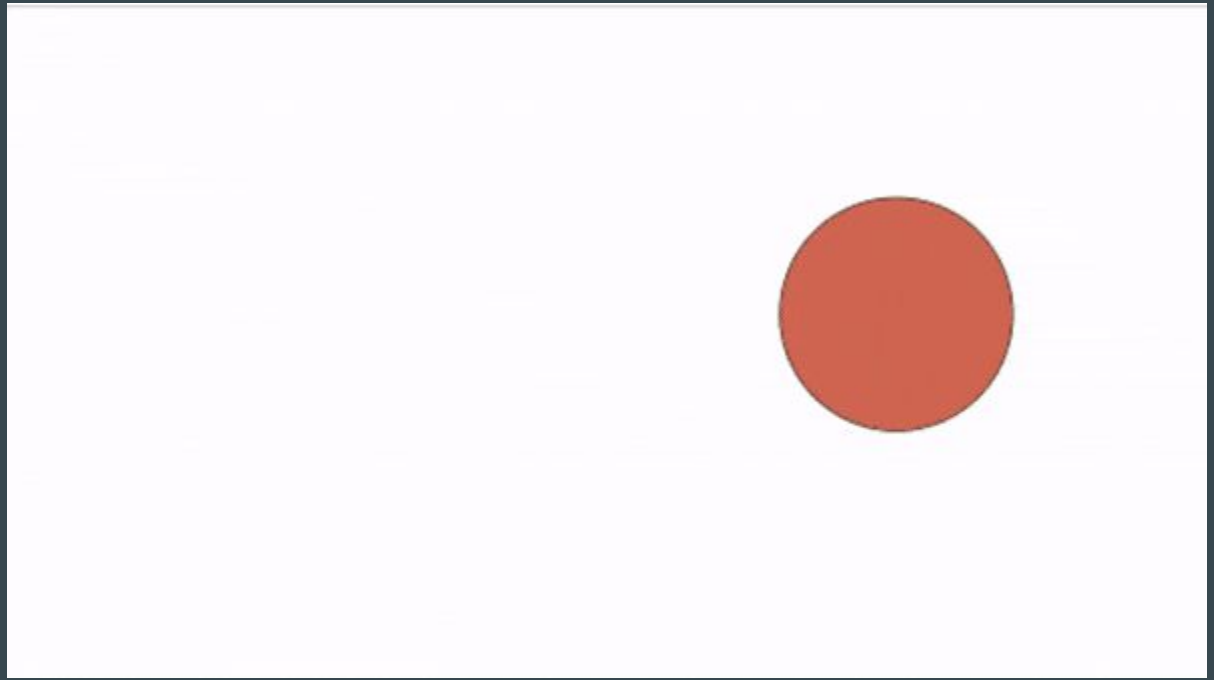


https://muse.hackclub.com/

Muse Tunes!

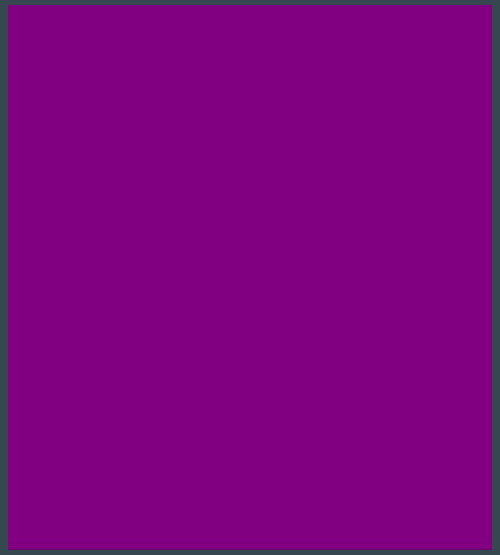
- Fill-Up Glassy
- Circus
- Twinkle-Twinkle
- Samples Sample
- Starter

