Bloc for Pharo
Current State and Future Perspective

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Martín Dias
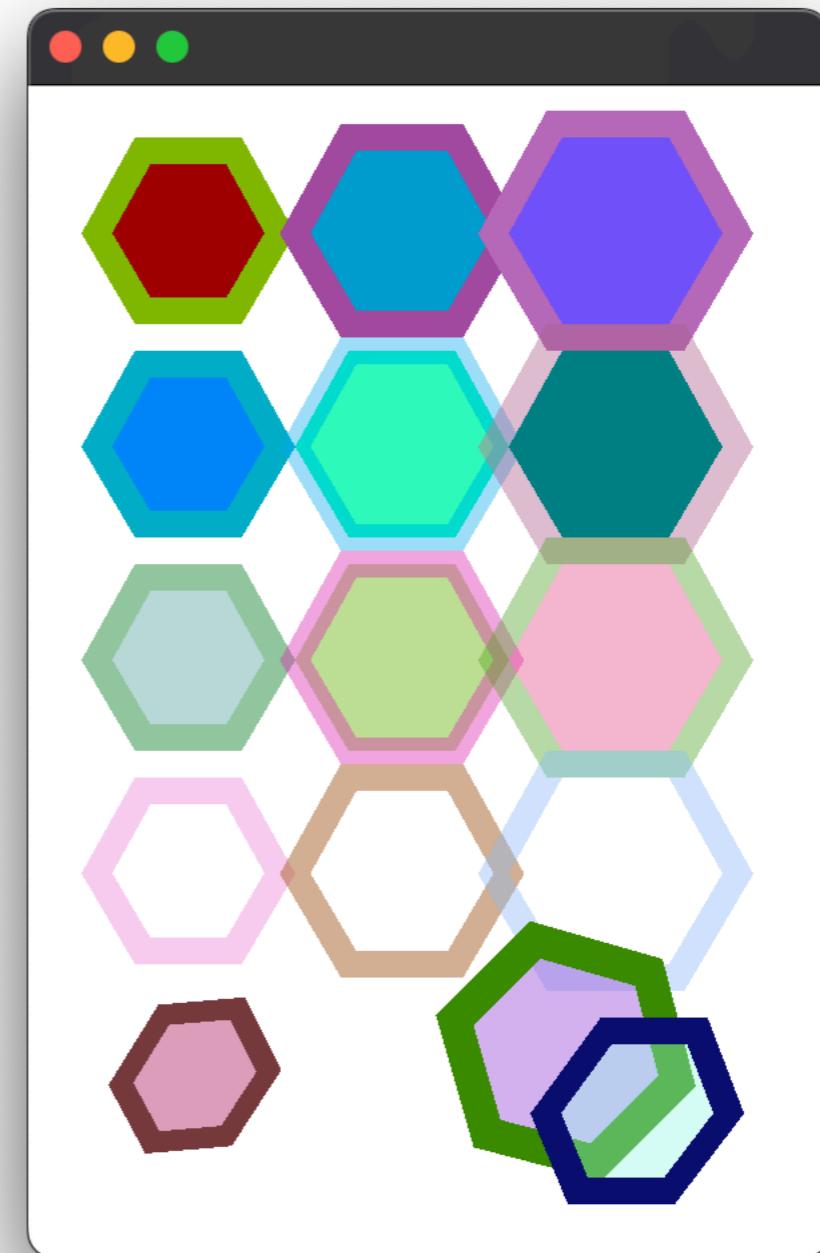
ESUG 2022 - Novi Sad

