

# The Cables.gl Book

A Comprehensive Guide to Visual Programming

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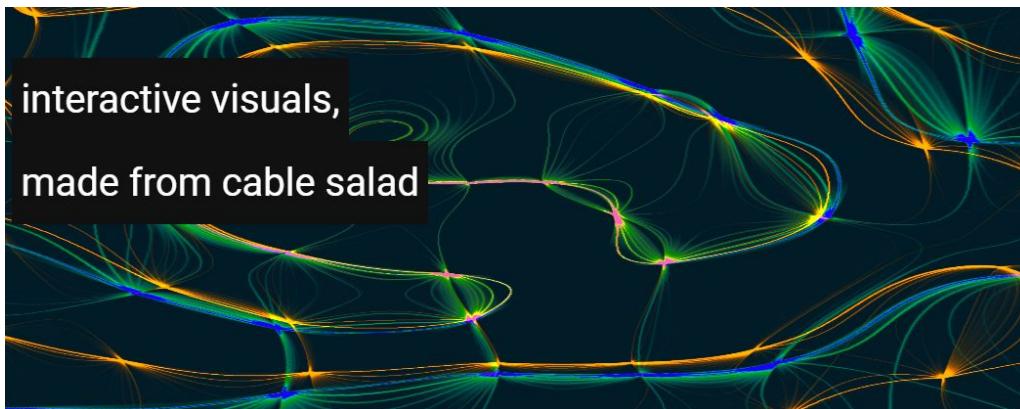
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# 1 Introduction to Cables.gl

## 1.1 What is Cables.gl?



**Cables.gl** is a powerful, browser-based visual programming environment for creating interactive 2D and 3D graphics using WebGL. It was created by **undev** in Berlin and has become a popular tool for creative coding, interactive installations, data visualization, and web-based visual experiences.

Unlike traditional coding environments, cables.gl uses a **node-based** (or “patch-based”) approach where you connect visual operators (ops) together to create your projects. This makes it accessible to artists and designers while still being powerful enough for developers.

## 1.2 A (Brief) History of cables.gl

cables.gl was created by **undev** (Berlin) with the goal of making **real-time WebGL** creation approachable through a node-based workflow—similar in spirit to visual programming environments used in motion design and interactive installations, but built for the browser.

Over time, cables.gl grew from a tool for quick experiments into a full ecosystem:

- **Early days:** a strong focus on rapid prototyping and sharing patches online.
- **Maturing platform:** a steadily growing op library for 2D, 3D, textures, audio, and interaction, plus better tooling (timeline, profiling/debugging utilities, export options).

- **Community-driven growth:** more public patches, tutorials, Discord knowledge-sharing, and reusable patterns (e.g., render-to-texture workflows, post-processing chains, audio-reactive setups).
- **Production use:** cables.gl exports make it viable for deployment in websites, installations, and client work—where performance, asset management, and reliable runtime behavior matter.

If you’re coming from traditional code, it helps to think of cables.gl as a **visual runtime graph**: triggers define *when* things run; value connections define *what data flows*; and the patch as a whole becomes a web-ready app.

## 1.3 Why Use Cables.gl?

### 1.3.1 Visual Programming

- No coding required to get started
- Drag-and-drop interface
- See results in real-time as you build

### 1.3.2 Browser-Based

- No installation needed
- Works on any modern browser
- Collaborate and share easily

### 1.3.3 High Performance

- Built on WebGL for GPU-accelerated graphics
- Optimized for real-time rendering
- Handles complex 3D scenes smoothly

### 1.3.4 Export Options

- Standalone HTML/JS builds
- Embed in websites
- Create offline applications

### 1.3.5 Extensible

- Write custom operators (ops) in JavaScript
- GLSL shader support
- Import external libraries

## 1.4 Key Concepts

### 1.4.1 Operators (Ops)

The building blocks of cables.gl. Each op performs a specific function - from drawing shapes to processing audio to handling user input.

### 1.4.2 Patches

A patch is your complete project - a collection of ops connected together to create your visual experience.

### 1.4.3 Ports

Ops have input and output ports. You connect ports together with "cables" (hence the name!) to pass data between ops.

### 1.4.4 Types of Ports

- **Trigger** (grey) - Execution flow, like "when to do something"
- **Number** (green) - Numerical values
- **String** (yellow) - Text values
- **Object** (blue) - Complex data like meshes, textures, arrays
- **Array** (cyan) - Collections of data

## 1.5 Featured Videos

### 1.5.1 Overview and Getting Started



<https://youtu.be/hVxrxXhH7vQ>  
**Cables.gl Standalone (Offline) Build: Create Without Limits!**  
by Decode GL



<https://youtu.be/goO3PhuenBI>  
**First Steps in Cables.gl - Tutorial**  
by The Interactive & Immersive HQ



<https://youtu.be/xnObNRv8n9I>  
**Introduction to cables.gl - Data-Driven Gradient from Geo-Located Weather - Part 0**  
by Kirell Benzi

### 1.5.2 More Resources

**Note:** There are limited intro-specific YouTube videos for cables.gl, but the platform has excellent resources:

- Browse the cables.gl Public Patches to see examples
- Check the official cables.gl YouTube channel for official tutorials
- The Decode GL channel has multiple cables.gl tutorials
- Search for "cables.gl" on YouTube for the latest community content
- Many cables.gl creators share their work on social media and personal channels

## 1.6 Getting Help

- **Official Documentation:** [cables.gl/docs](https://cables.gl/docs)
- **Example Patches:** Browse public patches for inspiration

## 2 Getting Started with Cables.gl

### 2.1 Creating Your Account

1. Go to [cables.gl](https://cables.gl)
2. Click “Sign Up” to create a free account
3. Verify your email
4. You’re ready to start creating!

### 2.2 The Interface

#### 2.2.1 Main Areas

TOOLBAR  
OP LIBRARY CANVAS (Preview)  
PATCH EDITOR  
(Node workspace)

#### 2.2.2 Key Interface Elements

1. **Canvas** - Live preview of your creation
2. **Patch Editor** - Where you place and connect ops
3. **Op Library** - Browse and search for operators
4. **Parameters Panel** - Adjust settings for selected ops
5. **Timeline** - For animation keyframes

### 2.3 Navigation Controls

- **Pan the view:** Middle mouse drag or Space + drag
- **Zoom in/out:** Mouse scroll wheel
- **Select op:** Left click
- **Multi-select:** Shift + click or drag box
- **Delete selected:** Delete or Backspace
- **Add new op:** Double-click or Tab
- **Connect ports:** Drag from output to input

## 2.4 Keyboard Shortcuts

Mastering keyboard shortcuts will significantly speed up your workflow in cables.gl.

### 2.4.1 Essential Shortcuts

- **Tab or Double-click:** Add new op (opens search)
- **Delete or Backspace:** Delete selected op(s)
- **Ctrl + C / Cmd + C:** Copy selected op(s)
- **Ctrl + V / Cmd + V:** Paste selected op(s)
- **Ctrl + X / Cmd + X:** Cut selected op(s)
- **Ctrl + D / Cmd + D:** Duplicate selected op(s)
- **Ctrl + Z / Cmd + Z:** Undo
- **Ctrl + Shift + Z / Cmd + Shift + Z:** Redo

### 2.4.2 Selection & Navigation

- **Ctrl + A / Cmd + A:** Select all ops
- **Shift + Click:** Add to selection
- **Ctrl + Click / Cmd + Click:** Toggle selection
- **Escape:** Deselect all
- **Space + Drag:** Pan the patch view
- **Mouse Wheel:** Zoom in/out
- **Ctrl + 0 / Cmd + 0:** Zoom to fit all ops
- **F:** Focus/frame selected op(s)

### 2.4.3 Organizing & Aligning

- **Ctrl + Shift + A / Cmd + Shift + A:** Align selected ops horizontally
- **Ctrl + Shift + D / Cmd + Shift + D:** Distribute selected ops evenly
- **Ctrl + G / Cmd + G:** Group selected ops
- **Arrow Keys:** Nudge selected op(s) by small amount
- **Shift + Arrow Keys:** Nudge selected op(s) by larger amount

### 2.4.4 Working with Ops

- **Enter:** Open/edit selected op's parameters
- **Ctrl + E / Cmd + E:** Enable/disable selected op
- **Ctrl + M / Cmd + M:** Mute selected op
- **R:** Rename selected op
- **C:** Add comment node
- **Ctrl + F / Cmd + F:** Find/search ops in patch

### 2.4.5 Cables & Connections

- **Drag from port:** Create connection
- **Click connection:** Select cable
- **Alt + Click connection:** Delete cable
- **Shift + Drag port:** Create cable with search

### 2.4.6 View & Interface

- **T:** Toggle timeline
- **Ctrl + / / Cmd + /:** Toggle op library
- **H:** Toggle patch editor visibility
- **P:** Toggle parameters panel
- **Ctrl + S / Cmd + S:** Save patch
- **Ctrl + Shift + S / Cmd + Shift + S:** Save as...

### 2.4.7 Performance & Debugging

- **Ctrl + Shift + P / Cmd + Shift + P:** Performance monitor
- **Ctrl + Shift + L / Cmd + Shift + L:** Show patch loading info
- **Alt + Click op:** View op documentation

### 2.4.8 Pro Tips

- **Hold Shift while connecting:** Automatically opens op search to insert an op in the connection
- **Hold Alt while dragging:** Duplicate op while moving
- **Double-click a connection:** Insert a new op in that cable
- **Right-click an op:** Quick access to op menu (rename, mute, group, etc.)
- **Click and drag in empty space:** Selection box for multiple ops

## 2.5 Your First Patch

Let's create a simple animated shape!

### 2.5.1 Step 1: Create the Render Pipeline

1. Double-click in the patch editor to open the op search
2. Search for MainLoop and add it
3. The MainLoop is the heartbeat of your patch - it triggers every frame

## 2.5.2 Step 2: Add a BasicMaterial

1. Add a BasicMaterial op
2. Connect MainLoop's trigger output to BasicMaterial's trigger input
3. You should see a black canvas appear

## 2.5.3 Step 3: Draw a Circle

1. Add a Circle op
2. Connect BasicMaterial -> Circle
3. A white circle appears!

Here's what your patch should look like:

### Visualization Options

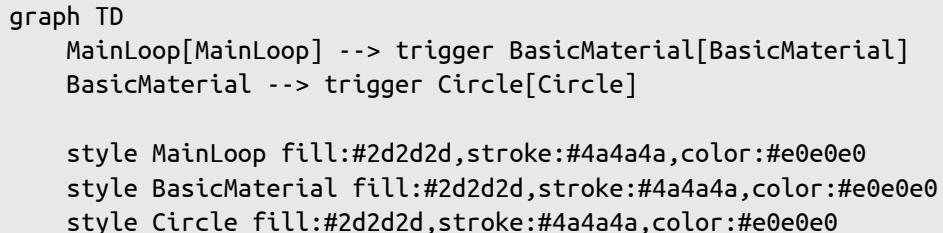
#### Option 1: Screenshot from Real Cables.gl (Most Authentic)

See Screenshot Guide for instructions on capturing real cables.gl patches.

#### Option 3: HTML/CSS Interactive

Open HTML Version in your browser for an interactive view.

#### Option 4: Mermaid Diagram (Simple Flow)



*The basic render chain: MainLoop triggers the BasicMaterial, which then draws the Circle*

## 2.5.4 Step 4: Add Color

1. Select the BasicMaterial op
2. Adjust the color values (r, g, b) in the parameters panel
3. Or connect a SetColor op's output to BasicMaterial's color input ports
4. The circle will display with your chosen color

## 2.5.5 Step 5: Animate It

1. Add a Time op (outputs current time)
2. Add a Math op (for calculations)
3. Add a Sin op (sine wave)
4. Connect: Time -> Sin -> Circle's Scale input
5. Watch your circle pulse!

## 2.6 Understanding the Flow

Data flows from **top to bottom** and **left to right**:

MainLoop (starts the frame)  
BasicMaterial (defines appearance and color)  
Circle (draws the shape)

The **trigger** connection (grey) determines WHEN things happen. The **value** connections (colored) determine WHAT values are used.

## 2.7 Saving Your Work

- Patches auto-save regularly
- Click the save icon to force a save
- Use "Save As" to create copies
- Export for standalone deployment

## 2.8 Tips for Beginners

1. **Start Simple** - Begin with basic shapes before complex 3D
2. **Explore Examples** - Study public patches to learn patterns
3. **Use Comments** - Add comment ops to document your work
4. **Name Your Ops** - Rename ops for clarity in complex patches
5. **Save Often** - And use versioning for major changes

## 2.9 Featured Videos

## 2.10 Common First-Patch Issues

### 2.10.1 “I don’t see anything!”

- Make sure MainLoop is connected to BasicMaterial
- Check that your shape ops are connected in the chain
- Verify the canvas is visible (not minimized)

### 2.10.2 “Colors aren’t changing!”

- Check BasicMaterial’s color values (r, g, b) in the parameters panel
- Make sure RGB values aren’t all 0 (black)
- If using SetColor, connect it to BasicMaterial’s color input ports

### 2.10.3 “Animation isn’t working!”

- Ensure Time op is connected
- Check that the animated value is actually changing (view the port value)

## 3 2D Graphics in Cables.gl

### 3.1 Introduction to 2D Drawing

Cables.gl excels at creating stunning 2D graphics and animations, from simple shapes to complex generative art. This comprehensive chapter covers fundamental 2D drawing operations, advanced transformations, interactive elements, feedback loops, post-processing effects, and professional techniques for creating production-ready 2D visuals.

Whether you’re creating data visualizations, interactive installations, or generative art, this chapter will give you the tools and knowledge to master 2D graphics in cables.gl.

### 3.2 Basic Shapes

#### 3.2.1 Circle

The Circle op is one of the most common 2D primitives.

##### Key Parameters:

- Radius - Size of the circle
- Segments - Smoothness (more segments = smoother circle)
- Inner Radius - Creates a ring when > 0

#### 3.2.2 Rectangle

The Rectangle op draws rectangular shapes.

##### Key Parameters:

- Width - Horizontal size
- Height - Vertical size
- Pivot - Origin point for positioning

#### 3.2.3 RoundedRectangle

A rectangle with smooth corners.

##### Key Parameters:

- Width / Height - Dimensions
- Corner Radius - How rounded the corners are

## 3.2.4 Polygon

Create regular polygons (triangles, pentagons, etc.)

### Key Parameters:

- Sides - Number of sides (3 = triangle, 5 = pentagon, etc.)
- Radius - Size of the polygon

## 3.2.5 Line / Lines

Draw single or multiple lines.

### Key Parameters:

- Start and End coordinates
- Line width
- Line style (solid, dashed)

## 3.3 Color and Appearance

### 3.3.1 SetColor

Changes the drawing color for subsequent shapes.

```
MainLoop -> BasicMaterial -> Circle
```

Connect SetColor output to BasicMaterial's color input ports (r, g, b, a) to set the color.

**Color Modes:** - RGB (Red, Green, Blue) - HSB (Hue, Saturation, Brightness) - Hex values

### 3.3.2 SetAlpha

Controls transparency.

```
MainLoop -> BasicMaterial -> Shape
```

Connect SetAlpha output to BasicMaterial's alpha (a) input port to control transparency.

Values range from 0 (invisible) to 1 (fully opaque).

## 3.3.3 Gradients

Use texture-based gradients or shader-generated gradients for smooth color transitions.

## 3.4 Transformations

### 3.4.1 Transform

The Transform op modifies position, rotation, and scale of all following shapes.

```
TRANSFORM PIPELINE
MainLoop
BasicMaterial
Transform
+-> Position (X, Y, Z)
+-> Rotation (X, Y, Z)
+-> Scale
Shape (Circle, Rectangle, etc.)
```

**Parameters:** - TranslateX, TranslateY, TranslateZ - Position - RotateX, RotateY, RotateZ - Rotation (degrees) - Scale - Uniform scaling

### 3.4.2 Transformation Order Matters!

Transformations are applied in order. These produce different results:

#### Rotate then Translate:

```
ROTATE THEN TRANSLATE
Original Position
o
Step 1: Rotate 45 degrees
o
(rotate)
Step 2: Translate Right
-> o
Result: Object rotates around origin, then moves
```

```
Transform (rotate) -> Transform (translate) -> Shape
```

#### Translate then Rotate:

TRANSLATE THEN ROTATE

Original Position

o

Step 1: Translate Right

-> o

Step 2: Rotate 45 degrees (around new position)

(rotate) o

Result: Object moves first, then rotates around new origin

Transform (translate) -> Transform (rotate) -> Shape

### 3.4.3 Nested Transforms

Create hierarchies by chaining transforms:

Transform (parent)

Transform (child)

Shape

The child inherits and adds to the parent's transformations.

## 3.5 Blending Modes

### 3.5.1 SetBlending

Controls how colors combine when shapes overlap.

**Common Modes:** - Normal - Standard opacity blending - Add - Colors add together (great for glow effects) - Multiply - Colors multiply (darkening effect)

### 3.5.2 Depth Testing

For 2D, you often want to disable depth testing:

MainLoop -> BasicMaterial -> DepthTest (disabled) -> Your 2D Content

This ensures draw order matches your connection order.

## 3.6 Patterns and Repetition

### 3.6.1 IteratorLoop

Create patterns by repeating shapes:

MainLoop -> IteratorLoop -> [Your Shape Setup]

Use the iterator index to offset position, color, or other properties.

### 3.6.2 ArrayIterator

Iterate over data arrays to position multiple shapes.

## 3.7 Text Rendering

### 3.7.1 DrawText

Display text in your patches.

**Key Parameters:**

- Text - The string to display
- Font - Font family
- Size - Text size
- Alignment - Left, center, right

### 3.7.2 TextTexture

Create textures from text for more advanced effects.

## 3.8 Advanced Transformation Techniques

### 3.8.1 Matrix Transformations

For precise control, work directly with transformation matrices:

MatrixMultiply -> Combine multiple transformations

MatrixInvert -> Reverse a transformation

## 3.8.2 Pivot Points

Control the center of rotation and scaling:

```
Transform (set pivot) -> Transform (rotate) -> Shape
```

**Common Pivot Values:** - 0, 0 - Bottom left corner - 0.5, 0.5 - Center (default)  
- 1, 1 - Top right corner

## 3.8.3 Compound Transformations

Build complex motion by layering transforms:

### Example: Orbital Motion

```
Transform (parent orbit)
Transform (child rotation)
Transform (child offset)
Shape
```

This creates a shape that orbits while rotating on its own axis.

## 3.9 Interactive 2D Elements

### 3.9.1 InteractiveRectangle

Create draggable, clickable UI elements:

```
InteractiveRectangle
  (outputs X, Y, Width, Height on interaction)
  Control other ops with mouse input
```

#### Use Cases:

- On-screen sliders
- Draggable controllers
- Interactive buttons
- Touch-enabled interfaces

## 3.9.2 Mouse Input

Capture and use mouse position:

```
Mouse -> Map (screen to world coords) -> Visual property
```

**Mouse Ops:** - MouseX / MouseY - Cursor position - MouseButton - Click detection -  
MouseWheel - Scroll input

### 3.9.3 Example: Interactive Color Picker

```
MainLoop
MouseX -> Map (0 to 1) -> Hue
MouseY -> Map (0 to 1) -> Brightness
HSBtoRGB -> BasicMaterial (color input)
FullscreenRectangle
```

## 3.10 Generative Art Techniques

### 3.10.1 Feedback Loops

Create evolving, self-referential visuals by feeding output back as input:

#### Basic Feedback Setup:

```
MainLoop
RenderToTexture (previous frame)
ImageCompose (blend with new content)
Transform (slight scale/rotate)
TextureEffects (blur, fade)
Draw new shapes
Output (becomes next frame's input)
```

**Parameters to Experiment With:** - Feedback decay (fade amount) - Transformation amount (scale, rotation) - Blend mode (add, multiply, screen) - Blur intensity

**Result:** Trails, echoes, and organic growth patterns

## 3.10.2 Op Art and Moiré Patterns

Create optical illusions with overlapping patterns:

```
IteratorLoop (creates grid)
Time -> Sin -> Rotation angle
IteratorLoop (nested for lines)
Rectangle (thin line)
```

Vary parameters like: - Line spacing - Rotation speed - Line thickness - Pattern density

## 3.10.3 Procedural Pattern Generation

Use noise and math to create endless variations:

### Perlin Noise-Based Patterns:

```
IteratorLoop
Position -> NoiseTexture sample
Noise value -> Circle size
Noise value -> Color
```

### Grid Distortion:

```
IteratorLoop (grid)
Position + (Noise * distortion amount)
Shape
```

## 3.11 Post-Processing Effects

### 3.11.1 Image Composition

Layer multiple render passes for rich effects:

```
RenderToTexture (Pass 1: Shapes)
RenderToTexture (Pass 2: Glow)
RenderToTexture (Pass 3: Noise)
ImageCompose (blend all layers)
Final Output
```

## 3.11.2 TextureEffects for 2D

Apply effects to your rendered 2D scene:

### Blur:

```
RenderTarget -> TextureEffects (Blur) -> Output
```

### Color Grading:

```
RenderTarget -> ColorCorrection
(adjust hue, saturation, brightness, contrast)
Output
```

### Glow Effect:

```
Original scene
RenderTarget (bright pass)
Blur (large radius)
ImageCompose (add to original)
```

## 3.11.3 Displacement Mapping

Distort shapes using textures:

```
NoiseTexture -> DisplacementMap -> Shape rendering
```

Creates wavy, distorted effects on 2D graphics.

## 3.12 Advanced Pattern Techniques

### 3.12.1 Recursive Subdivision

Create fractal-like patterns:

```
// Custom op: Recursive shape division
for (depth = 0; depth < maxDepth; depth++) {
    // Draw shape
    // Divide into smaller shapes
    // Recursively apply
```

## 3.12.2 Particle Systems in 2D

Simple particle engine structure:

```
ArrayLoop (particle count)
Particle data (position, velocity, life)
Physics update (gravity, friction)
Transform -> Circle (particle visual)
```

## 3.12.3 Grid-Based Automata

Cellular automata and Game of Life patterns:

```
ArrayIterator (grid cells)
Cell state + neighbor count
Update rules (Conway's rules, etc.)
Visual representation
```

# 3.13 Data Visualization

## 3.13.1 Chart Generation

Create custom charts and graphs:

**Bar Chart:**

```
ArrayIterator (data values)
Index -> X position
Value -> Rectangle height
Rectangle (bar)
```

**Line Chart:**

```
ArrayIterator (data points)
Connect points with Lines op
Add circles for data points
```

## 3.13.2 Integration with ECharts

Apache ECharts is a powerful open-source charting library that integrates seamlessly with cables.gl. This combination lets you create professional-grade data visualizations with interactive 3D effects and real-time updates.

**Why ECharts + cables.gl?**

- **Rich Chart Types:** Bar, line, pie, scatter, radar, candlestick, heatmap, treemap, sunburst, and more
- **Interactive Features:** Tooltips, zooming, panning, data selection
- **Real-Time Updates:** Stream live data into animated charts
- **3D Enhancement:** Apply cables.gl effects to chart outputs

**Setup and Integration:**

1. **Load the ECharts Extension** in cables.gl using the `Ops.Extension.ECharts.ECh` op
2. **Configure Chart Options** using JSON format (same as standard ECharts)
3. **Connect Data Sources** from other cables.gl ops (JSON fetch, WebSocket, etc.)
4. **Apply Visual Effects** using cables.gl post-processing

**Basic ECharts Patch Structure:**

```
MainLoop
ECharts Op
  +-> Option (JSON configuration)
  +-> Width / Height
  +-> Data inputs
ECharts Instance -> Use in other ops
```

**Example: Simple Bar Chart Configuration:**

```
{
  "xAxis": {
    "type": "category",
    "data": ["Mon", "Tue", "Wed", "Thu", "Fri"]
  },
  "yAxis": {
    "type": "value"
  },
  "series": [
    {
      "data": [120, 200, 150, 80, 70],
      "label": "Sales"
    }
  ]
}
```

```
    "type": "bar",
    "color": "#5470c6"
  ]]
}
```

#### Example: Real-Time Line Chart:

```
WebSocket (data stream)
ParseJSON -> Extract values
Array (rolling buffer of last N values)
ECharts Op (line chart config)
Render to texture
Apply glow effect
```

#### Example: Interactive Pie Chart with Events:

```
ECharts Op (pie chart)
EChartsEvent Op
  +-> Click event -> Trigger actions
  +-> Hover event -> Show details
Update other visuals based on selection
```

#### Combining Charts with 3D:

```
ECharts Op -> Render to texture
Plane3D (apply texture)
Transform (rotate in 3D space)
Post-processing (glow, bloom)
```

#### Advanced Techniques:

- **Multi-Chart Dashboards:** Use multiple ECharts ops with different configurations
- **Animated Transitions:** ECharts handles smooth data transitions automatically
- **Custom Themes:** Define color palettes that match your cables.gl aesthetic
- **Responsive Charts:** Connect viewport size to chart dimensions

#### Performance Tips:

- Limit data points for smooth animation (< 1000 for real-time)

- Use `notMerge: true` for complete data replacement
- Disable animations for very high-frequency updates
- Cache chart instances when possible

#### Resources:

- Apache ECharts Documentation
- ECharts Examples Gallery
- cables.gl ECharts Integration Tutorial

### 3.13.3 Real-Time Data

Visualize live data streams:

```
WebSocket/API -> Parse data
ArrayIterator -> Visualize each value
Smooth/Interpolate for fluid animation
```

## 3.14 Complex Example Projects

### 3.14.1 Example 4: Kaleidoscope Effect

```
MainLoop
BasicMaterial
IteratorLoop (6 segments)
Transform (rotate by index * 60°)
Transform (mirror flip alternating)
Your content (shapes, webcam, etc.)
```

### 3.14.2 Example 5: Audio-Reactive Loading Animation

```
AudioAnalyzer (beat detection)
IteratorLoop (circle of dots)
Index + Time -> Rotation
Beat amplitude -> Scale pulse
SetColor (beat changes color)
Circle (dot)
```

### 3.14.3 Example 6: Data-Driven Weather Visualization

```
API -> Fetch weather data  
Parse JSON -> Extract values  
Temperature -> Background color  
Humidity -> Particle density  
Wind -> Animation speed  
Animated scene reflecting weather
```

### 3.14.4 Example 7: Feedback Tunnel Effect

```
RenderToTexture (previous frame)  
Transform (scale 1.05, center pivot)  
SetAlpha (0.98 for fade)  
Draw to screen  
Add new circles at edges  
Feed back into texture
```

Creates an infinite tunnel effect.

### 3.14.5 Example 8: Mouse Trail with Fade

```
MousePosition  
RenderToTexture (with feedback)  
ColorCorrection (reduce brightness)  
Draw circle at mouse position  
Blend with previous frame
```

Creates smooth, fading trails following the cursor.

## 3.15 Performance Optimization

### 3.15.1 Culling and Clipping

Only draw what's visible:

```
If (shape position in viewport bounds)  
    -> Draw shape  
Else  
    -> Skip
```

### 3.15.2 Object Pooling

Reuse shape instances instead of creating new ones:

```
// Maintain pool of inactive shapes  
// Activate/deactivate as needed  
// Prevents GC thrashing
```

### 3.15.3 Level of Detail (LOD)

Simplify distant or small shapes:

```
If (shape size < threshold)  
    -> Use simple circle  
Else  
    -> Use detailed polygon
```

### 3.15.4 Batching Draw Calls

Group similar operations:

```
SetColor once  
Draw all shapes of same color  
SetColor again  
Draw next batch
```

Reduces state changes and improves performance.

## 3.16 Masking and Clipping

### 3.16.1 Stencil Buffer Masking

Use shapes as masks for other shapes:

```
EnableStencil  
Draw mask shape (Circle)  
SetStencilMode (draw only inside)  
Draw content (Rectangle)  
DisableStencil
```

## 3.16.2 Alpha Mask Technique

Use texture alpha for complex masks:

MaskTexture -> AlphaMask  
Your content (masked by texture)

Distance from center -> Mix (Inner, Outer, t)

## 3.17 Color Theory in Practice

### 3.17.1 Color Harmonies

Generate pleasing color palettes:

Complementary:

BaseHue -> SetColor (shape 1)  
BaseHue + 180° -> SetColor (shape 2)

Triadic:

BaseHue -> Color 1  
BaseHue + 120° -> Color 2  
BaseHue + 240° -> Color 3

Analogous:

BaseHue -> Color 1  
BaseHue + 30° -> Color 2  
BaseHue - 30° -> Color 3

### 3.17.2 Gradient Creation

Smooth color transitions:

Linear Gradient:

IteratorLoop (steps)  
Index / TotalSteps -> Mix (Color1, Color2, t)  
SetColor -> Rectangle strip

Radial Gradient:

## 3.18 Typography and Text Effects

### 3.18.1 Dynamic Text

Animate text properties:

Time -> Character spacing  
MouseX -> Font size  
AudioLevel -> Text opacity

### 3.18.2 Text as Texture

Use text rendering for effects:

TextTexture (render text to texture)  
Apply shader effects  
Use as sprite or background

### 3.18.3 Kinetic Typography

Animate individual letters:

TextArray (split into chars)  
ArrayIterator  
Transform (unique per character)  
DrawText (single char)

## 3.19 Practical Examples

### 3.19.1 Example 1: Pulsing Circle

MainLoop  
BasicMaterial (set your color)  
Time -> Sin -> Scale input  
Circle

## 3.19.2 Example 2: Rotating Grid

```
MainLoop  
BasicMaterial  
IteratorLoop (10x10)  
Transform (position from iterator)  
Transform (rotation from Time)  
Rectangle
```

## 3.19.3 Example 3: Color Gradient Circle

```
MainLoop  
IteratorLoop (for each ring)  
IteratorIndex -> Map to Hue -> HSBtoRGB -> BasicMaterial (color  
input)  
BasicMaterial  
Circle (radius from iterator index)
```

## 3.20 Debugging and Workflow Tips

### 3.20.1 Visualizing Values

See what your ops are outputting:

```
Value -> NumberDisplay  
Value -> DrawNumber (on screen)
```

### 3.20.2 Color Coding

Use consistent colors to identify different element types:  
- Structural elements: Blue  
- Interactive elements: Green  
- Data elements: Yellow  
- Background: Dark grey

### 3.20.3 Naming Convention

Name ops descriptively:  
- TransformRotation\_MainShape - Color\_Background -  
Iterator\_ParticleGrid

## 3.20.4 Comment Ops

Document complex sections:

```
Comment ("This section creates the feedback loop")  
Your complex patch area
```

## 3.21 Common Patterns and Recipes

### 3.21.1 Pattern: Circular Array

Arrange shapes in a circle:

```
IteratorLoop (count)  
Index * (360 / count) -> Angle  
Angle -> Cos -> X position  
Angle -> Sin -> Y position  
Transform -> Shape
```

### 3.21.2 Pattern: Wave Grid

Create wave motion across a grid:

```
IteratorLoop (rows)  
IteratorLoop (columns)  
(X + Time) -> Sin -> Y offset  
Transform -> Shape
```

### 3.21.3 Pattern: Spiral

Generate spiral patterns:

```
IteratorLoop  
Index -> Angle (index * goldenAngle)  
Index -> Radius (sqrt(index) * spacing)  
Polar to Cartesian  
Transform -> Shape
```

### 3.21.4 Pattern: Responsive Grid

Grid that adapts to screen size:

```
ViewportWidth / CellSize -> Columns  
ViewportHeight / CellSize -> Rows  
IteratorLoop (columns * rows)  
Grid positioning logic
```

## 3.22 Troubleshooting Common Issues

### 3.22.1 “Shapes not appearing”

- Check trigger connections (grey ports)
- Verify MainLoop is connected to BasicMaterial
- Check BasicMaterial alpha isn't 0
- Verify camera/viewport settings

### 3.22.2 “Performance is slow”

- Reduce segment count on circles
- Lower particle/iterator counts
- Disable antialiasing if not needed
- Use simpler blend modes
- Check for unnecessary texture reads

### 3.22.3 “Colors look wrong”

- Verify color space (RGB vs HSB)
- Check SetColor is before shapes
- Verify alpha values
- Check blend modes

### 3.22.4 “Animation is jerky”

- Use Smooth op for value transitions
- Check frame rate in performance monitor
- Reduce complexity during motion
- Pre-calculate expensive operations

## 3.23 Performance Tips

1. **Reduce Segments** - Circles don't need 100 segments if they're small
2. **Batch Similar Shapes** - Group similar operations together
3. **Use Instancing** - For many identical shapes, use instanced drawing
4. **Limit Transparency** - Overlapping transparent shapes are expensive
5. **Cache Calculations** - Don't recalculate same values each frame
6. **Cull Off-Screen** - Don't draw what's not visible
7. **Simplify Blending** - Complex blend modes are expensive
8. **Optimize Textures** - Use appropriate texture sizes
9. **Limit Feedback Depth** - Don't keep too many feedback history frames
10. **Profile Regularly** - Use performance monitor to identify bottlenecks

## 3.24 Featured Videos

### 3.24.1 Official Tutorials



<https://youtu.be/goO3PhuenBI>  
**First Steps in Cables.gl - Kaleidoscope Webcam Effect**  
by The Interactive & Immersive HQ



<https://youtu.be/xnObNRv8n9I>  
**Introduction to cables.gl - Data-Driven Gradient from Geo-Located Weather**  
by Kirell Benzi

## 3.24.2 Additional Resources

- **Generative Op Art Tutorial:** Class Central Course - Learn feedback loops and Op Art
- **Interactive Rectangle Tutorial:** Blog Post - Create on-screen sliders
- **Post-Processing Guide:** Official Docs - Apply effects to scenes
- **Data Visualization:** Apache ECharts Integration - Combine with charting libraries
- **Cables.gl Examples:** Official Examples - Browse community creations
- **Coding with Cables:** GitHub Repo - Code examples and custom ops

- 9. **Mouse-Driven Drawing Tool** - Paint with code
- 10. **Meditation Visual** - Calming, slowly evolving patterns

## 3.25 Exercises

### 3.25.1 Beginner

1. Create a colorful loading spinner using rotating circles
2. Build a grid of squares that change color based on mouse position
3. Make a simple particle system with random positions and sizes

### 3.25.2 Intermediate

1. Create a kaleidoscope effect with 8 mirrored segments
2. Build an interactive color picker using mouse position
3. Implement a feedback tunnel with infinite zoom effect
4. Create a data visualization showing time-series data as animated bars

### 3.25.3 Advanced

1. Build a generative Op Art piece using feedback loops
2. Create a particle system with physics (gravity, collision)
3. Implement a cellular automaton (Game of Life or similar)
4. Create an audio-reactive geometric pattern generator
5. Build a real-time weather visualization using API data

## 3.26 Project Ideas

1. **Abstract Clock** - Time visualization with geometric shapes
2. **Music Visualizer** - Frequency bands displayed as 2D patterns
3. **Generative Logo** - Company logo with parametric variations
4. **Loading Animations** - Collection of animated loaders
5. **Data Dashboard** - Real-time data display with charts
6. **Interactive Art Installation** - Touch/camera-driven visuals
7. **Typography Animation** - Kinetic text effects
8. **Pattern Generator** - Infinite procedural pattern variations

# 4 3D Graphics in Cables.gl

## 4.1 Introduction to 3D

Cables.gl provides powerful tools for creating real-time 3D graphics using WebGL. This chapter covers everything from basic 3D concepts to advanced rendering techniques, scene management, and performance optimization. Whether you're creating simple 3D visualizations or complex interactive experiences, this guide will give you the knowledge to master 3D graphics in cables.gl.