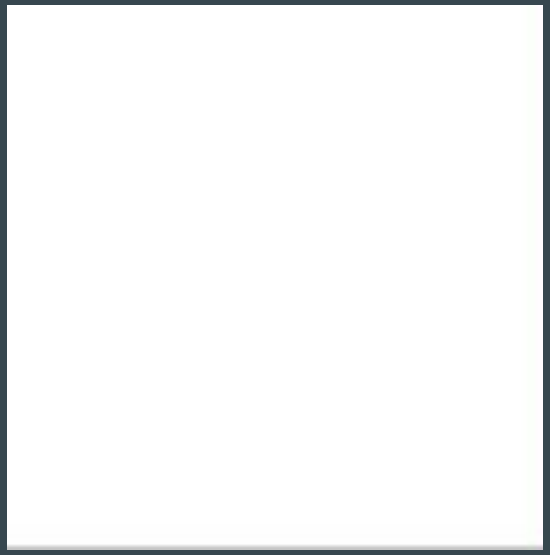
Reverse Workshop: The Stressed Ball



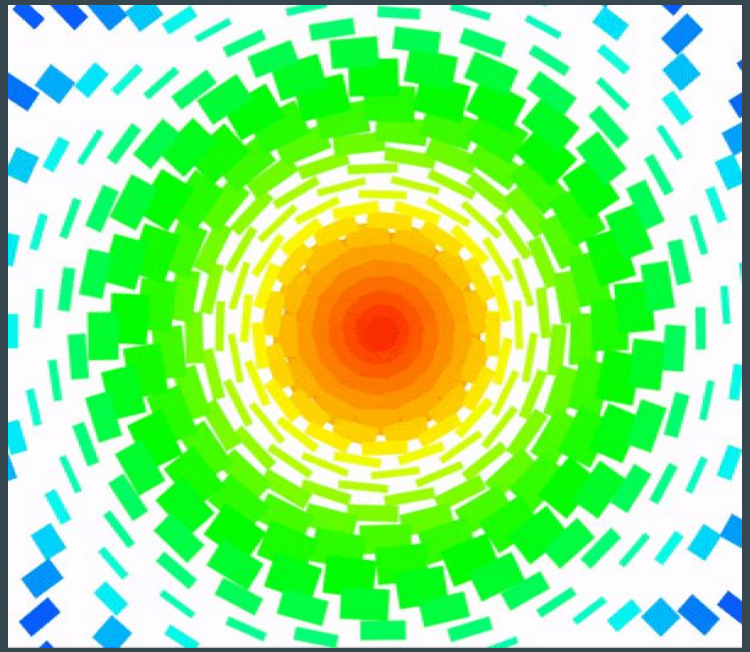
https://workshops.hackclub.com/stressed_ball/