THALES
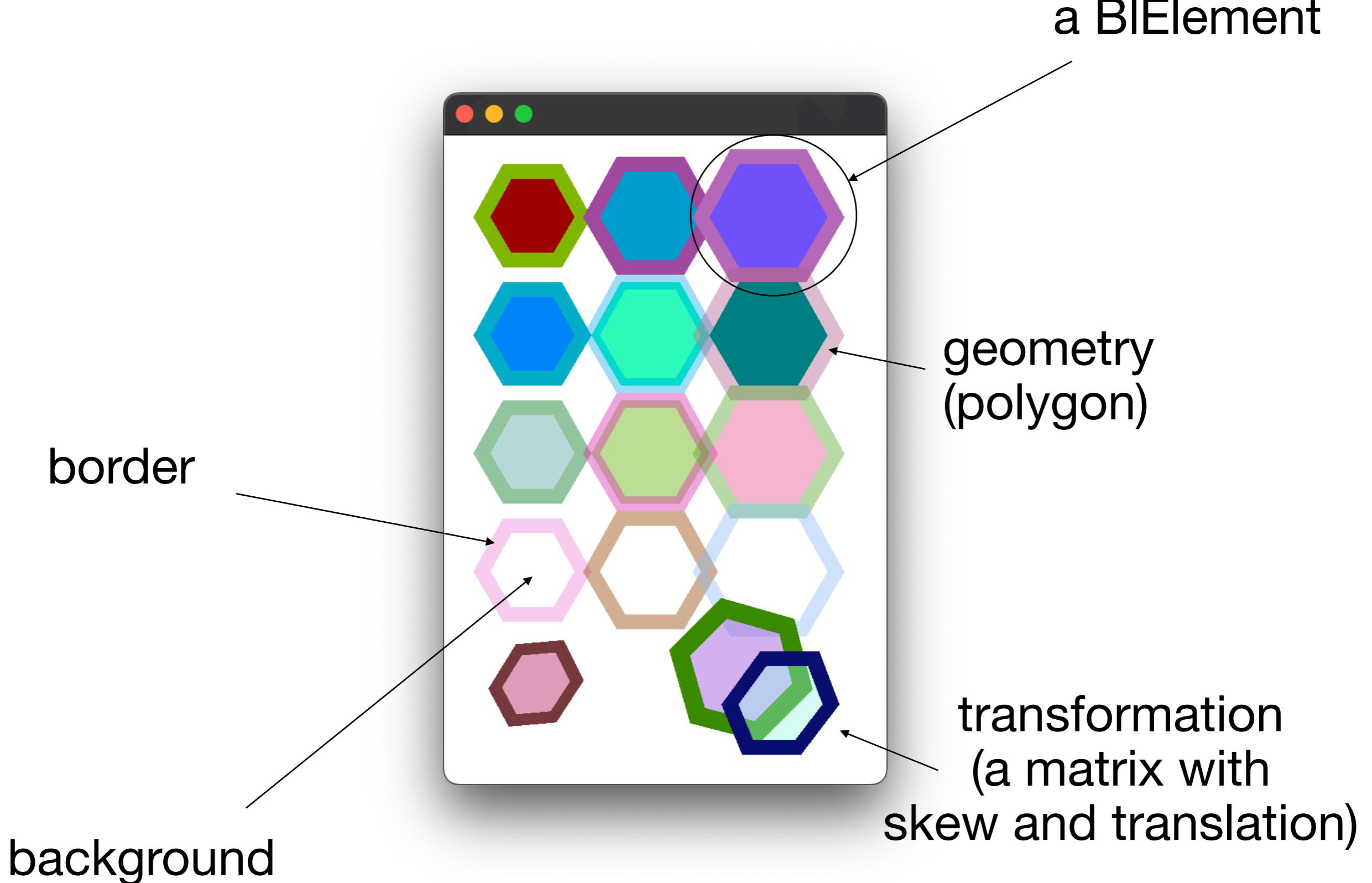
Pharo Consortium

# What is Bloc?
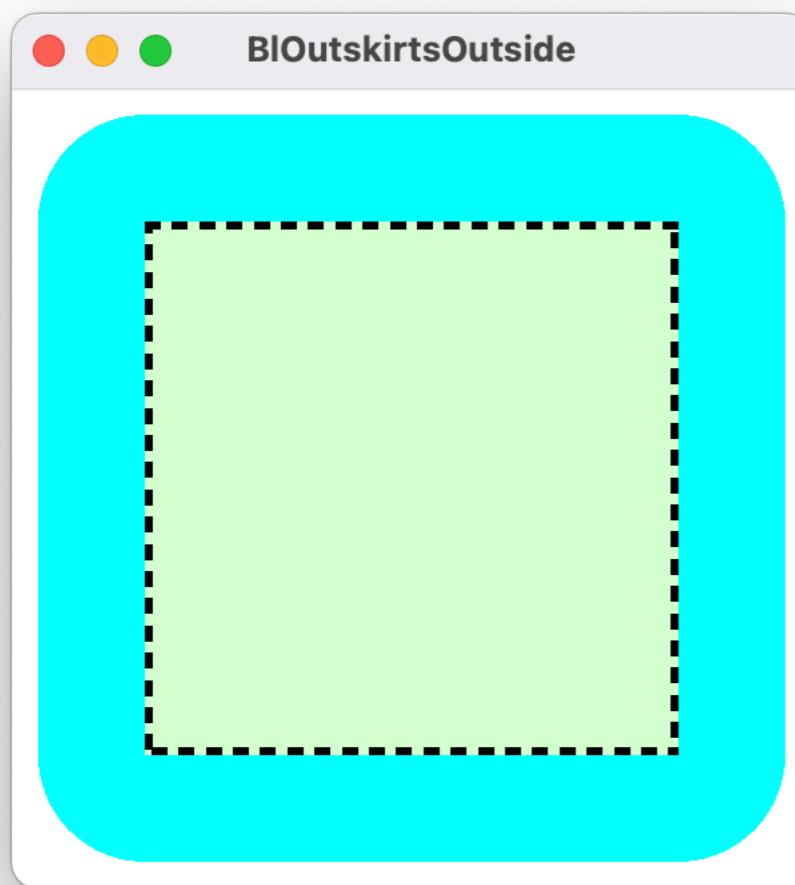
a low-level UI infrastructure & framework for Pharo
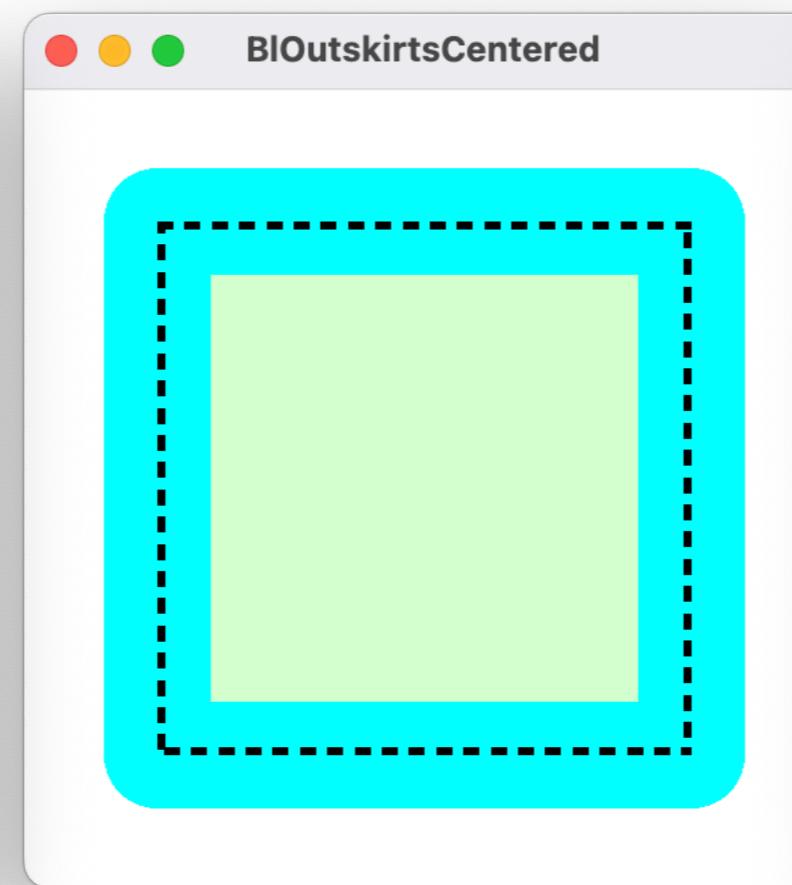
# Element's visual properties

a BIElement

geometry
(polygon)

border

background

transformation
(a matrix with
skew and translation)
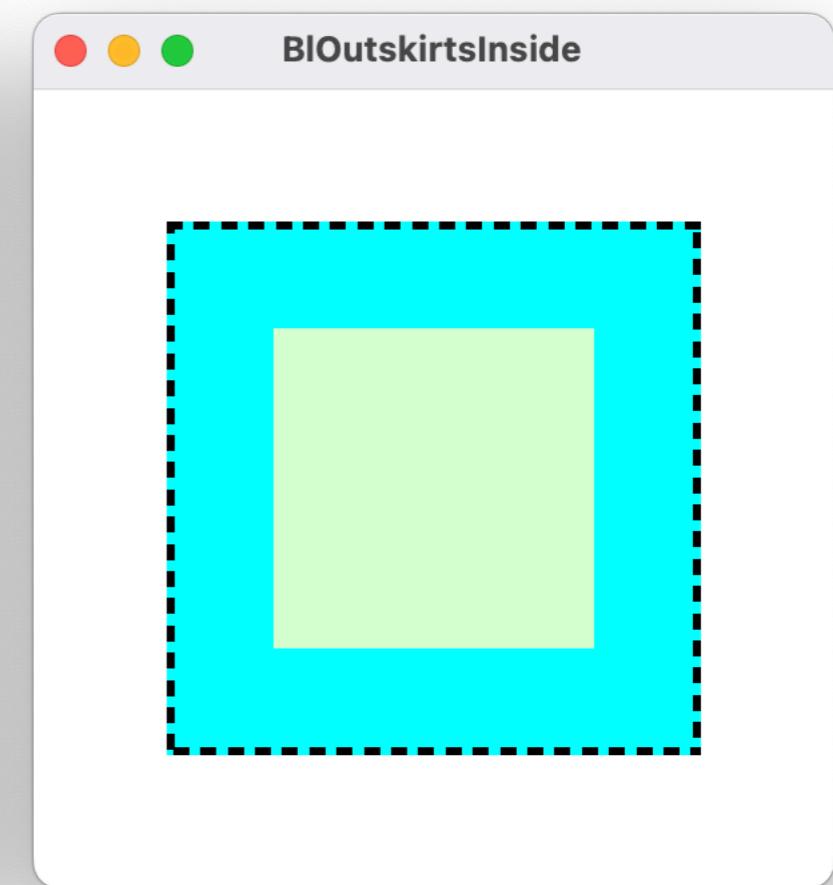
Element's outskirts