**Official reference:** start with cables.gl docs and search for **Cameras, Lights, Materials, GLTF, Textures, and Post Processing**. Operator names and ports can differ between versions, but the underlying concepts stay the same.

Quick links (official): - GLTF op reference example: `Ops.Gl.GLTF.GltfScene_v4` (operator pages are often the most direct "what ports exist?" reference)

## 4.2 The 3D Pipeline

A basic 3D setup requires:

```
3D RENDERING PIPELINE
MainLoop (Frame Start)
Camera (View Setup)
++> Position (X, Y, Z)
++> Rotation / LookAt
++> Projection (Perspective/Orthographic)
Lighting (Optional)
++> Directional Light
++> Point Light
++> Ambient Light
Materials (Surface Properties)
++> BasicMaterial / StandardMaterial
++> Color / Texture
++> Shading Properties
Mesh/Geometry (3D Shapes)
++> Box, Sphere, Plane, etc.
++> Custom Models
Rendered Output (Canvas)
```

## 4.3 Cameras

Cameras define how we view the 3D scene.

### 4.3.1 PerspectiveCamera

The most common camera type - mimics human vision with perspective distortion.

**Key Parameters:**

- FOV (Field of View) - How wide the view is (typically 45-90 degrees)
- Near / Far - Clipping planes (objects outside this range aren't rendered)
- Position X/Y/Z - Camera location

### 4.3.2 OrthographicCamera

No perspective distortion - useful for UI, 2D-style 3D, or technical views.

**Key Parameters:**

- Zoom - Scale of the view
- Near / Far - Clipping planes

### 4.3.3 Orbit Controls

Add interactive camera controls:

```
Camera -> OrbitControls
```

Allows users to rotate, zoom, and pan the view.

### 4.3.4 LookAt

Point the camera at a specific location or object.

```
Camera -> LookAt (target position)
```

**Use Cases:**

- Follow a moving object
- Create cinematic camera movements
- Focus on specific scene elements

## 4.3.5 Camera Animation

Animate camera movement for cinematic effects:

```
Time -> Sin -> Camera Position X  
Time -> Cos -> Camera Position Z  
Time -> Camera Rotation Y (orbit)
```

## 4.3.6 Camera Shake Effect

Add dynamic camera shake:

```
Random -> Multiply (shake intensity) -> Add to Camera Position
```

## 4.3.7 First-Person Camera

Create FPS-style camera controls:

```
MouseX -> Camera Rotation Y  
MouseY -> Camera Rotation X  
WASD Keys -> Camera Position
```

## 4.3.8 Camera Path Following

Follow a predefined path:

```
ArrayIterator (path points)  
Smooth interpolation between points  
Camera Position
```

## 4.3.9 Camera Constraints

Limit camera movement:

```
Camera Position -> Clamp (min, max) -> Constrained Position
```

## 4.4 Lighting

Lighting brings depth and realism to 3D scenes.

### 4.4.1 AmbientLight

Uniform light that illuminates everything equally.

```
MainLoop -> Camera -> AmbientLight -> [Rest of scene]
```

**Tip:** Use subtle ambient light to prevent completely black shadows.

### 4.4.2 DirectionalLight

Light from a specific direction (like the sun).

#### Key Parameters:

- Direction (X, Y, Z)
- Color
- Intensity

### 4.4.3 PointLight

Light emanating from a point in space (like a light bulb).

#### Key Parameters:

- Position (X, Y, Z)
- Color
- Intensity
- Falloff radius

### 4.4.4 SpotLight

Focused beam of light (like a flashlight or stage light).

#### Key Parameters:

- Position and direction
- Cone angle
- Falloff

## 4.4.5 Shadow Mapping

Enable shadows for more realism:

```
DirectionalLight (shadows enabled) -> ShadowMap -> Scene
```

**Shadow Parameters:** - Shadow Map Size - Resolution (higher = sharper, slower) - Shadow Bias - Prevents shadow acne - Shadow Radius - Softness of shadow edges

**Tip:** Use lower shadow map sizes for better performance. 1024x1024 is usually sufficient.

## 4.4.6 Three-Point Lighting Setup

Professional lighting arrangement:

```
MainLoop -> Camera  
AmbientLight (subtle, 0.2 intensity) - Fill light  
DirectionalLight (main, from top-left) - Key light  
PointLight (weaker, opposite side) - Rim light  
[Your scene]
```

**Key Light:** Main illumination (brightest) **Fill Light:** Reduces harsh shadows (ambient or weak directional) **Rim Light:** Creates edge highlights (back/side lighting)

## 4.4.7 Image-Based Lighting (IBL)

Use environment maps for realistic lighting:

```
HDRITexture -> Environment Map -> PBRMaterial
```

Creates reflections and lighting based on real-world environments.

## 4.4.8 Light Probes

Place light probes in your scene for accurate local lighting:

```
LightProbe -> Sample nearby lights -> Apply to objects
```

## 4.4.9 Volumetric Lighting

Create god rays and atmospheric lighting:

```
DirectionalLight -> VolumetricScattering -> [Scene]
```

## 4.4.10 Light Animation

Animate lights for dynamic scenes:

```
Time -> Sin -> Light Intensity (pulsing)  
Time -> Rotate -> Light Direction (rotating sun)  
AudioAnalyzer -> Light Color (audio-reactive)
```

## 4.5 Geometry and Meshes

### 4.5.1 Primitive Shapes

**Cube** - Basic box shape

Parameters: Width, Height, Depth

**Sphere** - Perfect sphere

Parameters: Radius, Segments (horizontal/vertical)

**Cylinder** - Tube shape

Parameters: Radius Top/Bottom, Height, Segments

**Plane** - Flat surface

Parameters: Width, Height

**Torus** - Donut shape

Parameters: Radius, Tube Radius, Segments

## 4.5.2 Loading 3D Models

**OBJLoader** - Load .obj format models

OBJLoader -> Mesh

**GLTFLoader** - Load .gltf/.glb models (recommended)

GLTFLoader -> Scene/Mesh

**FBXLoader** - Load .fbx models

## 4.5.3 Creating Custom Geometry

Use **PointCloud** or **CustomGeometry** ops to build meshes from data.

**PointCloud:**

ArrayIterator (positions) -> PointCloud

**CustomGeometry:**

Vertices Array -> Normals Array -> UVs Array -> CustomGeometry

## 4.5.4 Procedural Geometry Generation

Create geometry programmatically:

**Example: Procedural Terrain**

```
IteratorLoop (grid)
NoiseTexture (sample at position) -> Height
Calculate vertex positions
Generate normals
CustomGeometry
```

**Example: Parametric Surfaces**

```
U/V parameters -> Math functions -> Vertex positions
CustomGeometry
```

## 4.5.5 Geometry Instancing

Render many copies efficiently:

Mesh -> InstanceTransform (array of transforms) -> InstancedMesh

**Use Cases:**

- Forests of trees
- Crowds of characters
- Particle systems
- Repeating architectural elements

## 4.5.6 Geometry Modifiers

Modify existing geometry:

**Subdivision:**

Mesh -> Subdivide -> Smoother surface

**Displacement:**

Mesh -> DisplacementMap -> Deformed geometry

**Morphing:**

Mesh1 -> Morph -> Mesh2 (blend between shapes)

## 4.5.7 Boolean Operations

Combine geometries:

```
Mesh1 -> BooleanUnion -> Mesh2
Mesh1 -> BooleanSubtract -> Mesh2
Mesh1 -> BooleanIntersect -> Mesh2
```

## 4.6 Real-Time Mesh Distortion

Real-time mesh distortion allows you to dynamically modify geometry vertices during rendering, creating effects like bending walls, scaling surfaces, and warping shapes. This is essential for architectural visualization, interactive installations, and dynamic 3D effects.

### 4.6.1 Understanding Vertex Manipulation

Mesh distortion works by modifying vertex positions in real-time. Each vertex has:

- **Position** (X, Y, Z) - Where the vertex is located
- **Normal** (NX, NY, NZ) - Which direction the surface faces
- **UV Coordinates** (U, V) - Texture mapping coordinates

```
MESH DISTORTION PIPELINE
Base Mesh (Plane, Box, etc.)
Vertex Data Extraction
++> Positions Array
++> Normals Array
++> UVs Array
Distortion Function
++> Calculate new positions
++> Update normals (if needed)
++> Preserve UVs
CustomGeometry (with distorted vertices)
Material -> Render
```

### 4.6.2 Method 1: Node-Based Distortion

Using built-in cables.gl ops to distort meshes.

#### Example 1: Scaling a Wall (Size Transformation)

Transform a plain wall into different sizes using procedural scaling:

```
WALL SCALING SETUP
Plane (Base Wall)
GetVertices -> Positions Array
Scale Factor (X, Y, Z)
ArrayMap (multiply each vertex by scale)
GetNormals -> Normals Array
GetUVs -> UVs Array
```

CustomGeometry (new positions, normals, UVs)  
Material -> Render

#### Step-by-Step Node Setup:

- Create Base Plane:**
  - Add Plane op
  - Set Width: 10, Height: 5
  - Set Segments Width: 20, Segments Height: 10 (for smooth distortion)
- Extract Vertex Data:**
  - Add GetVertices op
  - Connect Plane -> GetVertices
  - Output: Array of vertex positions
- Create Scale Controls:**
  - Add Slider ops for X, Y, Z scale
  - Or use Number ops with values
- Apply Scaling:**
  - Use ArrayMap or ArrayIterator to multiply each vertex
  - For each vertex: [x, y, z] \* [scaleX, scaleY, scaleZ]
- Rebuild Geometry:**
  - Get original normals and UVs from Plane
  - Add CustomGeometry op
  - Connect: Scaled Positions -> CustomGeometry
  - Connect: Original Normals -> CustomGeometry
  - Connect: Original UVs -> CustomGeometry

#### Example 2: Bending a Wall (Curved Distortion)

Bend a plain wall into a curved wall with controllable angle:

```
WALL BENDING SETUP
Plane (Base Wall)
GetVertices -> Positions Array
Bend Angle (Slider/Number)
Bend Center (X position where bend occurs)
ArrayMap (apply bend transformation)
Calculate New Normals (for proper lighting)
CustomGeometry -> Material -> Render
```

#### Bending Algorithm (Node-Based):

For each vertex: 1. Calculate distance from bend center 2. Calculate angle based on distance and bend amount 3. Rotate vertex around bend axis 4. Update position

### Node Setup for Bending:

```
Plane
GetVertices -> ArrayIterator
For each vertex:
    Vertex X -> Subtract (Bend Center) -> Distance from center
    Distance -> Multiply (Bend Angle) -> Rotation angle
    Vertex Y -> Sin(Rotation) -> New Y position
    Vertex Z -> Cos(Rotation) -> New Z position
    Vertex X -> Keep original
    Combine -> New Vertex Position
ArrayCollect -> All Distorted Vertices
CustomGeometry
```

### 4.6.3 Method 2: JavaScript Custom Op for Mesh Distortion

For more control and performance, use a JavaScript custom op to handle distortion.

#### Custom Op: Wall Distorter

Create a custom op that handles both scaling and bending:

```
// Custom Op: WallDistorter
// Distorts a plane mesh with scaling and bending

const inVertices = op.inArray("Input Vertices");
const inNormals = op.inArray("Input Normals");
const inUVs = op.inArray("Input UVs");

// Scale parameters
const inScaleX = op.inFloat("Scale X", 1.0);
const inScaleY = op.inFloat("Scale Y", 1.0);
const inScaleZ = op.inFloat("Scale Z", 1.0);

// Bend parameters
const inBendAngle = op.inFloat("Bend Angle", 0.0); // in radians
```

```
const inBendCenter = op.inFloat("Bend Center X", 0.0); // X position of bend
const inBendAxis = op.inSwitch("Bend Axis", ["X", "Y", "Z"], "X");

// Outputs
const outVertices = op.outArray("Distorted Vertices");
const outNormals = op.outArray("Distorted Normals");
const outUVs = op.outArray("Output UVs");

function distortVertices() {
    const vertices = inVertices.get();
    const normals = inNormals.get();
    const uvs = inUVs.get();

    // `vertices` may be an Array or a TypedArray depending on where it comes from.
    if (!vertices || vertices.length === 0) {
        outVertices.set([]);
        outNormals.set([]);
        outUVs.set([]);
        return;
    }

    const scaleX = inScaleX.get();
    const scaleY = inScaleY.get();
    const scaleZ = inScaleZ.get();
    const bendAngle = inBendAngle.get();
    const bendCenter = inBendCenter.get();
    const bendAxis = inBendAxis.get();

    const distortedVertices = [];
    const distortedNormals = [];

    for (let i = 0; i < vertices.length; i += 3) {
        let x = vertices[i];
        let y = vertices[i + 1];
        let z = vertices[i + 2];

        // Apply scaling first
        x *= scaleX;
        y *= scaleY;
        z *= scaleZ;

        // Apply bending
        const distanceFromCenter = Math.sqrt((x - bendCenter) * (x - bendCenter) + (y - bendCenter) * (y - bendCenter));
        const rotationAngle = bendAngle * distanceFromCenter / 100.0;
        const sinAngle = Math.sin(rotationAngle);
        const cosAngle = Math.cos(rotationAngle);

        const newX = x + sinAngle * y - cosAngle * z;
        const newY = y + cosAngle * y + sinAngle * z;
        const newZ = z;

        x = newX;
        y = newY;
        z = newZ;
    }

    outVertices.set(distortedVertices);
    outNormals.set(distortedNormals);
    outUVs.set(uvs);
}
```

```

// Apply bending
if (Math.abs(bendAngle) > 0.001) {
    if (bendAxis === "X") {
        // Bend along X axis (curves in Y-Z plane)
        const distanceFromCenter = x - bendCenter;
        const angle = distanceFromCenter * bendAngle;

        // Rotate around X axis
        const cosA = Math.cos(angle);
        const sinA = Math.sin(angle);
        const newY = y * cosA - z * sinA;
        const newZ = y * sinA + z * cosA;
        y = newY;
        z = newZ;

        // Update normals
        if (normals && normals.length > i + 2) {
            const nx = normals[i];
            const ny = normals[i + 1];
            const nz = normals[i + 2];
            distortedNormals.push(
                nx,
                ny * cosA - nz * sinA,
                ny * sinA + nz * cosA
            );
        }
    } else if (bendAxis === "Y") {
        // Bend along Y axis (curves in X-Z plane)
        const distanceFromCenter = y - bendCenter;
        const angle = distanceFromCenter * bendAngle;

        const cosA = Math.cos(angle);
        const sinA = Math.sin(angle);
        const newX = x * cosA - z * sinA;
        const newZ = x * sinA + z * cosA;
        x = newX;
        z = newZ;

        if (normals && normals.length > i + 2) {
            const nx = normals[i];
            const ny = normals[i + 1];

```

```

            const nz = normals[i + 2];
            distortedNormals.push(
                nx * cosA - nz * sinA,
                ny,
                nx * sinA + nz * cosA
            );
        }
    } else if (bendAxis === "Z") {
        // Bend along Z axis (curves in X-Y plane)
        const distanceFromCenter = z - bendCenter;
        const angle = distanceFromCenter * bendAngle;

        const cosA = Math.cos(angle);
        const sinA = Math.sin(angle);
        const newX = x * cosA - y * sinA;
        const newY = x * sinA + y * cosA;
        x = newX;
        y = newY;

        if (normals && normals.length > i + 2) {
            const nx = normals[i];
            const ny = normals[i + 1];
            const nz = normals[i + 2];
            distortedNormals.push(
                nx * cosA - ny * sinA,
                nx * sinA + ny * cosA,
                nz
            );
        }
    }
} else {
    // No bending, just copy normals
    if (normals && normals.length > i + 2) {
        distortedNormals.push(
            normals[i],
            normals[i + 1],
            normals[i + 2]
        );
    }
}

distortedVertices.push(x, y, z);

```

```

    outVertices.set(distortedVertices);
    if (distortedNormals.length > 0) {
        outNormals.set(distortedNormals);
    } else if (normals) {
        outNormals.set(normals);
    }
    if (uvs) {
        outUVs.set(uvs);
    }
}

// Update when inputs change
inVertices.onChange = distortVertices;
inNormals.onChange = distortVertices;
inUVs.onChange = distortVertices;
inScaleX.onChange = distortVertices;
inScaleY.onChange = distortVertices;
inScaleZ.onChange = distortVertices;
inBendAngle.onChange = distortVertices;
inBendCenter.onChange = distortVertices;
inBendAxis.onChange = distortVertices;

```

## Using the Wall Distorter Op

### Setup:

```

Plane (Base Wall)
GetVertices -> WallDistorter (Input Vertices)
GetNormals -> WallDistorter (Input Normals)
GetUVs -> WallDistorter (Input UVs)
WallDistorter (Distorted Vertices) -> CustomGeometry
WallDistorter (Distorted Normals) -> CustomGeometry
WallDistorter (Output UVs) -> CustomGeometry
Material -> Render

```

**Controls:** - **Scale X/Y/Z:** Resize the wall - **Bend Angle:** Curvature amount (in radians, use `Math.PI/4` for 45°) - **Bend Center X:** Where the bend occurs along the wall - **Bend Axis:** Which axis to bend around

## 4.6.4 Advanced: Animated Wall Distortion

Combine distortion with animation for dynamic effects:

```

// Custom Op: AnimatedWallDistorter
// Adds time-based animation to distortion

const inVertices = op.inArray("Input Vertices");
const inNormals = op.inArray("Input Normals");
const inUVs = op.inArray("Input UVs");

// Animation parameters
const inTime = op.inFloat("Time", 0.0);
const inAnimationSpeed = op.inFloat("Animation Speed", 1.0);
const inAnimationType = op.inSwitch("Animation Type",
    ["None", "Pulse", "Wave", "Oscillate"], "None");

// Distortion parameters (same as before)
const inScaleX = op.inFloat("Scale X", 1.0);
const inScaleY = op.inFloat("Scale Y", 1.0);
const inScaleZ = op.inFloat("Scale Z", 1.0);
const inBendAngle = op.inFloat("Bend Angle", 0.0);
const inBendCenter = op.inFloat("Bend Center X", 0.0);

// Outputs
const outVertices = op.outArray("Distorted Vertices");
const outNormals = op.outArray("Distorted Normals");
const outUVs = op.outArray("Output UVs");

function getAnimatedBendAngle() {
    const baseAngle = inBendAngle.get();
    const time = inTime.get();
    const speed = inAnimationSpeed.get();
    const type = inAnimationType.get();

    if (type === "None") {
        return baseAngle;
    } else if (type === "Pulse") {
        // Pulse between 0 and baseAngle
        const pulse = (Math.sin(time * speed) + 1) / 2; // 0 to 1
        return baseAngle * pulse;
    } else if (type === "Wave") {

```

```

// Wave effect
return baseAngle * Math.sin(time * speed);
} else if (type === "Oscillate") {
    // Oscillate around baseAngle
    return baseAngle + Math.sin(time * speed) * (baseAngle * 0.5);
}

return baseAngle;
}

function distortVertices() {
    const vertices = inVertices.get();
    const normals = inNormals.get();
    const uvs = inUVs.get();

    if (!vertices || vertices.length === 0) {
        outVertices.set([]);
        outNormals.set([]);
        outUVs.set([]);
        return;
    }

    const scaleX = inScaleX.get();
    const scaleY = inScaleY.get();
    const scaleZ = inScaleZ.get();
    const bendAngle = getAnimatedBendAngle();
    const bendCenter = inBendCenter.get();

    const distortedVertices = [];
    const distortedNormals = [];

    for (let i = 0; i < vertices.length; i += 3) {
        let x = vertices[i];
        let y = vertices[i + 1];
        let z = vertices[i + 2];

        // Apply scaling
        x *= scaleX;
        y *= scaleY;
        z *= scaleZ;

        // Apply animated bending
    }
}

```

```

if (Math.abs(bendAngle) > 0.001) {
    const distanceFromCenter = x - bendCenter;
    const angle = distanceFromCenter * bendAngle;

    const cosA = Math.cos(angle);
    const sinA = Math.sin(angle);
    const newY = y * cosA - z * sinA;
    const newZ = y * sinA + z * cosA;
    y = newY;
    z = newZ;

    // Update normals
    if (normals && normals.length > i + 2) {
        const nx = normals[i];
        const ny = normals[i + 1];
        const nz = normals[i + 2];
        distortedNormals.push(
            nx,
            ny * cosA - nz * sinA,
            ny * sinA + nz * cosA
        );
    } else {
        if (normals && normals.length > i + 2) {
            distortedNormals.push(
                normals[i],
                normals[i + 1],
                normals[i + 2]
            );
        }
    }
    distortedVertices.push(x, y, z);
}

outVertices.set(distortedVertices);
if (distortedNormals.length > 0) {
    outNormals.set(distortedNormals);
} else if (normals) {
    outNormals.set(normals);
}
if (uvs) {
}

```

```

        outUVs.set(uvs);
    }

}

// Update on input changes
inVertices.onChange = distortVertices;
inNormals.onChange = distortVertices;
inUVs.onChange = distortVertices;
inTime.onChange = distortVertices;
inAnimationSpeed.onChange = distortVertices;
inAnimationType.onChange = distortVertices;
inScaleX.onChange = distortVertices;
inScaleY.onChange = distortVertices;
inScaleZ.onChange = distortVertices;
inBendAngle.onChange = distortVertices;
inBendCenter.onChange = distortVertices;

```

## 4.6.5 Practical Example: Interactive Curved Wall

Complete setup for an interactive curved wall with real-time controls:

```

INTERACTIVE CURVED WALL SETUP
MainLoop
Plane (Base Wall)
Width: 10, Height: 5
Segments: 30x15 (for smooth curves)
GetVertices -> WallDistorter
GetNormals -> WallDistorter
GetUVs -> WallDistorter
Slider (Bend Angle: 0 to PI/2) -> WallDistorter
Slider (Bend Center: -5 to 5) -> WallDistorter
Slider (Scale X: 0.5 to 2.0) -> WallDistorter
Slider (Scale Y: 0.5 to 2.0) -> WallDistorter
WallDistorter -> CustomGeometry
StandardMaterial -> Render
Camera -> OrbitControls

```

## 4.6.6 Performance Optimization

For real-time distortion, optimize your setup:

### 1. Reduce Vertex Count When Possible:

- Use fewer segments for static walls
- Increase segments only where distortion is visible

### 2. Cache Calculations:

```

let cachedVertices = null;
let cachedBendAngle = null;
let cachedScale = null;

function distortVertices() {
    const bendAngle = inBendAngle.get();
    const scale = inScaleX.get();

    // Only recalculate if inputs changed
    if (cachedVertices &&
        cachedBendAngle === bendAngle &&
        cachedScale === scale) {
        outVertices.set(cachedVertices);
        return; // Use cached result
    }

    // Recalculate...
    // (distortedVertices should be computed above)
    cachedVertices = distortedVertices;
    cachedBendAngle = bendAngle;
    cachedScale = scale;
}

```

### 3. Use Instancing for Multiple Walls:

- Create one distorted wall
- Use InstancedMesh to duplicate it
- Much faster than distorting each wall separately

### 4. Update Only When Needed:

```

// Only update on frame if animation is active
const inRender = op.inTrigger("Render");
inRender.onTriggered = function() {
    if (inAnimationType.get() !== "None") {
        distortVertices();
    }
};

```

## 4.6.7 Advanced Techniques

### Multi-Axis Bending

Bend along multiple axes simultaneously:

```
// Bend along both X and Y axes
const bendX = distanceFromCenterX * bendAngleX;
const bendY = distanceFromCenterY * bendAngleY;

// Apply rotations in sequence
// First rotate around X, then around Y
```

### Non-Linear Distortion

Use easing functions for smooth transitions:

```
function easeInOutCubic(t) {
    return t < 0.5
        ? 4 * t * t * t
        : 1 - Math.pow(-2 * t + 2, 3) / 2;
}

const easedAngle = baseAngle * easeInOutCubic(progress);
```

### Texture Coordinate Preservation

When distorting, UVs should remain unchanged for proper texturing:

```
// Always preserve original UVs
outUVs.set(inUVs.get()); // Don't modify UVs during distortion
```

## 4.6.8 Common Use Cases

### 1. Architectural Visualization:

- Bend walls to show different room layouts
- Scale walls to demonstrate space variations

### 2. Interactive Installations:

- User-controlled wall distortion
- Audio-reactive bending

### 3. Animation:

- Morphing between straight and curved walls
- Dynamic space transformations

### 4. Game Mechanics:

- Procedural level generation
- Dynamic environment changes

## 4.6.9 Troubleshooting

**Problem: Normals look wrong after distortion** - Solution: Recalculate normals after distortion - Use CalculateNormals op or compute in JavaScript

**Problem: Texture stretches or distorts** - Solution: Don't modify UV coordinates - Keep original UVs from the base mesh

**Problem: Performance is slow** - Solution: Reduce vertex count - Cache calculations - Only update when parameters change

**Problem: Bending looks jagged** - Solution: Increase mesh segments - Use smoother interpolation

## 4.7 Materials

Materials define how surfaces appear when lit.

### 4.7.1 BasicMaterial

Simple colored material, not affected by lighting.

### 4.7.2 LambertMaterial

Matte material with diffuse lighting.

### 4.7.3 PhongMaterial

Shiny material with specular highlights.

### Key Parameters:

- Diffuse Color - Base color
- Specular Color - Highlight color
- Shininess - How sharp the highlights are

## 4.7.4 PBRMaterial (Physically Based Rendering)

Most realistic material option.

### Key Parameters:

- Albedo - Base color
- Metalness - How metallic (0 = plastic, 1 = metal)
- Roughness - Surface smoothness (0 = mirror, 1 = rough)
- Normal Map - Surface detail
- Ambient Occlusion - Crevice shadows
- Emissive - Self-illumination
- Clearcoat - Additional glossy layer (for car paint, etc.)

**PBR Workflow Tips:** - Use real-world material values for best results - Metalness and Roughness are inverse - metals are usually smooth (low roughness) - Combine texture maps for realistic surfaces - Use HDR environment maps for accurate reflections

## 4.7.5 Material Blending

Blend between materials:

```
Material1 -> Mix -> Material2 (blend factor) -> BlendedMaterial
```

## 4.7.6 Animated Materials

Animate material properties:

```
Time -> Sin -> Material Color (pulsing)  
Time -> Material Roughness (shimmer effect)  
MouseX -> Material Metalness (interactive)
```

## 4.7.7 Material Variants

Create material variations:

```
BaseMaterial -> Multiply Color -> Variant1  
BaseMaterial -> Multiply Color -> Variant2
```

## 4.7.8 Custom Shader Materials

Use custom GLSL shaders (see Shaders chapter):

```
ShaderMaterial (custom GLSL) -> Mesh
```

## 4.7.9 Material Instancing

Apply same material to multiple objects efficiently:

```
Material -> Apply to multiple meshes
```

## 4.8 Transformations in 3D

### 4.8.1 Transform

Same as 2D but with full 3D control:

```
Transform  
+-- TranslateX, TranslateY, TranslateZ  
+-- RotateX, RotateY, RotateZ  
+-- ScaleX, ScaleY, ScaleZ (or uniform Scale)
```

### 4.8.2 Matrix Operations

For advanced control, use matrix ops: - MatrixMultiply - Combine transformations - LookAt - Point object at target - Billboard - Always face camera - MatrixInvert - Reverse transformation - MatrixDecompose - Extract position/rotation/scale

### 4.8.3 Hierarchical Transforms

Create parent-child relationships:

```
Transform (parent)  
Transform (child) - inherits parent's transform  
Mesh
```

### Use Cases:

- Character rigging (body -> arm -> hand)
- Vehicle systems (car -> wheel -> tire)

- Solar systems (sun -> planet -> moon)

## 4.8.4 Constraint Systems

Constrain object movement:

**Distance Constraint:**

```
Object1 Position -> Distance -> Object2 Position (maintain distance)
```

**Look-At Constraint:**

```
Object -> LookAt -> Target (always face target)
```

**Path Constraint:**

```
Object -> Follow Path -> Constrained movement
```

## 4.8.5 IK (Inverse Kinematics)

Control chains of objects:

```
End Effector Position -> IK Solver -> Joint Angles  
Transform chain
```

## 4.8.6 Physics-Based Transforms

Use physics for natural movement:

```
PhysicsBody -> Transform (position/rotation from physics)
```

## 4.8.7 Transform Caching

Cache expensive transformations:

```
Transform -> Cache -> Reuse for multiple objects
```

## 4.9 Rendering Techniques

### 4.9.1 Rendering Order

Opaque objects should render before transparent ones:

```
MainLoop -> Camera  
[Opaque objects]  
EnableBlending  
[Transparent objects]
```

### 4.9.2 Multiple Render Passes

Create effects like glow, depth of field, or reflections:

```
MainLoop -> Camera -> RenderToTexture -> [Scene]  
TextureEffect  
RenderToScreen
```

### 4.9.3 Fog

Add atmospheric depth:

```
MainLoop -> Camera -> Fog -> [Scene]
```

**Types:** - Linear fog - Constant density - Exponential fog - Density increases with distance - Height fog - Fog based on Y position

### 4.9.4 Screen-Space Ambient Occlusion (SSAO)

Add depth and realism:

```
MainLoop -> Camera -> RenderToTexture (depth)  
SSAO Effect  
Apply to scene
```

### 4.9.5 Screen-Space Reflections (SSR)

Realistic reflections without reflection probes:

Scene -> RenderToTexture -> SSR Effect -> Reflections

## 4.9.6 Depth of Field

Focus blur effect:

Camera -> DepthOfField -> Focus distance -> Blur amount

## 4.9.7 Bloom

Glowing highlights:

Scene -> Brightness threshold -> Blur -> Add back -> Bloom

## 4.9.8 Motion Blur

Blur moving objects:

Previous frame -> Current frame -> Blend -> Motion blur

## 4.9.9 Color Grading

Post-process color adjustments:

Scene -> ColorCorrection  
  +-- Exposure  
  +-- Contrast  
  +-- Saturation  
  +-- Color temperature  
  +-- Tint

## 4.9.10 Chromatic Aberration

Color separation effect:

Scene -> ChromaticAberration -> Distorted colors

## 4.9.11 Vignette

Darken edges:

Scene -> Vignette -> Darkened corners

## 4.9.12 Post-Processing Chain

Combine multiple effects:

Scene  
RenderToTexture  
SSAO  
Bloom  
ColorGrading  
ChromaticAberration  
Vignette  
Final Output

## 4.10 Scene Management

### 4.10.1 Scene Hierarchy

Organize complex scenes:

MainLoop -> Camera  
Scene (root)  
  +-- Environment  
  +-- Skybox  
  +-- Fog  
  +-- Lighting  
  +-- AmbientLight  
  +-- DirectionalLight  
  +-- PointLights (array)  
  +-- Static Objects  
  +-- [Buildings, terrain, etc.]  
  +-- Dynamic Objects  
  +-- [Characters, vehicles, etc.]  
  +-- Effects  
    +-- Particles  
    +-- Post-processing

## 4.10.2 Object Grouping

Group related objects:

```
Group (name: "Characters")
  +- Character1
  +- Character2
  +- Character3
```

## 4.10.3 Layer System

Use layers for organization:

```
Layer 0: Background
Layer 1: Environment
Layer 2: Characters
Layer 3: Effects
Layer 4: UI
```

## 4.10.4 Culling and Optimization

Hide objects outside view:

```
Object Position -> FrustumCull -> Only render if visible
```

## 4.10.5 LOD (Level of Detail) System

Use simpler models at distance:

```
Distance from camera -> If > threshold -> Use LOD model
```

## 4.11 Practical Examples

### 4.11.1 Example 1: Rotating Cube

```
MainLoop
PerspectiveCamera
DirectionalLight
Time -> RotateY input
PhongMaterial
```

Cube

### 4.11.2 Example 2: Lit Sphere with Orbit Controls

```
MainLoop
PerspectiveCamera -> OrbitControls
AmbientLight (subtle)
PointLight
PBRMaterial (metalness: 1, roughness: 0.2)
Sphere
```

### 4.11.3 Example 3: Loading a 3D Model

```
MainLoop
PerspectiveCamera
DirectionalLight
GLTFLoader (your model.gltf)
Transform (scale/position)
```

### 4.11.4 Example 4: Solar System

```
MainLoop
PerspectiveCamera -> OrbitControls
AmbientLight (space ambient)
DirectionalLight (sun)
[Sun] - Static sphere with emissive material
[Planet1] - Transform (orbit around sun)
  +- Time -> RotateY (orbit)
  +- Time -> RotateY (self-rotation)
  +- Sphere
[Planet2] - Different orbit speed
  +- [Moon] - Orbits planet
```

### 4.11.5 Example 5: Procedural Terrain

```
MainLoop
PerspectiveCamera -> OrbitControls
DirectionalLight
IteratorLoop (grid: 100x100)
Position -> NoiseTexture (3D noise) -> Height
```

```
Calculate vertex (X, height, Z)
Calculate normal from neighbors
CustomGeometry
PBRMaterial (terrain textures)
```

## 4.11.6 Example 6: Instanced Forest

```
MainLoop
PerspectiveCamera
DirectionalLight
TreeModel (loaded GLTF)
ArrayIterator (1000 positions)
Random -> Scale variation
Random -> Rotation variation
InstanceTransform
InstancedMesh
```

## 4.11.7 Example 7: Interactive 3D Scene

```
MainLoop
PerspectiveCamera -> OrbitControls
MouseX -> Map -> Light Direction X
MouseY -> Map -> Light Direction Y
DirectionalLight
MouseClick -> Toggle -> Object visibility
[Scene objects]
```

## 4.11.8 Example 8: Animated Character

```
MainLoop
PerspectiveCamera
DirectionalLight
CharacterModel
Timeline
    --- Frame 0: Idle pose
    --- Frame 30: Walk cycle start
    --- Frame 60: Walk cycle end
    --- [Loop]
Apply to skeleton
AnimatedMesh
```

## 4.11.9 Example 9: Particle System

```
MainLoop
PerspectiveCamera
ArrayIterator (particles)
Particle Data
    --- Position (update with velocity)
    --- Velocity (update with forces)
    --- Life (decrease over time)
    --- Size (scale with life)
Transform (position, scale)
BasicMaterial (color from life)
Sphere (small)
```

## 4.11.10 Example 10: Reflective Surface

```
MainLoop
PerspectiveCamera
[Scene to reflect]
RenderToTexture (reflection view)
CubemapTexture
PBRMaterial (reflection map)
Plane (mirror surface)
```

## 4.11.11 Example 11: Volumetric Fog

```
MainLoop
PerspectiveCamera
Scene
RenderToTexture (depth)
VolumetricFog
    --- Depth texture
    --- Noise texture (for variation)
    --- Light direction
Blend with scene
```

## 4.11.12 Example 12: Dynamic Lighting Setup

```
MainLoop
PerspectiveCamera
Time -> Sin -> Sun angle
```

```
Sun angle -> Calculate direction  
DirectionalLight (sun)  
    +-+ Color (warm -> cool based on angle)  
    +-+ Intensity (day -> night)  
AmbientLight  
    +-+ Intensity (complement sun)  
[Scene]
```

```
    +-+ Exposure  
    +-+ Contrast  
    +-+ Saturation  
ChromaticAberration  
Vignette  
Final output
```