Stressed Ball: Projects



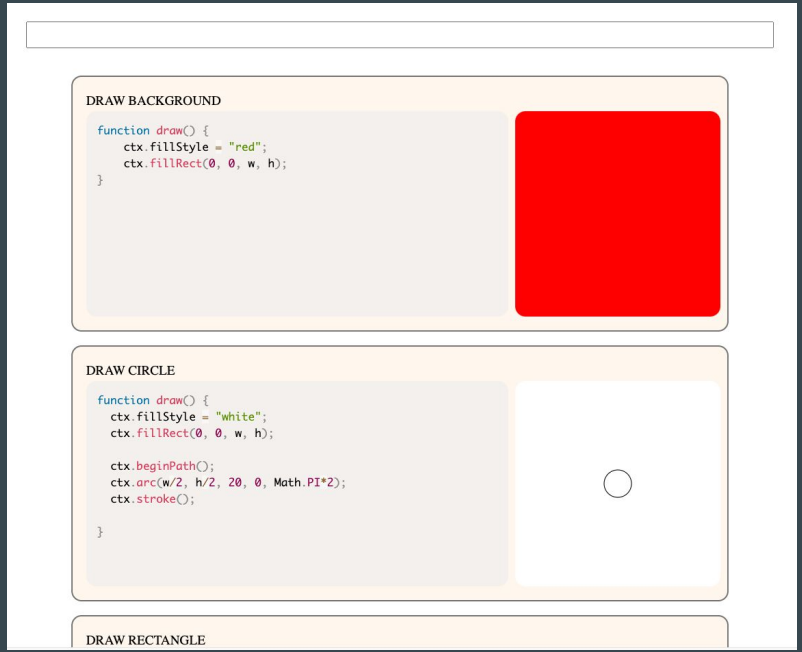


Reverse Workshop: Generative Art



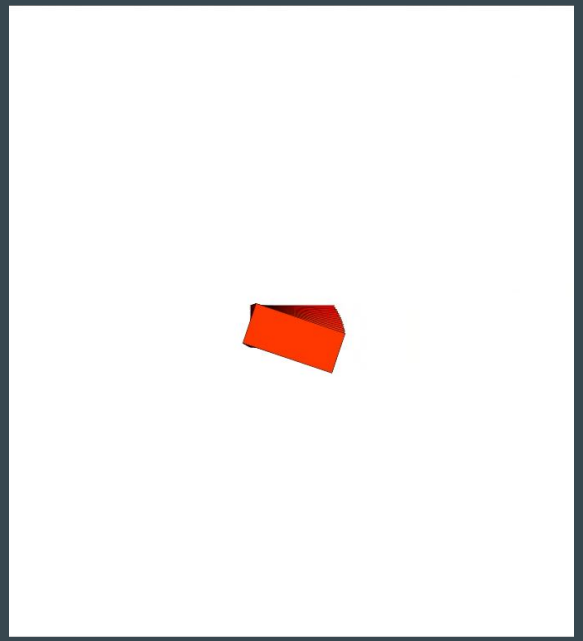
https://workshops.hackclub.com/reverse_workshop_generative_art/