BlOutskirtsOutside

aBlElement
    outskirts:
        BlOutskirts outside

BlOutskirtsCentered

aBlElement
    outskirts:
        BlOutskirts centered
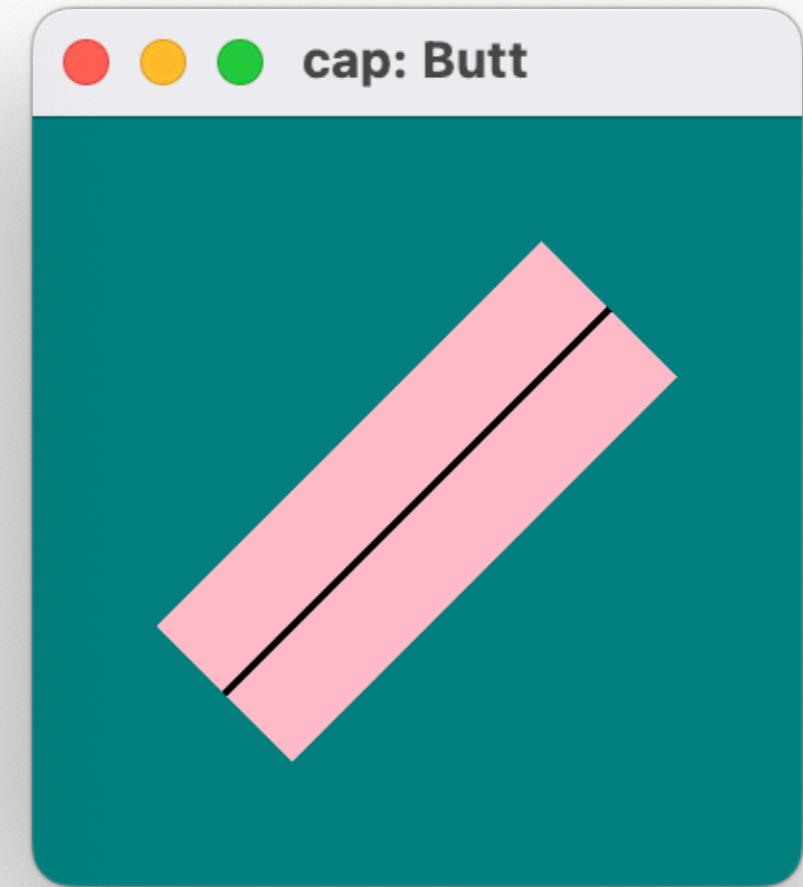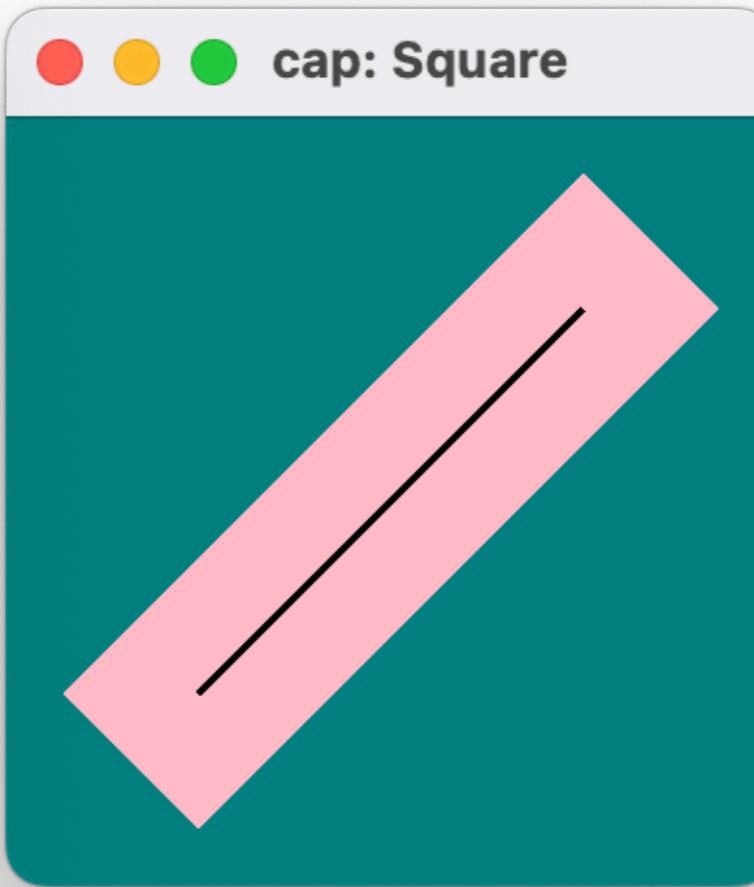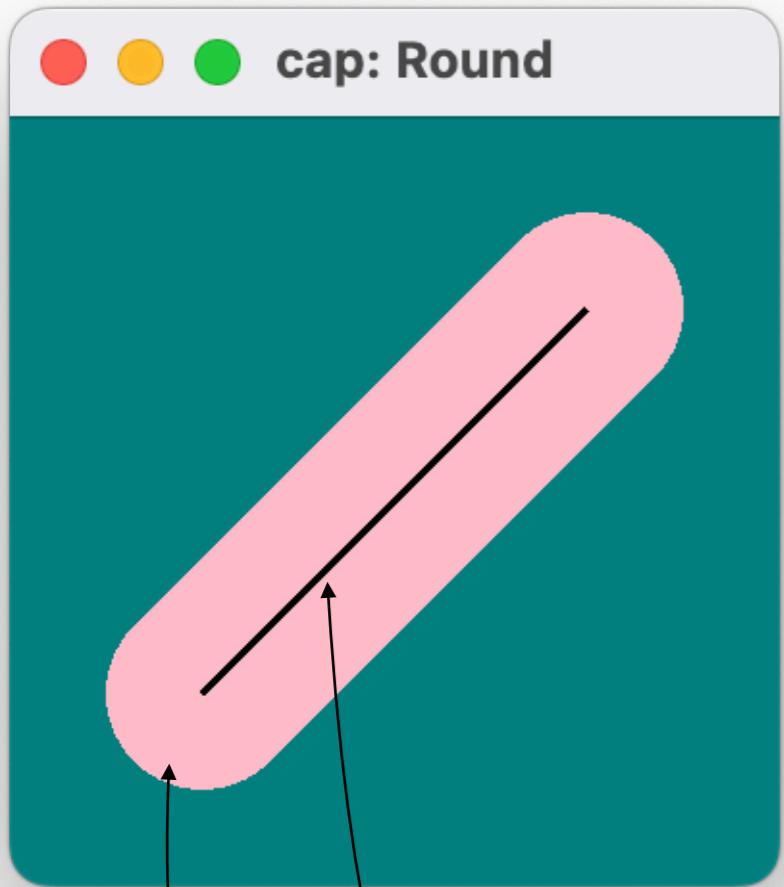
BlOutskirtsInside