### 4.11.13 Example 13: Morphing Objects

```
MainLoop  
PerspectiveCamera  
Time -> Sin -> Morph factor (0 to 1)  
Mesh1 -> Morph -> Mesh2  
Material
```

### 4.11.16 Example 16: Audio-Reactive 3D

```
MainLoop  
PerspectiveCamera  
AudioAnalyzer -> FFTArray  
ArrayIterator (frequency bands)  
FFT Value -> Scale Y  
Transform (position from index, scale from FFT)  
Cube (bar visualization)
```

### 4.11.14 Example 14: Physics Simulation

```
MainLoop  
PerspectiveCamera  
PhysicsWorld  
    +-+ Gravity  
    +-+ Colliders  
PhysicsBody (rigid body)  
    +-+ Mass  
    +-+ Forces  
    +-+ Collisions  
Transform (from physics)  
Mesh
```

### 4.11.17 Example 17: Procedural City

```
MainLoop  
PerspectiveCamera -> OrbitControls  
DirectionalLight  
IteratorLoop (grid: city blocks)  
NoiseTexture -> Building height  
Random -> Building type  
Transform (position, height)  
Cube (building)  
PBRMaterial (building texture)
```

### 4.11.15 Example 15: Post-Processing Pipeline

```
MainLoop  
PerspectiveCamera  
[Render scene]  
RenderTarget  
SSAO  
Bloom (extract bright areas)  
Blur (bloom)  
Add bloom back  
ColorGrading
```

### 4.11.18 Example 18: Water Surface

```
MainLoop  
PerspectiveCamera  
Time -> Sin -> Wave offset  
Plane (subdivided)  
Vertex shader (displace vertices)  
WaterMaterial  
    +-+ Normal map (animated)  
    +-+ Reflection (scene)  
    +-+ Refraction  
    +-+ Foam (at edges)
```

## 4.11.19 Example 19: Portal Effect

```
MainLoop  
PerspectiveCamera  
[Main scene]  
PortalCamera (different view)  
RenderToTexture (portal view)  
Plane (portal frame)  
Material (portal texture)  
Stencil buffer (mask to portal shape)
```

## 4.11.20 Example 20: Multi-Pass Rendering

```
MainLoop  
PerspectiveCamera  
[Pass 1: Opaque objects]  
RenderToTexture  
[Pass 2: Transparent objects]  
Blend with Pass 1  
[Pass 3: Effects]  
Blend all passes  
Post-processing
```

# 4.12 Advanced Animation Techniques

## 4.12.1 Skeletal Animation

Animate characters with bones:

```
Skeleton (bone hierarchy)  
Animation data (keyframes)  
Skin weights (vertex -> bone influence)  
AnimatedMesh
```

## 4.12.2 Morph Targets

Blend between shape variations:

```
BaseMesh -> MorphTarget1 (blend factor) -> MorphTarget2
```

Use Cases:

- Facial expressions
- Shape variations
- Smooth transitions

## 4.12.3 Procedural Animation

Generate animation with code:

```
Time -> Math functions -> Transform values  
Apply to objects
```

## 4.12.4 Physics Animation

Use physics for natural movement:

```
PhysicsBody -> Forces -> Motion -> Transform
```

## 4.12.5 Animation Blending

Smoothly transition between animations:

```
Animation1 -> Blend -> Animation2 (blend factor)
```

# 4.13 Performance Optimization

## 4.13.1 General Tips

1. **Reduce Polygon Count** - Use lower-poly models when possible
2. **Texture Atlas** - Combine textures to reduce draw calls
3. **Level of Detail (LOD)** - Use simpler models for distant objects
4. **Frustum Culling** - Built-in, but organize scenes efficiently
5. **Bake Lighting** - Pre-calculate lighting for static scenes

## 4.13.2 Advanced Optimization

Occlusion Culling:

```
Object -> Check if occluded -> Skip rendering
```

Batching:

Similar objects -> Batch -> Single draw call

**Texture Compression:** - Use compressed texture formats (DXT, ETC) - Reduce texture resolution when possible - Use mipmaps for distant objects

**Geometry Optimization:** - Remove unnecessary vertices - Use indexed geometry - Optimize UV mapping

**Shader Optimization:** - Minimize texture samples - Use simpler shaders when possible - Avoid branching in shaders

**Render Target Optimization:** - Use appropriate render target sizes - Don't render at higher resolution than display - Use half-precision floats when possible

### 4.13.3 Performance Monitoring

Track performance metrics:

```
PerformanceMonitor
  +-+ FPS
  +-+ Draw calls
  +-+ Triangle count
  +-+ Texture memory
  +-+ Shader compilation time
```

### 4.13.4 Adaptive Quality

Adjust quality based on performance:

```
FPS -> If < 30 -> Reduce quality
  +-+ Lower LOD
  +-+ Disable effects
  +-+ Reduce particle count
```

## 4.14 Common Patterns and Workflows

### 4.14.1 Pattern: Object Pooling

Reuse objects instead of creating/destroying:

Pool of inactive objects

Activate when needed  
Deactivate when done  
Return to pool

### 4.14.2 Pattern: Component System

Organize object behavior:

```
GameObject
  +-+ Transform component
  +-+ Render component
  +-+ Physics component
  +-+ Script component
```

### 4.14.3 Pattern: Event System

Decouple object interactions:

```
EventEmitter
  +-+ Subscribe (listener)
  +-+ Emit (event)
Objects react to events
```

### 4.14.4 Pattern: State Machine

Manage object states:

```
StateMachine
  +-+ Idle state
  +-+ Active state
  +-+ Transition conditions
```

## 4.15 Debugging 3D Scenes

### 4.15.1 Visual Debugging

Show Normals:

Mesh -> DebugNormals -> Visualize normals

## Show Bounding Boxes:

Mesh -> DebugBounds -> Show bounding boxes

## Show Wireframe:

Material -> Wireframe mode -> See geometry

## Show Grid:

GridHelper -> Visual reference

### 4.15.2 Common Issues

**"Objects not visible"** - Check camera position and direction - Verify objects are within near/far planes - Check material alpha values - Verify lighting setup

**"Shadows look wrong"** - Adjust shadow bias - Increase shadow map resolution - Check light shadow settings - Verify shadow receiving objects

**"Performance is slow"** - Reduce polygon count - Lower texture resolutions - Disable expensive effects - Use LOD system - Optimize shaders

**"Materials look incorrect"** - Verify texture UV mapping - Check normal map orientation - Verify PBR material values - Check lighting setup

## 4.16 Best Practices

1. **Start Simple** - Build complexity gradually
2. **Optimize Early** - Consider performance from the start
3. **Use Instancing** - For repeated objects
4. **Organize Scenes** - Use hierarchies and groups
5. **Test on Target Hardware** - Performance varies by device
6. **Use Appropriate Formats** - GLTF for models, compressed textures
7. **Profile Regularly** - Use performance tools
8. **Document Complex Setups** - Add comments to patches
9. **Version Control** - Save iterations of complex scenes
10. **Reuse Assets** - Don't duplicate unnecessarily

## 4.17 Featured Videos

## 4.18 Exercises

### 4.18.1 Beginner

1. Create a solar system with orbiting planets
2. Build a simple room with multiple light sources
3. Load a 3D model and add interactive rotation controls
4. Create a rotating cube with different materials
5. Build a simple scene with fog

### 4.18.2 Intermediate

1. Create a procedural terrain with noise
2. Build an instanced forest with 100+ trees
3. Implement a three-point lighting setup
4. Create a water surface with animated waves
5. Build a particle system with physics
6. Create a portal effect with dual cameras
7. Implement post-processing effects (bloom, SSAO)
8. Build an audio-reactive 3D visualization
9. Create a morphing object animation
10. Implement a character with skeletal animation

### 4.18.3 Advanced

1. Build a complete scene with LOD system
2. Create a volumetric fog effect
3. Implement screen-space reflections
4. Build a physics-based simulation
5. Create a procedural city generator
6. Implement a multi-pass rendering pipeline
7. Build an interactive 3D game scene
8. Create advanced post-processing chain
9. Implement custom shader materials
10. Build a complex scene with optimization techniques

## 4.19 Project Ideas

1. **3D Product Viewer** - Interactive product showcase
2. **Architectural Visualization** - Building walkthrough
3. **Game Prototype** - Simple 3D game mechanics
4. **Data Visualization** - 3D charts and graphs
5. **Virtual Gallery** - 3D art exhibition
6. **Interactive Installation** - Museum or event display
7. **Music Visualizer** - 3D audio-reactive visuals
8. **Procedural World** - Generated landscape exploration
9. **Character Animation** - Animated character showcase
10. **Physics Sandbox** - Interactive physics playground

## 5 Texturing in Cables.gl

### 5.1 Introduction to Textures

Textures add detail, color, and realism to your visuals. In cables.gl, textures can come from images, videos, webcams, or be generated procedurally.

### 5.2 Loading Textures

#### 5.2.1 ImageTexture

Load images from files or URLs:

```
ImageTexture -> Material (texture input)
```

**Supported Formats:** - PNG (with transparency) - JPG - WebP - GIF (first frame or animated)

#### Key Parameters:

- URL - Path to image
- Filter - Nearest (pixelated) or Linear (smooth)
- Wrap - Repeat, Clamp, Mirror

#### 5.2.2 VideoTexture

Use video as a texture:

```
VideoTexture -> Material (texture input)
```

#### Key Parameters:

- URL - Path to video file
- Loop - Whether to loop playback
- Playback Rate - Speed control
- Volume - Audio volume

**Supported Formats:** - MP4 (H.264) - WebM

#### 5.2.3 WebcamTexture

Live webcam input as a texture:

WebcamTexture -> Material (texture input)

**Tip:** Great for interactive installations!

## 5.3 Texture Mapping

### 5.3.1 UV Coordinates

UV coordinates define how textures wrap onto geometry:

#### UV COORDINATE SYSTEM

Texture (Image)

U=0,V=0 U=1,V=0 <- Top edge

U=0,V=1 U=1,V=1 <- Bottom edge

Mapped to 3D Geometry:

U=0,V=0 ----- U=1,V=0

3D Surface

U=0,V=1 ----- U=1,V=1

- U = Horizontal (0 to 1, left to right)

- V = Vertical (0 to 1, top to bottom)

- **U** = Horizontal position (0 to 1)
- **V** = Vertical position (0 to 1)

Most primitive shapes have automatic UV mapping.

### 5.3.2 UV Transform

Modify texture coordinates:

#### UV TRANSFORM OPERATIONS

Original Texture

Texture

Offset U/V: Shift texture position

+-----+

Texture <- Moved right/up

+-----+

Scale U/V: Tile or shrink texture

Tex Tex Tex <- Tiled horizontally

Rotate: Rotate texture around center

/ \

/ Texture \ <- Rotated

\ /

TextureTransform -> Before texture application

**Parameters:** - Offset U/V - Shift the texture - Scale U/V - Tile or shrink - Rotate  
- Rotate the texture

### 5.3.3 Tiling Textures

For seamless repeating:

1. Set wrap mode to Repeat
2. Scale UV coordinates > 1

## 5.4 Advanced Texture Workflow (Production Mindset)

Texturing is where many cables.gl projects move from “cool prototype” to “polished piece”. The two recurring themes are:

- **Correctness:** color space, alpha handling, UVs, aspect ratios, and predictable sampling.
- **Performance:** texture sizes, filtering, mipmaps, compression, and “how many textures are you sampling per pixel”.

### 5.4.1 Color Space: sRGB vs Linear (Why Your Colors Look “Off”)

Most images you download (JPG/PNG/WebP) are authored in **sRGB** (gamma corrected). Most lighting and shading math expects **linear** values. If your project mixes lit materials (e.g., PBR) with UI-like textures, you can run into:

- washed-out or too-dark textures
- incorrect blending
- “metal looks wrong” in PBR

**Practical rule of thumb:**

- **Color/albedo** textures are usually **sRGB**.
- **Data** textures (normal maps, roughness/metalness/AO, masks) are usually **linear**.

If a texture looks wrong, verify you’re not treating a data map like a color map (or vice versa).

## 5.4.2 Alpha (Transparency) Pitfalls

If you see dark/bright halos around transparent textures (logos, sprites), you're likely looking at one of these issues:

- The texture was exported with a bad matte color (common in PNGs).
- The pipeline expects **premultiplied alpha** but you provided straight alpha (or the other way around).
- Filtering/mipmaps sample transparent pixels and "bleed" colors into edges.

**Fix strategies:**

- Add padding/bleed around sprites in your source image.
- Prefer power-of-two textures with mipmaps for distant rendering.
- If you have control over asset export, re-export with correct alpha handling.

## 5.4.3 Filtering, Mipmaps, and Why Textures "Shimmer"

When a textured surface gets small on screen, the GPU needs mipmaps to avoid shimmer and crawling.

- **Nearest** filtering: crisp pixels, great for pixel-art, terrible for most 3D.
- **Linear** filtering: smoother sampling, better for general use.
- **Mipmaps**: essential for 3D surfaces viewed at varying distances.

If a ground texture "crawls" when the camera moves, you typically need mipmaps and (if available) anisotropic filtering.

## 5.4.4 Power-of-Two Sizes (and When It Matters)

Power-of-two textures (256/512/1024/2048/4096) generally behave better for:

- mipmaps
- repeating wrap modes
- GPU compatibility/performance

Non-power-of-two often still works in modern WebGL, but when things behave oddly, returning to power-of-two sizes is a reliable fix.

## 5.4.5 Aspect Ratio Correctness (Especially for Video)

Video textures are a frequent source of "why is it stretched?" issues.

- Match the **Plane** aspect ratio to the video's aspect ratio.

- If you use Fullscreen rectangles, make sure you're compensating for screen aspect.

## 5.5 Advanced Techniques and Patch Recipes

These are "building block" patterns you can reuse across many projects.

### 5.5.1 Recipe: Masked Texture Blend (Two Textures + a Mask)

Use a mask texture (black/white) to blend between two images.

**Conceptual chain:**

```
ImageTexture (A) -+  
                    +-> (blend using mask) -> Material -> Mesh  
ImageTexture (B) -+  
ImageTexture (Mask)
```

**Notes:** - The mask should be treated as a data texture (linear). - Great for dirt overlays, decals, and transitions.

### 5.5.2 Recipe: Animated UVs (Scrolling / Parallax)

Scrolling textures are perfect for conveyor belts, moving backgrounds, water normals, etc.

```
Time -> (speed multiply) -> TextureTransform (Offset U/V)  
ImageTexture -> Material (texture input)  
Material -> Mesh
```

### 5.5.3 Recipe: Render-to-Texture for Post-Processing

Render your scene to a texture, apply effects, then output.

```
MainLoop -> Camera -> RenderToTexture  
[Scene]  
TextureEffects -> Output
```

**Use Cases:**

- blur/glow chains

- color grading
- stylized distortion
- feedback trails (see next recipe)

## 5.5.4 Recipe: Feedback / Trails (Texture Feedback Loop)

Feedback is a signature look in real-time visuals.

High-level structure:

```
Previous Frame Texture
TextureEffects (fade/blur)
Combine with New Frame Content
RenderTargetTexture (becomes "previous frame" next tick)
```

**Tip:** Keep feedback subtle (small fade each frame). Large blur + high persistence can become very expensive.

## 5.5.5 Recipe: Planar “Mirror” Reflection (Render-to-Texture)

To fake a mirror floor:

- Render the scene from a reflected camera to a texture.
- Apply that texture onto a plane.

```
MainLoop
+-> Camera (main) -> [Scene]
+-> Camera (reflected) -> RenderToTexture -> Plane Material ->
    Mirror Plane
```

## 5.5.6 Recipe: Environment Reflections (Cubemap/HDR)

Use an environment texture for reflections and more believable PBR materials.

```
HDRITexture or CubemapTexture -> (environment input) -> PBRMaterial
-> Mesh
```

**Tip:** Even simple objects look dramatically better with good environment lighting.

## 5.5.7 Recipe: Video Texture “Billboard” (Reliable Playback)

```
VideoTexture -> BasicMaterial -> Plane
```

**Checklist:** - Use a browser-served URL (avoid file:// in production). - Make sure autoplay policies are satisfied (user interaction may be required). - Use a fallback poster image if video takes time to load.

## 5.5.8 Recipe: Webcam Texture (Permissions + UX)

```
WebcamTexture -> BasicMaterial -> Plane
```

**Checklist:** - Provide a UI prompt (“Click to enable camera”). - Handle denied permissions gracefully (fallback texture). - Keep resolution reasonable for performance.

## 5.6 Texture Types for PBR Materials

### 5.6.1 Albedo/Diffuse Map

The base color of the surface.

### 5.6.2 Normal Map

Adds surface detail without extra geometry.

```
NormalMap -> PBRMaterial (normal input)
```

**Tip:** Use tangent-space normal maps (blue-purple appearance).

### 5.6.3 Roughness Map

Controls surface smoothness per-pixel.

- White = rough
- Black = smooth/shiny

### 5.6.4 Metalness Map

Defines metallic vs. non-metallic regions.

- White = metal
- Black = non-metal (dielectric)

## 5.6.5 Ambient Occlusion Map

Pre-baked shadow information for crevices.

## 5.6.6 Height/Displacement Map

Actual geometry displacement (more expensive).

## 5.6.7 Emissive Map

Self-illuminating regions of the surface.

## 5.7 Procedural Textures

Generate textures with code/nodes:

### 5.7.1 Noise Textures

NoiseTexture -> Creates Perlin/Simplex noise

**Types:** - Perlin noise - Simplex noise - Voronoi - Fractal/FBM

### 5.7.2 Gradient Textures

GradientTexture -> Creates color gradients

### 5.7.3 Pattern Generators

- Checkerboard
- Stripes
- Dots
- Custom math-based patterns

## 5.8 Render to Texture

Capture your scene as a texture for post-processing or effects:

MainLoop -> Camera -> RenderToTexture  
[Scene to capture]  
TextureOutput -> Use elsewhere

## 5.8.1 Common Uses:

1. **Post-processing effects** - Apply shaders to the entire scene
2. **Mirrors/Reflections** - Render from reflection viewpoint
3. **Dynamic textures** - Use one patch's output in another
4. **Feedback effects** - Feed output back as input

## 5.9 Texture Effects

### 5.9.1 TextureEffects Op

Chain of image processing effects:

ImageTexture -> TextureEffects -> Output

**Available Effects:** - Blur - Sharpen - Color correction - Distortion - Edge detection - Pixelation

### 5.9.2 Custom Shader Effects

Write GLSL for custom texture processing (see Shaders chapter).

## 5.10 Cubemaps and Environment Maps

### 5.10.1 CubemapTexture

Six images forming a surrounding environment:

CubemapTexture -> Environment lighting

**Uses:** - Skyboxes - Reflections - Image-based lighting (IBL)

### 5.10.2 HDRITexture

High Dynamic Range images for realistic lighting:

HDRITexture -> IBL/Environment

## 5.11 Texture Compression and Optimization

### 5.11.1 File Size Tips:

1. **Use appropriate formats:**
  - PNG for transparency
  - JPG for photos (no transparency)
  - WebP for best compression
2. **Power of 2 sizes:** 256, 512, 1024, 2048, 4096 pixels
3. **Mipmaps:** Enable for textures viewed at varying distances
4. **Compress textures:** Use tools like TinyPNG, Squoosh

### 5.11.2 Memory Considerations:

- 512x512: ~1 MB
- 1024x1024: ~4 MB
- 2048x2048: ~16 MB
- 4096x4096: ~64 MB

## 5.12 Practical Examples

### 5.12.1 Example 1: Textured Rotating Cube

```
MainLoop  
PerspectiveCamera  
DirectionalLight  
Time -> RotateY  
ImageTexture -> PhongMaterial (texture input)  
Cube
```

### 5.12.2 Example 2: Video on a Plane

```
MainLoop  
VideoTexture -> BasicMaterial  
Plane (aspect ratio matching video)
```

### 5.12.3 Example 3: Animated Noise Background

```
MainLoop  
Time -> NoiseTexture (animate offset)
```

```
BasicMaterial  
FullscreenRectangle
```

### 5.12.4 Example 4: PBR Textured Material

```
ImageTexture (albedo)  
ImageTexture (normal)  
ImageTexture (roughness)  
ImageTexture (metalness)  
    (all connected to PBRMaterial)  
PBRMaterial  
Mesh
```

## 5.13 Featured Videos

## 5.14 Exercises

1. Create a textured cube that rotates and displays different images on each face
2. Build a video wall with multiple video textures
3. Create a procedural noise-based animated background
4. Apply PBR textures to a loaded 3D model

# 6 Shaders & GLSL in Cables.gl

## 6.1 Introduction to Shaders

Shaders are programs that run on the GPU, enabling custom visual effects and rendering techniques. Cables.gl provides powerful tools for writing and using GLSL (OpenGL Shading Language) shaders.

**Official reference:** start with cables.gl docs and search for **Shaders**, **TextureEffect**, **ShaderMaterial**, and **CustomShader**. The exact shader “template” and available built-ins can vary depending on the op/runtime version.

Quick links (official operator reference examples): - `Ops.Gl.Shader.ShaderMaterial`  
- `Ops.Gl.Shader.TextureEffect`

## 6.2 What Are Shaders?

Shaders are small programs that determine how graphics are rendered:

- **Vertex Shaders** - Transform vertex positions
- **Fragment Shaders** - Determine pixel colors

Together, they control everything you see on screen.

## 6.3 Why Use Custom Shaders?

- Create unique visual effects
- Achieve effects impossible with built-in ops
- Optimize performance for specific use cases
- Learn the fundamentals of graphics programming

## 6.4 Shader Ops in Cables.gl

### 6.4.1 ShaderMaterial

Apply custom GLSL code as a material:

```
ShaderMaterial -> Mesh
```

### 6.4.2 TextureEffect (Shader-based)

Process textures with custom fragment shaders.

### 6.4.3 CustomShader

Full control over vertex and fragment shaders.

## 6.5 GLSL Basics

### 6.5.1 Data Types

```
// Scalars
float a = 1.0;
int b = 5;
bool c = true;

// Vectors
vec2 uv = vec2(0.5, 0.5);
vec3 color = vec3(1.0, 0.0, 0.0); // RGB
vec4 rgba = vec4(1.0, 1.0, 1.0, 1.0);

// Matrices
mat4 transform;

// Samplers (textures)
sampler2D myTexture;
```

### 6.5.2 Swizzling

Access vector components in any order:

```
vec4 color = vec4(1.0, 0.5, 0.25, 1.0);
vec3 rgb = color.rgb; // (1.0, 0.5, 0.25)
vec2 rg = color.rg; // (1.0, 0.5)
float r = color.r; // 1.0
vec3 bgr = color.bgr; // (0.25, 0.5, 1.0) - reversed!
```

## 6.5.3 Built-in Functions

```
// Math  
sin(x), cos(x), tan(x)  
pow(x, y)  
sqrt(x)  
abs(x)  
min(a, b), max(a, b)  
clamp(x, min, max)  
  
// Interpolation  
mix(a, b, t) // Linear interpolation  
smoothstep(edge0, edge1, x)  
  
// Vector operations  
length(v)  
normalize(v)  
dot(a, b)  
cross(a, b)  
reflect(incident, normal)  
  
// Texture sampling  
// WebGL1 / GLSL ES 1.00:  
texture2D(sampler, uv)  
  
// WebGL2 / GLSL ES 3.00:  
texture(sampler, uv)
```

## 6.6 Your First Fragment Shader

A simple color gradient:

```
// Fragment Shader  
precision mediump float;  
  
varying vec2 vUV; // UV coordinates from vertex shader  
  
void main() {  
    // Create gradient based on UV  
    vec3 color = vec3(vUV.x, vUV.y, 0.5);  
}
```

```
    gl_FragColor = vec4(color, 1.0);  
}
```

Note: many cables.gl shader ops use a WebGL1-style fragment shader where `gl_FragColor` is valid. If you run into compile errors mentioning `gl_FragColor` or `texture2D`, check which shader op you're using and whether it targets WebGL / GLSL ES 3.00.

## 6.7 Common Shader Patterns

### 6.7.1 Solid Color

```
void main() {  
    gl_FragColor = vec4(1.0, 0.0, 0.0, 1.0); // Red  
}
```

### 6.7.2 UV Gradient

```
void main() {  
    gl_FragColor = vec4(vUV, 0.0, 1.0);  
}
```

### 6.7.3 Circle (SDF)

```
void main() {  
    vec2 center = vec2(0.5, 0.5);  
    float dist = length(vUV - center);  
    float circle = step(dist, 0.3);  
  
    gl_FragColor = vec4(vec3(circle), 1.0);  
}
```

### 6.7.4 Smooth Circle

```
void main() {  
    vec2 center = vec2(0.5, 0.5);  
    float dist = length(vUV - center);  
    float circle = smoothstep(0.3, 0.28, dist);  
  
    gl_FragColor = vec4(vec3(circle), 1.0);  
}
```

## 6.7.5 Animated Pattern

```
uniform float time;  
  
void main() {  
    float wave = sin(vUV.x * 10.0 + time) * 0.5 + 0.5;  
    gl_FragColor = vec4(vec3(wave), 1.0);  
}
```

## 6.8 Uniforms

Uniforms are values passed from cables.gl to your shader:

```
uniform float time; // Current time  
uniform vec2 resolution; // Canvas size  
uniform sampler2D tex; // Texture  
uniform vec3 color; // Custom color
```

In cables.gl, connect ops to shader uniform inputs.

## 6.9 Advanced Shader Workflows in cables.gl

The biggest jump in quality comes from treating shaders like reusable “modules”:

- a **clear input contract** (uniforms you expect: time, resolution, textures, parameters)
- predictable **coordinate conventions** (UV vs screen space vs world space)
- a **debug strategy** (visualize intermediate values)
- performance awareness (texture samples, loops, precision)

### 6.9.1 A Practical Uniform “Contract”

In most patches you’ll end up with a small set of recurring uniforms:

- **time** (float): animation driver
- **resolution** (vec2): coordinate normalization
- **tex / tex0 / tex1** (sampler2D): one or more textures
- **amount / strength** (float): effect intensity
- **colorA / colorB** (vec3): palette endpoints

**Tip:** name your uniforms consistently so you can reuse the same patch wiring across multiple shader materials/effects.

## 6.9.2 Coordinate Spaces: UV vs Screen Space

- **UV space** (vUV) is normalized 0..1 per surface.
- **Screen space** is often derived from UV + resolution when you need pixel-sized offsets.

Example helper:

```
vec2 pixel(vec2 uv, vec2 resolution) {  
    return 1.0 / resolution;  
}
```

### 6.9.3 Anti-Aliasing SDFs (Clean Edges)

Hard step() edges often look jagged. A common pattern is to use smoothstep() with a small “feather”:

```
float aa(float dist, float radius) {  
    float edge = 0.002; // tweak for your resolution / style  
    return 1.0 - smoothstep(radius - edge, radius + edge, dist);  
}
```

When available, fwidth() can provide adaptive edge widths, but keep in mind WebGL precision/derivative constraints in some contexts.

### 6.9.4 Palette Mapping (Better Color Fast)

Instead of picking random RGB values, map a scalar to a palette:

```
vec3 palette(float t, vec3 a, vec3 b, vec3 c, vec3 d) {  
    return a + b * cos(6.28318 * (c * t + d));  
}
```

This gives you rich gradients with a tiny amount of code.

## 6.10 Advanced Examples (Copy-and-Adapt)

These examples are written so you can drop them into a ShaderMaterial/TextureEffect style fragment shader and then wire the uniforms from your patch.

## 6.10.1 Example: Texture Distortion (UV Warp)

```
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;
uniform float time;
uniform float amount;

void main() {
    vec2 uv = vUV;
    uv.x += sin(uv.y * 10.0 + time) * amount;
    uv.y += cos(uv.x * 10.0 + time) * amount;
    gl_FragColor = texture2D(tex, uv);
}
```

**Patch wiring idea:** - Time -> time - a slider (0..0.05) -> amount - input texture -> tex

## 6.10.2 Example: Simple Bloom-ish Glow (Threshold + Blur-ish)

This isn't a full separable blur, but it demonstrates the "sample neighbors" pattern.

```
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform float threshold;
uniform float strength;

void main() {
    vec2 px = 1.0 / resolution;
    vec3 c = texture2D(tex, vUV).rgb;

    // crude 5-tap blur
    vec3 b = vec3(0.0);
    b += texture2D(tex, vUV + vec2( 1.0, 0.0) * px).rgb;
    b += texture2D(tex, vUV + vec2(-1.0, 0.0) * px).rgb;
    b += texture2D(tex, vUV + vec2( 0.0, 1.0) * px).rgb;
    b += texture2D(tex, vUV + vec2( 0.0,-1.0) * px).rgb;
    b *= 0.25;
```

```
float luma = dot(c, vec3(0.299, 0.587, 0.114));
vec3 glow = (luma > threshold) ? b : vec3(0.0);

gl_FragColor = vec4(c + glow * strength, 1.0);
}
```

## 6.10.3 Example: Domain Warping (More Organic Noise)

Domain warping is a standard "make it look expensive" trick: distort the coordinates before sampling noise.

```
precision mediump float;
varying vec2 vUV;
uniform float time;

float hash(vec2 p) {
    return fract(sin(dot(p, vec2(127.1, 311.7))) * 43758.5453);
}

float noise(vec2 p) {
    vec2 i = floor(p);
    vec2 f = fract(p);
    float a = hash(i);
    float b = hash(i + vec2(1.0, 0.0));
    float c = hash(i + vec2(0.0, 1.0));
    float d = hash(i + vec2(1.0, 1.0));
    vec2 u = f * f * (3.0 - 2.0 * f);
    return mix(a, b, u.x) + (c - a) * u.y * (1.0 - u.x) + (d - b) *
u.x * u.y;
}

void main() {
    vec2 uv = vUV * 4.0;
    vec2 warp = vec2(
        noise(uv + time * 0.2),
        noise(uv + vec2(5.2, 1.3) - time * 0.2)
    );
    float n = noise(uv + warp * 2.0);
    gl_FragColor = vec4(vec3(n), 1.0);
}
```

## 6.11 Debugging Shaders (In Practice)

When something is wrong, render the intermediate value:

- visualize UVs: `gl_FragColor = vec4(vUV, 0.0, 1.0);`
- visualize a scalar: `gl_FragColor = vec4(vec3(val), 1.0);`
- isolate channels: `gl_FragColor = vec4(texture2D(tex, vUV).rrr, 1.0);`

### 6.11.1 Common Gotchas

- **Black output:** your shader compiles but outputs 0 (check uniform wiring; check ranges).
- **Solid color:** UVs are constant or your sampling coord is wrong.
- **Stretching:** you're using UVs but expect square pixels; incorporate resolution.
- **Banding:** precision too low; consider `highp` where supported, or dither slightly.

## 6.12 Performance Guidelines (Real-Time Friendly)

- **Texture samples are expensive:** keep them minimal and reuse results.
- **Avoid nested loops:** especially dynamic loops in fragment shaders.
- **Prefer simple math over heavy branching:** GPUs dislike divergent branches.
- **Keep effects modular:** multiple simpler passes can be easier to tune than one huge shader.

## 6.13 Signed Distance Functions (SDFs)

SDFs define shapes mathematically:

### 6.13.1 SDF Primitives

```
// Circle
float sdCircle(vec2 p, float r) {
    return length(p) - r;
}

// Box
float sdBox(vec2 p, vec2 b) {
    vec2 d = abs(p) - b;
    return length(max(d, 0.0)) + min(max(d.x, d.y), 0.0);
}
```

```
// Line segment
float sdSegment(vec2 p, vec2 a, vec2 b) {
    vec2 pa = p - a, ba = b - a;
    float h = clamp(dot(pa, ba) / dot(ba, ba), 0.0, 1.0);
    return length(pa - ba * h);
}
```

### 6.13.2 SDF Operations

```
// Union (combine shapes)
float opUnion(float d1, float d2) {
    return min(d1, d2);
}

// Subtraction (cut one from another)
float opSubtract(float d1, float d2) {
    return max(-d1, d2);
}

// Intersection (overlap only)
float opIntersect(float d1, float d2) {
    return max(d1, d2);
}

// Smooth union
float opSmoothUnion(float d1, float d2, float k) {
    float h = clamp(0.5 + 0.5 * (d2 - d1) / k, 0.0, 1.0);
    return mix(d2, d1, h) - k * h * (1.0 - h);
}
```

## 6.14 Noise Functions

### 6.14.1 Simple Value Noise

```
float random(vec2 st) {
    return fract(sin(dot(st.xy, vec2(12.9898, 78.233))) *
43758.5453);
}

float noise(vec2 st) {
```

```

vec2 i = floor(st);
vec2 f = fract(st);

float a = random(i);
float b = random(i + vec2(1.0, 0.0));
float c = random(i + vec2(0.0, 1.0));
float d = random(i + vec2(1.0, 1.0));

vec2 u = f * f * (3.0 - 2.0 * f);

return mix(a, b, u.x) + (c - a) * u.y * (1.0 - u.x) + (d - b) *
u.x * u.y;
}

```

## 6.14.2 Fractal Brownian Motion (FBM)

```

float fbm(vec2 st) {
    float value = 0.0;
    float amplitude = 0.5;

    for (int i = 0; i < 5; i++) {
        value += amplitude * noise(st);
        st *= 2.0;
        amplitude *= 0.5;
    }

    return value;
}

```

```

void main() {
    vec2 offset = (vUV - 0.5) * 0.01;
    float r = texture2D(tex, vUV + offset).r;
    float g = texture2D(tex, vUV).g;
    float b = texture2D(tex, vUV - offset).b;
    vec3 color = vec3(r, g, b);
    gl_FragColor = vec4(color, 1.0);
}

```

## 6.15.3 Blur (Box Blur)

```

precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;

void main() {
    vec3 blur = vec3(0.0);
    float samples = 9.0;
    float offset = 0.005;

    for (float x = -1.0; x <= 1.0; x++) {
        for (float y = -1.0; y <= 1.0; y++) {
            blur += texture2D(tex, vUV + vec2(x, y) * offset).rgb;
        }
    }
    blur /= samples;
    gl_FragColor = vec4(blur, 1.0);
}

```

# 6.15 Post-Processing Effects

## 6.15.1 Vignette

```

float vignette = 1.0 - length(vUV - 0.5) * 1.5;
color *= vignette;

```

## 6.15.2 Chromatic Aberration

```

precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;

```

## 6.15.4 Pixelation

```

precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;

void main() {
    float pixels = 100.0;
    vec2 pixelUV = floor(vUV * pixels) / pixels;
    vec3 color = texture2D(tex, pixelUV).rgb;
    gl_FragColor = vec4(color, 1.0);
}

```

}

## 6.16 Vertex Shader Basics

Modify geometry positions:

```
// Vertex Shader
attribute vec3 position;
attribute vec2 uv;

uniform mat4 modelViewMatrix;
uniform mat4 projectionMatrix;
uniform float time;

varying vec2 vUV;

void main() {
    vUV = uv;

    vec3 pos = position;
    // Wave deformation
    pos.z += sin(pos.x * 5.0 + time) * 0.2;

    gl_Position = projectionMatrix * modelViewMatrix * vec4(pos,
    1.0);
}
```

## 6.17 Debugging Shaders

### 6.17.1 Visualize Values

```
// Show UV coordinates
gl_FragColor = vec4(vUV, 0.0, 1.0);

// Show a value as grayscale
gl_FragColor = vec4(vec3(someValue), 1.0);

// Show negative values in red
float val = someCalculation;
if (val < 0.0) {
```

```
    gl_FragColor = vec4(-val, 0.0, 0.0, 1.0);
} else {
    gl_FragColor = vec4(0.0, val, 0.0, 1.0);
}
```

## 6.18 Performance Tips

- Avoid branching** - GPUs don't like if/else
- Use built-in functions** - They're optimized
- Minimize texture samples** - Each sample has cost
- Precision matters** - Use mediump when possible
- Precompute values** - Do math in JavaScript when possible

## 6.19 Professional Video Projection Mapping in Cables.gl

Projection mapping (also called video mapping or spatial augmented reality) involves projecting images onto real-world surfaces, often requiring geometric correction, multi-projector blending, and specialized color correction. This section provides professional-grade shaders for simulating and preparing projection mapping content within cables.gl.