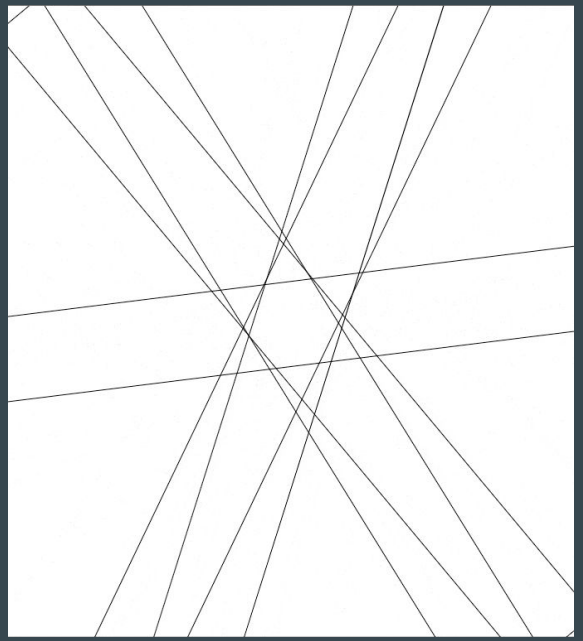
Generative Art: Example Sets

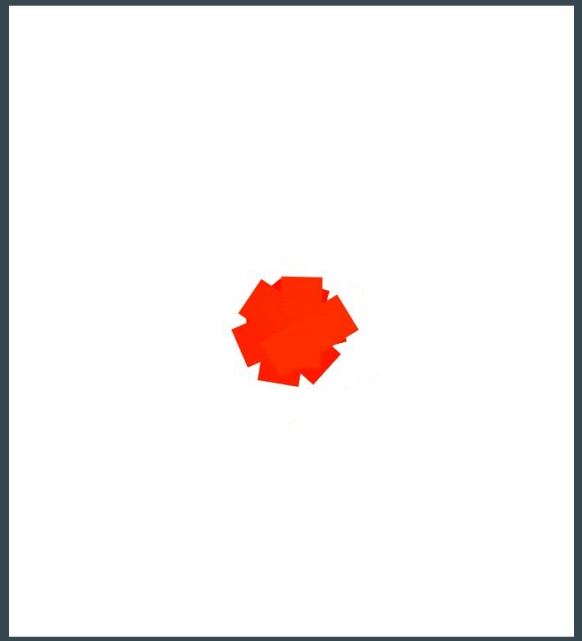


https://hackclub.github.io/js-canvas-examples/

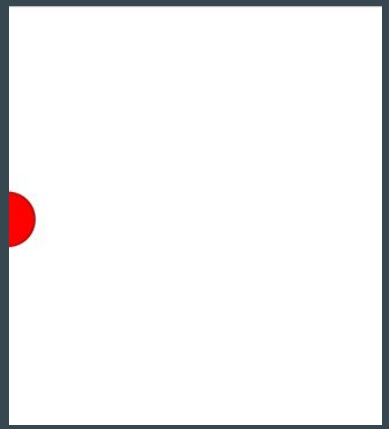