aBlElement
    outskirts:
        BlOutskirts inside

Border's cap

cap: Round
cap: Square
cap: Butt

```
vertices := { 50@150. 150@50}.

referenceLine := (BlPolylineGeometry vertices: vertices) asElement.

capLine := (BlPolylineGeometry vertices: vertices) asElement.
capLine border: (BlBorder builder
                 paint: Color pink;
                 width: 50;
                 lineCap: BlStrokeLineCap round;
                 build)
```
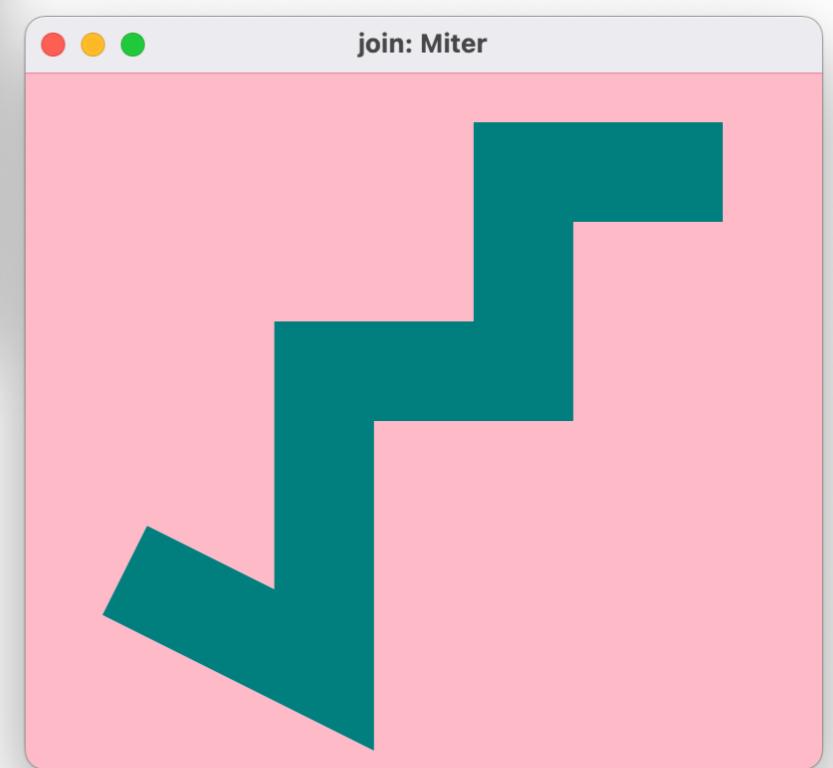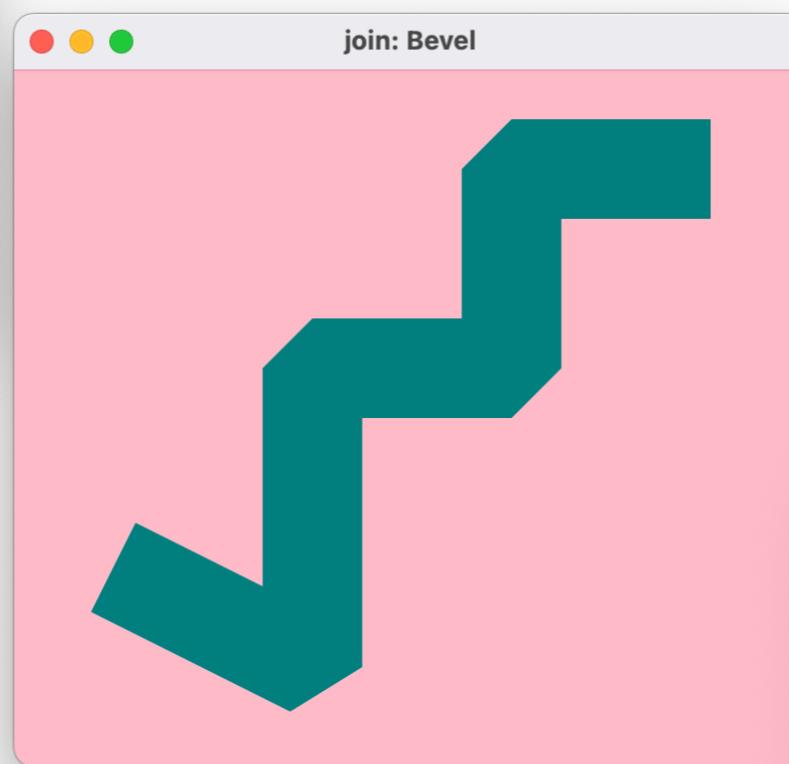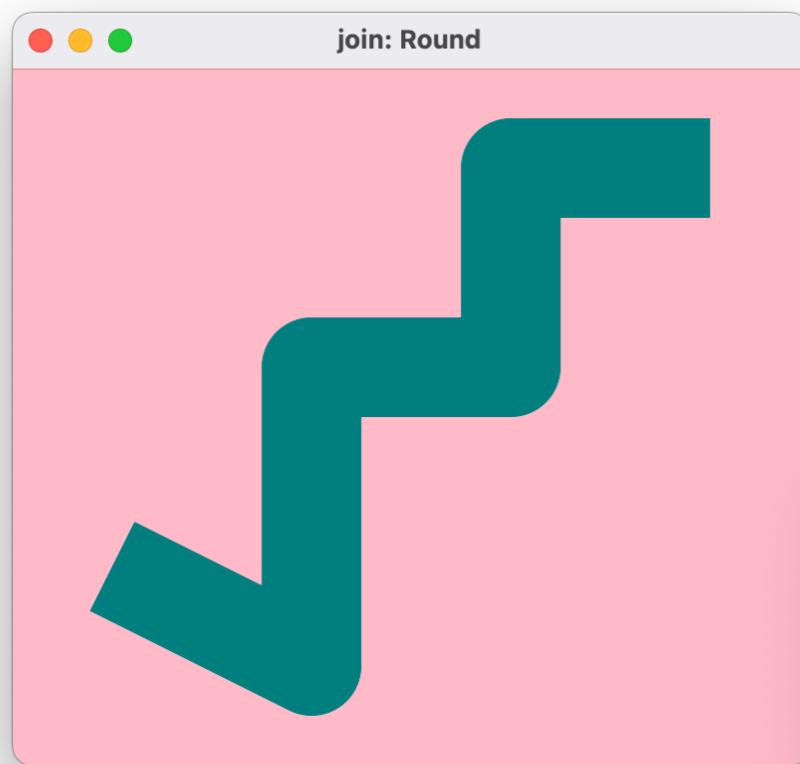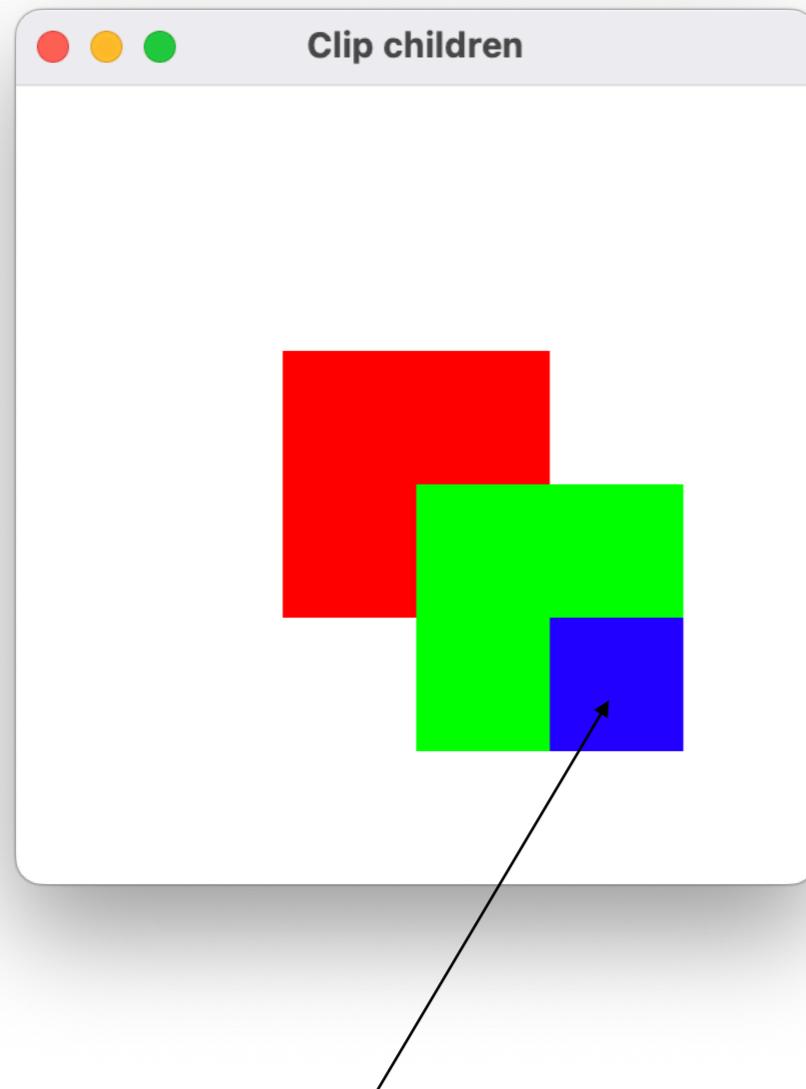
Border's join

join: Round

join: Bevel

join: Miter

Elements Tree & Clipping

Clip children

clipped

```
elementA := BlElement new
    size: 100 @ 100;
    background: Color red;
    relocate: 100 @ 100;
    clipChildren: false;
    yourself.


elementB := BlElement new
    size: 100 @ 100;
    background: Color green;
    relocate: 50 @ 50;
    clipChildren: true;
    yourself.
elementA addChild: elementB.


elementC := BlElement new
    size: 100 @ 100;
    background: Color blue;
    relocate: 50 @ 50;
    yourself.
elementB addChild: elementC.


BlSpace new
    addChild: elementA;
    show
```
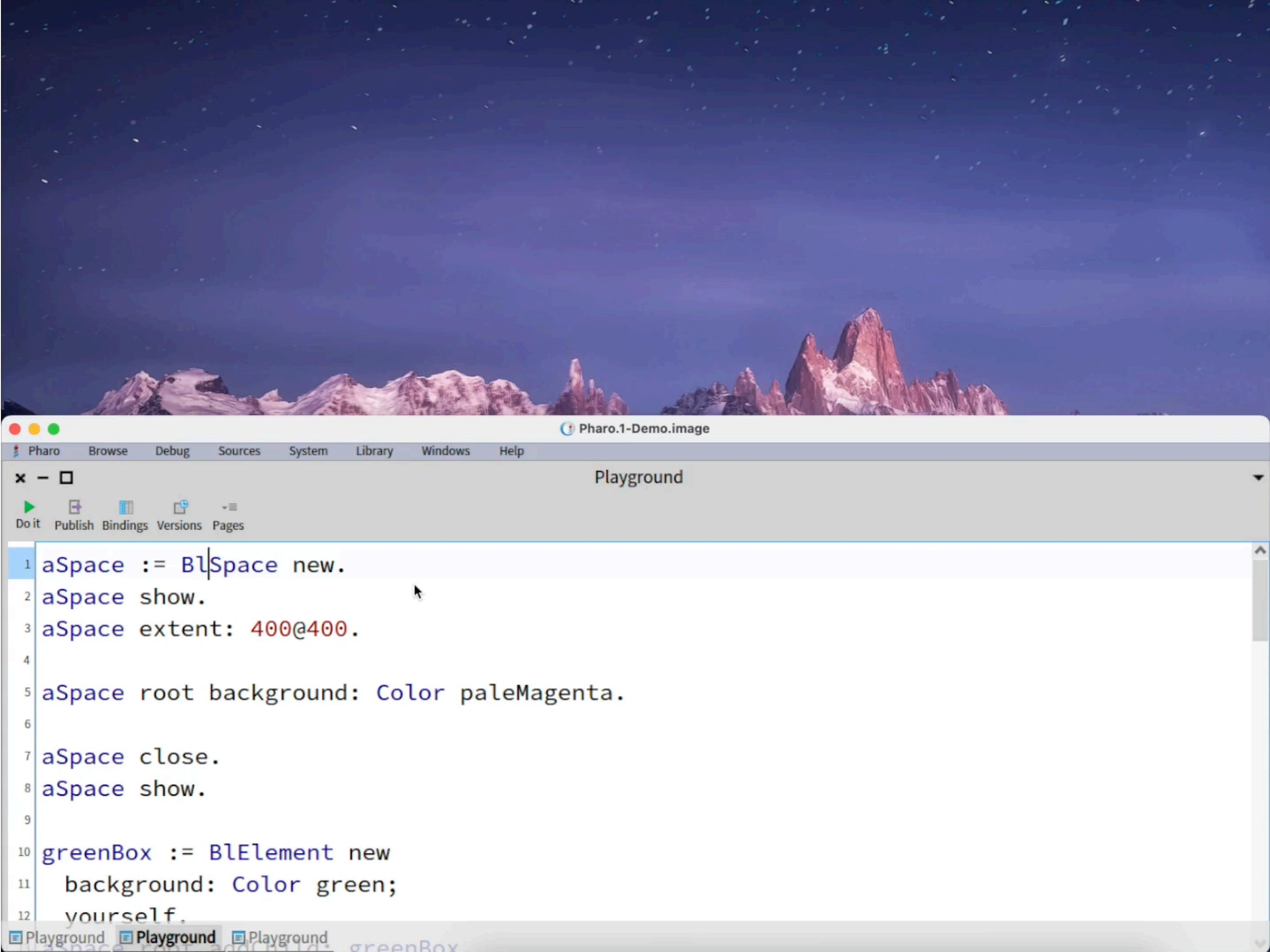
Playground