All shaders in this section are designed for use with cables.gl's built-in `TextureEffect` or `ShaderMaterial` ops - simply paste the shader code into the fragment shader field and connect your inputs. For JavaScript custom op implementations, see the "JavaScript Custom Op Examples" section below.

### 6.19.1 Understanding Cables.gl Shader Context

#### Critical Notes for Cables.gl Shaders:

- Resolution Handling:** In cables.gl, resolution uniform is typically `vec2(width, height)` in pixels. When working with UV coordinates (vUV), remember:
  - vUV ranges from 0.0 to 1.0
  - Screen space =  $vUV \times \text{resolution}$
  - Pixel size =  $1.0 / \text{resolution}$
  - Important:** resolution is NOT automatically provided - you must connect a `CanvasInfo` or `GetResolution` op to the `resolution` port
- Texture Sampling:** Most cables.gl shader ops are **WebGL 1.0 / GLSL ES 1.00 style**, where you sample with `texture2D()`. Some WebGL2-based contexts use `texture()` instead.

- If you're using **TextureEffect** and a classic fragment shader template (`gl_FragColor`), `texture2D()` is the safe default.
- If your shader template uses `out vec4 fragColor;` and GLSL 3.00 style syntax, you may need `texture()`.

### 3. Coordinate Systems:

- UV space: vUV (0.0 to 1.0) - automatically provided
- Screen space: vUV \* resolution
- Normalized screen space: (vUV - 0.5) \* 2.0 (ranges -1.0 to 1.0)

### 4. Shader Headers:

Always include precision declaration at the top:

```
precision mediump float;
```

### 5. Uniform Types:

- float, vec2, vec3, vec4 - Fully supported, become Number/Vector ports
- sampler2D - Fully supported, becomes Texture port
- mat3, mat4 - Supported, but verify with Matrix ops in your cables.gl version
- int - **Not recommended** - Use float instead and compare with < 0.5 patterns

### 6. Auto-Provided Variables:

- varying vec2 vUV - Always available (no need to declare in vertex shader for TextureEffect)
- uniform float time - Available if you connect a Time op
- uniform vec2 resolution - **NOT auto-provided** - must connect manually

## 6.19.2 Cables.gl Shader Compliance Checklist

Before using any shader in cables.gl, verify:

- Shader starts with `precision mediump float;`
- Texture sampling matches your shader context (`texture2D()` for most WebGL1-style cables ops; `texture()` for GLSL 3.00 / WebGL2 contexts)
- Uses varying `vec2 vUV` (auto-provided, don't declare in vertex shader for TextureEffect)
- No uniform `int` - converted to `uniform float` with float comparisons
- All uniforms are properly typed (float, vec2, vec3, vec4, sampler2D)
- Resolution uniform is documented as requiring manual connection
- Shader compiles without errors

- All texture samples are within 0.0-1.0 UV bounds (or clamped)
- No WebGL 2.0 specific features (use WebGL 1.0 compatible code)

## 6.19.3 Troubleshooting Common Issues

**Issue: "Shader won't compile"** - Check for precision `mediump float`; at the top - Verify texture sampling matches the shader context (WebGL1-style: `texture2D`; WebGL2-style: `texture`) - Ensure no WebGL 2.0 features are used - Check for syntax errors (missing semicolons, etc.)

**Issue: "Black screen or no output"** - Verify texture is connected to `tex` (or appropriate `sampler2D`) port - Check UV coordinates are in 0.0-1.0 range - Ensure resolution is connected if shader uses it - Check if shader is sampling outside texture bounds

**Issue: "Resolution uniform not working"** - `resolution` is NOT automatically provided - Connect `CanvasInfo` op or `GetResolution` op to `resolution` port - Verify resolution values are correct (width, height in pixels)

**Issue: "Integer uniforms not working"** - Cables.gl may not support `uniform int` reliably - Convert to `uniform float` and use float comparisons: - if (`direction == 0`) -> if (`direction < 0.5`) - if (`direction == 1`) -> if (`direction > 0.5 && direction < 1.5`)

**Issue: "Matrix uniforms not working"** - Verify your cables.gl version supports `mat3`/`mat4` - Use Matrix ops to create matrix values - Consider using `vec4` arrays or separate `vec2`/`vec3` values if matrices aren't supported

**Issue: "Performance is poor"** - Reduce texture samples per pixel - Use `mediump` precision (already done) - Avoid branching in shaders when possible - Consider breaking into multiple passes - Check if using custom JavaScript ops (adds overhead)

**Issue: "Ports not appearing"** - Ensure uniform declarations match exactly (case-sensitive) - Check uniform types are supported - Verify shader compiles successfully - Try recompiling the shader in TextureEffect

## 6.19.4 Using Shaders in Cables.gl: Two Approaches

Cables.gl offers two ways to use custom shaders:

### Approach 1: Built-in Shader Ops (Recommended for Most Cases)

**ShaderMaterial** and **TextureEffect** ops automatically: - Create input ports for each uniform declaration - Provide varying `vec2 vUV` automatically - Handle shader compilation and execution on GPU - Require no JavaScript wrapper code

**How to Use:** 1. Add a TextureEffect op to your patch 2. Paste the shader code into the “Fragment Shader” field 3. Connect your textures and values to the automatically created ports 4. The shader runs directly on the GPU

**Auto-Provided Uniforms:** - varying vec2 vUV - Always available (0.0 to 1.0) - uniform float time - Available if you connect a Time op - uniform vec2 resolution - Available if you connect a Resolution/CanvasInfo op

**Manual Uniforms:** - All other uniform declarations become input ports automatically - Connect Texture ops for sampler2D uniforms - Connect Number/Vector ops for float, vec2, vec3, vec4 uniforms - Connect Matrix ops for mat3, mat4 uniforms (if supported)

### Example Patch Wiring for Keystone Correction:

```
ImageTexture -> TextureEffect (tex port)
CanvasInfo -> TextureEffect (resolution port)
Vector2 (topLeft) -> TextureEffect (topLeft port)
Vector2 (topRight) -> TextureEffect (topRight port)
Vector2 (bottomLeft) -> TextureEffect (bottomLeft port)
Vector2 (bottomRight) -> TextureEffect (bottomRight port)
```

### Approach 2: Custom JavaScript Ops (For Advanced Control)

JavaScript custom ops allow you to: - Wrap shader code with additional logic - Dynamically modify shader uniforms - Create reusable, parameterized shader ops - Add custom UI and port organization - Handle complex texture management

**Trade-offs:** - More setup required (JavaScript wrapper code) - Potential JavaScript overhead - More control over execution flow - Better for reusable, packaged ops

See the “JavaScript Custom Op Examples” section below for implementation details.

## 6.19.5 Geometric Distortion Correction

Geometric distortion occurs when projectors are not perpendicular to the projection surface. Common types include keystone distortion, barrel distortion, and pincushion distortion.

### Keystone Correction (Perspective Distortion)

**Built-in Shader Op Ready** - Paste into TextureEffect

Keystone distortion creates a trapezoidal shape. This shader corrects it by applying inverse perspective transformation:

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Keystone correction parameters
// topLeft, topRight, bottomLeft, bottomRight corners in UV space
// (0-1)
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;

// Helper function: bilinear interpolation for perspective correction
vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2
br) {
    // Convert UV to normalized coordinates (-1 to 1)
    vec2 nuv = (uv - 0.5) * 2.0;

    // Perspective correction using bilinear interpolation
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    vec2 corrected = mix(bottom, top, uv.y);

    return corrected;
}

void main() {
    vec2 correctedUV = perspectiveTransform(vUV, topLeft, topRight,
bottomLeft, bottomRight);

    // Clamp to prevent sampling outside texture
    correctedUV = clamp(correctedUV, 0.0, 1.0);
```

```

vec3 color = texture2D(tex, correctedUV).rgb;
gl_FragColor = vec4(color, 1.0);
}

```

### Usage with TextureEffect (Built-in Shader Op):

1. Add a TextureEffect op to your patch
2. Paste the shader code above into the “Fragment Shader” field
3. Connect your inputs:
  - Input texture -> tex port (automatically created)
  - CanvasInfo op -> resolution port (or use GetResolution op)
  - Four Vector2 ops for corners -> topLeft, topRight, bottomLeft, bottomRight ports
4. The output texture will have keystone correction applied

**Note:** The resolution uniform is not automatically provided. You must connect a Resolution or CanvasInfo op to the resolution port.

### Advanced Keystone with Homography Matrix

For more precise control, use a 3x3 homography matrix:

**Note:** mat3 support may vary in cables.gl versions. Verify with Matrix ops or use the corner-based approach above if matrices aren't supported.

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform mat3 homographyMatrix; // 3x3 transformation matrix - verify
Matrix op support in your cables.gl version

vec2 applyHomography(mat3 H, vec2 uv) {
    vec3 p = vec3(uv, 1.0);
    vec3 result = H * p;
    return result.xy / result.z;
}

void main() {
    vec2 correctedUV = applyHomography(homographyMatrix, vUV);

    // Check if point is within bounds
    if (correctedUV.x < 0.0 correctedUV.x > 1.0
        correctedUV.y < 0.0 correctedUV.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0);
    }
}

```

```

correctedUV.y < 0.0 correctedUV.y > 1.0) {
    gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0); // Black outside
bounds
} else {
    vec3 color = texture2D(tex, correctedUV).rgb;
    gl_FragColor = vec4(color, 1.0);
}
}

```

### Barrel Distortion Correction

#### Built-in Shader Op Ready - Paste into TextureEffect

Barrel distortion creates a “bulging” effect. This shader corrects it:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform float barrelStrength; // Typically -0.1 to -0.3 for
correction

vec2 barrelDistortion(vec2 uv, float strength) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);

    // Barrel distortion formula
    float factor = 1.0 + strength * dist * dist;
    vec2 corrected = center + coord * factor;

    return corrected;
}

void main() {
    vec2 correctedUV = barrelDistortion(vUV, barrelStrength);

    // Only sample if within bounds
    if (correctedUV.x < 0.0 correctedUV.x > 1.0
        correctedUV.y < 0.0 correctedUV.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0);
    }
}

```

```

} else {
    vec3 color = texture2D(tex, correctedUV).rgb;
    gl_FragColor = vec4(color, 1.0);
}
}

```

## Pincushion Distortion Correction

### Built-in Shader Op Ready - Paste into TextureEffect

Pincushion distortion creates a “pinched” effect. This shader corrects it:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform float pincushionStrength; // Typically 0.1 to 0.3 for
correction

vec2 pincushionDistortion(vec2 uv, float strength) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);

    // Pincushion distortion formula (opposite of barrel)
    float factor = 1.0 - strength * dist * dist;
    vec2 corrected = center + coord * factor;

    return corrected;
}

void main() {
    vec2 correctedUV = pincushionDistortion(vUV, pincushionStrength);

    if (correctedUV.x < 0.0 || correctedUV.x > 1.0 ||
        correctedUV.y < 0.0 || correctedUV.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0);
    } else {
        vec3 color = texture2D(tex, correctedUV).rgb;
        gl_FragColor = vec4(color, 1.0);
    }
}

```

```

}
```

## Combined Geometric Correction

A comprehensive shader combining multiple distortion types:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Keystone corners
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;

// Distortion parameters
uniform float barrelAmount;
uniform float pincushionAmount;
uniform float rotation; // Rotation in radians

vec2 rotateUV(vec2 uv, float angle) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float c = cos(angle);
    float s = sin(angle);
    mat2 rot = mat2(c, -s, s, c);
    return center + rot * coord;
}

vec2 applyDistortion(vec2 uv, float barrel, float pincushion) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);

    float factor = 1.0 + (barrel + pincushion) * dist * dist;
    return center + coord * factor;
}

```

```

vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2
br) {
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    return mix(bottom, top, uv.y);
}

void main() {
    vec2 uv = vUV;

    // Apply transformations in order: rotation -> distortion ->
    keystone
    uv = rotateUV(uv, rotation);
    uv = applyDistortion(uv, barrelAmount, pincushionAmount);
    uv = perspectiveTransform(uv, topLeft, topRight, bottomLeft,
bottomRight);

    if (uv.x < 0.0 uv.x > 1.0 uv.y < 0.0 uv.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 1.0);
    } else {
        vec3 color = texture2D(tex, uv).rgb;
        gl_FragColor = vec4(color, 1.0);
    }
}

```

## 6.19.6 Multi-Projector Setups

When using multiple projectors, you need to define projection zones and blend overlapping areas.

### Projection Zone Mask

Define which projector covers which area:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Projection zone definition (in UV space, 0-1)

```

```

uniform vec4 zoneRect; // x, y, width, height of this projector's
zone
uniform float feather; // Edge feathering amount

float getZoneMask(vec2 uv, vec4 zone) {
    vec2 zoneMin = zone.xy;
    vec2 zoneMax = zone.xy + zone.zw;

    // Distance to zone edges
    vec2 distToMin = uv - zoneMin;
    vec2 distToMax = zoneMax - uv;
    vec2 distToEdge = min(distToMin, distToMax);

    // Create mask with feathering
    float mask = 1.0;
    if (distToEdge.x < feather) {
        mask *= smoothstep(0.0, feather, distToEdge.x);
    }
    if (distToEdge.y < feather) {
        mask *= smoothstep(0.0, feather, distToEdge.y);
    }

    // Check if outside zone
    if (uv.x < zoneMin.x uv.x > zoneMax.x
        uv.y < zoneMin.y uv.y > zoneMax.y) {
        mask = 0.0;
    }

    return mask;
}

void main() {
    float mask = getZoneMask(vUV, zoneRect);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * mask, mask);
}

```

### Multi-Projector Blending

Blend multiple projector outputs with smooth transitions:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Blend zone definition
uniform vec4 blendZone; // x, y, width, height of blend area
uniform float blendWidth; // Width of blend transition
uniform float blendDirection; // 0.0=horizontal, 1.0=vertical,
2.0=both (use float instead of int for cables.gl compatibility)

float getBlendMask(vec2 uv, vec4 zone, float width, float direction)
{
    vec2 zoneMin = zone.xy;
    vec2 zoneMax = zone.xy + zone.zw;
    vec2 zoneCenter = (zoneMin + zoneMax) * 0.5;

    float mask = 1.0;

    // Use float comparisons instead of int (cables.gl compatibility)
    if (direction < 0.5 || direction > 1.5) {
        // Horizontal blend (direction == 0.0 or 2.0)
        float distToCenter = abs(uv.x - zoneCenter.x);
        float zoneWidth = zone.z;
        if (distToCenter < zoneWidth * 0.5) {
            float blendDist = (zoneWidth * 0.5 - distToCenter) /
width;
            mask *= smoothstep(0.0, 1.0, blendDist);
        }
    }

    if (direction > 0.5 && direction < 1.5 || direction > 1.5) {
        // Vertical blend (direction == 1.0 or 2.0)
        float distToCenter = abs(uv.y - zoneCenter.y);
        float zoneHeight = zone.w;
        if (distToCenter < zoneHeight * 0.5) {
            float blendDist = (zoneHeight * 0.5 - distToCenter) /
width;
            mask *= smoothstep(0.0, 1.0, blendDist);
        }
    }
}

```

```

        return clamp(mask, 0.0, 1.0);
    }

    void main() {
        float blendMask = getBlendMask(vUV, blendZone, blendWidth,
blendDirection);
        vec3 color = texture2D(tex, vUV).rgb;

        gl_FragColor = vec4(color * blendMask, blendMask);
    }

```

## 6.19.7 Projector Stacking

Projector stacking involves overlapping multiple projectors to increase brightness and redundancy. This shader combines multiple inputs:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex1; // First projector
uniform sampler2D tex2; // Second projector
uniform sampler2D tex3; // Optional third projector
uniform sampler2D tex4; // Optional fourth projector

uniform float stackCount; // Number of active projectors (1-4)
uniform float blendMode; // 0=additive, 1=average, 2=max

vec3 blendStacked(vec3 c1, vec3 c2, vec3 c3, vec3 c4, float count,
float mode) {
    vec3 result = vec3(0.0);

    if (mode < 0.5) {
        // Additive blending (brightest, but can clip)
        if (count > 0.5) result += c1;
        if (count > 1.5) result += c2;
        if (count > 2.5) result += c3;
        if (count > 3.5) result += c4;
        result = clamp(result, 0.0, 1.0);
    } else if (mode < 1.5) {
        // Average blending (natural, reduces brightness)
        float sum = 0.0;

```

```

        if (count > 0.5) { result += c1; sum += 1.0; }
        if (count > 1.5) { result += c2; sum += 1.0; }
        if (count > 2.5) { result += c3; sum += 1.0; }
        if (count > 3.5) { result += c4; sum += 1.0; }
        result /= max(sum, 1.0);
    } else {
        // Maximum blending (preserves highlights)
        result = c1;
        if (count > 1.5) result = max(result, c2);
        if (count > 2.5) result = max(result, c3);
        if (count > 3.5) result = max(result, c4);
    }

    return result;
}

void main() {
    vec3 c1 = texture2D(tex1, vUV).rgb;
    vec3 c2 = texture2D(tex2, vUV).rgb;
    vec3 c3 = texture2D(tex3, vUV).rgb;
    vec3 c4 = texture2D(tex4, vUV).rgb;

    vec3 result = blendStacked(c1, c2, c3, c4, stackCount,
blendMode);

    gl_FragColor = vec4(result, 1.0);
}

```

## 6.19.8 Gradient Blend Composition

Gradient blends create smooth transitions between overlapping projectors. This is essential for seamless multi-projector setups.

### Linear Gradient Blend

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Blend parameters

```

```

uniform float blendStart; // Where blend starts (0-1)
uniform float blendEnd; // Where blend ends (0-1)
uniform float blendAxis; // 0.0=horizontal, 1.0=vertical (use float
instead of int for cables.gl compatibility)
uniform float blendPower; // Blend curve (1.0=linear, 2.0=smooth)

float getLinearBlend(vec2 uv, float start, float end, float axis,
float power) {
    float pos = axis < 0.5 ? uv.x : uv.y; // Use float comparison

    // Calculate blend factor
    float blendFactor = 0.0;
    if (pos < start) {
        blendFactor = 0.0;
    } else if (pos > end) {
        blendFactor = 1.0;
    } else {
        // Normalize to 0-1 range
        float t = (pos - start) / (end - start);
        // Apply power curve
        blendFactor = pow(t, power);
    }

    return blendFactor;
}

void main() {
    float blend = getLinearBlend(vUV, blendStart, blendEnd,
blendAxis, blendPower);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * blend, blend);
}

```

### Radial Gradient Blend

For circular or elliptical blend zones:

```

precision mediump float;

varying vec2 vUV;

```

```

uniform sampler2D tex;
uniform vec2 resolution;

// Radial blend parameters
uniform vec2 center; // Blend center in UV space
uniform float innerRadius; // Inner radius (full opacity)
uniform float outerRadius; // Outer radius (zero opacity)
uniform float aspectRatio; // Aspect ratio correction
uniform float blendPower; // Blend curve

float getRadialBlend(vec2 uv, vec2 center, float innerR, float
outerR, float aspect, float power) {
    vec2 offset = (uv - center) * vec2(aspect, 1.0);
    float dist = length(offset);

    float blendFactor = 0.0;
    if (dist < innerR) {
        blendFactor = 1.0;
    } else if (dist > outerR) {
        blendFactor = 0.0;
    } else {
        float t = (dist - innerR) / (outerR - innerR);
        blendFactor = 1.0 - pow(t, power);
    }

    return blendFactor;
}

void main() {
    float blend = getRadialBlend(vUV, center, innerRadius,
outerRadius, aspectRatio, blendPower);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * blend, blend);
}

```

## Advanced Feather Blend with Soft Edges

Professional-grade blend with multiple falloff curves:

```
precision mediump float;
```

```

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

uniform vec4 blendRect; // x, y, width, height
uniform float featherSize; // Feather size in UV units
uniform float featherCurve; // 0.0=linear, 1.0=smooth, 2.0=very
smooth

float getFeatherBlend(vec2 uv, vec4 rect, float feather, float
curve) {
    vec2 rectMin = rect.xy;
    vec2 rectMax = rect.xy + rect.zw;

    // Calculate distance to each edge
    float distLeft = uv.x - rectMin.x;
    float distRight = rectMax.x - uv.x;
    float distBottom = uv.y - rectMin.y;
    float distTop = rectMax.y - uv.y;

    // Find minimum distance to any edge
    float minDist = min(min(distLeft, distRight), min(distBottom,
distTop));

    // Create feather mask
    float mask = 1.0;
    if (minDist < feather) {
        float t = minDist / feather;
        // Apply curve
        if (curve < 0.5) {
            // Linear
            mask = t;
        } else if (curve < 1.5) {
            // Smoothstep
            mask = smoothstep(0.0, 1.0, t);
        } else {
            // Custom smooth curve
            mask = t * t * (3.0 - 2.0 * t);
            mask = pow(mask, 1.0 / (curve - 0.5));
        }
    }
}
```

```

// Check if outside rectangle
if (uv.x < rectMin.x || uv.x > rectMax.x
    || uv.y < rectMin.y || uv.y > rectMax.y) {
    mask = 0.0;
}

return mask;
}

void main() {
    float blend = getFeatherBlend(vUV, blendRect, featherSize,
featherCurve);
    vec3 color = texture2D(tex, vUV).rgb;

    gl_FragColor = vec4(color * blend, blend);
}

```

## 6.19.9 Color Correction for Projection Mapping

Projection mapping requires specialized color correction to account for surface colors, ambient light, and projector characteristics.

### Basic Color Correction

**Built-in Shader Op Ready** - Paste into TextureEffect

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Color correction parameters
uniform float brightness; // -1.0 to 1.0
uniform float contrast; // -1.0 to 1.0
uniform float saturation; // -1.0 to 1.0
uniform float gamma; // Typically 0.5 to 3.0

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam) {

```

```

// Brightness
color += bright;

// Contrast
color = (color - 0.5) * (1.0 + cont) + 0.5;

// Saturation
float luma = dot(color, vec3(0.299, 0.587, 0.114));
color = mix(vec3(luma), color, 1.0 + sat);

// Gamma
color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyColorCorrection(color, brightness, contrast,
saturation, gamma);

    gl_FragColor = vec4(color, 1.0);
}

```

### Advanced Color Correction with Color Temperature

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

uniform float brightness;
uniform float contrast;
uniform float saturation;
uniform float gamma;
uniform float colorTemperature; // -1.0 (cool/blue) to 1.0
(warm/orange)

// Color temperature adjustment
vec3 adjustColorTemperature(vec3 color, float temp) {

```

```

// Convert to warmer (orange) or cooler (blue)
if (temp > 0.0) {
    // Warmer: increase red/orange, decrease blue
    color.r += temp * 0.2;
    color.b -= temp * 0.1;
} else {
    // Cooler: increase blue, decrease red
    color.r += temp * 0.1;
    color.b -= temp * 0.2;
}
return color;
}

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam, float temp) {
    // Brightness
    color += bright;

    // Contrast
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    // Saturation
    float luma = dot(color, vec3(0.299, 0.587, 0.114));
    color = mix(vec3(luma), color, 1.0 + sat);

    // Color temperature
    color = adjustColorTemperature(color, temp);

    // Gamma
    color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyColorCorrection(color, brightness, contrast,
saturation, gamma, colorTemperature);

    gl_FragColor = vec4(color, 1.0);
}

```

## Per-Channel Color Correction

Independent control over RGB channels:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Per-channel brightness and contrast
uniform vec3 channelBrightness; // R, G, B
uniform vec3 channelContrast; // R, G, B
uniform vec3 channelGamma; // R, G, B

vec3 applyPerChannelCorrection(vec3 color, vec3 bright, vec3 cont,
vec3 gam) {
    // Apply per-channel brightness
    color += bright;

    // Apply per-channel contrast
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    // Apply per-channel gamma
    color = pow(max(color, 0.0), vec3(1.0 / max(gam, vec3(0.01))));

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyPerChannelCorrection(color, channelBrightness,
channelContrast, channelGamma);

    gl_FragColor = vec4(color, 1.0);
}

```

## Surface Color Compensation

Compensate for colored projection surfaces (e.g., projecting on a red wall):

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Surface color (what color the surface appears)
uniform vec3 surfaceColor;
uniform float compensationStrength; // 0.0 to 1.0

vec3 compensateSurfaceColor(vec3 color, vec3 surface, float strength) {
    // Calculate inverse of surface color
    vec3 inverseSurface = vec3(1.0) - surface;

    // Blend between original and compensated
    vec3 compensated = color / max(surface, vec3(0.01)); // Prevent division by zero
    compensated = clamp(compensated, 0.0, 1.0);

    return mix(color, compensated, strength);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = compensateSurfaceColor(color, surfaceColor,
compensationStrength);

    gl_FragColor = vec4(color, 1.0);
}

```

## Advanced LUT-Based Color Correction

Use a 3D Look-Up Table (LUT) for professional color grading:

```

precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;

```

```

uniform sampler2D lutTexture; // 3D LUT as 2D texture (typically 64x64 or 32x32)
uniform vec2 resolution;
uniform float lutStrength; // 0.0 to 1.0

// Sample 3D LUT (stored as 2D texture)
vec3 sampleLUT(sampler2D lut, vec3 color, float lutSize) {
    // Assume LUT is organized as a grid
    // For a 64x64 LUT, we have 8x8 grid of 8x8 color cubes

    float cellSize = 1.0 / 8.0; // 8x8 grid
    float cellPixelSize = 1.0 / 64.0; // 64 pixels per cell

    // Find which cell we're in
    vec3 cell = floor(color * 7.0);
    vec3 cellPos = fract(color * 7.0);

    // Calculate UV coordinates in LUT texture
    float cellIndex = cell.b * 8.0 + cell.r;
    vec2 lutUV = vec2(
        (cellIndex * cellSize) + (cellPos.r * cellPixelSize * 8.0),
        cell.g * cellSize + cellPos.g * cellPixelSize * 8.0
    );

    // Sample LUT
    vec3 lutColor = texture2D(lut, lutUV).rgb;

    return lutColor;
}

void main() {
    vec3 originalColor = texture2D(tex, vUV).rgb;
    vec3 lutColor = sampleLUT(lutTexture, originalColor, 64.0);

    vec3 finalColor = mix(originalColor, lutColor, lutStrength);

    gl_FragColor = vec4(finalColor, 1.0);
}

```

**Note:** For LUT textures, you'll need to create or load a 3D LUT texture. Common formats include 64x64 (8x8 grid) or 32x32 (4x4 grid) textures.

## Shadow and Highlight Recovery

Recover details in shadows and highlights:

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

uniform float shadowRecovery; // 0.0 to 1.0
uniform float highlightRecovery; // 0.0 to 1.0
uniform float shadowPoint; // Where shadows start (0.0 to 1.0)
uniform float highlightPoint; // Where highlights start (0.0 to 1.0)

vec3 recoverShadowsHighlights(vec3 color, float shadowRec, float
highlightRec, float shadowPt, float highlightPt) {
    float luma = dot(color, vec3(0.299, 0.587, 0.114));

    // Shadow recovery
    float shadowMask = smoothstep(shadowPt - 0.1, shadowPt, luma);
    color += shadowMask * shadowRec * (1.0 - luma) * 0.5;

    // Highlight recovery (compress highlights)
    float highlightMask = smoothstep(highlightPt, highlightPt + 0.1,
luma);
    color = mix(color, vec3(1.0) - (vec3(1.0) - color) * (1.0 -
highlightRec), highlightMask);

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = recoverShadowsHighlights(color, shadowRecovery,
highlightRecovery, shadowPoint, highlightPoint);

    gl_FragColor = vec4(color, 1.0);
}
```

## 6.19.10 Complete Projection Mapping Pipeline

**Built-in Shader Op Ready** - Paste into TextureEffect (Note: This is a complex shader with many uniforms - consider breaking into multiple passes for easier management)

A comprehensive shader combining all projection mapping features:

```
precision mediump float;

varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;

// Geometric correction
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;
uniform float barrelAmount;
uniform float rotation;

// Blend parameters
uniform vec4 blendZone;
uniform float blendWidth;
uniform float blendPower;

// Color correction
uniform float brightness;
uniform float contrast;
uniform float saturation;
uniform float gamma;
uniform float colorTemperature;
uniform vec3 surfaceColor;
uniform float surfaceCompensation;

// Helper functions (include all from above)
vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2
br) {
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    return mix(bottom, top, uv.y);
}
```

```

vec2 applyDistortion(vec2 uv, float barrel) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float dist = length(coord);
    float factor = 1.0 + barrel * dist * dist;
    return center + coord * factor;
}

vec2 rotateUV(vec2 uv, float angle) {
    vec2 center = vec2(0.5, 0.5);
    vec2 coord = uv - center;
    float c = cos(angle);
    float s = sin(angle);
    mat2 rot = mat2(c, -s, s, c);
    return center + rot * coord;
}

float getBlendMask(vec2 uv, vec4 zone, float width, float power) {
    vec2 zoneMin = zone.xy;
    vec2 zoneMax = zone.xy + zone.zw;
    vec2 zoneCenter = (zoneMin + zoneMax) * 0.5;

    float distToCenter = length(uv - zoneCenter);
    float maxDist = length(zoneMax - zoneCenter);

    if (distToCenter > maxDist) return 0.0;

    float blendDist = (maxDist - distToCenter) / width;
    return pow(clamp(blendDist, 0.0, 1.0), power);
}

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam, float temp, vec3 surface, float comp) {
    color += bright;
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    float luma = dot(color, vec3(0.299, 0.587, 0.114));
    color = mix(vec3(luma), color, 1.0 + sat);

    if (temp > 0.0) {
        color.r += temp * 0.2;
    }
}

```

```

        color.b -= temp * 0.1;
    } else {
        color.r += temp * 0.1;
        color.b -= temp * 0.2;
    }

    vec3 compensated = color / max(surface, vec3(0.01));
    color = mix(color, clamp(compensated, 0.0, 1.0), comp);

    color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

    return clamp(color, 0.0, 1.0);
}

void main() {
    // Step 1: Geometric correction
    vec2 uv = vUV;
    uv = rotateUV(uv, rotation);
    uv = applyDistortion(uv, barrelAmount);
    uv = perspectiveTransform(uv, topLeft, topRight, bottomLeft,
bottomRight);

    // Step 2: Sample texture
    if (uv.x < 0.0 uv.x > 1.0 uv.y < 0.0 uv.y > 1.0) {
        gl_FragColor = vec4(0.0, 0.0, 0.0, 0.0);
        return;
    }

    vec3 color = texture2D(tex, uv).rgb;

    // Step 3: Color correction
    color = applyColorCorrection(color, brightness, contrast,
saturation, gamma, colorTemperature, surfaceColor,
surfaceCompensation);

    // Step 4: Apply blend mask
    float blend = getBlendMask(vUV, blendZone, blendWidth,
blendPower);
    color *= blend;

    gl_FragColor = vec4(color, blend);
}

```

## 6.19.11 JavaScript Custom Op Examples

For cases where you need more control, reusable components, or dynamic shader management, you can wrap shaders in JavaScript custom ops. Here are examples for key projection mapping features:

### Keystone Correction Custom Op

```
// Custom Op: KeystoneCorrection
// Name: Ops.User.ProjectionMapping.KeystoneCorrection

const inTexture = op.inTexture("Input Texture");
const inTopLeft = op.inVec2("Top Left", [0.0, 1.0]);
const inTopRight = op.inVec2("Top Right", [1.0, 1.0]);
const inBottomLeft = op.inVec2("Bottom Left", [0.0, 0.0]);
const inBottomRight = op.inVec2("Bottom Right", [1.0, 0.0]);
const inResolution = op.inVec2("Resolution", [1920.0, 1080.0]);
const outTexture = op.outTexture("Output");

// Shader code as string
const shaderCode = `
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;

vec2 perspectiveTransform(vec2 uv, vec2 tl, vec2 tr, vec2 bl, vec2 br) {
    vec2 top = mix(tl, tr, uv.x);
    vec2 bottom = mix(bl, br, uv.x);
    return mix(bottom, top, uv.y);
}

void main() {
    vec2 correctedUV = perspectiveTransform(vUV, topLeft, topRight,
bottomLeft, bottomRight);
    correctedUV = clamp(correctedUV, 0.0, 1.0);
    vec3 color = texture2D(tex, correctedUV).rgb;
```

```
gl_FragColor = vec4(color, 1.0);
}

;

let shaderMaterial = null;

function updateShader() {
    const tex = inTexture.get();
    if (!tex) return;

    // Create or update shader material
    if (!shaderMaterial) {
        shaderMaterial = new op.patch.cgl.ShaderMaterial({
            fragmentShader: shaderCode,
            uniforms: {}
        });
    }

    // Update uniforms
    shaderMaterial.uniforms.tex = { value: tex };
    shaderMaterial.uniforms.resolution = { value: inResolution.get() };
    shaderMaterial.uniforms.topLeft = { value: inTopLeft.get() };
    shaderMaterial.uniforms.topRight = { value: inTopRight.get() };
    shaderMaterial.uniforms.bottomLeft = { value: inBottomLeft.get() };
    shaderMaterial.uniforms.bottomRight = { value: inBottomRight.get() };

    // Render to texture
    const renderTarget = op.patch.cgl.createRenderTarget(
        inResolution.get()[0],
        inResolution.get()[1]
    );

    // Apply shader and render
    op.patch.cgl.render(renderTarget, shaderMaterial);

    outTexture.set(renderTarget.texture);
}

inTexture.onChange = updateShader;
```

```

inTopLeft.onChange = updateShader;
inTopRight.onChange = updateShader;
inBottomLeft.onChange = updateShader;
inBottomRight.onChange = updateShader;
inResolution.onChange = updateShader;

```

**Note:** The above example shows the concept, but cables.gl's actual API may differ. In practice, you might use TextureEffect programmatically or create a render pass.