Generative Art: Projects

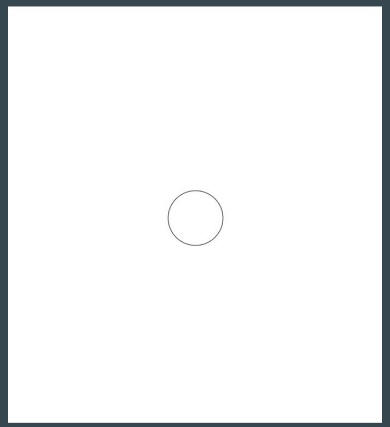


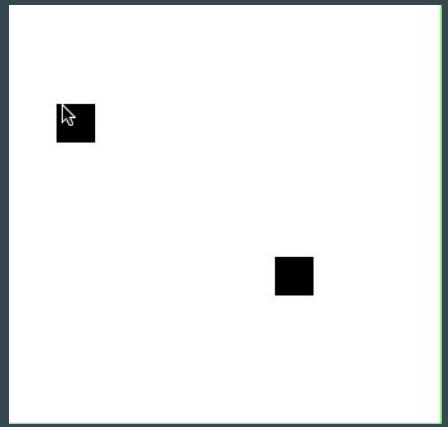


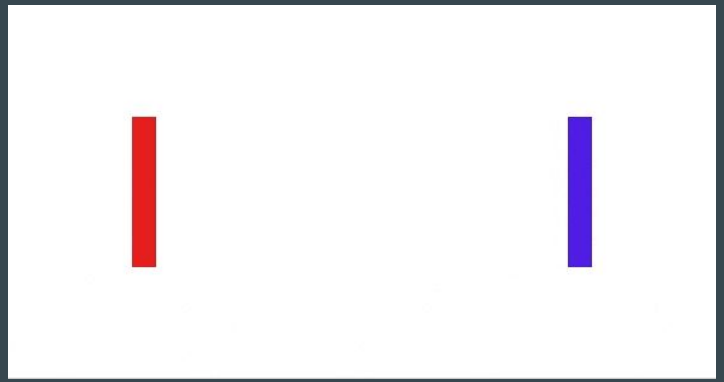


Generative Art Projects → Games

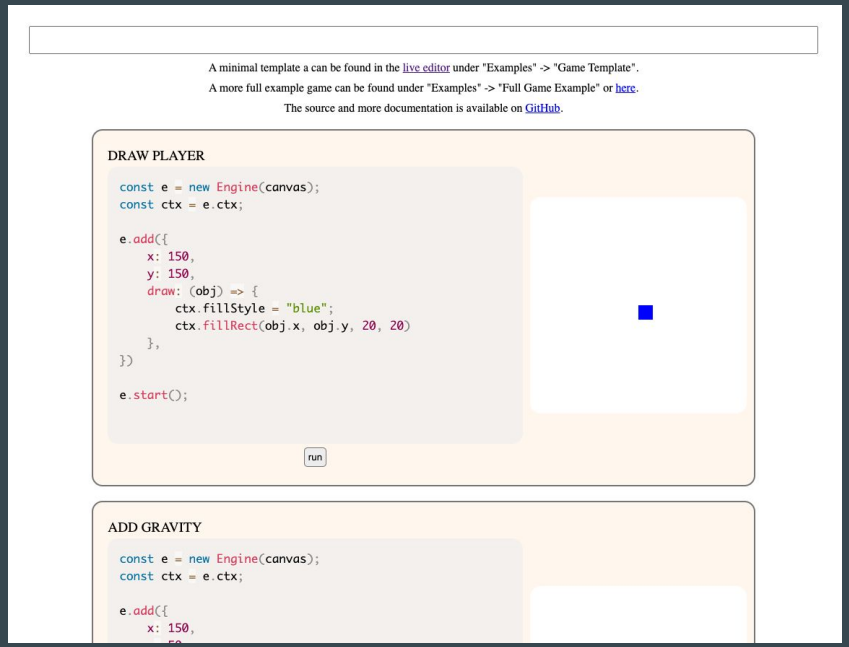