Do it   Publish   Bindings   Versions   Pages

```
1  aSpace := BlSpace new.
2  aSpace show.
3  aSpace extent: 400@400.
4
5  aSpace root background: Color paleMagenta.
6
7  aSpace close.
8  aSpace show.
9
10 greenBox := BlElement new
11   background: Color green;
12   yourself.
```

Playground   Playground   Playground

Space and Host
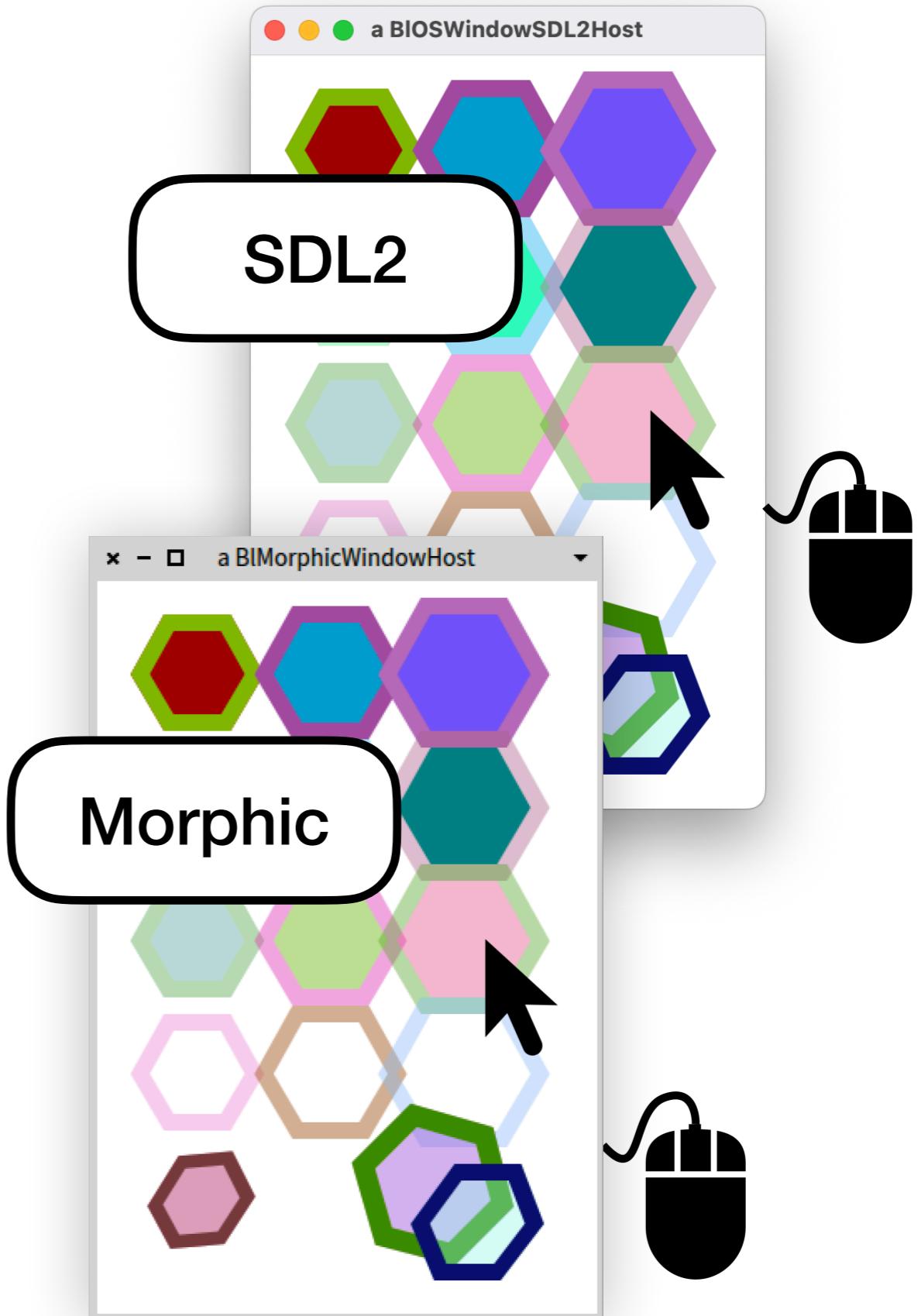
Options:

SPACE = "window"

SPACE has a HOST
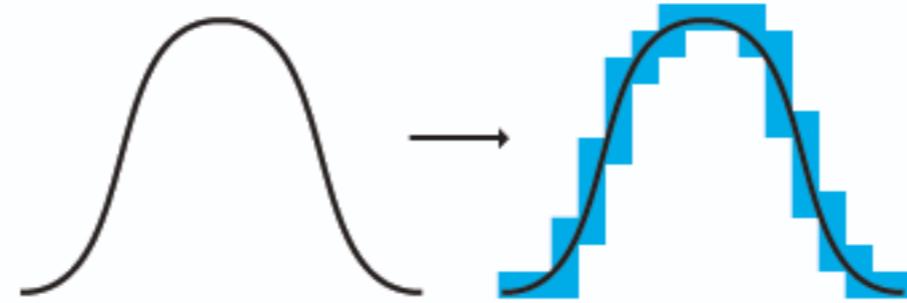
HOST provides a loop:
- events (e.g. mouse move)
- layout elements
- draw elements
- etc

Canvas

INPUT: a tree of BIElements

OUTPUT: pixels

Bloc options:

Sparta

SKIA

Sparta

cairo

Alexandrie

NEW

cairo
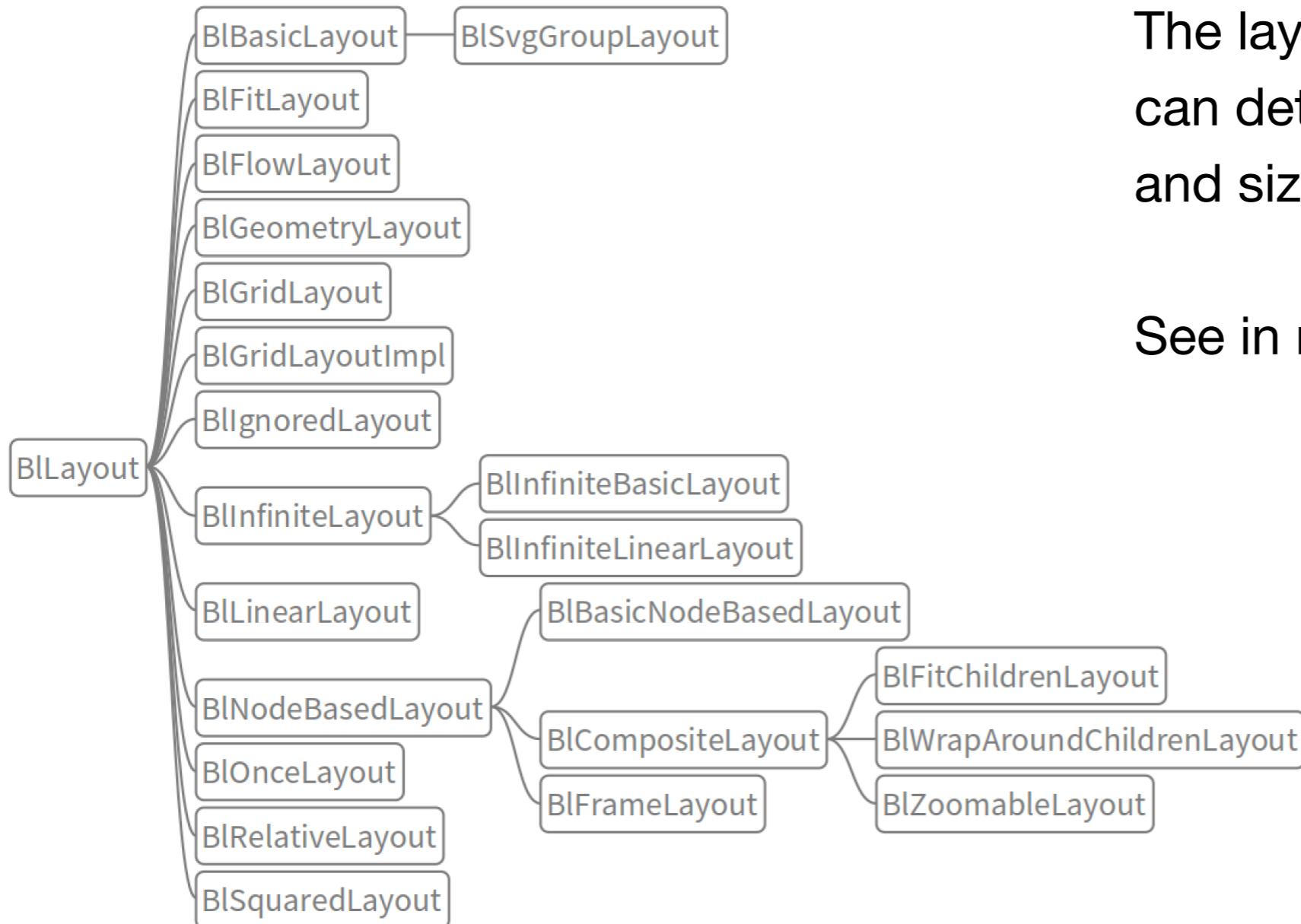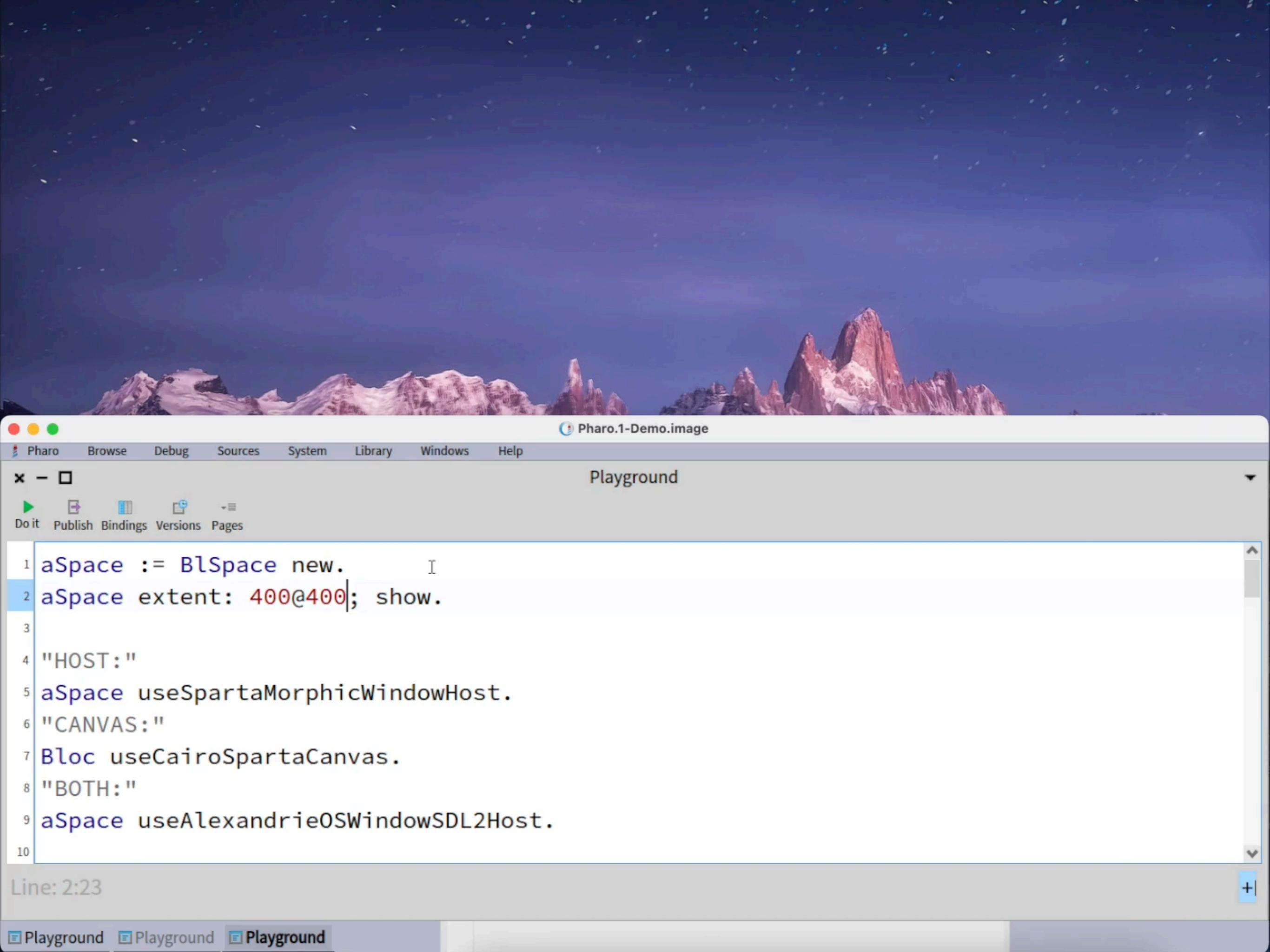
Element's layout & constraints

The layout of an Element can determine the position and size of its children.

See in next demo!

Pharo   Browse   Debug   Sources   System   Library   Windows   Help

Playground

Do it   Publish   Bindings   Versions   Pages

```
1  aSpace := BlSpace new.
2  aSpace extent: 400@400; show.
3
4  "HOST:"
5  aSpace useSpartaMorphicWindowHost.
6  "CANVAS:"
7  Bloc useCairoSpartaCanvas.
8  "BOTH:"
9  aSpace useAlexandrieOSWindowSDL2Host.
10
```