## Color Correction Custom Op

```

// Custom Op: ColorCorrection
// Name: Ops.User.ProjectionMapping.ColorCorrection

const inTexture = op.inTexture("Input Texture");
const inBrightness = op.inFloat("Brightness", 0.0);
const inContrast = op.inFloat("Contrast", 0.0);
const inSaturation = op.inFloat("Saturation", 0.0);
const inGamma = op.inFloat("Gamma", 1.0);
const inColorTemperature = op.inFloat("Color Temperature", 0.0);
const outTexture = op.outTexture("Output");

const shaderCode = `
precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;
uniform float brightness;
uniform float contrast;
uniform float saturation;
uniform float gamma;
uniform float colorTemperature;

vec3 adjustColorTemperature(vec3 color, float temp) {
    if (temp > 0.0) {
        color.r += temp * 0.2;
        color.b -= temp * 0.1;
    } else {
        color.r += temp * 0.1;
        color.b -= temp * 0.2;
    }
    return color;
}

const inTexture = op.inTexture("Input Texture");
const inBrightness = op.inFloat("Brightness", 0.0);
const inContrast = op.inFloat("Contrast", 0.0);
const inSaturation = op.inFloat("Saturation", 0.0);
const inGamma = op.inFloat("Gamma", 1.0);
const inColorTemperature = op.inFloat("Color Temperature", 0.0);
const outTexture = op.outTexture("Output");

```

```

}

vec3 applyColorCorrection(vec3 color, float bright, float cont,
float sat, float gam, float temp) {
    color += bright;
    color = (color - 0.5) * (1.0 + cont) + 0.5;

    float luma = dot(color, vec3(0.299, 0.587, 0.114));
    color = mix(vec3(luma), color, 1.0 + sat);

    color = adjustColorTemperature(color, temp);
    color = pow(max(color, 0.0), vec3(1.0 / max(gam, 0.01)));

    return clamp(color, 0.0, 1.0);
}

void main() {
    vec3 color = texture2D(tex, vUV).rgb;
    color = applyColorCorrection(color, brightness, contrast,
saturation, gamma, colorTemperature);
    gl_FragColor = vec4(color, 1.0);
}
`;

// Implementation similar to keystone op above
// (Actual implementation depends on cables.gl's rendering API)

```

## Blend Composition Custom Op

```

// Custom Op: BlendComposition
// Name: Ops.User.ProjectionMapping.BlendComposition

const inTexture = op.inTexture("Input Texture");
const inBlendStart = op.inFloat("Blend Start", 0.0);
const inBlendEnd = op.inFloat("Blend End", 1.0);
const inBlendAxis = op.inFloat("Blend Axis", 0.0); // 0.0=horizontal, 1.0=vertical
const inBlendPower = op.inFloat("Blend Power", 1.0);
const inResolution = op.inVec2("Resolution", [1920.0, 1080.0]);
const outTexture = op.outTexture("Output");
const outAlpha = op.outNumber("Alpha Mask"); // For compositing

```

```

const shaderCode = `

precision mediump float;
varying vec2 vUV;
uniform sampler2D tex;
uniform vec2 resolution;
uniform float blendStart;
uniform float blendEnd;
uniform float blendAxis;
uniform float blendPower;

float getLinearBlend(vec2 uv, float start, float end, float axis,
float power) {
    float pos = axis < 0.5 ? uv.x : uv.y;
    float blendFactor = 0.0;

    if (pos < start) {
        blendFactor = 0.0;
    } else if (pos > end) {
        blendFactor = 1.0;
    } else {
        float t = (pos - start) / (end - start);
        blendFactor = pow(t, power);
    }

    return blendFactor;
}

void main() {
    float blend = getLinearBlend(vUV, blendStart, blendEnd,
blendAxis, blendPower);
    vec3 color = texture2D(tex, vUV).rgb;
    gl_FragColor = vec4(color * blend, blend);
}
`;

// Implementation with uniform updates
// Note: This is a conceptual example - actual cables.gl API may vary

```

### Important Notes for JavaScript Custom Ops:

- Texture Handling:** You need to manage texture creation, rendering, and cleanup
- Render Targets:** May need to create render targets for shader output

- Performance:** JavaScript overhead can impact real-time performance
- API Differences:** Cables.gl's internal API may differ from these examples
- Best Practice:** Use built-in TextureEffect when possible; use custom ops for complex logic or reusable components

## 6.19.12 Comparison: Built-in Shader Ops vs Custom JavaScript Ops

### Code Cleanliness

**Built-in Shader Ops (TextureEffect/ShaderMaterial):** - Pure GLSL code - no wrapper needed - Minimal boilerplate - Easy to read and maintain - Direct shader editing in cables.gl UI - No JavaScript knowledge required

**Custom JavaScript Ops:** - [!] Requires JavaScript wrapper code - [!] Shader code stored as string (less readable) - [!] More complex file structure - [!] Requires understanding of both GLSL and JavaScript - Can organize shader code in separate files - Can add pre/post processing logic

**Winner:** Built-in Shader Ops - cleaner, more maintainable for pure shader effects

### Integration Ease

**Built-in Shader Ops:** - Paste shader code directly into TextureEffect - Ports created automatically from uniforms - Immediate visual feedback - No compilation step - Works out of the box - [!] Limited customization of port UI - [!] Can't add custom logic around shader

**Custom JavaScript Ops:** - [!] Must create op, write wrapper code - [!] Must manually create and configure ports - [!] More setup time - [!] Requires testing and debugging - Full control over port organization - Can add port groups, custom UI - Can add validation, error handling - Reusable across patches

**Winner:** Built-in Shader Ops - significantly easier to get started

### Performance

**Built-in Shader Ops:** - Direct GPU execution - Minimal overhead - Optimized by cables.gl - No JavaScript execution per frame - Efficient texture passing - Automatic shader compilation caching

**Custom JavaScript Ops:** - [!] Potential JavaScript overhead per frame - [!] Texture copying may be required - [!] Render target management overhead - [!] Uniform updates in JavaScript (CPU work) - Can optimize with dirty flags - Can batch operations - Can cache render targets

**Performance Comparison:** - Built-in: ~0.1-0.5ms overhead (shader execution only) - Custom: ~1-5ms overhead (JavaScript + shader execution) - **Winner:** Built-in Shader Ops - better performance for real-time applications

## When to Use Each Approach

**Use Built-in Shader Ops (TextureEffect/ShaderMaterial) when:** - You have pure shader effects (no complex logic) - You want quick prototyping - Performance is critical - You're learning shaders - You need immediate visual feedback - You don't need custom port organization

**Use Custom JavaScript Ops when:** - You need reusable, packaged shader components - You need complex pre/post processing logic - You need dynamic shader generation - You want custom port UI and organization - You're building a library of shader ops - You need conditional shader selection - You need to manage multiple render passes

**Hybrid Approach:** - Use built-in shader ops for individual effects - Use custom JavaScript ops to orchestrate multiple shader passes - Use custom ops for complex parameter management - Use built-in ops for simple, one-off effects

## 6.19.13 Quick Reference: Using These Shaders

### Step-by-Step Guide:

#### 1. Add TextureEffect Op:

- Click "+" in your patch
- Search for "TextureEffect"
- Add it to your patch

#### 2. Paste Shader Code:

- Click on the TextureEffect op
- Find the "Fragment Shader" field
- Paste the shader code (including precision mediump float; and varying vec2 vUV;)

#### 3. Connect Inputs:

- Input texture -> tex port (or tex0, tex1, etc. for multi-texture shaders)
- CanvasInfo or GetResolution -> resolution port (if shader uses it)
- Number/Vector ops -> parameter ports (brightness, contrast, corners, etc.)

#### 4. Get Output:

- Connect TextureEffect output to your render target or next effect

**Common Port Types:** - sampler2D tex -> Texture port (connect ImageTexture, VideoTexture, etc.) - vec2 resolution -> Vec2 port (connect CanvasInfo or Ge-

tResolution) - float brightness -> Number port (connect Number op or slider) - vec2 topLeft -> Vec2 port (connect Vector2 op) - vec3 color -> Vec3 port (connect Vector3 op or Color op)

## 6.19.14 Best Practices for Projection Mapping in Cables.gl

**1. Resolution Handling:** Always use resolution uniform for pixel-perfect calculations. Convert between UV space and screen space as needed. **Remember:** resolution is NOT auto-provided - connect it manually.

**2. Performance:** Projection mapping shaders can be expensive. Consider:

- Using lower precision where possible (mediump instead of highp)
- Minimizing texture samples
- Pre-computing values in JavaScript ops when possible

**3. Modular Approach:** Break complex setups into multiple shader passes:

- First pass: Geometric correction
- Second pass: Color correction
- Third pass: Blending

**4. Testing:** Always test with actual projection surfaces when possible. Screen simulation can differ from real-world results.

**5. Calibration:** Use test patterns (grids, color bars) to calibrate geometric and color corrections.

**6. Masking:** Use alpha channel output for blend masks to composite multiple projectors correctly.

## 6.19.15 Debug Visualization Shaders

Helpful shaders for debugging projection mapping setups:

### Grid Overlay

```
precision mediump float;

varying vec2 vUV;
uniform vec2 resolution;
uniform float gridSize; // Grid divisions
uniform vec3 gridColor;
uniform float gridOpacity;

void main() {
```

```

vec2 gridUV = vUV * gridSize;
// Use manual derivative calculation instead of fwidth() for
better WebGL 1.0 compatibility
vec2 grid = abs(fract(gridUV - 0.5) - 0.5);
// Approximate derivative using step function
float line = min(grid.x, grid.y) * gridSize * 100.0; // Scale
factor for visibility
float gridMask = 1.0 - min(line, 1.0);

vec3 color = mix(vec3(0.0), gridColor, gridMask * gridOpacity);
gl_FragColor = vec4(color, 1.0);
}

```

## Corner Pin Visualization

```

precision mediump float;

varying vec2 vUV;
uniform vec2 resolution;
uniform vec2 topLeft;
uniform vec2 topRight;
uniform vec2 bottomLeft;
uniform vec2 bottomRight;
uniform vec3 cornerColor;

void main() {
    vec3 color = vec3(0.0);

    // Draw corner points
    float cornerSize = 0.02;
    float dist1 = length(vUV - topLeft);
    float dist2 = length(vUV - topRight);
    float dist3 = length(vUV - bottomLeft);
    float dist4 = length(vUV - bottomRight);

    float minDist = min(min(dist1, dist2), min(dist3, dist4));
    if (minDist < cornerSize) {
        color = cornerColor;
    }

    // Draw lines between corners

```

// (Simplified - you'd use line SDF for proper lines)

```

gl_FragColor = vec4(color, 1.0);
}
```

### 6.19.16 Summary: Shader Compliance and Usage

All shaders in this projection mapping section are:

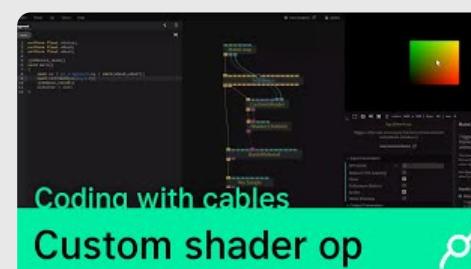
**Compliant with cables.gl's built-in shader ops** (TextureEffect/ShaderMaterial)  
**Ready to paste directly** into the fragment shader field **WebGL 1.0 compatible** (using texture2D(), mediump precision) **Properly formatted** with required headers and declarations **Uniform types verified** (float instead of int, proper vector types)

**Key Compliance Features:** - All shaders start with precision mediump float;  
- All use texture2D() for texture sampling - All use varying vec2 vUV (auto-provided by cables.gl) - Integer uniforms converted to float with float comparisons - Resolution handling documented (requires manual connection) - Matrix uniforms noted with version compatibility warnings

**Usage Pattern:** 1. Copy shader code 2. Paste into TextureEffect op's fragment shader field 3. Connect inputs to automatically created ports 4. Get output texture

**For Advanced Use Cases:** - See "JavaScript Custom Op Examples" section for wrapper implementations - See "Comparison" section for when to use each approach - See "Troubleshooting" section for common issues

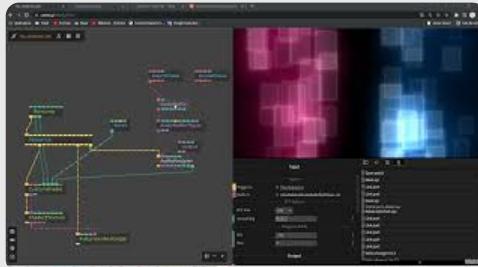
## 6.20 Featured Videos



<https://youtu.be/Zfhn8xSM0SE>  
**Coding with cables - custom shader op**  
by cables\_gl



[https://youtu.be/j\\_ins4RW0c8](https://youtu.be/j_ins4RW0c8)  
**Shadertoy to cables - part 01**  
by cables\_gl



<https://youtu.be/nil-HkZgNZ8>  
**Programmation d'un shadertoy avec Cables.gl Partie 8.**  
by Meletou1

7. **Projection Mapping:** Build a color correction shader that compensates for a colored projection surface
8. **Projection Mapping:** Combine geometric correction, color correction, and blending in a single shader pipeline
9. **Projection Mapping:** Create a debug visualization shader showing projection zones and blend areas
10. **Projection Mapping:** Implement projector stacking with additive and average blend modes

## 6.21 Resources

- The Book of Shaders - Excellent GLSL learning resource
- Shadertoy - Shader examples and inspiration
- GLSL Sandbox - More shader experiments

## 6.22 Exercises

1. Create a animated gradient that shifts colors over time
2. Build a kaleidoscope effect using UV manipulation
3. Write an SDF shader that draws a morphing shape
4. Create a post-processing glow effect
5. **Projection Mapping:** Implement keystone correction for a trapezoidal projection
6. **Projection Mapping:** Create a multi-projector blend setup with gradient transitions

# 7 JavaScript & Custom Ops in Cables.gl

## 7.1 Introduction

While cables.gl's visual node system is powerful, sometimes you need custom functionality. JavaScript allows you to create your own operators (ops) and extend cables.gl's capabilities.

**Official reference:** if you ever wonder "is this a real API?", start with cables.gl docs and search for terms like **Custom Ops**, **JavaScript Op**, **Ports**, or **Standalone Export**. The editor/runtime evolves, so keeping one "source of truth" bookmark helps.

## 7.2 When to Use Custom Ops

- Processing data in ways built-in ops don't support
- Integrating external APIs or libraries
- Creating reusable custom functionality
- Performance optimization for specific tasks
- Complex mathematical operations

## 7.3 Creating Your First Op

### 7.3.1 Step 1: Open the Op Editor

1. In your patch, click the "+" button
2. Select "Create Op"
3. Choose a name (e.g., `Ops.User.YourName.MyFirstOp`)

**Naming tip:** treat op names like package names. Keep them stable and descriptive (e.g. `Ops.User.Rangel.Math.ClampSmooth`), because you'll likely reuse the op across patches and exports.

### 7.3.2 Step 2: Understanding the Structure

```
// Ports (inputs and outputs)
const inValue = op.inFloat("Input Value", 0);
const outResult = op.outNumber("Result");

// When input changes, recalculate
inValue.onChange = function() {
    outResult.set(inValue.get() * 2);
};
```

## 7.4 Port Types

### 7.4.1 Input Ports

```
// Trigger (execution flow)
const inTrigger = op.inTrigger("Trigger");

// Numbers
const inFloat = op.inFloat("Float Value", 0.0);
const inInt = op.inInt("Integer", 0);
const inValue = op.inValue("Value", 0);

// Boolean
const inBool = op.inBool("Enabled", true);

// String
const inString = op.inString("Text", "default");

// Objects (textures, arrays, etc.)
const inObject = op.inObject("Object");
const inTexture = op.inTexture("Texture");
const inArray = op.inArray("Array");
```

### 7.4.2 Output Ports

```
// Trigger
const outTrigger = op.outTrigger("Trigger Out");

// Numbers
const outNumber = op.outNumber("Number Out");
const outValue = op.outValue("Value Out");

// Boolean
const outBool = op.outBool("Bool Out");

// String
const outString = op.outString("String Out");

// Objects
const outObject = op.outObject("Object Out");
const outTexture = op.outTexture("Texture Out");
const outArray = op.outArray("Array Out");
```

## 7.5 Handling Events

### 7.5.1 Trigger Execution

```
const inTrigger = op.inTrigger("Execute");
const outNext = op.outTrigger("Next");

inTrigger.onTriggered = function() {
    // Do something when triggered
    console.log("Op was triggered!");

    // Continue the chain
    outNext.trigger();
};
```

### 7.5.2 Value Changes

```
const inValue = op.inFloat("Value", 0);
const outDouble = op.outNumber("Double");

inValue.onChange = function() {
    const val = inValue.get();
    outDouble.set(val * 2);
};
```

### 7.5.3 Linking Ports

```
// Automatically update output when input changes
const inValue = op.inFloat("Value", 0);
const outValue = op.outNumber("Value Out");

inValue.onChange = outValue.setRef.bind(outValue, inValue);
// or simply:
// inValue.onChange = () => outValue.set(inValue.get());
```

## 7.6 Working with Arrays

```
const inArray = op.inArray("Input Array");
const outArray = op.outArray("Output Array");

inArray.onChange = function() {
```

```
    const arr = inArray.get();
    if (!arr) return;

    // Process array
    const result = arr.map(x => x * 2);

    outArray.set(result);
};
```

## 7.7 Working with Objects

```
const inObject = op.inObject("Input");
const outObject = op.outObject("Output");

inObject.onChange = function() {
    const obj = inObject.get();
    if (!obj) return;

    // Process or wrap the object
    const processed = {
        ...obj,
        processed: true
    };

    outObject.set(processed);
};
```

## 7.8 Render Loop Integration

For ops that need to run every frame:

```
const inTrigger = op.inTrigger("Render");
const outNext = op.outTrigger("Next");

let time = 0;

inTrigger.onTriggered = function() {
    time += op.patch.timer.getDelta();

    // Do per-frame calculations
};
```

```
    outNext.trigger();
};


```

## 7.9 UI Port Groups

Organize your ports into collapsible groups:

```
// Create ports
const inX = op.inFloat("X", 0);
const inY = op.inFloat("Y", 0);
const inZ = op.inFloat("Z", 0);

// Group them
op.setPortGroup("Position", [inX, inY, inZ]);
```

## 7.10 Port UI Types

Change how ports appear in the UI:

```
// Slider
const inValue = op.inFloat("Value", 0.5);
op.setUiAttrib({ "type": "slider", "min": 0, "max": 1 });

// Color picker
const inR = op.inFloat("R", 1);
const inG = op.inFloat("G", 1);
const inB = op.inFloat("B", 1);
op.setPortGroup("Color", [inR, inG, inB]);
inR.setUiAttribs({ colorPick: true });

// Dropdown
const inMode = op.inSwitch("Mode", ["Option1", "Option2",
"Option3"], "Option1");
```

## 7.11 Accessing Patch Resources

### 7.11.1 Timer and Time

```
// Current time
const time = op.patch.timer.getTime();

// Delta time (time since last frame)
const delta = op.patch.timer.getDelta();

// FPS
const fps = op.patch.timer.getFPS();
```

### 7.11.2 Canvas and Context

```
// Canvas element
const canvas = op.patch.cgl.canvas;

// WebGL context
const gl = op.patch.cgl.gl;
```

### 7.11.3 Loading External Resources

```
const inUrl = op.inString("URL", "");
const outData = op.outObject("Data");

inUrl.onChange = function() {
    const url = inUrl.get();
    if (!url) return;

    fetch(url)
        .then(response => {
            if (!response.ok) throw new Error(`HTTP
${response.status}`);
            return response.json();
        })
        .then(data => {
            outData.set(data);
        })
        .catch(error => {
            op.LogError("Failed to load:", error);
        });
};
```

};

Notes:

- Many APIs require CORS headers; if `fetch()` fails in the browser console, it's often *not* your code.
- If this request should block "patch is ready", pair it with `op.patch.loading.start()` / `finished()` (see the **Async Ops** section later in this chapter).

## 7.12 Using External Libraries

### 7.12.1 Including Libraries

```
// In op's code, load an external script
const script = document.createElement("script");
script.src = "https://cdn.example.com/library.js";
script.onload = function() {
    // Library is ready
    initLibrary();
};
document.head.appendChild(script);
```

**Best practice:** prefer shipping a local copy for standalone exports (and environments with strict CSP), and load from CDN only when you control the hosting/security headers.

### 7.12.2 Or use `op.patch.loading` for proper load tracking:

```
op.patch.loading.start();

const script = document.createElement("script");
script.src = "https://cdn.example.com/library.js";
script.onload = function() {
    op.patch.loading.finished();
    initLibrary();
};
script.onerror = function() {
    op.patch.loading.finished();
    op.LogError("Failed to load library");
};
document.head.appendChild(script);
```

## 7.13 Integrating Hydra (by Olivia Jack)

**Hydra** (by Olivia Jack) is a live-coded, GPU-accelerated visual synth for the browser. In practice it's a **shader graph you can write as code**: generators like `osc()` / `noise()` / `shape()` chained with modifiers like `kaleid()` / `rotate()` / `modulate()` and sent to buffers with `.out()`.

Hydra pairs extremely well with cables.gl because cables already has a strong "everything is a texture" workflow: you can treat Hydra as a **procedural texture source** (2D or 3D), then run it through your usual cables effects chain.

**Official resources:** - Hydra editor: [Hydra](#) - Docs: [Hydra documentation](#) - Source: [ojack/hydra](#) - npm package commonly used in-browser: [hydra-synth](#) (often loaded as a single bundled JS file)

### 7.13.1 Where Hydra fits in cables.gl

- **Procedural textures:** drive a `BasicMaterial` / `PBRMaterial` texture input with Hydra output.
- **2D overlays:** layer Hydra output over your render.
- **Feedback & post:** render-to-texture, then `TextureEffect` chains on Hydra output.
- **Audio-reactive visuals:** use cables audio analysis to drive Hydra parameters (without Hydra's own audio system).

### 7.13.2 Integration paths (choose based on your export target)

**Option A: Fastest (editor / hosted patch) — load Hydra from a CDN**

- **Pros:** quick, no build step.
- **Cons:** requires network, can be blocked by CSP, less deterministic for offline installs.

**Option B: Standalone export — ship a local `hydra-synth.js`**

If you export a standalone patch, you can include `hydra-synth.js` inside the exported folder and load it locally (no CDN). This is best for **galleries, offline installations, kiosks**.

## Option C: npm package export / external JS project — bundle Hydra with your app

If you export as an npm package and integrate into another JS project, you can add Hydra as a dependency and bundle it with your build pipeline. That keeps everything versioned and reproducible.

### 7.13.3 Most stable approach: Hydra > hidden <canvas> > HtmlToTexture

Instead of trying to push Hydra pixels into a custom WebGL texture manually (fragile, runtime-specific), use this pattern:

- **Hydra renders into a hidden HTML <canvas>**
- cables.gl uses `Ops.Extension.HtmlToTexture.HtmlToTexture` to capture that canvas as a texture

This stays close to cables.gl's existing patterns and tends to survive exports better.

#### Step 1: Create a “Hydra Host” custom op (creates and runs the Hydra canvas)

This op: - loads Hydra once (CDN or local) - creates a canvas with a known id - initializes Hydra to render into that canvas - exposes a few numeric parameters you can drive from the patch

```
// Op: Ops.User.Hydra.HydraHost
//
// Patch wiring idea:
// - Trigger this op from MainLoop (Render)
// - Use HtmlToTexture to capture the canvas by ID: #hydra-canvas

const inInit = op.inTriggerButton("Init");
const inRender = op.inTrigger("Render");

const inCanvasId = op.inString("Canvas Id", "hydra-canvas");
const inWidth = op.inInt("Width", 1024);
const inHeight = op.inInt("Height", 1024);

const inPreset = op.inSwitch("Preset", ["osc", "noise", "kaleid"], "osc");
const inP1 = op.inFloat("P1", 0.5);
```

```
const inP2 = op.inFloat("P2", 0.5);
const inP3 = op.inFloat("P3", 0.5);

const outReady = op.outBool("Ready");
const outError = op.outString("Error");
const outNext = op.outTrigger("Next");

let hydra = null;
let canvasEl = null;
let presetApplied = null;

// Keep params as plain JS variables so Hydra can read them via
functions.
let p1 = inP1.get();
let p2 = inP2.get();
let p3 = inP3.get();
inP1.onChange = () => (p1 = inP1.get());
inP2.onChange = () => (p2 = inP2.get());
inP3.onChange = () => (p3 = inP3.get());

function ensureCanvas() {
    const id = inCanvasId.get();
    const w = Math.max(16, inWidth.get() | 0);
    const h = Math.max(16, inHeight.get() | 0);

    let el = document.getElementById(id);
    if (!el) {
        el = document.createElement("canvas");
        el.id = id;
        // keep it out of the way
        el.style.position = "fixed";
        el.style.left = "-10000px";
        el.style.top = "-10000px";
        document.body.appendChild(el);
    }
    el.width = w;
    el.height = h;
    return el;
}

function loadHydraScriptOnce(url) {
    // Cache the promise globally so multiple ops don't race-load.
```

```

if (window.__hydraSynthLoading) return window.__hydraSynthLoading;
window.__hydraSynthLoading = new Promise((resolve, reject) => {
  const script = document.createElement("script");
  script.src = url;
  script.onload = resolve;
  script.onerror = () => reject(new Error("Failed to load Hydra
script"));
  document.head.appendChild(script);
});
return window.__hydraSynthLoading;
}

function initHydra() {
try {
  canvasEl = ensureCanvas();

  // If Hydra is already global, reuse it.
  if (window.__hydraInstance) {
    hydra = window.__hydraInstance;
    outReady.set(true);
    return;
  }

  // Hydra constructor is typically global after loading the
  // script.
  // makeGlobal=true gives you global functions like osc(),
  noise(), shape(), etc.
  hydra = new Hydra({
    canvas: canvasEl,
    detectAudio: false,
    makeGlobal: true,
  });

  window.__hydraInstance = hydra;
  outReady.set(true);
  outError.set("");
} catch (e) {
  outReady.set(false);
  outError.set(String(e && e.message ? e.message : e));
}
}

```

```

function applyPreset(name) {
  // Only apply when changed; many Hydra params can be functions so
  // they stay "live".
  if (!outReady.get()) return;
  if (presetApplied === name) return;
  presetApplied = name;

  // Clear output first (simple "reset").
  // solid(0,0,0,1).out() would be an alternative, depending on your
  // desired baseline.
  try {
    if (name === "osc") {
      osc(
        () => 5 + p1 * 40,      // frequency
        () => p2 * 2,          // sync
        () => p3                // offset
      ).kaleid(() => 1 + Math.floor(p1 * 6)).out();
      return;
    }

    if (name === "noise") {
      noise(() => 1 + p1 * 8, () => p2).colorama(() => p3 * 4).out();
      return;
    }

    if (name === "kaleid") {
      shape(() => 3 + Math.floor(p1 * 8), () => p2 * 0.5, () => p3 *
      0.5)
        .kaleid(() => 2 + Math.floor(p1 * 10))
        .rotate(() => p2 * Math.PI * 2)
        .out();
      return;
    }
  } catch (e) {
    outError.set(String(e && e.message ? e.message : e));
  }
}

inInit.onTriggered = async function () {
  outError.set("");
  outReady.set(false);
}

```

```

op.patch.loading.start();
try {
    // CDN option. For offline/standalone, point this to a local file
    // you ship.
    await loadHydraScriptOnce("https://cdn.jsdelivr.net/npm/hydra-synth@latest/dist/hydra-synth.js");
    initHydra();
} catch (e) {
    outError.set(String(e && e.message ? e.message : e));
} finally {
    op.patch.loading.finished();
}
};

inRender.onTriggered = function () {
    // Ensure canvas stays at chosen size even if width/height ports
    // change.
    if (outReady.get()) {
        canvasEl = ensureCanvas();
        applyPreset(inPreset.get());
    }
    outNext.trigger();
};

```

## Step 2: Capture the Hydra canvas as a texture

Use the op documentation entry for:

- `Ops.Extension.HtmlToTexture.HtmlToTexture` (see the corresponding ops chapter page)

The key idea is: configure `HtmlToTexture` to target the canvas id you created (default `#hydra-canvas`) and then treat the output like any other texture.

## 7.13.4 Why presets (instead of “Hydra code as a string”)?

Running arbitrary code strings (via `eval` / `new Function`) is powerful, but it's also: - **unsafe** (especially in exported / embedded contexts) - **hard to debug** (errors happen in dynamic code paths) - **often blocked** by stricter Content Security Policy configurations

The preset approach gives you 90% of the creative power with better stability. If you *do* want live-coded strings, keep it as an explicit “advanced / unsafe” path and gate it behind a boolean toggle in the op UI.

## 7.13.5 Audio-reactive Hydra (cables-driven)

Hydra has its own audio features, but in `cables.gl` it's usually cleaner to drive Hydra using audio analysis you already have in the patch:

- Use cables FFT / RMS □ map into P1/P2/P3 □ Hydra preset reads them via functions.

Example mapping: - **bass** □ P1 (structure) - **mid** □ P2 (motion) - **treble** □ P3 (color/detail)

## 7.13.6 Performance & quality tips

- **Resolution matters:** start at 512–1024 square for Hydra canvas; scale up only if needed.
- **Avoid re-building the Hydra graph every frame:** set up the chain once (preset), then let parameters be functions.
- **Export/offline:** prefer local Hydra JS file rather than CDN.
- **One Hydra instance:** with `makeGlobal=true`, treat Hydra like a singleton (simple + reliable).

## 7.13.7 Troubleshooting

- **Hydra canvas exists but texture is blank:** confirm the canvas is in the DOM and its id matches your `HtmlToTexture` selector.
- **Nothing renders after export:** CDN might be blocked; switch to a local Hydra file shipped with the export.
- **Errors like “Hydra is not defined”:** the script didn't load; check network/CSP and the script URL.

## 7.14 Error Handling

```

try {
    // Risky operation
    const result = riskyFunction();
    outResult.set(result);
} catch (error) {
    op.LogError("Operation failed:", error);
    op.setUiError("error", error.message);
}

// Clear error when fixed
op.setUiError("error", null);

```

## 7.15 Example: Custom Math Op

```
// Custom clamp with smoothing

const inValue = op.inFloat("Value", 0);
const inMin = op.inFloat("Min", 0);
const inMax = op.inFloat("Max", 1);
const inSmoothing = op.inFloat("Smoothing", 0);
const outValue = op.outNumber("Result");

let currentValue = 0;

function update() {
    let val = inValue.get();
    const min = inMin.get();
    const max = inMax.get();
    const smooth = inSmoothing.get();

    // Clamp
    val = Math.max(min, Math.min(max, val));

    // Smooth
    if (smooth > 0) {
        currentValue += (val - currentValue) * (1 - smooth);
    } else {
        currentValue = val;
    }

    outValue.set(currentValue);
}

inValue.onChange = update;
inMin.onChange = update;
inMax.onChange = update;
inSmoothing.onChange = update;
```

## 7.16 Example: Array Processor

```
// Sum all values in an array

const inArray = op.inArray("Values");
const outSum = op.outNumber("Sum");
const outAverage = op.outNumber("Average");
const outCount = op.outNumber("Count");

inArray.onChange = function() {
    const arr = inArray.get();

    if (!Array.isArray(arr) || arr.length === 0) {
        outSum.set(0);
        outAverage.set(0);
        outCount.set(0);
        return;
    }

    const sum = arr.reduce((a, b) => a + b, 0);
    const count = arr.length;
    const average = sum / count;

    outSum.set(sum);
    outAverage.set(average);
    outCount.set(count);
};
```

## 7.17 Example: API Fetcher

```
// Fetch data from an API

const inUrl = op.inString("API URL", "");
const inFetch = op.inTriggerButton("Fetch");
const outData = op.outObject("Data");
const outLoading = op.outBool("Loading");
const outError = op.outString("Error");

inFetch.onTriggered = async function() {
    const url = inUrl.get();
    if (!url) return;
```

```

outLoading.set(true);
outError.set("");

try {
  const response = await fetch(url);
  const data = await response.json();
  outData.set(data);
} catch (error) {
  outError.set(error.message);
  outData.set(null);
} finally {
  outLoading.set(false);
}
};

```

## 7.18 Debugging Tips

```

// Log to console
console.log("Value:", inValue.get());

// Op-specific logging (shows in cables UI)
op.log("This is a log message");
op.logWarn("This is a warning");
op.logError("This is an error");

// Visual debugging
op.setUiAttrib({ "error": "Something went wrong" });

```

## 7.19 Advanced Patterns (How to Build “Good” Ops)

Once you start writing more than a couple custom ops, quality becomes less about JavaScript syntax and more about **behavior**:

- **Determinism**: given the same inputs, the op produces the same outputs.
- **Clear execution model**: value changes vs trigger-based evaluation are intentional.
- **Performance**: avoid unnecessary allocations and expensive work per frame.

- **Good UI/UX**: errors are visible, defaults are sane, ports are grouped and labeled.

### 7.19.1 Pattern: Separate “Compute” from “Trigger”

A clean approach is:

- collect values in onChange
- do the heavy compute in one update() function
- call update() from whichever events are relevant

```

const inTrigger = op.inTrigger("Update");
const inA = op.inFloat("A", 0);
const inB = op.inFloat("B", 0);
const outResult = op.outNumber("Result");
const outNext = op.outTrigger("Next");

function update() {
  outResult.set(inA.get() + inB.get());
}

inA.onChange = update;
inB.onChange = update;

inTrigger.onTriggered = function () {
  update();
  outNext.trigger();
};

```

### 7.19.2 Pattern: “Only Recompute When Dirty”

If an op gets triggered every frame but its inputs rarely change, cache the result:

```

const inTrigger = op.inTrigger("Render");
const outNext = op.outTrigger("Next");

const inValue = op.inFloat("Value", 0);
const outProcessed = op.outNumber("Processed");

let dirty = true;
let cached = 0;

```

```

function recompute() {
  const v = inValue.get();
  // pretend this is expensive:
  cached = Math.sin(v) * Math.cos(v) * 1000;
  outProcessed.set(cached);
  dirty = false;
}

inValue.onChange = function () {
  dirty = true;
};

inTrigger.onTriggered = function () {
  if (dirty) recompute();
  outNext.trigger();
};

```

### 7.19.3 Pattern: Debounce (Stabilize Noisy Inputs)

Useful for sliders, mouse input, or network-driven values.

```

const inValue = op.inFloat("Value", 0);
const inDelayMs = op.inInt("Delay (ms)", 200);
const outValue = op.outNumber("Debounced");

let t = null;

inValue.onChange = function () {
  if (t) clearTimeout(t);
  const v = inValue.get();
  t = setTimeout(() => outValue.set(v), inDelayMs.get());
};

```

### 7.19.4 Pattern: Rate-Limit (Prevent Flooding Downstream)

Useful when sending values to other systems (e.g., API calls, heavy compute, UI).

```

const inTrigger = op.inTrigger("Trigger");
const inMinIntervalMs = op.inInt("Min Interval (ms)", 100);

```

```

const outNext = op.outTrigger("Next");

let last = 0;

inTrigger.onTriggered = function () {
  const now = performance.now();
  if (now - last >= inMinIntervalMs.get()) {
    last = now;
    outNext.trigger();
  }
};

```

### 7.19.5 Pattern: Stateful Ops (Resettable Systems)

Any op that accumulates state should expose a reset trigger.

```

const inAdd = op.inTrigger("Add");
const inReset = op.inTrigger("Reset");
const inValue = op.inFloat("Value", 1);
const outSum = op.outNumber("Sum");

let sum = 0;

function emit() {
  outSum.set(sum);
}

inAdd.onTriggered = function () {
  sum += inValue.get();
  emit();
};

inReset.onTriggered = function () {
  sum = 0;
  emit();
};

```

## 7.20 Async Ops (Fetching Data Safely)

When you talk to the network, the two most important qualities are:

- **cancellation**: don't keep old requests alive if the user changes the URL
- **loading/error UX**: surface the state to the patch (and optionally the UI)

### 7.20.1 Example: Fetch JSON with Cancellation

```
const inUrl = op.inString("URL", "");  
const inFetch = op.inTriggerButton("Fetch");  
  
const outData = op.outObject("Data");  
const outLoading = op.outBool("Loading");  
const outError = op.outString("Error");  
  
let controller = null;  
  
inFetch.onTriggered = async function () {  
    const url = inUrl.get();  
    if (!url) return;  
  
    // cancel previous request  
    if (controller) controller.abort();  
    controller = new AbortController();  
  
    outLoading.set(true);  
    outError.set("");  
  
    try {  
        const res = await fetch(url, { signal: controller.signal });  
        if (!res.ok) throw new Error(`HTTP ${res.status}`);  
        const json = await res.json();  
        outData.set(json);  
    } catch (e) {  
        // ignore abort errors as "expected"  
        if (e && e.name === "AbortError") return;  
        outError.set(String(e && e.message ? e.message : e));  
        outData.set(null);  
    } finally {  
        outLoading.set(false);  
    }  
};
```

### 7.20.2 Loading Semantics (Patch-Friendly)

If an op blocks the patch from being "ready" until something loads, use the patch loading tracking mechanism shown earlier (`op.patch.loading.start()` / `finished()`), and keep those calls paired even on error paths.