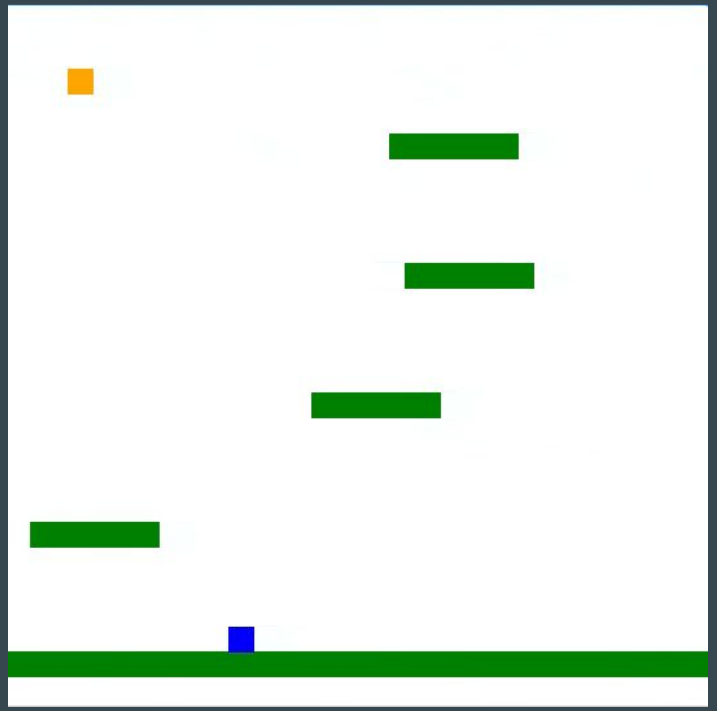


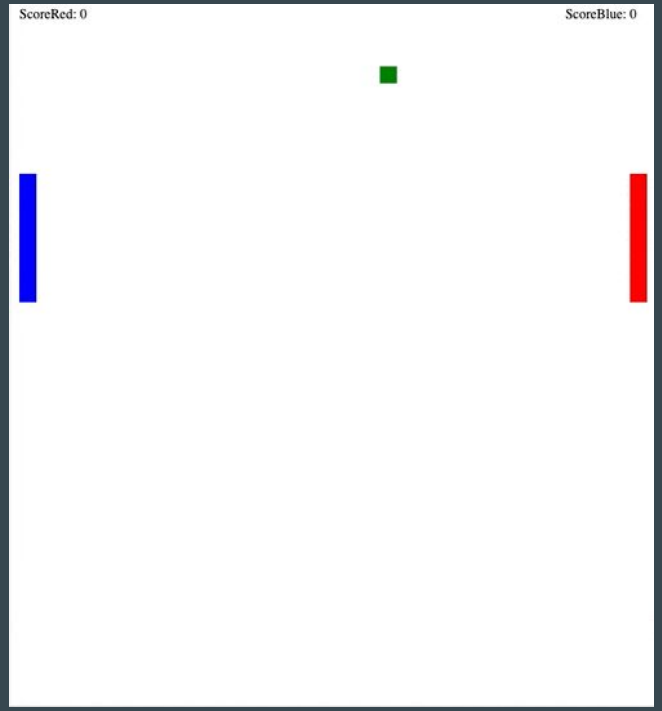
Tiny Game Engine



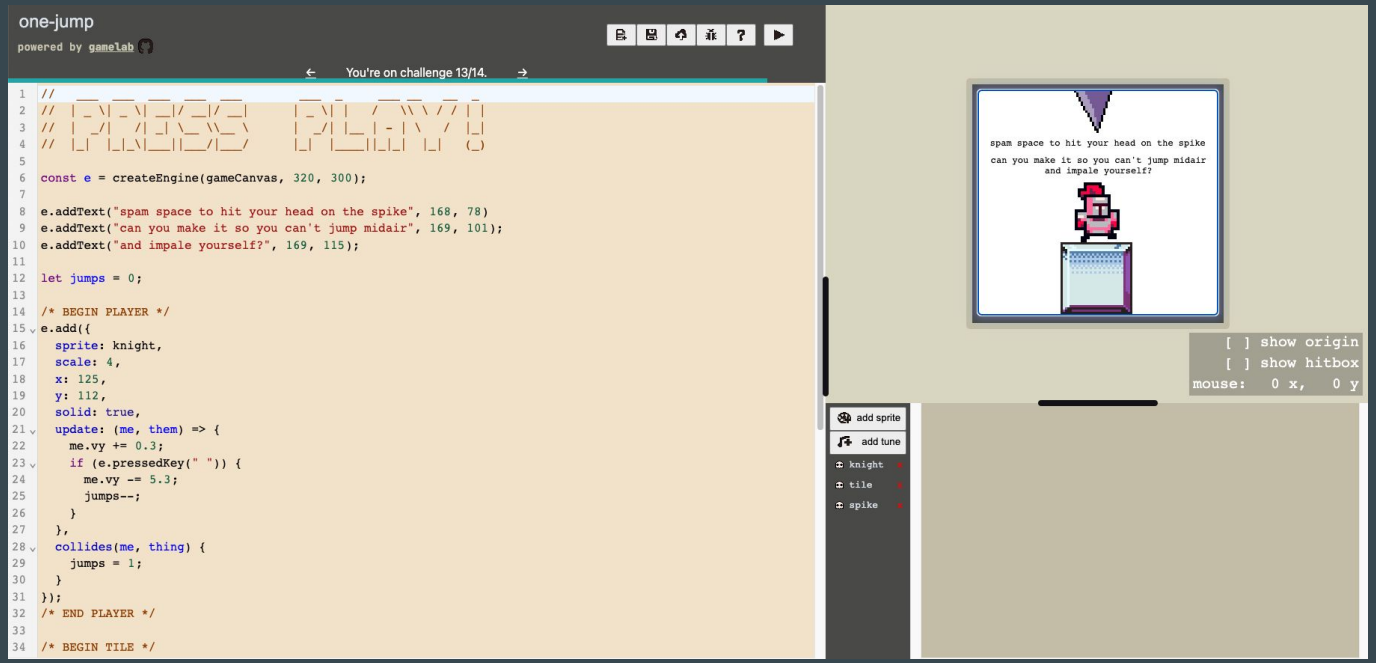
https://hackclub.github.io/mini-engine-examples/