Line: 2:23

Playground   Playground   Playground

Bloc for Pharo

Objectives

A clean library that may be included in Pharo

- Make it easier to understand

- Have a clear maintenance process

Our code retrofits a part of the development made by feenk

Host & Canvas - Current Direction

Stay with simple FFI bindings to C libraries
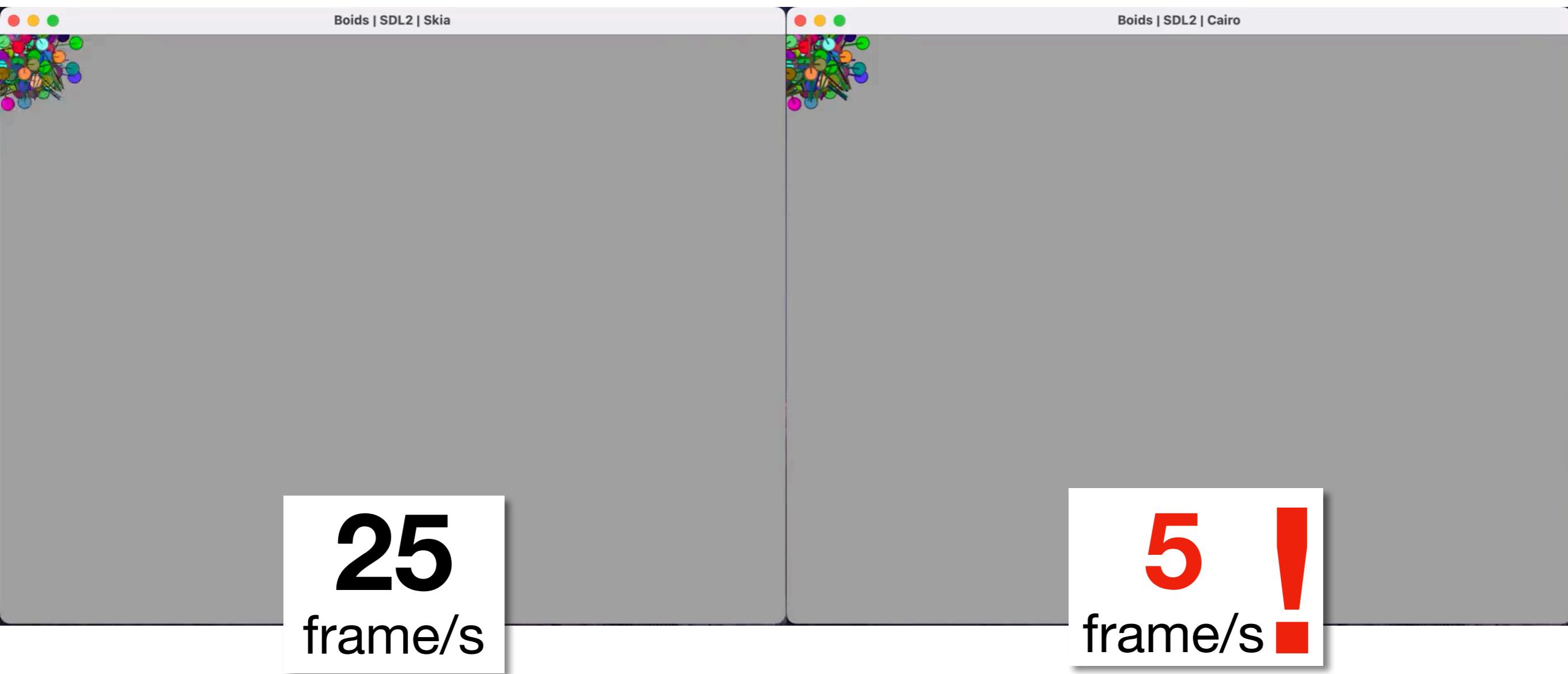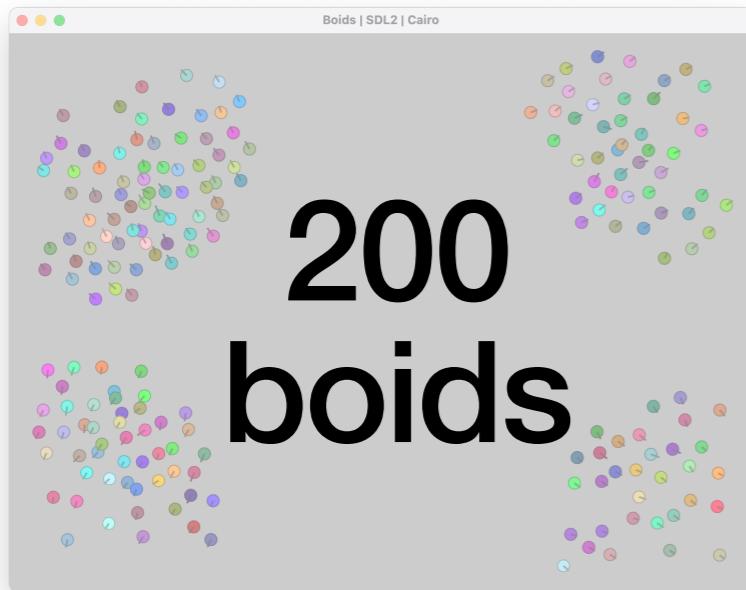
- Works on all Pharo's platforms

- GPU acceleration

- Active gamer community

- Stable. Active gnome community (it's the way to draw custom widgets in gtk 3 and 4).

- Not GPU-optimized but we can use buffering, layer composition and other techniques to mitigate.

We chose Cairo... but Sparta-Cairo?

# Boids Example: Bird Flock Simulation

Boids | SDL2 | Cairo

200 boids

= 🟢 x 200

Few and simple geometries but the whole surface is updated on each frame

Sparta

SKIA

VS.

Sparta

🪲cairo🪲

5.6k

FFI calls / frame

10.4k

Too Much?

FFI calls / frame

Boids | SDL2 | Skia

FFI Calls (Avg. per Frame) | Raw

Key	Value
skia_paint_set_rgba	589.7
skia_paint_drop	589.7
skia_paint_set_anti_alias	589.7
skia_paint_set_blend_m	589.7
skia_paint_default	589.7
skia_paint_set_stroke_m	393.1
skia_paint_set_stroke_jo	393.1
skia_paint_set_stroke_w	393.1
skia_canvas_draw_circle	393.1
skia_paint_set_stroke_ca	393.1
skia_paint_set_style	393.1
skia_canvas_draw_line	196.6
SDL_GetWindowSize	16.2
SDL_PollEvent	12.4
skia_canvas_restore	2.9
skia_canvas_save	2.9
SDL_GetRendererOutput	2.0
skia_canvas_fill_rectangl	2.0
skia_canvas_clip_rect	2.0
SDL_UpdateTexture	1.0
SDL_RenderCopy	1.0

O(n) stops here

Sparta

SKIA

Boids | SDL2 | Cairo

FFI Calls (Avg. per Frame) | Raw

Key	Value
cairo_set_source_rgba	1213.1
cairo_new_path	1011.6
cairo_set_fill_rule	810.1
cairo_move_to	604.6
cairo_set_operator	604.5
cairo_append_path	604.5
cairo_get_current_point	403.1
cairo_set_line_cap	403.0
cairo_set_miter_limit	403.0
cairo_stroke	403.0
cairo_set_line_join	403.0
cairo_set_antialias	403.0
cairo_set_dash	403.0
cairo_set_line_width	403.0
cairo_fill	203.6
cairo_clip_preserve	203.6
cairo_save	203.6
cairo_restore	203.5
cairo_copy_path	201.5
cairo_arc	201.5
cairo_close_path	201.5
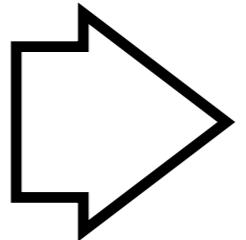
change color 6 times per boid

new path 5 times per boid

Sparta

cairo

Sparta → Alexandrie **NEW**

Call the C API smartly

Avoid redundant calls

Start by rendering Bloc elements faster,
then look for abstract API

Bloc + Alexandrie v1.0

- Support for most features of Sparta-Cairo, but fast.

- Doesn't depend on SurfacePlugin, like Sparta-Cairo, unlike Athens-Cairo

- Bloc v1.0 comes with Alexandrie, plus Sparta-Cairo and Sparta-Skia.

- Check it: https://github.com/pharo-graphics/Bloc

Bloc + Alexandrie Next

- Optimize transformations (this is Bloc level)

- Cache more Cairo objects

- Layer composition and Buffer unchanged elements

- Effects (blur, shadow)

- Bug in SVG path geometry

- Clear API (still not stable)

BlSpaceFixture

Utilities

Extensions

▶ 🗀 Bloc-Animation
▶ 🗀 Bloc-Compositor
▶ 🗀 Bloc-DevTool
▶ 🗀 Bloc-Exporter
▶ 🗀 Bloc-Layout
🗀 Bloc-Layout-Tests
▶ 🗀 Bloc-LayoutZoomable
🗀 Bloc-PharoExtensions
▶ 🗀 Bloc-Scripter
▶ 🗀 Bloc-Sparta
▶ 🗀 Bloc-Spec2
🗀 Bloc-Spec2-Tests
▶ 🗀 Bloc-Tests
▶ 🗀 Bloc-Text
▶ 🗀 Bloc-Text-Elements
🗀 Bloc-Text-Rope
🗀 Bloc-Text-Rope-Tests
▶ 🗀 Bloc-UnitedTests
▶ 🗀 BlocBenchs-FPS
▶ 🗀 BlocBenchs-Old

Ⓒ BAHitFormFactory
Ⓒ BlHitDifferenceInspector
Ⓒ BlRenderDifferenceInspector
Ⓒ BlSpaceBuilder
Ⓒ BlSpaceFixture

▶ instance side
⚠ flags
  accessing
  fixtures
◆ initialization
🔲 private
  overrides

buildClippingOutskirts
buildClippingWithoutBorders
buildElevation
buildEmptyGeometry
buildGradients
buildImagesAndTransformatio
buildLinearLayoutWithPadding
buildOpacities
buildOutskirtsAndOpaqueBord
buildOutskirtsAndTranslucentl
buildOutskirtsOfPolygons
buildOverlappingCircles
buildOverlappingRectangles
buildOverlappingTriangles
buildStrokeStyles
buildTextAttributes
buildTextEmoji
buildTextMeasurements
buildTextOpacities
buildTextTransformations
buildTransformRotate
buildTransformScale
buildTransformTranslate

Filter...   Filter...