## 7.21 Performance Tips for Custom Ops

- **Avoid allocations in per-frame triggers**: reuse arrays/objects when possible.
- **Minimize DOM work**: avoid creating elements repeatedly; cache references.
- **Don't spam logs**: logging inside every-frame triggers will kill performance.
- **Prefer simple math**: it's easy to do too much in JS when the GPU could do it (shader).

## 7.22 Featured Videos

## 7.23 Exercises

1. Create a custom op that formats a number with a prefix and suffix
2. Build an array shuffler op
3. Create a simple state machine op
4. Build an op that fetches and parses CSV data

# 8 Audio & Sound in Cables.gl

## 8.1 Introduction

Cables.gl has powerful audio capabilities, enabling you to create audio-reactive visuals, music visualizations, and interactive sound experiences.

## 8.2 Audio Sources

### 8.2.1 AudioFile

Load and play audio files:

```
AudioFile -> AudioAnalyzer -> Visual ops
```

**Supported Formats:** - MP3 - WAV - OGG

**Key Parameters:**

- URL - Path to audio file
- Loop - Repeat playback
- Volume - Playback volume
- Playback Rate - Speed control

### 8.2.2 Microphone

Capture live audio input:

```
Microphone -> AudioAnalyzer -> Visual ops
```

**Note:** Requires user permission in browser.

### 8.2.3 AudioBuffer

Load audio into memory for precise control.

### 8.2.4 WebAudio Oscillator

Generate synthetic sounds:

```
Oscillator -> Audio output
```

**Types:** - Sine - Square - Sawtooth - Triangle

## 8.3 Audio Analysis

### 8.3.1 AudioAnalyzer

The core op for audio-reactive visuals:

```
 AudioSource -> AudioAnalyzer  
 Outputs: FFT, Volume, Bass, Mid, High
```

**Key Outputs:** - FFT Array - Frequency spectrum data - Volume - Overall loudness - Bass - Low frequency level - Mid - Middle frequency level - High - High frequency level

### 8.3.2 FFT (Fast Fourier Transform)

Breaks audio into frequency bands:

```
 AudioAnalyzer -> FFTArray -> ArrayIterator  
 Visualize each band
```

**FFT Size Options:** - 32, 64, 128, 256, 512, 1024, 2048, 4096 - Larger = more detail, but slower

### 8.3.3 Smoothing

Apply smoothing to prevent jittery visuals:

```
 AudioValue -> Smooth -> Visual parameter
```

## 8.4 Common Audio-Reactive Patterns

### 8.4.1 Volume-Based Scaling

```
 AudioAnalyzer (volume) -> Scale input of shape
```

### 8.4.2 Frequency Band Visualization

```
MainLoop  
BasicMaterial  
AudioAnalyzer -> FFTArray  
ArrayIterator
```

Transform (X position from index)  
Transform (Y scale from FFT value)  
Rectangle

### 8.4.3 Color from Audio

AudioAnalyzer (bass) -> Hue input of HSBtoRGB  
HSBtoRGB -> BasicMaterial (color input)

### 8.4.4 Beat Detection

AudioAnalyzer (volume) -> Threshold -> Trigger  
(triggers on beat)

## 8.5 Audio Effects

### 8.5.1 Gain

Control volume:

AudioSource -> Gain -> Output

### 8.5.2 Filter

Shape the frequency content:

AudioSource -> Filter -> Output

**Filter Types:** - Lowpass - Removes high frequencies - Highpass - Removes low frequencies  
- Bandpass - Keeps only middle frequencies - Notch - Removes specific frequency

### 8.5.3 Delay

Add echo effect:

AudioSource -> Delay -> Output

### 8.5.4 Reverb

Add space/ambience:

AudioSource -> Reverb -> Output

### 8.5.5 Compressor

Even out dynamics:

AudioSource -> Compressor -> Output

## 8.6 Building a Visualizer

### 8.6.1 Step 1: Set Up Audio

AudioFile (your music)  
 AudioAnalyzer

### 8.6.2 Step 2: Create Base Render

MainLoop  
 Camera (for 3D) or BasicMaterial (for 2D)

### 8.6.3 Step 3: Add Audio-Reactive Elements

#### Example: Pulsing Circle

MainLoop -> BasicMaterial  
 AudioAnalyzer (volume)  
 Smooth (for smoother animation)  
 Math (multiply by desired scale)  
 Circle (size input)

### 8.6.4 Step 4: Add Frequency Visualization

AudioAnalyzer -> FFTArray  
 ArrayIterator (iterate through frequencies)  
 Index -> Calculate X position

FFT Value -> Calculate height/color  
Rectangle (bar for each frequency)

AudioAnalyzer (volume/bass/mid/high)  
+> Smooth (slow) -> Energy signal  
+> Threshold -> (optional Delay/Interval gating) -> Transient trigger

## 8.7 Synchronizing to Music

### 8.7.1 BPM and Beat Sync

AudioFile  
BPMSync (set your song's BPM)  
Beat triggers for animations

### 8.7.2 Timeline with Audio

1. Load audio file
2. Add to timeline
3. Use timeline markers for sync points
4. Keyframe animations to match audio

## 8.8 Advanced Audio Techniques (Make It Feel "Musical")

Audio-reactive visuals often fail in the same way: they're *too jittery* and *too literal*. The goal is usually:

- stable motion with **musical** response (not "random noise" response)
- clear separation between **slow energy** (overall level) and **fast transients** (kicks/snare hits)
- mappings that feel good: log frequency, clamped ranges, smoothing that doesn't lag

### 8.8.1 Technique: Energy vs Transient (Two-Signal Approach)

Treat audio as two complementary control signals:

- **Energy**: smoothed volume/bass/mid/high (drives slow changes: camera drift, fog density, palette)
- **Transients**: thresholded + debounced triggers (drives discrete events: flashes, spawns, scene cuts)

Typical building blocks:

### 8.8.2 Technique: Log Frequency Mapping (Better Spectra)

FFT bins are linear in frequency, but our hearing is closer to logarithmic. If your spectrum visualization looks "all action on the left", try mapping indices in a non-linear way:

- compress the low bins less (give bass more space)
- compress high bins more (reduce over-detail)

Conceptually:

Index -> Normalize (0..1) -> Pow (curve) -> Sample FFT

### 8.8.3 Technique: Peak Hold (Readable Visuals)

Human-friendly meters often have a "peak hold" that decays slowly. You can build this by:

- capturing the max value over a short window
- then decaying it over time

Conceptually:

AudioValue -> Max (with previous peak) -> Decay over time -> Peak output

### 8.8.4 Technique: Band-Specific Control (Bass Drives Scale, High Drives Detail)

Instead of driving everything from overall volume:

- **bass** -> big scale/position changes
- **mid** -> color shifts or mid-size motion
- **high** -> small jitter/detail/particles

This makes visuals feel much more "mixed".

## 8.8.5 Technique: Audio -> Shader (The “Pro” Move)

Shading is where audio-reactive projects often become cinematic.

High-level pattern:

```
AudioAnalyzer (energy) -> Smooth -> Shader uniform (e.g., amount)  
FFTArray -> (reduce / select bands) -> Shader uniform(s)  
Time -> Shader uniform (time)
```

Then, in the shader, use audio as a **modulation source**, not as the final value.  
(Example: warp UVs slightly, not wildly.)

## 8.9 Advanced Patch Recipes

### 8.9.1 Recipe: Stable Beat Trigger (Avoid Double-Triggers)

The simplest fix for “machine-gun” beats is gating:

```
AudioAnalyzer (volume or bass)  
Threshold (set just above noise floor)  
(Gate / minimum time between triggers)  
Trigger (spawn / flash / step timeline)
```

### 8.9.2 Recipe: Audio-Reactive Post-Processing

Drive a texture effect strength from music:

```
MainLoop -> Camera -> RenderToTexture -> TextureEffect -> Output  
^  
AudioAnalyzer (volume) -> Smooth -> Map -> effect strength
```

### 8.9.3 Recipe: Audio-Reactive 3D Equalizer (Optimized)

If you build an equalizer with many bars:

- keep geometry simple
- reduce FFT size to what you need
- avoid doing heavy work per bar per frame

Conceptually:

```
AudioAnalyzer -> FFTArray  
ArrayIterator (N bands)  
Transform (X from index, Y scale from FFT)  
Cube (bar)
```

### 8.9.4 Recipe: Audio-Driven Palette

Map energy to hue/saturation to get coherent color shifts:

```
AudioAnalyzer (mid) -> Smooth -> Map -> Hue  
AudioAnalyzer (bass) -> Smooth -> Map -> Saturation  
HSBtoRGB -> BasicMaterial (color)
```

## 8.10 Practical Examples

### 8.10.1 Example 1: Bass-Reactive Background

```
MainLoop  
AudioFile -> AudioAnalyzer (bass)  
Smooth (0.9)  
Map (0-1 to desired range)  
HSBtoRGB (bass controls saturation) -> BasicMaterial (color input)  
BasicMaterial  
FullscreenRectangle
```

### 8.10.2 Example 2: Circular Spectrum

```
MainLoop  
BasicMaterial  
AudioAnalyzer -> FFTArray  
ArrayIterator  
Transform (rotate based on index)  
Transform (translate by FFT value)  
Circle (small)
```

### 8.10.3 Example 3: Waveform Display

```
MainLoop  
BasicMaterial
```

AudioAnalyzer -> WaveformArray  
PointCloud or LineStrip

#### 8.10.4 Example 4: 3D Audio Visualization

MainLoop  
Camera -> OrbitControls  
AudioAnalyzer -> FFTArray  
ArrayIterator (creates ring)  
Transform (position in circle)  
Transform (scale Y by FFT)  
Cube

### 8.13 Featured Videos

### 8.14 Exercises

1. Create a simple volume meter with animated bars
2. Build a circular frequency spectrum visualizer
3. Make a 3D landscape that morphs to music
4. Create a beat-triggered strobe effect

## 8.11 Performance Considerations

1. **FFT Size** - Use smallest size that gives needed detail
2. **Smoothing** - Higher smoothing = less CPU for animations
3. **Update Rate** - Don't need 60fps for all audio analysis
4. **Visualizer Complexity** - Balance detail with performance

## 8.12 Browser Audio Policies

Modern browsers require user interaction before playing audio:

1. Add a "Start" button
2. Start audio on button click
3. Or use `AudioContext.resume()` on first interaction

```
// In custom op or patch
document.addEventListener('click', () => {
  if (audioContext.state === 'suspended') {
    audioContext.resume();
  }
}, { once: true });
```

# 9 Animation & Timeline in Cables.gl

## 9.1 Introduction

Cables.gl provides multiple ways to create animations, from simple time-based movements to complex keyframed sequences using the timeline.

**Official reference:** start with cables.gl docs and search for **Timeline**, **Anim**, **Keyframes**, and **Easing**. UI labels and available features can change between releases, so using the docs as the “source of truth” helps.

## 9.2 Types of Animation

### 9.2.1 1. Procedural Animation

Using math and time to create continuous motion.

### 9.2.2 2. Keyframe Animation

Defining specific values at specific times.

### 9.2.3 3. Physics-Based Animation

Simulating natural motion with springs, gravity, etc.

### 9.2.4 4. Data-Driven Animation

Animating based on input data or user interaction.

## 9.3 Procedural Animation

### 9.3.1 The Time Op

The foundation of procedural animation:

Time -> Outputs current time in seconds

**Uses:** - Input for trigonometric functions - Driving continuous rotation - Creating loops and cycles

### 9.3.2 Basic Movement Patterns

#### Linear Movement:

Time -> Modulo (loop duration) -> Position

#### Oscillation (Sine Wave):

Time -> Sin -> Scale/Position

#### Bounce:

Time -> Sin -> Abs -> Position

#### Circular Motion:

Time -> Cos -> X position

Time -> Sin -> Y position

### 9.3.3 Easing Functions

Transform linear time into smooth curves:

#### Ease In (slow start):

```
// Assume: t is normalized to [0..1]
t * t;           // Quadratic
t * t * t;      // Cubic
```

#### Ease Out (slow end):

```
// Assume: t is normalized to [0..1]
1 - (1 - t) * (1 - t);
```

#### Ease In-Out (smooth both):

```
// Assume: t is normalized to [0..1]
t < 0.5 ? 2 * t * t : 1 - Math.pow(-2 * t + 2, 2) / 2;
```

Tip: easing functions expect a **normalized** input (t) in ([0,1]). In patches, that often means Time -> Range/Map -> Clamp before easing (or using timeline curves directly).

### 9.3.4 The Smooth Op

Smoothly interpolate towards target values:

TargetValue -> Smooth -> AnimatedValue

**Parameter:** - Smoothing - Higher = slower, smoother transitions

### 9.3.5 Spring Animation

Create bouncy, natural motion:

TargetValue -> Spring -> AnimatedValue

**Parameters:** - Stiffness - How quickly it moves - Damping - How quickly it settles

## 9.4 Timeline Animation

### 9.4.1 Opening the Timeline

1. Click the timeline icon in the toolbar
2. Or press T to toggle timeline visibility

### 9.4.2 Timeline Interface

[Play][Pause][Stop] [Time: 00:00:00] [BPM: 120]  
Property Name o-----o-----o-----o-----  
Property 2 o-----o-----o-----  
Property 3 o-----o-----o-----  
<- 0s 5s 10s 15s 20s ->

### 9.4.3 Adding Keyframes

1. Select the op with the property to animate
2. Move the timeline playhead to the desired time
3. Set the value
4. Click the keyframe button (or right-click the property)

### 9.4.4 Keyframe Types

- **Linear** - Straight line between keyframes
- **Step** - Instant change at keyframe
- **Ease In** - Slow start
- **Ease Out** - Slow end
- **Ease In-Out** - Smooth start and end
- **Bezier** - Custom curve with handles

### 9.4.5 Editing Keyframes

- **Move:** Drag keyframe left/right (time) or up/down (value)
- **Delete:** Select and press Delete
- **Copy/Paste:** Ctrl+C, Ctrl+V
- **Multi-select:** Shift+click or drag box

### 9.4.6 Timeline Tracks

Organize animations into tracks:

- **Property tracks** - Individual values
- **Trigger tracks** - Fire events at specific times
- **Audio tracks** - Sync with music

## 9.5 Non-Linear Animation Clips (New Animation System - November 2025)

The new animation system in Cables.gl introduces powerful non-linear animation capabilities through **animation clips**. Clips are reusable, addable, and mixable animation sequences that can be layered and blended to create complex motion.

### 9.5.1 What Are Animation Clips?

Animation clips are self-contained animation sequences that can be:  
- **Reusable** - Create once, apply to multiple parameters  
- **Addable** - Layer multiple clips together (additive blending)  
- **Mixable** - Blend between clips with different weights  
- **Non-linear** - Don't require strict sequential playback

### 9.5.2 Creating Animation Clips

#### Step 1: Enable Clip Mode

1. Add an **Anim** operator to your patch
2. Connect it to the parameter you want to animate

3. Open the Anim operator's properties
4. Enable the **Clip** option
5. Assign a **Clip Name** (e.g., "bounce", "fadeln", "rotate360")

Parameter -> Anim (Clip enabled, Name: "myClip") -> Animated Value

## Step 2: Define Keyframes

1. With the Anim operator selected, open the Timeline
2. Set keyframes for your animation sequence
3. Adjust easing curves and timing
4. The animation is now stored as a named clip

## Step 3: Apply Clips to Other Parameters

Once created, clips can be applied to any other Anim operator:

1. Add another Anim operator
2. In the Timeline, right-click on a keyframe
3. Select "Apply Clip" and choose your clip name
4. The clip's animation will be applied at that keyframe

## 9.5.3 Clip Properties and Options

### Looping Modes

Clips support different looping behaviors:

- **None** - Play once and stop
- **Repeat** - Loop from start to end
- **Mirror** - Play forward, then backward
- **Offset** - Continue from end value

### Interpolation Methods

- **Linear** - Straight interpolation
- **Ease In/Out** - Smooth acceleration/deceleration
- **Bezier** - Custom curve control
- **Step** - Instant value changes

## 9.5.4 Additive Animation (Layering Clips)

Multiple clips can be **added together** to create combined effects:

### Base Value

Anim Clip 1 ("bounce") -> Add  
 Anim Clip 2 ("rotate") -> Add  
 Anim Clip 3 ("scale") -> Add  
 Final Animated Value

### Use Cases:

- Base idle animation + triggered bounce effect
- Procedural motion + keyframed structure
- Multiple independent motion layers

### Example: Character Animation

Idle Clip (continuous breathing)  
 Walk Clip (additive, triggered on movement)  
 Jump Clip (additive, triggered on jump)  
 Final Position

## 9.5.5 Mixable Animation (Blending Clips)

Clips can be **mixed** with different weights to blend between animations:

Clip A ("walk") -> Mix (weight: 0.7)  
 Clip B ("run") -> Mix (weight: 0.3)  
 Blended Animation

**Blending Modes:** - **Linear Blend** - Simple weighted average - **Smooth Blend**  
 - Eased transition between clips - **Additive Blend** - Add clips together with weights

### Example: Walk-to-Run Transition

Walk Clip -> Mix (weight: 1.0 - runProgress)  
 Run Clip -> Mix (weight: runProgress)  
 Smooth transition from walk to run

## 9.5.6 Clip Management

### Organizing Clips

Clips are stored within your project and can be:

- **Renamed** - Right-click clip in timeline -> Rename
- **Duplicated** - Copy clip to create variations
- **Deleted** - Remove unused clips
- **Exported/Imported** - Share clips between projects

### Clip Library

Access all clips in your project:

1. Open Timeline
2. Click "Clips" tab
3. View all available clips
4. Drag clips onto timeline tracks

## 9.5.7 Advanced Clip Techniques

### Clip Offsets and Time Remapping

Apply clips at different time offsets:

```
Clip "bounce" (duration: 2s)
Apply at t=0s: Full clip
Apply at t=5s: Clip starts here
Apply at t=10s: Clip with 0.5x speed (time remap)
```

### Clip Masking

Use clips to mask or modulate other animations:

```
Base Animation -> Multiply
Clip "mask" (0 to 1) -> Multiply
Masked Animation (only active where mask = 1)
```

### Conditional Clip Playback

Control clip playback based on conditions:

```
Condition -> If
  +-> True: Play Clip A
  +-> False: Play Clip B
```

## 9.6 JavaScript Custom Op Integration with Animation System

The new animation system integrates seamlessly with JavaScript custom operators, allowing programmatic control and extension of animation capabilities.

### 9.6.1 Accessing Animation Data from Custom Ops

#### Reading Animation Values

```
// Get current animation value from an Anim op
// NOTE: patch inspection APIs can vary between cables
// versions/runtimes.
// Treat this as a pattern: find the op you care about, then read its
// output port.
const animOp = op.patch.findOpByName ?
op.patch.findOpByName("MyAnimOp") : null;
if (animOp && animOp.outValue && typeof animOp.outValue.get ===
"function") {
    const currentValue = animOp.outValue.get();
    // Use the animated value
}
```

#### Monitoring Animation State

```
const inTrigger = op.inTrigger("Render");
const outAnimValue = op.outNumber("Animation Value");
const outIsPlaying = op.outBool("Is Playing");

let animOp = null;

// Find the Anim op (call once on init)
op.onInit = function() {
    animOp = op.patch.findOpByName ?
op.patch.findOpByName("MyAnimOp") : null;
};

inTrigger.onTriggered = function() {
    if (animOp) {
        // Get current animated value
        outAnimValue.set(animOp.outValue.get());
    }
};
```

```

// Check if timeline is playing
const timeline = op.patch.timeline;
if (timeline) {
    outIsPlaying.set(timeline.isPlaying());
}
};


```

## 9.6.2 Controlling Timeline from Custom Ops

### Playback Control

```

const inPlay = op.inTriggerButton("Play");
const inPause = op.inTriggerButton("Pause");
const inStop = op.inTriggerButton("Stop");
const inSeek = op.inFloat("Seek Time", 0);
const inSeekTrigger = op.inTrigger("Seek");

inPlay.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) timeline.play();
};

inPause.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) timeline.pause();
};

inStop.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) timeline.stop();
};

inSeekTrigger.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) {
        timeline.seek(inSeek.get());
    }
};

```

## Timeline Time and Progress

```

const inTrigger = op.inTrigger("Render");
const outTime = op.outNumber("Current Time");
const outProgress = op.outNumber("Progress (0-1)");
const outDuration = op.outNumber("Total Duration");

inTrigger.onTriggered = function() {
    const timeline = op.patch.timeline;
    if (timeline) {
        const currentTime = timeline.getTime();
        const duration = timeline.getDuration();

        outTime.set(currentTime);
        outDuration.set(duration);
        outProgress.set(duration > 0 ? currentTime / duration : 0);
    }
};

```

## 9.6.3 Creating Animation Clips Programmatically

### Generating Clip Data

```

// Custom op that generates animation clip data
const inDuration = op.inFloat("Duration", 2.0);
const inAmplitude = op.inFloat("Amplitude", 1.0);
const inFrequency = op.inFloat("Frequency", 1.0);
const inGenerate = op.inTriggerButton("Generate Clip");
const outClipData = op.outObject("Clip Data");

inGenerate.onTriggered = function() {
    const duration = inDuration.get();
    const amplitude = inAmplitude.get();
    const freq = inFrequency.get();
    const sampleRate = 60; // samples per second
    const numSamples = Math.floor(duration * sampleRate);

    const keyframes = [];
    for (let i = 0; i <= numSamples; i++) {
        const t = i / numSamples;
        const time = t * duration;
        // Generate sine wave animation
    }
};

```

```

        const value = Math.sin(time * freq * Math.PI * 2) * amplitude;
        keyframes.push({
            time: time,
            value: value,
            easing: "easeInOut"
        });
    }

    outClipData.set({
        name: "generatedSine",
        duration: duration,
        keyframes: keyframes,
        loop: "repeat"
    });
}

```

## 9.6.4 Manipulating Animation Clips

### Blending Multiple Clips

```

// Custom op that blends multiple animation clips
const inClipA = op.inObject("Clip A Data");
const inClipB = op.inObject("Clip B Data");
const inBlendFactor = op.inFloat("Blend Factor", 0.5); // 0 = A, 1 = B
const inTime = op.inFloat("Time", 0);
const outBlendedValue = op.outNumber("Blended Value");

inTime.onChange = function() {
    const clipA = inClipA.get();
    const clipB = inClipB.get();
    const blend = inBlendFactor.get();
    const t = inTime.get();

    if (!clipA || !clipB) return;

    // Sample both clips at time t
    const valueA = sampleClip(clipA, t);
    const valueB = sampleClip(clipB, t);

    // Blend
    const blended = valueA * (1 - blend) + valueB * blend;
}

```

```

        outBlendedValue.set(blended);
    }

    function sampleClip(clip, time) {
        const keyframes = clip.keyframes;
        if (!Array.isArray(keyframes) || keyframes.length === 0) return 0;

        // Clamp / wrap time to clip duration (and handle negative times)
        const duration = Number(clip.duration) || 0;
        if (duration > 0) {
            time = ((time % duration) + duration) % duration;
        } else {
            // No duration (or invalid): treat as "hold last keyframe"
            const last = keyframes[keyframes.length - 1];
            return last && typeof last.value === "number" ? last.value : 0;
        }

        // Find surrounding keyframes
        for (let i = 0; i < keyframes.length - 1; i++) {
            if (time >= keyframes[i].time && time <= keyframes[i + 1].time) {
                // Interpolate
                const t0 = keyframes[i].time;
                const t1 = keyframes[i + 1].time;
                const v0 = keyframes[i].value;
                const v1 = keyframes[i + 1].value;

                const t = (time - t0) / (t1 - t0);
                // NOTE: this demo uses linear interpolation only.
                // If you want per-keyframe easing, apply an easing
                function to `t` here
                // based on keyframe metadata (e.g. keyframes[i + 1].easing).
                return v0 + (v1 - v0) * t;
            }
        }

        return keyframes[keyframes.length - 1].value;
    }
}

```

## Additive Clip Combination

```
// Custom op that adds multiple clips together
const inClips = op.inArray("Clips Array");
const inTime = op.inFloat("Time", 0);
const outCombinedValue = op.outNumber("Combined Value");

inTime.onChange = function() {
    const clips = inClips.get();
    const t = inTime.get();

    if (!Array.isArray(clips) || clips.length === 0) {
        outCombinedValue.set(0);
        return;
    }

    let sum = 0;
    for (let i = 0; i < clips.length; i++) {
        const clip = clips[i];
        if (clip && clip.keyframes) {
            sum += sampleClip(clip, t);
        }
    }

    outCombinedValue.set(sum);
};


```

### 9.6.5 Advanced: Custom Easing Functions

```
// Custom op with advanced easing functions
const inValue = op.inFloat("Input (0-1)", 0);
const inEasingType = op.inSwitch("Easing",
    ["linear", "easeInQuad", "easeOutQuad", "easeInOutQuad",
     "easeInCubic", "easeOutCubic", "easeInOutCubic",
     "easeInElastic", "easeOutBounce"],
    "easeInOutQuad");
const outEased = op.outNumber("Eased Value");

inValue.onChange = function() {
    const t = Math.max(0, Math.min(1, inValue.get()));
    const type = inEasingType.get();
    let eased = 0;
```

```
switch(type) {
    case "linear":
        eased = t;
        break;
    case "easeInQuad":
        eased = t * t;
        break;
    case "easeOutQuad":
        eased = 1 - (1 - t) * (1 - t);
        break;
    case "easeInOutQuad":
        eased = t < 0.5
            ? 2 * t * t
            : 1 - Math.pow(-2 * t + 2, 2) / 2;
        break;
    case "easeInCubic":
        eased = t * t * t;
        break;
    case "easeOutCubic":
        eased = 1 - Math.pow(1 - t, 3);
        break;
    case "easeInOutCubic":
        eased = t < 0.5
            ? 4 * t * t * t
            : 1 - Math.pow(-2 * t + 2, 3) / 2;
        break;
    case "easeInElastic":
        const c4 = (2 * Math.PI) / 3;
        eased = t === 0 ? 0 : t === 1 ? 1
            : -Math.pow(2, 10 * t - 10) * Math.sin((t * 10 -
10.75) * c4);
        break;
    case "easeOutBounce":
        const n1 = 7.5625;
        const d1 = 2.75;
        if (t < 1 / d1) {
            eased = n1 * t * t;
        } else if (t < 2 / d1) {
            eased = n1 * (t -= 1.5 / d1) * t + 0.75;
        } else if (t < 2.5 / d1) {
            eased = n1 * (t -= 2.25 / d1) * t + 0.9375;
```

```

        } else {
            eased = n1 * (t -= 2.625 / d1) * t + 0.984375;
        }
        break;
    }

    outEased.set(eased);
};


```

## 9.6.6 Real-Time Animation Modification

```

// Custom op that modifies animation in real-time based on input
const inBaseAnim = op.inObject("Base Animation Clip");
const inModifier = op.inFloat("Modifier", 1.0);
const inTime = op.inFloat("Time", 0);
const outModifiedValue = op.outNumber("Modified Value");

inTime.onChange = function() {
    const clip = inBaseAnim.get();
    const mod = inModifier.get();
    const t = inTime.get();

    if (!clip) return;

    // Sample base animation
    let value = sampleClip(clip, t);

    // Apply modifier (could be scale, offset, etc.)
    value *= mod;

    outModifiedValue.set(value);
};

```

## 9.6.7 Integration Example: Physics-Driven Animation

```

// Custom op that combines physics simulation with animation clips
const inAnimClip = op.inObject("Animation Clip");
const inPhysicsForce = op.inFloat("Physics Force", 0);
const inDamping = op.inFloat("Damping", 0.9);
const inTime = op.inFloat("Time", 0);
const outCombinedValue = op.outNumber("Combined Value");

```

```

let velocity = 0;
let position = 0;

inTime.onChange = function() {
    const clip = inAnimClip.get();
    const force = inPhysicsForce.get();
    const damp = inDamping.get();
    const t = inTime.get();

    // Get base animation value
    const animValue = clip ? sampleClip(clip, t) : 0;

    // Apply physics
    velocity += force;
    velocity *= damp;
    position += velocity;

    // Combine animation + physics
    const combined = animValue + position;
    outCombinedValue.set(combined);
};


```

## 9.6.8 Best Practices for Animation + Custom Ops

- Cache Clip Sampling** - If sampling clips every frame, cache results when time hasn't changed
- Batch Operations** - Process multiple clips in one op rather than multiple ops
- Use Native Anim Op When Possible** - Only use custom ops when you need functionality beyond built-in features
- Optimize Keyframe Lookups** - Use binary search for large clip keyframe arrays
- Handle Edge Cases** - Always check for null/undefined clips and handle time out of bounds

## 9.6.9 Example: Complete Animation Controller Op

```

// Comprehensive animation controller custom op
const inPlay = op.inTriggerButton("Play");
const inPause = op.inTriggerButton("Pause");
const inStop = op.inTriggerButton("Stop");

```

```

const inSeek = op.inFloat("Seek", 0);
const inSpeed = op.inFloat("Speed", 1.0);
const inLoop = op.inBool("Loop", true);

const outTime = op.outNumber("Current Time");
const outProgress = op.outNumber("Progress");
const outIsPlaying = op.outBool("Is Playing");

let currentTime = 0;
let isPlaying = false;
let lastFrameTime = 0;

op.onInit = function() {
    lastFrameTime = op.patch.timer.getTime();
};

const inRender = op.inTrigger("Render");
inRender.onTriggered = function() {
    const now = op.patch.timer.getTime();
    const delta = now - lastFrameTime;
    lastFrameTime = now;

    if (isPlaying) {
        currentTime += delta * inSpeed.get();

        const timeline = op.patch.timeline;
        if (timeline) {
            const duration = timeline.getDuration();
            if (currentTime >= duration) {
                if (inLoop.get()) {
                    currentTime = currentTime % duration;
                } else {
                    currentTime = duration;
                    isPlaying = false;
                }
            }
        }

        timeline.seek(currentTime);
    }
}

outTime.set(currentTime);
}

```

```

const timeline = op.patch.timeline;
if (timeline) {
    const duration = timeline.getDuration();
    outProgress.set(duration > 0 ? currentTime / duration : 0);
}
outIsPlaying.set(isPlaying);
};

inPlay.onTriggered = function() {
    isPlaying = true;
    const timeline = op.patch.timeline;
    if (timeline) timeline.play();
};

inPause.onTriggered = function() {
    isPlaying = false;
    const timeline = op.patch.timeline;
    if (timeline) timeline.pause();
};

inStop.onTriggered = function() {
    isPlaying = false;
    currentTime = 0;
    const timeline = op.patch.timeline;
    if (timeline) {
        timeline.stop();
        timeline.seek(0);
    }
};

inSeek.onChange = function() {
    currentTime = inSeek.get();
    const timeline = op.patch.timeline;
    if (timeline) timeline.seek(currentTime);
};

```

## 9.7 Sequence and Timing Ops

### 9.7.1 Sequence

Chain multiple actions in order:

```
Trigger -> Sequence
    +-> Action 1
    +-> Action 2 (after delay)
    +-> Action 3 (after delay)
```

### 9.7.2 Delay

Pause before triggering:

```
Trigger -> Delay (seconds) -> DelayedAction
```

### 9.7.3 Timer

Count down or up:

```
StartTrigger -> Timer -> TimeValue
```

### 9.7.4 Interval

Trigger repeatedly:

```
Interval (every X seconds) -> RepeatedAction
```

## 9.8 Animation Patterns

### 9.8.1 Staggered Animation

Animate multiple items with offset timing:

```
ArrayIterator
Index -> Delay offset
AnimatedProperty
```

### 9.8.2 Loop with Pause

```
Time -> Modulo (total duration)
-> If < activeTime: animate
-> Else: hold at end value
```

### 9.8.3 Ping-Pong (Back and Forth)

```
Time -> Sin -> Map to range -> Property
```

Or with timeline: set keyframes to go forward then backward.

### 9.8.4 One-Shot Animation

```
Trigger -> SetValue (start)
-> Smooth -> AnimatedValue
```

## 9.9 State Machines

Create complex animation logic:

### 9.9.1 Simple States

```
// In custom op
let state = "idle";

function setState(newState) {
    state = newState;
    switch(state) {
        case "idle":
            // Set idle animation params
            break;
        case "active":
            // Set active animation params
            break;
        case "exit":
            // Set exit animation params
            break;
    }
}
```

## 9.9.2 Transition Between States

Use Smooth or Spring ops to blend between state values.

Timeline -> Base position  
Time -> Sin (small) -> Add  
Result -> Transform position

## 9.10 Interactive Animation

### 9.10.1 Mouse-Based

MouseX -> Map to range -> Target value -> Smooth -> Property

### 9.10.2 Scroll-Based

ScrollPosition -> Map (0 to page height) -> (0 to 1) -> Animation progress

### 9.10.3 Click-Triggered

MouseClicked -> Toggle state -> Smooth -> Animated property

## 9.11 Advanced Animation Systems (How to Build "Scenes")

As patches grow, animation becomes less about a single value moving and more about **systems**:

- multiple objects animated together ("shots" / "scenes")
- blending procedural motion with keyframed structure
- sequencing events reliably (no double-triggers, no race conditions)
- keeping things readable and maintainable

### 9.11.1 Layering: Timeline for Structure, Procedural for Life

A reliable pattern is:

- **Timeline:** controls the big structure (when things appear, when the camera moves, when a section starts/ends)
- **Procedural:** adds micro-motion (subtle noise, breathing, idle motion, wobble)

Example idea:

### 9.11.2 Shot-Based Timelines (Cinematic Organization)

Instead of one giant timeline track list, treat the timeline as a set of "shots":

- Shot 1: intro framing
- Shot 2: reveal
- Shot 3: close-up detail
- Shot 4: outro / logo

Each shot has:

- a start time, end time
- a camera pose
- a set of object visibility/alpha states

### 9.11.3 Animation Curves: Clamp Early, Map Late

If you see overshoot or sudden jumps, it's usually a range mismatch.