Tiny Game Engine: Projects





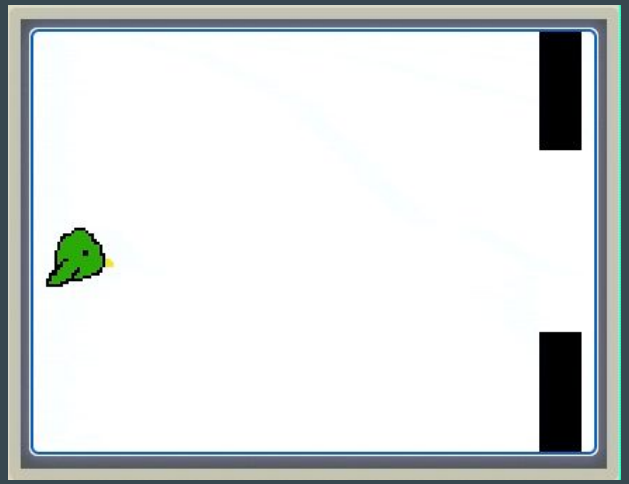
Microworld: Game Lab

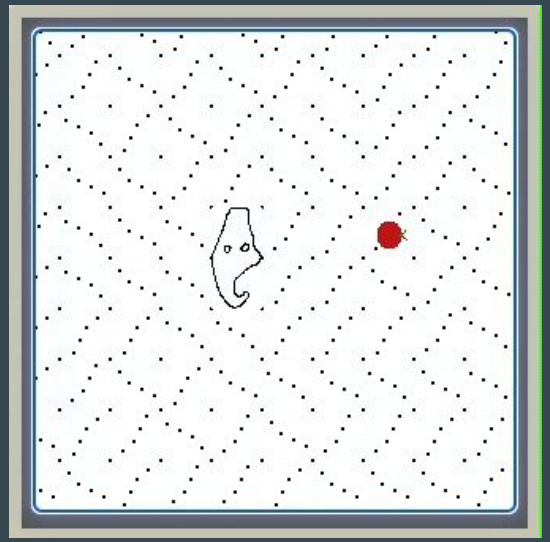


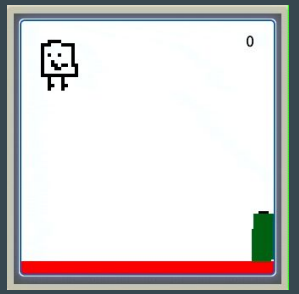

```
//  ___  ___  ___  ___  ___        ___  _    ___  __  __  _
//  | _ \| _ \| __|/ __|/ __|      | _ \| |   /  \ \ / / | |
//  |  _/|   /| _| \__ \\__ \      |  _/| |__ | - | \   /  |_|
//  |_|  |_|_\|___||___/|___/      |_|  |____||_|_|  |_|   (_)

const e = createEngine(gameCanvas, 320, 300);

e.addText("spam space to hit your head on the spike", 168, 78)
e.addText("can you make it so you can't jump midair", 169, 101);
e.addText("and impale yourself?", 169, 115);

let jumps = 0;

/* BEGIN PLAYER */
e.add({
  sprite: knight,
  scale: 4,
  x: 125,
  y: 112,
  solid: true,
  update: (me, them) => {
    me.vy += 0.3;
    if (e.pressedKey(" ")) {
      me.vy -= 5.3;
      jumps--;
    }
  },
  collides(me, thing) {
    jumps = 1;
  }
});
/* END PLAYER */

/* BEGIN TILE */
```

https://gamelab.hackclub.com/

Game Lab: Projects







The Construction Kit

Can be

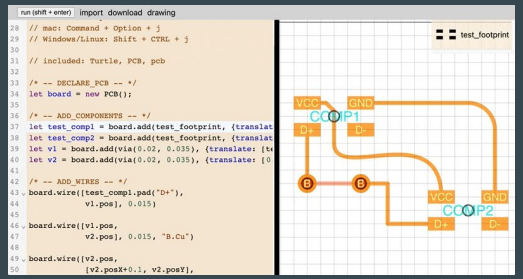
- Language
- Library

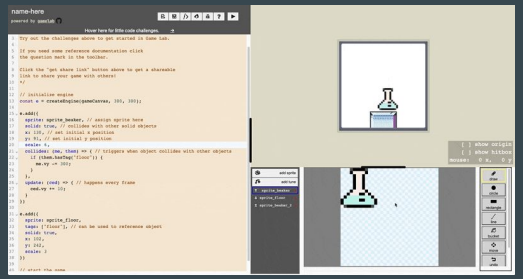
Should be

- Small, “mind-sized bites”
  - You should be able to hold it all in your head
- Composable
- Sufficiently specific to define a “species” yet sufficiently abstract to allow expression

The Environment (Reactivity)

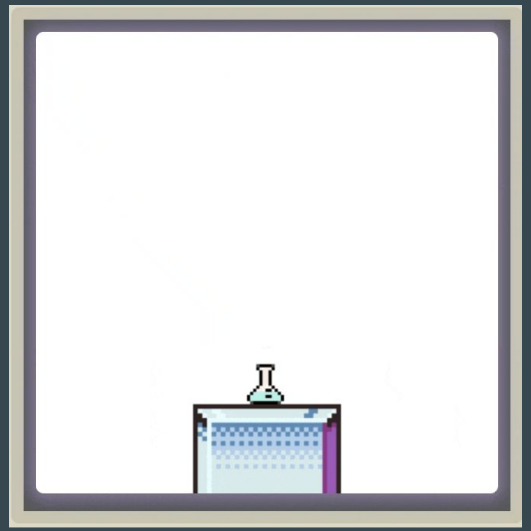
- Make ideas relatable
- Make activity matter
- Help the learner understand what they said
- Help them say what the mean