🔘 All Packages ⚪ Scoped View | ⚪ Flat ⚪ Hier. | 🔘 Inst. side ⚪ Class side | 🔘 Methods ⚪ Vars | **Class refs.**

❓ Comme ×   Ⓒ BlSpace ×   👤 UML-Cla ×   ➕ Inst. sid ×

```
Object subclass: #BlSpaceFixture
    instanceVariableNames: 'builder'
    classVariableNames: ''
    package: 'Bloc-Alexandrie-Tests-Utilities'
```

☐ Fluid

☐ Fluid

Performance

Sparta

10.4k calls/frame

🪲 cairo 🪲

Alexandrie

3k calls/frame

🪲 cairo 🪲

Boids | SDL2 | Cairo

⇕ Key	⇕ Value
FFI Calls (Avg. per Frame)	Raw
cairo_set_source_rgba	1213.1
cairo_new_path	1011.6
cairo_set_fill_rule	810.1
cairo_move_to	604.6
cairo_set_operator	604.5
cairo_append_path	604.5
cairo_get_current_point	403.1
cairo_set_line_cap	403.0
cairo_set_miter_limit	403.0
cairo_stroke	403.0
cairo_set_line_join	403.0
cairo_set_antialias	403.0
cairo_set_dash	403.0
cairo_set_line_width	403.0
cairo_fill	203.6
cairo_clip_preserve	203.6
cairo_save	203.6

Boids | SDL2 Alexandrie | Ca

⇕ Key	⇕ Value
FFI Calls (Avg. per Frame)	Raw
cairo_set_source_rgb	599.0
cairo_stroke	398.1
cairo_set_line_width	398.1
cairo_restore	201.0
cairo_paint_with_alpha	201.0
cairo_save	201.0
cairo_move_to	199.1
cairo_clip_preserve	199.0
cairo_arc	199.0
cairo_rel_line_to	199.0
cairo_reset_clip	199.0
SDL_GetWindowSize	7.9
SDL_PollEvent	6.9
cairo_rectangle	2.0
cairo_clip	2.0
SDL_GetRendererOutput	2.0
SDL_RenderPresent	1.0

👍 Can be better, but 1/3 is good!

25 frame/s	5 frame/s	30 frame/s
Sparta	Sparta	Alexandrie
SKIA	cairo	cairo
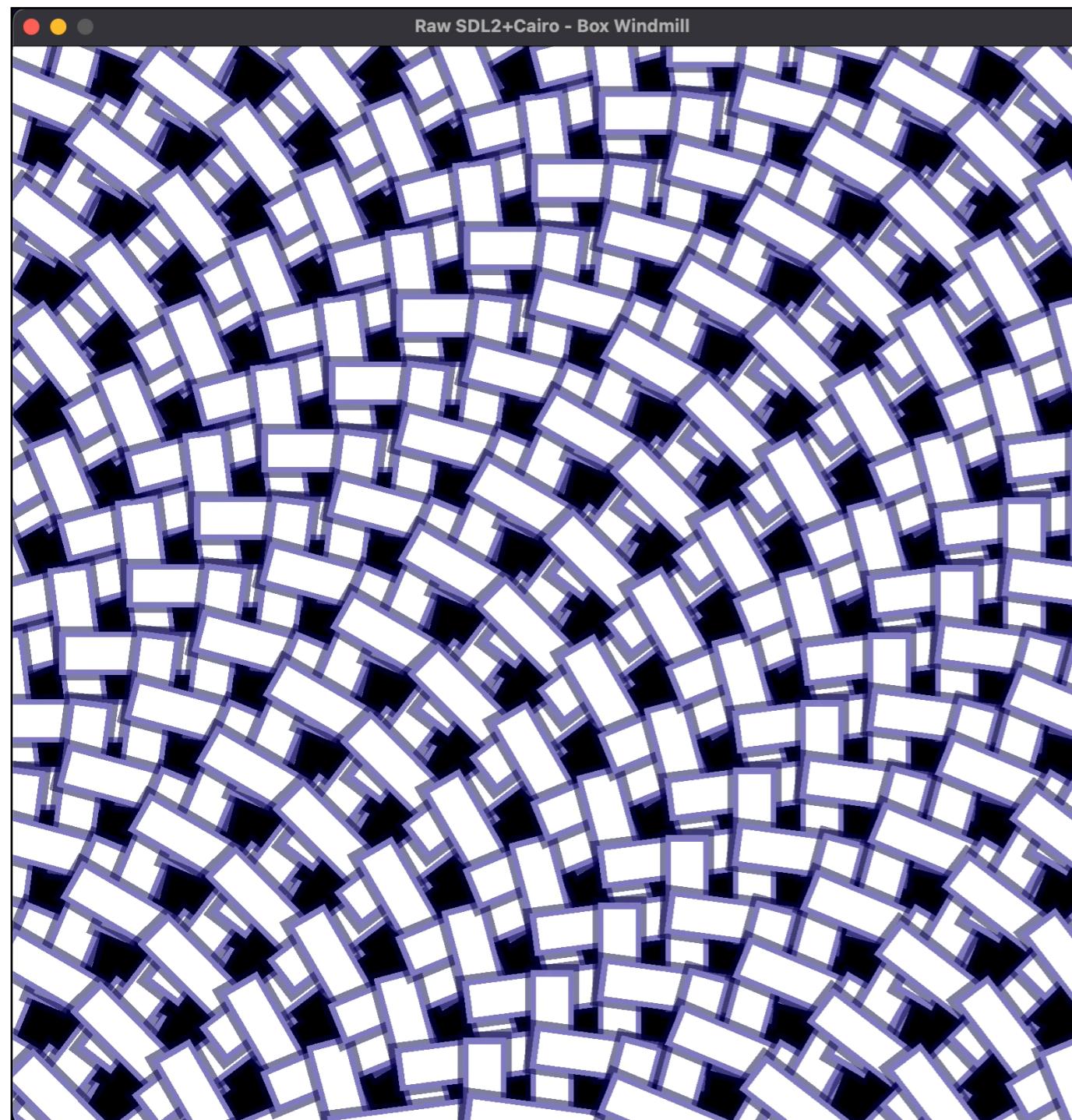
Still poor: Users need at least 60 FPS, but this is one step.

About GPU

Explore last generation techniques (e.g. Chrome's RenderingNG, Firefox's WebRender, GTK4) with SDL and Cairo:

- Layer composition

  - buffer elements in GPU textures / tiles

  - composite layers in GPU

- GPU rastering

  - take advantage of GPU

  - avoid bottleneck of transferring from CPU to GPU memory

- Dedicated thread to render and animate elements

- 1600x1600 pixels to update on every frame

- Elements only update their transformation matrix

=> Having the elements in a texture and operate with GPU makes a good difference

Canvas	FPS
Bloc Skia	18.3
Bloc Cairo	12.5
Bloc Alexandrie	40.3
Experimental (SDL2+Cairo)*	187.7

*: SDL2 w/OpenGL Renderer, on a MacbookPro 2018

(Example based on "Box Windmill" by Milton Mamani in RS3)

FFI Call Logger
Monitor calls, live!

https://github.com/tinchodias/FFICallLogger

Call filters

Recorded calls
(in a circular collection)

Copy of the stack that
performed the selected call

Plans as a User of Bloc

- Spec backend

- Create Examples

  - Microdown editor

  - Small game

Bloc for Pharo

Discord: Pharo server / #bloc channel

Mailing-list: lse-bloc@inria.fr

Bloc Core: https://github.com/pharo-graphics/Bloc

Bloc Tutorial: https://github.com/pharo-graphics/Tutorials

Bloc Dev Ecosystem: https://github.com/pharo-graphics/BlocBenchs