Good practice:

- normalize to 0..1 early
- clamp to 0..1 before sensitive operations
- map to target range at the end

Conceptually:

$t (0..1) \rightarrow \text{Clamp} \rightarrow \text{Ease} \rightarrow \text{Map (min..max)}$

### 9.11.4 Reusable "Rig" Pattern

For any object you animate often, create a mini rig:

- one Transform for position
- one Transform for rotation
- one Transform for scale
- optional "wobble" layer

This makes it easy to swap animation sources later without rewiring the whole patch.

## 9.11.5 Avoiding Jitter in Interactive Animation

If input is noisy (mouse, audio, sensors):

- map input into a safe range
- apply Smooth/Spring
- optionally add dead zones

Input -> Map -> Clamp -> Smooth -> Property

## 9.11.6 Choreographing Triggers Reliably

For sequences of actions:

- use Sequence for deterministic ordering
- use Delay for spacing
- use Interval for periodic triggers

The key is to avoid “implicit timing” where the order depends on frame timing.

## 9.12 Advanced Recipes

### 9.12.1 Recipe: Scroll-Driven Scene (Interactive Storytelling)

Use scroll position as a normalized progress value:

ScrollPosition -> Map (0..pageHeight -> 0..1) -> Clamp -> progress  
progress -> Ease -> Drive camera/object parameters

Then you can tie multiple properties to the same progress signal for a coherent experience.

### 9.12.2 Recipe: Beat-Synced Timeline Sections

Use BPM sync to trigger timeline jumps or section changes:

AudioFile -> BPMSync -> Beat trigger  
Beat trigger -> Sequence -> (advance state) -> set target animation values

### 9.12.3 Recipe: One-Shot “Punch” Animation (No Keyframes)

Great for UI hits, impacts, kick drums:

Trigger -> SetValue (1)  
-> Smooth (fast decay) -> scale/brightness

You can combine a fast rise + slower decay by chaining two Smooth ops with different parameters.

### 9.12.4 Recipe: Camera Rig (Orbit + Handheld Micro Motion)

Time -> Sin/Cos -> Orbit position  
Random (small) -> Smooth -> micro offset  
Add (orbit + micro) -> Camera position  
LookAt -> Camera aim

This produces camera movement that feels “alive” but still controlled.

## 9.13 Practical Examples

### 9.13.1 Example 1: Bouncing Ball

MainLoop  
BasicMaterial  
Time -> Sin -> Abs -> Y position  
Transform  
Circle

### 9.13.2 Example 2: Rotating Carousel

MainLoop  
Camera  
ArrayIterator (items)  
Time + (Index \* offset) -> Cos -> X position  
Time + (Index \* offset) -> Sin -> Z position  
Transform  
Item

### 9.13.3 Example 3: Fade In Sequence

```
MainLoop  
BasicMaterial  
ArrayIterator  
Time - (Index * staggerDelay) -> Clamp (0, 1) -> BasicMaterial  
(alpha input)  
Shape
```

### 9.13.4 Example 4: Timeline-Based Scene

```
Timeline  
+-- 0s: Camera position keyframe  
+-- 2s: Object appears (alpha 0->1)  
+-- 4s: Object rotates  
+-- 6s: Color change  
+-- 8s: Fade out
```

### 9.13.5 Example 5: Layered Animation Clips (Additive)

Create a character with multiple animation layers:

```
Base Position (0, 0, 0)  
Anim Clip "idleBreath" (vertical oscillation) -> Add  
Anim Clip "walkCycle" (horizontal movement, triggered) -> Add  
Anim Clip "jump" (vertical boost, triggered) -> Add  
Final Position -> Transform
```

**Setup:** 1. Create "idleBreath" clip: 2-second vertical sine wave (amplitude: 0.1)  
2. Create "walkCycle" clip: 1-second horizontal movement (0 to 1, repeat)  
3. Create "jump" clip: 0.5-second vertical boost (0 to 2, one-shot)  
4. Connect all three Anim ops to Add ops in sequence  
5. Trigger walkCycle and jump clips via user input

### 9.13.6 Example 6: Blended Animation Clips (Mixable)

Smooth transition between walk and run:

```
Walk Clip -> Anim (weight: 1.0 - runBlend)  
Run Clip -> Anim (weight: runBlend)  
Mix -> Final Position
```

**Setup:** 1. Create "walk" clip: slow horizontal movement  
2. Create "run" clip: fast horizontal movement  
3. Use a Smooth op to blend between 0 (walk) and 1 (run)  
4. Connect both clips to Mix op with blend factor

### 9.13.7 Example 7: Reusable Clip System

Create a library of reusable animation clips:

Clip Library:

- "fadeIn" (alpha 0->1, 1s, easeOut)
- "fadeOut" (alpha 1->0, 1s, easeIn)
- "bounce" (scale 1->1.2->1, 0.5s, easeOut)
- "slideInLeft" (x: -100->0, 1s, easeOut)
- "rotate360" (rotation 0->360, 2s, linear)

Apply to multiple objects:

Object 1: fadeIn at t=0s, bounce at t=2s  
Object 2: slideInLeft at t=1s, fadeOut at t=5s  
Object 3: rotate360 at t=3s (looping)

### 9.13.8 Example 8: JavaScript-Controlled Animation

Custom op that controls animation based on game state:

```
Game State -> Custom Op  
+-- State = "idle": Play "idle" clip  
+-- State = "walk": Play "walk" clip  
+-- State = "run": Play "run" clip  
+-- State = "jump": Play "jump" clip (one-shot)  
Selected Clip -> Anim -> Position
```

**Custom Op Code:**

```
const inState = op.inString("State", "idle");  
const inTime = op.inFloat("Time", 0);  
const outClipName = op.outString("Clip Name");  
const outValue = op.outNumber("Animation Value");  
  
let currentClip = null;  
  
inState.onChange = function() {
```

```

const state = inState.get();
switch(state) {
    case "idle":
        currentClip = "idle";
        break;
    case "walk":
        currentClip = "walk";
        break;
    case "run":
        currentClip = "run";
        break;
    case "jump":
        currentClip = "jump";
        break;
}
outClipName.set(currentClip);
};

inTime.onChange = function() {
    // Sample the current clip
    if (currentClip) {
        // Convention example: if you name your Anim ops predictably,
        // you can locate them.
        // (API availability may vary; treat as a pattern.)
        const animOp = op.patch.findOpByName ?
op.patch.findOpByName("Anim_" + currentClip) : null;
        if (animOp && animOp.outValue && typeof animOp.outValue.get
        === "function") {
            outValue.set(animOp.outValue.get());
        }
    }
};

```

## 9.13.9 Example 9: Physics + Animation Clip Hybrid

Combine procedural physics with keyframed animation:

```

Anim Clip "baseMotion" (keyframed path)
Add
Physics Force (gravity, wind) -> Integrate -> Add
Final Position

```

## Custom Op for Physics Integration:

```

const inAnimValue = op.inFloat("Animation Value", 0);
const inPhysicsForce = op.inFloat("Physics Force", 0);
const inDamping = op.inFloat("Damping", 0.95);
const inRender = op.inTrigger("Render");
const outCombined = op.outNumber("Combined Value");

let velocity = 0;
let position = 0;

inRender.onTriggered = function() {
    const delta = op.patch.timer.getDelta();
    const anim = inAnimValue.get();
    const force = inPhysicsForce.get();
    const damp = inDamping.get();

    // Update physics
    velocity += force * delta;
    velocity *= damp;
    position += velocity * delta;

    // Combine with animation
    outCombined.set(anim + position);
};

```

## 9.13.10 Example 10: Conditional Clip Playback

Play different clips based on conditions:

```

Condition A -> If (True: Clip A, False: Clip B)
Condition B -> If (True: Clip C, False: Clip D)
Mix (blend between conditional results)
Final Animation

```

## 9.14 Performance Tips

1. **Limit active animations** - Don't animate everything
2. **Use requestAnimationFrame** - Built into cables.gl
3. **Cache calculations** - Don't recalculate every frame
4. **Simplify when far** - Reduce animation complexity for distant objects
5. **Use GPU** - Animate in shaders when possible

## 9.15 Debugging Animation

### 9.15.1 Slow Motion

Time -> Multiply (0.1) -> SlowTime

### 9.15.2 Visualize Values

Add a DrawNumber op to see animated values in real-time.

### 9.15.3 Pause at Problem

Use timeline pause to inspect a specific frame.

## 9.16 Featured Videos

## 9.17 Exercises

### 9.17.1 Basic Animation

1. Create a loading animation with staggered dots
2. Build an interactive hover animation
3. Design a full intro sequence with timeline
4. Create a physics-based pendulum

### 9.17.2 Animation Clips

1. Create a reusable “bounce” clip and apply it to 5 different objects
2. Build a character animation system with 3 additive clips (idle, walk, jump)
3. Create a smooth walk-to-run transition using clip blending
4. Design a clip library with 5 common animations (fade, slide, scale, rotate, bounce)

### 9.17.3 JavaScript Integration

1. Build a custom op that generates a sine wave animation clip programmatically
2. Create an animation controller op with play/pause/stop/seek functionality
3. Design a custom op that blends two animation clips with a configurable blend factor
4. Build a state machine op that switches between different animation clips based on input

### 9.17.4 Advanced

1. Combine procedural animation (Time -> Sin) with a keyframed clip using additive blending
2. Create a custom easing function op and apply it to an animation clip
3. Build a system that plays different animation clips based on user interaction (mouse, keyboard, touch)
4. Design a complex scene with multiple objects, each using a combination of clips and procedural motion

# 10 Interfaces in Cables.gl

## 10.1 Introduction

Cables.gl provides multiple ways to create user interfaces for your patches. You can build interfaces using HTML and CSS for full customization, or use native Cables sidebar interface operators for quick, integrated controls. This chapter covers both approaches in detail.

## 10.2 Interface Approaches Overview

### INTERFACE OPTIONS

#### 1. HTML/CSS Interfaces

Full DOM control

Custom styling

Overlay on canvas

Complete flexibility

#### 2. Native Sidebar Interface Ops

Built-in UI elements

Integrated with patch

CSS-stylable

Quick to implement

## 10.3 HTML/CSS Interfaces

### 10.3.1 Overview

HTML/CSS interfaces give you complete control over the user interface. You can create custom overlays, forms, buttons, and any HTML element positioned over or alongside your canvas.

### 10.3.2 The HTML Op

The HTML op allows you to create and manipulate DOM elements directly within your patch.

#### Basic HTML Op Setup

##### HTML OP FLOW

MainLoop

HTML Op

```
+--> HTML Content (string)
+--> CSS Styles (string)
+--> Position (x, y)
+--> Size (width, height)
+--> Visibility (bool)
DOM Element (rendered on page)
```

### Creating a Simple HTML Interface

#### Step 1: Add HTML Op

1. Add a MainLoop op
2. Add an HTML op
3. Connect MainLoop -> HTML

#### Step 2: Define HTML Content

In the HTML op's "HTML" parameter, enter your HTML:

```
<div id="myInterface">
  <h1>My Interface</h1>
  <button id="myButton">Click Me</button>
  <input type="range" id="mySlider" min="0" max="100" value="50">
  <p id="myText">Value: <span id="valueDisplay">50</span></p>
</div>
```

#### Step 3: Add CSS Styling

In the HTML op's "CSS" parameter:

```
#myInterface {
  position: absolute;
  top: 20px;
  left: 20px;
  background: rgba(30, 30, 30, 0.9);
  padding: 20px;
  border-radius: 8px;
  color: white;
  font-family: Arial, sans-serif;
  z-index: 1000;
}
```

```

#myButton {
    background: #4a9eff;
    color: white;
    border: none;
    padding: 10px 20px;
    border-radius: 4px;
    cursor: pointer;
    font-size: 16px;
}

#myButton:hover {
    background: #5aaeff;
}

#mySlider {
    width: 200px;
    margin: 10px 0;
}

#myText {
    margin-top: 10px;
    font-size: 14px;
}

```

#### Step 4: Position the Interface

Set the HTML op's position parameters: - X: 0 (or desired x position) - Y: 0 (or desired y position) - Width: 300 - Height: 200

### 10.3.3 Connecting HTML to Patch Logic

#### Using JavaScript Custom Op for Interaction

To make HTML elements interactive with your patch, use a JavaScript custom op:

```

// Custom Op: HTML Controller
const inTrigger = op.inTrigger("Render");
const outSliderValue = op.outNumber("Slider Value");
const outButtonClicked = op.outTrigger("Button Clicked");

let sliderValue = 50;
let buttonClicked = false;

```

```

// Access DOM elements
op.onInit = function() {
    const slider = document.getElementById("mySlider");
    const button = document.getElementById("myButton");
    const display = document.getElementById("valueDisplay");

    if (slider) {
        slider.addEventListener("input", function(e) {
            sliderValue = parseFloat(e.target.value);
            if (display) {
                display.textContent = sliderValue;
            }
            outSliderValue.set(sliderValue);
        });
    }

    if (button) {
        button.addEventListener("click", function() {
            buttonClicked = true;
            outButtonClicked.trigger();
        });
    }
};

inTrigger.onTriggered = function() {
    outSliderValue.set(sliderValue);
    if (buttonClicked) {
        buttonClicked = false;
    }
};

```

#### Complete Example: Interactive Control Panel

INTERACTIVE SETUP  
MainLoop  
+-> HTML Op (UI elements)  
+-> Custom Op (JavaScript controller)  
+-> Reads DOM events  
+-> Outputs: Slider Value  
+-> Outputs: Button Trigger

+-> Outputs: Text Input  
Patch Logic (uses values)  
Visual Output (canvas)

### HTML Content:

```
<div id="controlPanel">
  <h2>Animation Controls</h2>

  <div class="control-group">
    <label>Speed:</label>
    <input type="range" id="speedSlider" min="0.1" max="5"
step="0.1" value="1">
    <span id="speedValue">1.0</span>
  </div>

  <div class="control-group">
    <label>Color:</label>
    <input type="color" id="colorPicker" value="#4a9eff">
  </div>

  <div class="control-group">
    <label>Mode:</label>
    <select id="modeSelect">
      <option value="normal">Normal</option>
      <option value="fast">Fast</option>
      <option value="slow">Slow</option>
    </select>
  </div>

  <button id="resetButton">Reset</button>
  <button id="playButton">Play/Pause</button>
</div>
```

### CSS Styling:

```
#controlPanel {
  position: fixed;
  top: 20px;
  right: 20px;
  width: 280px;
```

```
background: linear-gradient(135deg, #1e1e1e 0%, #2d2d2d 100%);
padding: 24px;
border-radius: 12px;
box-shadow: 0 8px 32px rgba(0, 0, 0, 0.4);
border: 1px solid rgba(255, 255, 255, 0.1);
font-family: 'Segoe UI', Tahoma, Geneva, Verdana, sans-serif;
z-index: 1000;
}

#controlPanel h2 {
  margin: 0 0 20px 0;
  color: #ffffff;
  font-size: 20px;
  font-weight: 600;
  border-bottom: 2px solid #4a9eff;
  padding-bottom: 10px;
}

.control-group {
  margin-bottom: 20px;
}

.control-group label {
  display: block;
  color: #b0b0b0;
  font-size: 14px;
  margin-bottom: 8px;
  font-weight: 500;
}

#speedSlider {
  width: 100%;
  height: 6px;
  border-radius: 3px;
  background: #3a3a3a;
  outline: none;
  -webkit-appearance: none;
}

#speedSlider::-webkit-slider-thumb {
  -webkit-appearance: none;
  appearance: none;
```

```

width: 18px;
height: 18px;
border-radius: 50%;
background: #4a9eff;
cursor: pointer;
box-shadow: 0 2px 4px rgba(0, 0, 0, 0.3);
}

#speedSlider::-moz-range-thumb {
    width: 18px;
    height: 18px;
    border-radius: 50%;
    background: #4a9eff;
    cursor: pointer;
    border: none;
    box-shadow: 0 2px 4px rgba(0, 0, 0, 0.3);
}

#speedValue {
    color: #4a9eff;
    font-weight: 600;
    margin-left: 10px;
}

#colorPicker {
    width: 100%;
    height: 40px;
    border: 2px solid #3a3a3a;
    border-radius: 6px;
    cursor: pointer;
    background: transparent;
}

#modeSelect {
    width: 100%;
    padding: 10px;
    background: #3a3a3a;
    color: #ffffff;
    border: 2px solid #3a3a3a;
    border-radius: 6px;
    font-size: 14px;
    cursor: pointer;
}

```

```

}

#modeSelect:hover {
    border-color: #4a9eff;
}

#modeSelect:focus {
    outline: none;
    border-color: #4a9eff;
}

button {
    width: 100%;
    padding: 12px;
    margin-top: 10px;
    background: #4a9eff;
    color: white;
    border: none;
    border-radius: 6px;
    font-size: 14px;
    font-weight: 600;
    cursor: pointer;
    transition: all 0.2s ease;
}

button:hover {
    background: #5aaeff;
    transform: translateY(-1px);
    box-shadow: 0 4px 12px rgba(74, 158, 255, 0.3);
}

button:active {
    transform: translateY(0);
}

```

## 10.3.4 Advanced HTML Interface Patterns

### Pattern 1: Responsive Overlay

```

#myInterface {
    position: fixed;
    top: 0;
}

```

```

left: 0;
width: 100vw;
height: 100vh;
background: rgba(0, 0, 0, 0.8);
display: flex;
align-items: center;
justify-content: center;
z-index: 10000;
}

#myInterface .content {
  background: #2d2d2d;
  padding: 40px;
  border-radius: 12px;
  max-width: 500px;
  width: 90%;
}

```

## Pattern 2: Sidebar Panel

```

#sidebar {
  position: fixed;
  top: 0;
  right: 0;
  width: 300px;
  height: 100vh;
  background: #1e1e1e;
  box-shadow: -4px 0 16px rgba(0, 0, 0, 0.3);
  padding: 20px;
  overflow-y: auto;
  z-index: 1000;
  transform: translateX(0);
  transition: transform 0.3s ease;
}

#sidebar.hidden {
  transform: translateX(100%);
}

```

## Pattern 3: HUD (Heads-Up Display)

```

#hud {
  position: fixed;
  top: 0;
  left: 0;
  width: 100%;
  height: 100%;
  pointer-events: none;
  z-index: 100;
}

#hud .info {
  position: absolute;
  top: 20px;
  left: 20px;
  color: white;
  font-family: monospace;
  font-size: 14px;
  text-shadow: 2px 2px 4px rgba(0, 0, 0, 0.8);
}

#hud .crosshair {
  position: absolute;
  top: 50%;
  left: 50%;
  transform: translate(-50%, -50%);
  width: 20px;
  height: 20px;
  border: 2px solid rgba(255, 255, 255, 0.5);
  border-radius: 50%;
}

```

## 10.4 Native Sidebar Interface Ops

### 10.4.1 Overview

Cables.gl provides native interface operators that create UI elements directly in the sidebar. These are faster to set up and integrate seamlessly with the patch system.

## 10.4.2 Available Interface Ops

### NATIVE INTERFACE OPS

- Slider - Numeric input with range
- Button - Clickable trigger
- Toggle - Boolean on/off switch
- Text Input - String input field
- Color Picker - Color selection
- Dropdown - Selection from options
- Number Input - Direct numeric input
- Text Display - Display text/values

## 10.4.3 Basic Interface Op Setup

### Example: Simple Control Panel

```
SIDE BAR INTERFACE
Slider Op (Speed)
+--> Min: 0.1
+--> Max: 5.0
+--> Default: 1.0
+--> Output: Speed Value
Patch Logic
Button Op (Reset)
+--> Output: Trigger
Reset Logic
Toggle Op (Enabled)
+--> Output: Boolean
Conditional Logic
```

## Step-by-Step: Creating a Sidebar Interface

### Step 1: Add Interface Ops

1. Add a Slider op for speed control
2. Add a Button op for actions
3. Add a Toggle op for enable/disable
4. Add a ColorPicker op for color selection

### Step 2: Configure Each Op

**Slider Op:** - Name: "Speed" - Min: 0.1 - Max: 5.0 - Default: 1.0 - Step: 0.1

**Button Op:** - Name: "Reset" - Label: "Reset Animation"

**Toggle Op:** - Name: "Enabled" - Default: true

**ColorPicker Op:** - Name: "Base Color" - Default: #4a9eff

### Step 3: Connect to Patch

```
Speed Slider -> Multiply -> Animation Speed
Reset Button -> SetValue -> Reset Position
Enabled Toggle -> If -> Conditional Execution
ColorPicker -> SetColor -> Material Color
```

## 10.4.4 Styling Native Sidebar with CSS

This is a powerful technique that allows you to customize the appearance of native sidebar interface ops using CSS.

### Understanding the Sidebar Structure

The sidebar interface ops render in a specific DOM structure that you can target with CSS:

```
SIDE BAR DOM STRUCTURE
<div class="cables-sidebar">
  <div class="cables-sidebar-content">
    <div class="cables-op-slider" data-op-name="Speed">
      <label>Speed</label>
      <input type="range" ...>
      <span class="value">1.0</span>
    </div>
    <div class="cables-op-button" data-op-name="Reset">
      <button>Reset</button>
    </div>
    ...
  </div>
</div>
```

### Method 1: Global CSS Injection

Use an HTML op to inject CSS that styles the entire sidebar:

#### HTML Op Setup:

```
<style id="sidebar-styles">
/* Sidebar styling will go here */
</style>
```

## CSS Content:

```
/* Target the entire sidebar */
.cables-sidebar {
    background: linear-gradient(180deg, #1a1a1a 0%, #2d2d2d 100%);
    border-left: 2px solid #4a9eff;
}

/* Style all interface ops */
.cables-sidebar-content > div {
    background: rgba(255, 255, 255, 0.05);
    border-radius: 8px;
    padding: 16px;
    margin-bottom: 12px;
    border: 1px solid rgba(255, 255, 255, 0.1);
    transition: all 0.2s ease;
}

.cables-sidebar-content > div:hover {
    background: rgba(255, 255, 255, 0.08);
    border-color: #4a9eff;
}

/* Style slider ops specifically */
.cables-op-slider {
    /* Custom slider container */
}

.cables-op-slider label {
    color: #b0b0b0;
    font-size: 14px;
    font-weight: 500;
    margin-bottom: 8px;
    display: block;
    text-transform: uppercase;
    letter-spacing: 0.5px;
}
```

```
.cables-op-slider input[type="range"] {
    width: 100%;
    height: 6px;
    border-radius: 3px;
    background: #3a3a3a;
    outline: none;
    -webkit-appearance: none;
    margin: 10px 0;
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb {
    -webkit-appearance: none;
    appearance: none;
    width: 20px;
    height: 20px;
    border-radius: 50%;
    background: #4a9eff;
    cursor: pointer;
    box-shadow: 0 2px 8px rgba(74, 158, 255, 0.4);
    transition: all 0.2s ease;
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb:hover {
    background: #5aaeff;
    transform: scale(1.1);
    box-shadow: 0 4px 12px rgba(74, 158, 255, 0.6);
}

.cables-op-slider input[type="range"]::-moz-range-thumb {
    width: 20px;
    height: 20px;
    border-radius: 50%;
    background: #4a9eff;
    cursor: pointer;
    border: none;
    box-shadow: 0 2px 8px rgba(74, 158, 255, 0.4);
}

.cables-op-slider .value {
    color: #4a9eff;
    font-weight: 600;
```

```

font-size: 16px;
float: right;
margin-top: -24px;
}

/* Style button ops */
.cables-op-button button {
  width: 100%;
  padding: 12px 24px;
  background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
  color: white;
  border: none;
  border-radius: 6px;
  font-size: 14px;
  font-weight: 600;
  cursor: pointer;
  transition: all 0.2s ease;
  text-transform: uppercase;
  letter-spacing: 1px;
  box-shadow: 0 4px 12px rgba(74, 158, 255, 0.3);
}

.cables-op-button button:hover {
  background: linear-gradient(135deg, #5aaeff 0%, #4a9eff 100%);
  transform: translateY(-2px);
  box-shadow: 0 6px 16px rgba(74, 158, 255, 0.4);
}

.cables-op-button button:active {
  transform: translateY(0);
  box-shadow: 0 2px 8px rgba(74, 158, 255, 0.3);
}

/* Style toggle ops */
.cables-op-toggle {
  display: flex;
  align-items: center;
  justify-content: space-between;
}

.cables-op-toggle label {
  color: #b0b0b0;
}

```

```

font-size: 14px;
font-weight: 500;
}

.cables-op-toggle input[type="checkbox"] {
  width: 50px;
  height: 26px;
  -webkit-appearance: none;
  appearance: none;
  background: #3a3a3a;
  border-radius: 13px;
  position: relative;
  cursor: pointer;
  transition: background 0.3s ease;
  border: 2px solid #2a2a2a;
}

.cables-op-toggle input[type="checkbox"]:checked {
  background: #4a9eff;
  border-color: #4a9eff;
}

.cables-op-toggle input[type="checkbox"]::before {
  content: '';
  position: absolute;
  width: 20px;
  height: 20px;
  border-radius: 50%;
  background: white;
  top: 1px;
  left: 1px;
  transition: transform 0.3s ease;
  box-shadow: 0 2px 4px rgba(0, 0, 0, 0.3);
}

.cables-op-toggle input[type="checkbox"]:checked::before {
  transform: translateX(24px);
}

/* Style color picker ops */
.cables-op-colorpicker {
  display: flex;

```

```

align-items: center;
gap: 12px;
}

.cables-op-colorpicker label {
  color: #b0b0b0;
  font-size: 14px;
  font-weight: 500;
  flex: 1;
}

.cables-op-colorpicker input[type="color"] {
  width: 60px;
  height: 40px;
  border: 2px solid #3a3a3a;
  border-radius: 6px;
  cursor: pointer;
  background: transparent;
  transition: border-color 0.2s ease;
}

.cables-op-colorpicker input[type="color"]:hover {
  border-color: #4a9eff;
}

/* Style text input ops */
.cables-op-textinput input[type="text"] {
  width: 100%;
  padding: 10px 12px;
  background: #3a3a3a;
  color: #ffffff;
  border: 2px solid #3a3a3a;
  border-radius: 6px;
  font-size: 14px;
  transition: all 0.2s ease;
}

.cables-op-textinput input[type="text"]:focus {
  outline: none;
  border-color: #4a9eff;
  background: #404040;
  box-shadow: 0 0 0 3px rgba(74, 158, 255, 0.1);
}

```

```

}

/* Style dropdown ops */
.cables-op-dropdown select {
  width: 100%;
  padding: 10px 12px;
  background: #3a3a3a;
  color: #ffffff;
  border: 2px solid #3a3a3a;
  border-radius: 6px;
  font-size: 14px;
  cursor: pointer;
  transition: all 0.2s ease;
}

.cables-op-dropdown select:hover {
  border-color: #4a9eff;
}

.cables-op-dropdown select:focus {
  outline: none;
  border-color: #4a9eff;
  box-shadow: 0 0 0 3px rgba(74, 158, 255, 0.1);
}

```

## Method 2: Targeted Op Styling

Style specific ops by their data attributes:

```

/* Style a specific slider by op name */
.cables-op-slider[data-op-name="Speed"] {
  background: rgba(74, 158, 255, 0.1);
  border: 2px solid #4a9eff;
}

.cables-op-slider[data-op-name="Speed"] label {
  color: #4a9eff;
  font-weight: 600;
}

/* Style a specific button */

```

```

.cables-op-button[data-op-name="Reset"] button {
    background: linear-gradient(135deg, #ff4a4a 0%, #ef3a3a 100%);
}

.cables-op-button[data-op-name="Reset"] button:hover {
    background: linear-gradient(135deg, #ff5a5a 0%, #ff4a4a 100%);
}

```

### Method 3: Dynamic CSS with JavaScript Custom Op

Create a custom op that injects CSS based on patch state:

```

// Custom Op: Dynamic Sidebar Styling
const inTheme = op.inSwitch("Theme", ["dark", "light", "neon"], "dark");
const inAccentColor = op.inString("Accent Color", "#4a9eff");

let currentTheme = "dark";
let currentAccent = "#4a9eff";

function updateStyles() {
    const theme = inTheme.get();
    const accent = inAccentColor.get();

    if (theme === currentTheme && accent === currentAccent) return;

    currentTheme = theme;
    currentAccent = accent;

    let styleElement =
document.getElementById("dynamic-sidebar-styles");
    if (!styleElement) {
        styleElement = document.createElement("style");
        styleElement.id = "dynamic-sidebar-styles";
        document.head.appendChild(styleElement);
    }

    let css = "";

    if (theme === "dark") {
        css = `

.cables-op-button[data-op-name="Reset"] button {
    background: linear-gradient(135deg, #ff4a4a 0%, #ef3a3a 100%);
}

.cables-op-button[data-op-name="Reset"] button:hover {
    background: linear-gradient(135deg, #ff5a5a 0%, #ff4a4a 100%);
}

```

```

.cables-sidebar {
    background: linear-gradient(180deg, #1a1a1a 0%, #2d2d2d 100%);
}
.cables-sidebar-content > div {
    background: rgba(255, 255, 255, 0.05);
    border-color: rgba(255, 255, 255, 0.1);
}
;
} else if (theme === "light") {
    css = `

.cables-sidebar {
    background: linear-gradient(180deg, #f5f5f5 0%, #e0e0e0 100%);
}
.cables-sidebar-content > div {
    background: rgba(0, 0, 0, 0.05);
    border-color: rgba(0, 0, 0, 0.1);
}
.cables-op-slider label,
.cables-op-button label {
    color: #333;
}
`;
} else if (theme === "neon") {
    css = `

.cables-sidebar {
    background: #0a0a0a;
    border-left: 2px solid ${accent};
    box-shadow: -4px 0 20px ${accent}40;
}
.cables-sidebar-content > div {
    background: rgba(0, 0, 0, 0.5);
    border: 1px solid ${accent}40;
    box-shadow: 0 0 10px ${accent}20;
}
`;
}

// Apply accent color
css += `

.cables-op-slider input[type="range"]::-webkit-slider-thumb {

```

```

background: ${accent};
box-shadow: 0 2px 8px ${accent}60;
}
.cables-op-button button {
    background: linear-gradient(135deg, ${accent} 0%,
${adjustBrightness(accent, -20)} 100%);
}
.cables-op-toggle input[type="checkbox"]:checked {
    background: ${accent};
}
`;
}

styleElement.textContent = css;
}

function adjustBrightness(color, percent) {
    // Simple brightness adjustment (simplified)
    const num = parseInt(color.replace("#", ""), 16);
    const r = Math.max(0, Math.min(255, (num >> 16) + percent));
    const g = Math.max(0, Math.min(255, ((num >> 8) & 0x00FF) +
percent));
    const b = Math.max(0, Math.min(255, (num & 0x0000FF) + percent));
    return "#" + ((r << 16) | (g << 8) | b).toString(16).padStart(6, "0");
}

inTheme.onChange = updateStyles;
inAccentColor.onChange = updateStyles;

op.onInit = function() {
    updateStyles();
};

```

#### 10.4.5 Complete Styling Example: Professional Control Panel

Here's a complete example that styles all interface ops with a cohesive, professional design:

##### HTML Op (CSS Injection):

```
<style id="professional-sidebar-styles">
/* Professional Sidebar Styling */
```

```

/* Sidebar Container */
.cables-sidebar {
    background: linear-gradient(180deg,
        #1a1a1a 0%,
        #1e1e1e 50%,
        #2d2d2d 100%);
    border-left: 3px solid #4a9eff;
    box-shadow: -4px 0 24px rgba(0, 0, 0, 0.5);
    font-family: 'Inter', 'Segoe UI', system-ui, sans-serif;
}

/* Sidebar Header (if exists) */
.cables-sidebar-header {
    padding: 20px;
    border-bottom: 2px solid rgba(74, 158, 255, 0.2);
    background: rgba(74, 158, 255, 0.05);
}

.cables-sidebar-header h2 {
    margin: 0;
    color: #ffffff;
    font-size: 18px;
    font-weight: 600;
    text-transform: uppercase;
    letter-spacing: 1px;
}

/* Content Container */
.cables-sidebar-content {
    padding: 16px;
}

/* All Interface Op Containers */
.cables-sidebar-content > div {
    background: rgba(255, 255, 255, 0.03);
    border: 1px solid rgba(255, 255, 255, 0.08);
    border-radius: 10px;
    padding: 18px;
    margin-bottom: 16px;
    transition: all 0.3s cubic-bezier(0.4, 0, 0.2, 1);
    position: relative;
}
```

```

        overflow: hidden;
    }

.cables-sidebar-content > div::before {
    content: '';
    position: absolute;
    top: 0;
    left: 0;
    width: 100%;
    height: 2px;
    background: linear-gradient(90deg,
        transparent 0%,
        #4a9eff 50%,
        transparent 100%);
    opacity: 0;
    transition: opacity 0.3s ease;
}

.cables-sidebar-content > div:hover {
    background: rgba(255, 255, 255, 0.06);
    border-color: rgba(74, 158, 255, 0.3);
    transform: translateX(4px);
    box-shadow: 0 4px 16px rgba(0, 0, 0, 0.3);
}

.cables-sidebar-content > div:hover::before {
    opacity: 1;
}

/* Slider Styling */
.cables-op-slider label {
    display: block;
    color: #b0b0b0;
    font-size: 12px;
    font-weight: 600;
    margin-bottom: 10px;
    text-transform: uppercase;
    letter-spacing: 0.5px;
}

.cables-op-slider input[type="range"] {
    width: 100%;

```

```

    height: 8px;
    border-radius: 4px;
    background: linear-gradient(90deg,
        #2a2a2a 0%,
        #3a3a3a 100%);
    outline: none;
    -webkit-appearance: none;
    margin: 12px 0;
    position: relative;
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb {
    -webkit-appearance: none;
    appearance: none;
    width: 24px;
    height: 24px;
    border-radius: 50%;
    background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
    cursor: pointer;
    box-shadow:
        0 2px 8px rgba(74, 158, 255, 0.4),
        0 0 0 4px rgba(74, 158, 255, 0.1),
        inset 0 1px 0 rgba(255, 255, 255, 0.2);
    transition: all 0.2s ease;
    border: 2px solid rgba(255, 255, 255, 0.1);
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb:hover {
    background: linear-gradient(135deg, #5aaeff 0%, #4a9eff 100%);
    transform: scale(1.15);
    box-shadow:
        0 4px 12px rgba(74, 158, 255, 0.6),
        0 0 0 6px rgba(74, 158, 255, 0.15),
        inset 0 1px 0 rgba(255, 255, 255, 0.3);
}

.cables-op-slider input[type="range"]::-webkit-slider-thumb:active {
    transform: scale(1.05);
}

.cables-op-slider input[type="range"]::-moz-range-thumb {
    width: 24px;