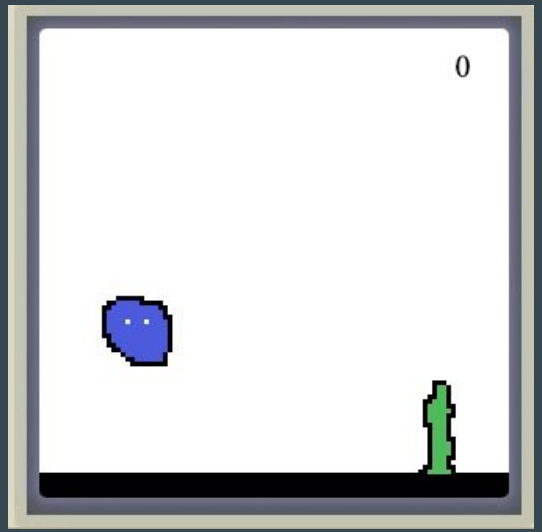




Examples and Documentation

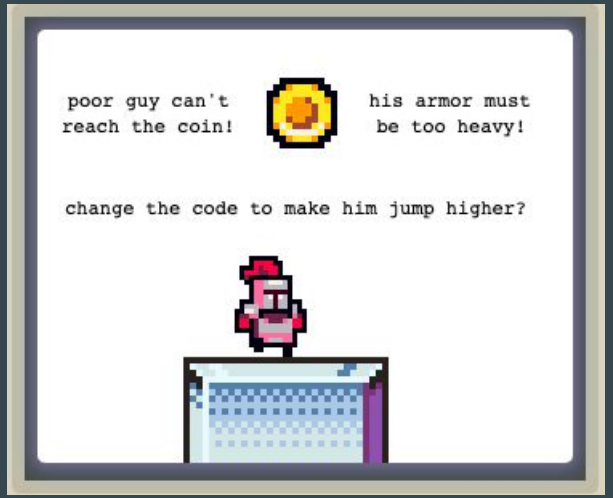
- Show us useful patterns
- Give us starting points
- Inspire us

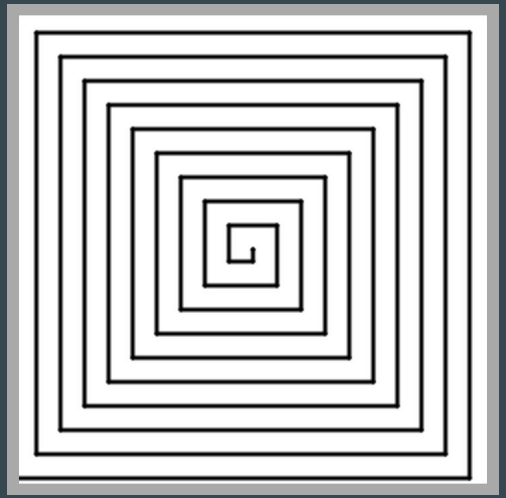




Prompts/Challenges

- Give a quest
- Don’t have to get where you direct them to, just need to get going





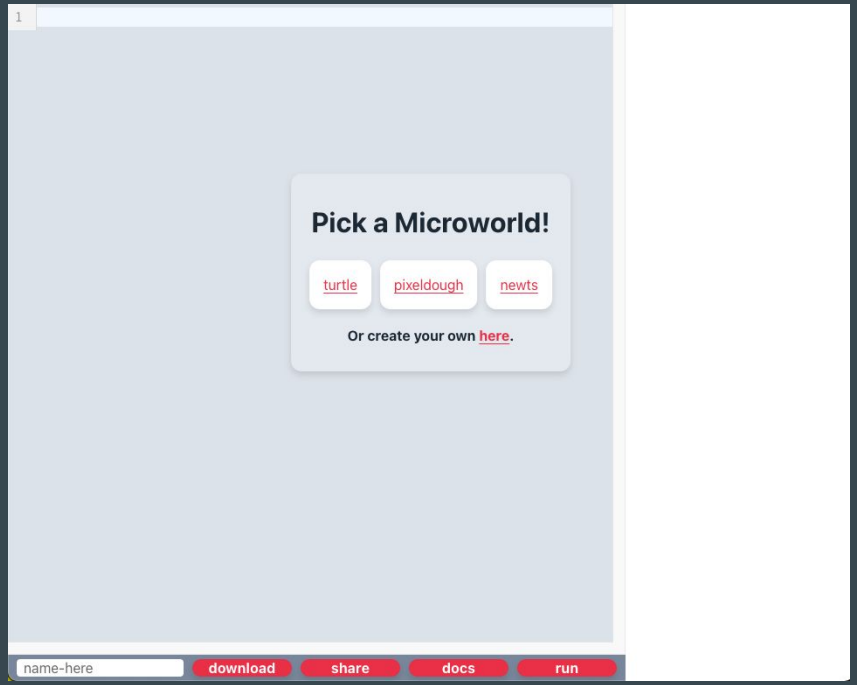
Sharing

- Make it easy to connect with a community

What's in our microworld?

- Powerful ideas
- A construction kit
- An environment
  - Helps us relate to ideas
  - Reflect on expressions
- Explanation on how to use our kit as examples
  - Shows useful patterns
  - Gives us a place to start
  - Inspires us
- A prompt to give us direction when starting
- A community to provide feedback and draw inspiration from

A Meta-Microworld



https://microworlds.hackclub.dev/

Thank you! Questions?

- leomcelroy.com
- Everything we saw today is open-source
  - https://github.com/hackclub/
  - https://github.com/leomcelroy/