```

```

height: 24px;
border-radius: 50%;
background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
cursor: pointer;
border: 2px solid rgba(255, 255, 255, 0.1);
box-shadow:
  0 2px 8px rgba(74, 158, 255, 0.4),
  0 0 4px rgba(74, 158, 255, 0.1);
}

.cables-op-slider .value {
  color: #4a9eff;
  font-weight: 700;
  font-size: 18px;
  float: right;
  margin-top: -32px;
  font-variant-numeric: tabular-nums;
  text-shadow: 0 0 8px rgba(74, 158, 255, 0.5);
}

/* Button Styling */
.cables-op-button button {
  width: 100%;
  padding: 14px 24px;
  background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
  color: white;
  border: none;
  border-radius: 8px;
  font-size: 14px;
  font-weight: 600;
  cursor: pointer;
  transition: all 0.3s cubic-bezier(0.4, 0, 0.2, 1);
  text-transform: uppercase;
  letter-spacing: 1.2px;
  box-shadow:
    0 4px 12px rgba(74, 158, 255, 0.3),
    inset 0 1px 0 rgba(255, 255, 255, 0.2);
  position: relative;
  overflow: hidden;
}

.cables-op-button button::before {

```

```

  content: '';
  position: absolute;
  top: 50%;
  left: 50%;
  width: 0;
  height: 0;
  border-radius: 50%;
  background: rgba(255, 255, 255, 0.3);
  transform: translate(-50%, -50%);
  transition: width 0.6s, height 0.6s;
}

.cables-op-button button:hover {
  background: linear-gradient(135deg, #5aaeff 0%, #4a9eff 100%);
  transform: translateY(-2px);
  box-shadow:
    0 6px 20px rgba(74, 158, 255, 0.4),
    inset 0 1px 0 rgba(255, 255, 255, 0.3);
}

.cables-op-button button:hover::before {
  width: 300px;
  height: 300px;
}

.cables-op-button button:active {
  transform: translateY(0);
  box-shadow:
    0 2px 8px rgba(74, 158, 255, 0.3),
    inset 0 1px 0 rgba(255, 255, 255, 0.1);
}

/* Toggle Styling */
.cables-op-toggle {
  display: flex;
  align-items: center;
  justify-content: space-between;
}

.cables-op-toggle label {
  color: #b0b0b0;
  font-size: 14px;
}
```

```

font-weight: 500;
flex: 1;
}

.cables-op-toggle input[type="checkbox"] {
  width: 56px;
  height: 30px;
  -webkit-appearance: none;
  appearance: none;
  background: #2a2a2a;
  border-radius: 15px;
  position: relative;
  cursor: pointer;
  transition: all 0.3s cubic-bezier(0.4, 0, 0.2, 1);
  border: 2px solid #1a1a1a;
  box-shadow: inset 0 2px 4px rgba(0, 0, 0, 0.3);
}

.cables-op-toggle input[type="checkbox"]:checked {
  background: linear-gradient(135deg, #4a9eff 0%, #3a8eef 100%);
  border-color: #4a9eff;
  box-shadow:
    inset 0 2px 4px rgba(0, 0, 0, 0.2),
    0 0 12px rgba(74, 158, 255, 0.4);
}

.cables-op-toggle input[type="checkbox"]::before {
  content: '';
  position: absolute;
  width: 24px;
  height: 24px;
  border-radius: 50%;
  background: linear-gradient(135deg, #ffffff 0%, #f0f0f0 100%);
  top: 1px;
  left: 1px;
  transition: transform 0.3s cubic-bezier(0.4, 0, 0.2, 1);
  box-shadow:
    0 2px 6px rgba(0, 0, 0, 0.3),
    inset 0 1px 0 rgba(255, 255, 255, 0.5);
}

.cables-op-toggle input[type="checkbox"]:checked::before {

```

```

  transform: translateX(26px);
}

/* Color Picker Styling */
.cables-op-colorpicker {
  display: flex;
  align-items: center;
  gap: 16px;
}

.cables-op-colorpicker label {
  color: #b0b0b0;
  font-size: 14px;
  font-weight: 500;
  flex: 1;
}

.cables-op-colorpicker input[type="color"] {
  width: 70px;
  height: 50px;
  border: 3px solid #3a3a3a;
  border-radius: 8px;
  cursor: pointer;
  background: transparent;
  transition: all 0.3s ease;
  box-shadow: 0 2px 8px rgba(0, 0, 0, 0.3);
}

.cables-op-colorpicker input[type="color"]:hover {
  border-color: #4a9eff;
  transform: scale(1.05);
  box-shadow:
    0 4px 12px rgba(0, 0, 0, 0.4),
    0 0 0 4px rgba(74, 158, 255, 0.1);
}

/* Text Input Styling */
.cables-op-textinput label {
  display: block;
  color: #b0b0b0;
  font-size: 12px;
  font-weight: 600;

```

```

margin-bottom: 8px;
text-transform: uppercase;
letter-spacing: 0.5px;
}

.cables-op-textinput input[type="text"] {
  width: 100%;
  padding: 12px 16px;
  background: #2a2a2a;
  color: #ffffff;
  border: 2px solid #3a3a3a;
  border-radius: 8px;
  font-size: 14px;
  transition: all 0.3s ease;
  box-sizing: border-box;
}

.cables-op-textinput input[type="text"]:focus {
  outline: none;
  border-color: #4a9eff;
  background: #333333;
  box-shadow:
    0 0 0 4px rgba(74, 158, 255, 0.1),
    inset 0 2px 4px rgba(0, 0, 0, 0.2);
}

/* Dropdown Styling */
.cables-op-dropdown label {
  display: block;
  color: #b0b0b0;
  font-size: 12px;
  font-weight: 600;
  margin-bottom: 8px;
  text-transform: uppercase;
  letter-spacing: 0.5px;
}

.cables-op-dropdown select {
  width: 100%;
  padding: 12px 16px;
  background: #2a2a2a;
  color: #ffffff;
}

```

```

border: 2px solid #3a3a3a;
border-radius: 8px;
font-size: 14px;
cursor: pointer;
transition: all 0.3s ease;
appearance: none;
background-image: url("data:image/svg+xml,%3Csvg
xmlns='http://www.w3.org/2000/svg' width='12' height='12' viewBox='0
0 12 12'%3E%3Cpath fill='%234a9eff' d='M6 9L1 4h10z'/%3E%3C/svg%3E");
background-repeat: no-repeat;
background-position: right 12px center;
padding-right: 40px;
}

.cables-op-dropdown select:hover {
  border-color: #4a9eff;
  background-color: #333333;
}

.cables-op-dropdown select:focus {
  outline: none;
  border-color: #4a9eff;
  box-shadow:
    0 0 0 4px rgba(74, 158, 255, 0.1),
    inset 0 2px 4px rgba(0, 0, 0, 0.2);
}

/* Number Input Styling */
.cables-op-numberinput {
  display: flex;
  align-items: center;
  gap: 12px;
}

.cables-op-numberinput label {
  color: #b0b0b0;
  font-size: 14px;
  font-weight: 500;
  flex: 1;
}

.cables-op-numberinput input[type="number"] {

```

```

width: 100px;
padding: 10px 12px;
background: #2a2a2a;
color: #ffffff;
border: 2px solid #3a3a3a;
border-radius: 6px;
font-size: 14px;
text-align: center;
transition: all 0.3s ease;
}

.cables-op-numberinput input[type="number"]:focus {
outline: none;
border-color: #4a9eff;
background: #333333;
box-shadow: 0 0 0 3px rgba(74, 158, 255, 0.1);
}

/* Text Display Styling */
.cables-op-textdisplay {
padding: 12px;
background: rgba(74, 158, 255, 0.1);
border: 1px solid rgba(74, 158, 255, 0.3);
border-radius: 6px;
color: #4a9eff;
font-family: 'Courier New', monospace;
font-size: 14px;
text-align: center;
font-weight: 600;
}

/* Responsive adjustments */
@media (max-width: 768px) {
.cables-sidebar {
width: 100% !important;
height: auto !important;
position: relative !important;
}
}
</style>

```

## 10.4.6 Advanced CSS Techniques

### Technique 1: Animated Transitions

```

.cables-sidebar-content > div {
    animation: slideIn 0.3s ease-out;
}

@keyframes slideIn {
    from {
        opacity: 0;
        transform: translateX(-20px);
    }
    to {
        opacity: 1;
        transform: translateX(0);
    }
}

/* Stagger animation delays */
.cables-sidebar-content > div:nth-child(1) { animation-delay: 0.05s; }
.cables-sidebar-content > div:nth-child(2) { animation-delay: 0.10s; }
.cables-sidebar-content > div:nth-child(3) { animation-delay: 0.15s; }
.cables-sidebar-content > div:nth-child(4) { animation-delay: 0.20s; }

```

### Technique 2: Custom Scrollbar

```

.cables-sidebar-content::-webkit-scrollbar {
    width: 8px;
}

.cables-sidebar-content::-webkit-scrollbar-track {
    background: #1a1a1a;
    border-radius: 4px;
}

.cables-sidebar-content::-webkit-scrollbar-thumb {
    background: #4a9eff;
}

```

```

border-radius: 4px;
border: 2px solid #1a1a1a;
}

.cables-sidebar-content::-webkit-scrollbar-thumb:hover {
  background: #5aaeff;
}

```

### Technique 3: Glassmorphism Effect

```

.cables-sidebar {
  background: rgba(30, 30, 30, 0.7);
  backdrop-filter: blur(20px);
  -webkit-backdrop-filter: blur(20px);
  border-left: 1px solid rgba(255, 255, 255, 0.1);
}

.cables-sidebar-content > div {
  background: rgba(255, 255, 255, 0.05);
  backdrop-filter: blur(10px);
  -webkit-backdrop-filter: blur(10px);
  border: 1px solid rgba(255, 255, 255, 0.1);
}

```

## 10.5 Combining HTML and Native Interfaces

You can combine both approaches for maximum flexibility:

### HYBRID INTERFACE APPROACH

- Native Sidebar Ops
- +--> Quick controls (sliders, buttons)
- +--> Styled with CSS
- HTML Overlay
- +--> Complex UI elements
- +--> Custom layouts
- +--> Interactive components
- JavaScript Custom Op
- +--> Bridges both systems
- +--> Syncs values
- +--> Handles interactions

## 10.6 Best Practices

### 10.6.1 1. Performance

- **Minimize DOM Manipulation:** Cache element references
- **Use CSS Transforms:** For animations instead of position changes
- **Debounce Inputs:** For sliders and text inputs that trigger heavy computations

### 10.6.2 2. Accessibility

- **Labels:** Always provide clear labels for controls
- **Keyboard Navigation:** Ensure keyboard accessibility
- **Color Contrast:** Maintain sufficient contrast ratios
- **Focus States:** Provide visible focus indicators

### 10.6.3 3. Responsive Design

```

/* Mobile-first approach */
.cables-sidebar {
  width: 100%;
  height: auto;
  position: relative;
}

@media (min-width: 768px) {
  .cables-sidebar {
    width: 320px;
    height: 100vh;
    position: fixed;
  }
}

```

### 10.6.4 4. Organization

- **Group Related Controls:** Use visual grouping
- **Clear Hierarchy:** Use size, color, and spacing
- **Consistent Spacing:** Maintain uniform margins and padding

## 10.7 Practical Examples

### 10.7.1 Example 1: Animation Control Panel

Create a comprehensive control panel for animation parameters:

```
Speed Slider -> Animation Speed
Color Picker -> Material Color
Toggle (Loop) -> Loop Animation
Button (Reset) -> Reset Animation
Text Display -> Current Frame
```

### 10.7.2 Example 2: Game UI Overlay

HTML overlay for game-like interface:

```
<div id="gameUI">
  <div class="hud-top">
    <div class="score">Score: <span id="score">0</span></div>
    <div class="health">Health: <span id="health">100</span></div>
  </div>
  <div class="hud-bottom">
    <button id="pauseBtn">Pause</button>
    <button id="menuBtn">Menu</button>
  </div>
</div>
```

### 10.7.3 Example 3: Data Visualization Dashboard

Combine native ops with HTML for a data dashboard:

- Native sliders for filtering
- HTML charts and graphs
- Real-time data display

## 10.8 Debugging Interface Issues

### 10.8.1 Common Issues

#### 1. CSS Not Applying

- Check selector specificity
- Verify CSS is injected after sidebar renders
- Use !important sparingly

#### 2. Elements Not Visible

- Check z-index values
- Verify position properties
- Check for overflow: hidden

#### 3. Events Not Firing

- Ensure JavaScript runs after DOM is ready
- Check event listener attachment
- Verify element selectors

### 10.8.2 Debugging Tools

```
// Log sidebar structure
console.log(document.querySelector('.cables-sidebar'));

// Check computed styles
const element = document.querySelector('.cables-op-slider');
console.log(window.getComputedStyle(element));

// Monitor style changes
const observer = new MutationObserver((mutations) => {
  console.log('DOM changed:', mutations);
});
observer.observe(document.querySelector('.cables-sidebar'), {
  childList: true,
  subtree: true,
  attributes: true
});
```

## 10.9 Exercises

1. **Basic HTML Interface:** Create a simple HTML overlay with a button and slider that control patch parameters
2. **Styled Sidebar:** Style native sidebar ops with a cohesive color scheme and modern design
3. **Responsive Panel:** Create a sidebar that adapts to different screen sizes

4. **Interactive Dashboard:** Build a complete control panel combining HTML and native ops
5. **Theme Switcher:** Create a custom op that dynamically changes sidebar styling based on user selection
6. **Advanced Styling:** Implement glassmorphism or other modern design trends in your sidebar

# 11 Export & Deployment in Cables.gl

## 11.1 Introduction

Once you've created your cables.gl project, you'll want to share it with the world. This chapter covers all the ways to export and deploy your creations.

## 11.2 Export Options

### 11.2.1 1. Public Patch Link

The simplest way to share - just make your patch public and share the URL.

**Pros:** - Instant sharing - Always up-to-date - No hosting needed

**Cons:** - Requires internet - Cables.gl branding - Limited customization

### 11.2.2 2. Embedded iframe

Embed your patch in any website:

```
<iframe  
    src="https://cables.gl/view/YOUR_PATCH_ID"  
    width="800"  
    height="600"  
    frameborder="0"  
    allowfullscreen>  
</iframe>
```

### 11.2.3 3. Standalone Export

Download your patch as a standalone web application.

**Includes:** - HTML file - JavaScript bundle - Assets (textures, models, audio) - No cables.gl dependency

### 11.2.4 4. npm Package Export

Export as an npm package for integration with other JavaScript projects.

## 11.3 Standalone Export Process

### 11.3.1 Step 1: Prepare Your Patch

1. Test thoroughly in the editor
2. Optimize assets (compress images, reduce model complexity)
3. Remove unused ops and connections
4. Set default camera/view position

### 11.3.2 Step 2: Export

1. Click the export/download button in the editor
2. Choose "Standalone" export
3. Configure options:
  - Include minified code
  - Include source maps (for debugging)
  - Asset optimization level

### 11.3.3 Step 3: Download

You'll receive a ZIP file containing:

```
exported-patch/
+-- index.html # Main HTML file
+-- js/
+-- cables.min.js # Cables runtime
+-- ops.js # Your patch's operators
+-- patch.js # Patch configuration
+-- assets/
+-- textures/ # Image files
+-- audio/ # Sound files
+-- models/ # 3D models
+-- css/
    +-- style.css # Optional styles
```

### 11.3.4 Step 4: Test Locally

```
# Using Python
python -m http.server 8000

# Using Node.js
npx --yes serve .
```

```
# Using PHP
php -S localhost:8000
```

Then open <http://localhost:8000> in your browser.

**Why this matters:** don't test an exported patch via `file:///...` (double-clicking `index.html`). Browsers block or restrict a bunch of features in that mode (fetching assets, some audio policies, etc.). A tiny local server makes your test match real deployment much more closely.

## 11.4 Customizing the Export

### 11.4.1 Custom HTML Template

```
<!DOCTYPE html>
<html>
<head>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width,
initial-scale=1">
  <title>My Cables Project</title>
  <style>
    body { margin: 0; overflow: hidden; }
    #cables-container { width: 100vw; height: 100vh; }
  </style>
</head>
<body>
  <div id="cables-container"></div>

  <script src="js/cables.min.js"></script>
  <script src="js/ops.js"></script>
  <script>
    CABLES.patch = new CABLES.Patch({
      patchFile: 'js/patch.js',
      prefixAssetPath: 'assets/',
      glCanvasId: 'cables-container',
      onFinishedLoading: function() {
        console.log('Patch loaded!');
      }
    });
  </script>
</body>
</html>
```

## 11.4.2 Configuration Options

```
new CABLES.Patch({
  patchFile: 'js/patch.js',
  prefixAssetPath: 'assets/',
  glCanvasId: 'myCanvas',
  glCanvasResizeToWindow: true,
  onFinishedLoading: callback,
  onError: errorCallback,
  variables: {
    // Pass custom variables to the patch
    customColor: '#ff0000',
    userName: 'Guest'
  }
});
```

## 11.5 Communicating with Your Patch

### 11.5.1 Setting Variables from JavaScript

```
// Get the patch instance
const patch = CABLES.patch;

// Set a variable
patch.setVariable('myValue', 42);
patch.setVariable('myColor', [1, 0, 0, 1]);
```

### 11.5.2 Getting Values from the Patch

```
// Get a variable
const value = patch.getVariable('myValue');

// Listen for variable changes
patch.on('variableChanged', function(name, value) {
  console.log(name, 'changed to', value);
});
```

### 11.5.3 Triggering Events

```
// Trigger an op
patch.getOpById('YOUR_OP_ID').trigger();

// Or use variables as triggers
patch.setVariable('doSomething', true);
```

## 11.6 Advanced Embedding & Integration

When cables.gl becomes part of a larger website/app, you want the embed to be **robust**:

- correct sizing and device pixel ratio handling
- pause/resume behavior when the tab is hidden
- a clean integration API (events in, telemetry out)
- predictable asset paths across dev/staging/prod

### 11.6.1 Responsive Canvas: Beyond Width/Height

If you embed into dynamic layouts (resizable panels, CSS grid, etc.), treat `resize` as a first-class event:

- call your `resize` function on load
- call it on `resize`
- call it when layout changes (route changes, UI toggles, etc.)

### 11.6.2 Pausing When Not Visible

For performance and battery life, consider pausing expensive animation when the page is hidden:

```
document.addEventListener("visibilitychange", () => {
  if (!window.CABLES || !CABLES.patch) return;
  // Depending on your patch/runtime, you may gate updates via a
  // variable:
  CABLES.patch.setVariable("isVisible", !document.hidden);
});
```

Then in your patch, use `isVisible` to reduce workload (lower particle count, skip effects, etc.).

## 11.6.3 postMessage Integration (iframe Control)

If you embed via iframe, postMessage is the clean way to send commands and data.

Parent page -> iframe:

```
const iframe = document.getElementById("cablesFrame");
const targetOrigin = new URL(iframe.src).origin; // avoid "*" in
// production
iframe.contentWindow.postMessage(
  { type: "CABLES_SET", name: "myValue", value: 0.75 },
  targetOrigin
);
```

Inside the exported patch wrapper page:

```
window.addEventListener("message", (event) => {
  // IMPORTANT: validate sender. In production, never blindly accept
  "*" messages.
  // Example:
  // if (event.origin !== "https://your-site.example") return;

  const msg = event.data;
  if (!msg || !window.CABLES || !CABLES.patch) return;

  if (msg.type === "CABLES_SET") {
    CABLES.patch.setVariable(msg.name, msg.value);
  }
});
```

**Tip:** treat postMessage payloads as an API. Version them ({ v: 1, type: ... }), validate types, and consider allowing only a small, explicit set of variable names you're willing to expose.

## 11.6.4 Environment-Specific Configuration (dev / test / prod)

Keep environment differences in **configuration**, not in the patch logic:

- dev: verbose logging, source maps, local asset path
- test/staging: production-like hosting + debug overlays
- prod: minified, caching enabled, stable URLs

Common patterns:

- query string flags: ?debug=1
- separate config.json loaded at runtime
- environment variables handled by the site that embeds the patch

## 11.6.5 Asset Path Gotchas

Most “works locally but not in prod” issues come down to:

- wrong prefixAssetPath
- case-sensitive paths on Linux hosts
- missing assets in the exported zip upload

If you deploy under a sub-path (e.g., <https://site.com/myproject/>), ensure all paths are relative or correctly prefixed.

## 11.7 Hosting Options

### 11.7.1 Static Hosting

Your exported patch is static files - host anywhere:

- **GitHub Pages** - Free, great for projects
- **Netlify** - Free tier, easy deployment
- **Vercel** - Free tier, automatic deploys
- **Amazon S3** - Scalable, pay-per-use
- **Any web server** - Apache, Nginx, etc.

### 11.7.2 GitHub Pages Deployment

```
# Create a gh-pages branch
git checkout -b gh-pages

# Add your exported files
git add .

git commit -m "Deploy cables patch"

# Push to GitHub
git push origin gh-pages
```

Enable GitHub Pages in repository settings.

### 11.7.3 Netlify Deployment

1. Connect your GitHub repository
2. Set build command: (none needed for static)
3. Set publish directory: / or your export folder
4. Deploy!

## 11.8 Embedding in Existing Websites

### 11.8.1 As a Background

```
<style>
  #cables-bg {
    position: fixed;
    top: 0;
    left: 0;
    width: 100%;
    height: 100%;
    z-index: -1;
  }
</style>
<canvas id="cables-bg"></canvas>
<script>
  CABLES.patch = new CABLES.Patch({
    patchFile: 'patch.js',
    glCanvasId: 'cables-bg'
  });
</script>
```

### 11.8.2 As a Hero Section

```
<section class="hero">
  <div id="cables-hero"></div>
  <div class="hero-content">
    <h1>Welcome</h1>
    <p>Your content here</p>
  </div>
</section>
```

### 11.8.3 Responsive Embedding

```
function resizeCables() {
  const container = document.getElementById('cables-container');
  container.style.width = window.innerWidth + 'px';
  container.style.height = window.innerHeight + 'px';

  // Notify cables of resize
  if (CABLES.patch) {
    CABLES.patch.cgl.setSize(window.innerWidth,
    window.innerHeight);
  }
}

window.addEventListener('resize', resizeCables);
resizeCables();
```

## 11.9 Performance Optimization

### 11.9.1 Before Export

1. **Remove unused ops** - Clean up your patch
2. **Optimize textures** - Use appropriate sizes
3. **Reduce polygon count** - Simplify 3D models
4. **Minimize audio files** - Compress audio

### 11.9.2 Asset Optimization

**Images:** - Use WebP format when possible - Use power-of-2 dimensions - Compress with tools like TinyPNG

**3D Models:** - Use glTF/GLB format - Remove unnecessary detail - Use Draco compression

**Audio:** - Use MP3 or OGG - Compress appropriately - Consider streaming for long files

### 11.9.3 Loading Optimization

```
// Show loading progress
CABLES.patch = new CABLES.Patch({
  patchFile: 'patch.js',
  onLoadingProgress: function(percent) {
```

```

        document.getElementById('loader').style.width = percent +
        '%';
    },
    onFinishedLoading: function() {
        document.getElementById('loader').style.display = 'none';
    }
});

```

## 11.10 Deployment Checklist (The Stuff That Breaks at the Worst Time)

Before you publish, run through this list:

- **Loading:** Do you show a loader/progress bar for heavy patches?
- **Autoplay policies:** If you use audio/video/webcam, do you require a user click?
- **Mobile sanity:** Does it run on a mid-tier phone without overheating?
- **Resize:** Does it handle orientation changes and dynamic layout resizing?
- **Asset paths:** Are all assets included and paths correct on a case-sensitive host?
- **Cache behavior:** Are you accidentally serving old JS after updates?
- **Console:** Is the browser console clean (no noisy logs, no repeated warnings)?

### 11.10.1 Cache Busting and Versioning

Static hosts cache aggressively. If you deploy a new version and still see the old one:

- add a version/hash to filenames (e.g. ops.v123.js)
- or configure cache headers (short cache for HTML, long cache for hashed assets)

### 11.10.2 MIME Types (Especially for Wasm / Binary Assets)

Some servers mis-serve file types. If a resource fails to load, check response headers:

- .wasm should be served as application/wasm
- .json as application/json
- textures as correct image mime types

## 11.10.3 CORS (Cross-Origin Assets)

If you load assets from another domain:

- ensure that server sends correct CORS headers
- prefer hosting assets alongside the patch when possible (simpler)

## 11.10.4 Content Security Policy (CSP)

If your patch is embedded into a site with strict CSP, you may need to allow:

- fetching assets from required domains
- media playback sources

When possible, avoid “unsafe-inline” and instead rely on your host app’s approved patterns.

## 11.11 CI/CD Ideas (Optional, But Great for Teams)

If you repeatedly export and deploy:

- treat the export zip as a build artifact
- deploy to staging on every change
- promote to prod when approved

Even a simple workflow that publishes static files to GitHub Pages can save time and reduce mistakes.

## 11.12 Offline/PWA

Make your patch work offline as a Progressive Web App:

### 11.12.1 manifest.json

```
{
  "name": "My Cables App",
  "short_name": "CablesApp",
  "start_url": "/",
  "display": "standalone",
  "background_color": "#000000",
  "theme_color": "#000000",
  "icons": [
    {
      "src": "icon-192.png",
      "sizes": "192x192",
    }
  ]
}
```

```

        "type": "image/png"
    },
    {
        "src": "icon-512.png",
        "sizes": "512x512",
        "type": "image/png"
    }
]
}

```

## 11.12.2 Service Worker

```

// sw.js
const CACHE_NAME = 'cables-app-v1';
const urlsToCache = [
    '/',
    '/index.html',
    '/js/cables.min.js',
    '/js/ops.js',
    '/js/patch.js',
    // Add your assets
];

self.addEventListener('install', event => {
    event.waitUntil(
        caches.open(CACHE_NAME)
            .then(cache => cache.addAll(urlsToCache))
    );
});

self.addEventListener('fetch', event => {
    event.respondWith(
        caches.match(event.request)
            .then(response => response || fetch(event.request))
    );
});

```

# 11.13 Electron Desktop Applications

For a truly native desktop experience, you can package your cables.gl export as an Electron application. Electron allows you to create cross-platform desktop apps using web technologies, perfect for distributing your cables.gl creations as standalone applications.

## 11.13.1 Why Electron?

**Advantages:** - Native desktop experience (menus, system tray, notifications) - Full file system access - Better performance control - No browser UI chrome - Can work offline completely - Access to native OS APIs - Professional distribution via installers

**Considerations:** - Larger app size (~100-200MB) - Requires code signing for distribution - More complex build process - Platform-specific considerations

## 11.13.2 Getting Started with Electron

### Project Structure

After exporting your cables.gl patch, set up an Electron project:

```

electron-app/
+-- package.json
+-- main.js # Main Electron process
+-- preload.js # Preload script (optional)
+-- renderer/
+-- index.html # Your exported cables HTML
+-- js/
+-- cables.min.js
+-- ops.js
+-- patch.js
+-- assets/ # Your exported assets
+-- assets/
+-- icon.ico # Windows icon
+-- icon.icns # macOS icon
+-- icon.png # Linux icon
+-- build/ # Build configuration
    +-- mac/
    +-- win/
    +-- linux/

```

## Initial Setup

### package.json:

```
{  
  "name": "my-cables-app",  
  "version": "1.0.0",  
  "description": "My Cables.gl Desktop App",  
  "main": "main.js",  
  "scripts": {  
    "start": "electron .",  
    "build": "electron-builder",  
    "build:mac": "electron-builder --mac",  
    "build:win": "electron-builder --win",  
    "build:linux": "electron-builder --linux"  
  },  
  "build": {  
    "appId": "com.yourcompany.cablesapp",  
    "productName": "My Cables App",  
    "directories": {  
      "output": "dist"  
    },  
    "files": [  
      "main.js",  
      "preload.js",  
      "renderer/**/*"  
    ],  
    "mac": {  
      "icon": "assets/icon.icns",  
      "category": "public.app-category.graphics-design"  
    },  
    "win": {  
      "icon": "assets/icon.ico",  
      "target": ["nsis", "portable"]  
    },  
    "linux": {  
      "icon": "assets/icon.png",  
      "target": ["AppImage", "deb"]  
    }  
  },  
  "devDependencies": {  
    "electron": "^28.0.0",  
    "electron-builder": "24.9.1"  
  }  
}
```

```
  "electron-builder": "24.9.1"  
}  
}  
}
```

### Install dependencies:

```
npm install --save-dev electron electron-builder
```

## 11.13.3 Main Process (main.js)

The main process controls the application lifecycle and creates windows:

```
const { app, BrowserWindow, Menu, ipcMain, dialog, shell } =  
require('electron');  
const path = require('path');  
const fs = require('fs').promises;  
  
// Keep a global reference of the window object  
let mainWindow;  
let splashWindow;  
  
// Determine if we're in development  
const isDev = process.env.NODE_ENV === 'development' !app.isPackaged;  
  
function createSplashWindow() {  
  splashWindow = new BrowserWindow({  
    width: 400,  
    height: 300,  
    frame: false,  
    transparent: true,  
    alwaysOnTop: true,  
    resizable: false,  
    webPreferences: {  
      nodeIntegration: false,  
      contextIsolation: true  
    }  
  });  
  
  // Load splash screen HTML  
  splashWindow.loadFile('splash.html');
```

```

// Center the window
splashWindow.center();

return splashWindow;
}

function createMainWindow() {
  // Create the browser window
  mainWindow = new BrowserWindow({
    width: 1280,
    height: 720,
    minWidth: 800,
    minHeight: 600,
    show: false, // Don't show until ready
    frame: true,
    titleBarStyle: process.platform === 'darwin' ? 'hiddenInset' :
    'default',
    backgroundColor: '#000000',
    icon: getIconPath(),
    webPreferences: {
      nodeIntegration: false, // Security: don't expose Node.js
      contextIsolation: true, // Security: isolate context
      preload: path.join(__dirname, 'preload.js'), // Preload script
      webSecurity: !isDev, // Disable in dev for easier debugging
      enableRemoteModule: false
    }
  });
}

// Load your exported cables.gl patch
if (isDev) {
  mainWindow.loadFile('renderer/index.html');
  // Open DevTools in development
  mainWindow.webContents.openDevTools();
} else {
  mainWindow.loadFile(path.join(__dirname,
  'renderer/index.html'));
}

// Show window when ready to prevent visual flash
mainWindow.once('ready-to-show', () => {
  if (splashWindow) {
    splashWindow.close();
  }
}

```

```

  splashWindow = null;
}

mainWindow.show();

// Focus the window
if (isDev) {
  mainWindow.focus();
}

// Handle window closed
mainWindow.on('closed', () => {
  mainWindow = null;
});

// Handle external links
mainWindow.webContents.setWindowOpenHandler(({ url }) => {
  shell.openExternal(url);
  return { action: 'deny' };
});

// Prevent navigation to external URLs
mainWindow.webContents.on('will-navigate', (event, navigationUrl) => {
  const parsedUrl = new URL(navigationUrl);

  if (parsedUrl.origin !== 'file://') {
    event.preventDefault();
    shell.openExternal(navigationUrl);
  }
});

return mainWindow;
}

function getIconPath() {
  if (process.platform === 'win32') {
    return path.join(__dirname, 'assets/icon.ico');
  } else if (process.platform === 'darwin') {
    return path.join(__dirname, 'assets/icon.icns');
  } else {
    return path.join(__dirname, 'assets/icon.png');
  }
}

```

```

        }
    }

function createMenu() {
    const template = [
        {
            label: 'File',
            submenu: [
                {
                    label: 'Load Settings',
                    accelerator: 'CmdOrCtrl+O',
                    click: async () => {
                        const result = await dialog.showOpenDialog(mainWindow, {
                            properties: ['openFile'],
                            filters: [
                                { name: 'JSON Files', extensions: ['json'] },
                                { name: 'All Files', extensions: ['*'] }
                            ]
                        });
                        if (!result.canceled && result.filePaths.length > 0) {
                            mainWindow.webContents.send('load-settings',
result.filePath);
                        }
                    }
                },
                {
                    label: 'Save Settings',
                    accelerator: 'CmdOrCtrl+S',
                    click: async () => {
                        const result = await dialog.showSaveDialog(mainWindow, {
                            filters: [
                                { name: 'JSON Files', extensions: ['json'] },
                                { name: 'All Files', extensions: ['*'] }
                            ],
                            defaultPath: 'settings.json'
                        });
                        if (!result.canceled) {
                            mainWindow.webContents.send('save-settings',
result.filePath);
                        }
                    }
                }
            ]
        }
    ];
}

```

```

        }
    ],
    { type: 'separator' },
    {
        label: 'Exit',
        accelerator: process.platform === 'darwin' ? 'Cmd+Q' :
'Ctrl+Q',
        click: () => {
            app.quit();
        }
    ]
},
{
    label: 'Edit',
    submenu: [
        { role: 'undo', label: 'Undo' },
        { role: 'redo', label: 'Redo' },
        { type: 'separator' },
        { role: 'cut', label: 'Cut' },
        { role: 'copy', label: 'Copy' },
        { role: 'paste', label: 'Paste' },
        { role: 'selectAll', label: 'Select All' }
    ]
},
{
    label: 'View',
    submenu: [
        { role: 'reload', label: 'Reload' },
        { role: 'forceReload', label: 'Force Reload' },
        { role: 'toggleDevTools', label: 'Toggle Developer Tools' },
        { type: 'separator' },
        { role: 'resetZoom', label: 'Actual Size' },
        { role: 'zoomIn', label: 'Zoom In' },
        { role: 'zoomOut', label: 'Zoom Out' },
        { type: 'separator' },
        { role: 'togglefullscreen', label: 'Toggle Fullscreen' }
    ]
},
{
    label: 'Window',
    submenu: [

```

```

        { role: 'minimize', label: 'Minimize' },
        { role: 'close', label: 'Close' }
    ],
},
{
    label: 'Help',
    submenu: [
        {
            label: 'About',
            click: () => {
                dialog.showMessageBox(mainWindow, {
                    type: 'info',
                    title: 'About',
                    message: 'My Cables App',
                    detail: 'Version 1.0.0\nBuilt with cables.gl and
Electron'
                });
            }
        }
    ]
};

// macOS specific menu adjustments
if (process.platform === 'darwin') {
    template.unshift({
        label: app.getName(),
        submenu: [
            { role: 'about', label: 'About ' + app.getName() },
            { type: 'separator' },
            { role: 'services', label: 'Services' },
            { type: 'separator' },
            { role: 'hide', label: 'Hide ' + app.getName() },
            { role: 'hideOthers', label: 'Hide Others' },
            { role: 'unhide', label: 'Show All' },
            { type: 'separator' },
            { role: 'quit', label: 'Quit ' + app.getName() }
        ]
    });
}

// Window menu
template[4].submenu = [

```

```

        { role: 'close', label: 'Close' },
        { role: 'minimize', label: 'Minimize' },
        { role: 'zoom', label: 'Zoom' },
        { type: 'separator' },
        { role: 'front', label: 'Bring All to Front' }
    ];
}

const menu = Menu.buildFromTemplate(template);
Menu.setApplicationMenu(menu);

// IPC Handlers for inter-process communication
function setupIpcHandlers() {
    // Handle file reading
    ipcMain.handle('read-file', async (event, filePath) => {
        try {
            const data = await fs.readFile(filePath, 'utf-8');
            return { success: true, data: JSON.parse(data) };
        } catch (error) {
            return { success: false, error: error.message };
        }
    });

    // Handle file writing
    ipcMain.handle('write-file', async (event, filePath, data) => {
        try {
            await fs.writeFile(filePath, JSON.stringify(data, null, 2),
'utf-8');
            return { success: true };
        } catch (error) {
            return { success: false, error: error.message };
        }
    });

    // Get app version
    ipcMain.handle('get-app-version', () => {
        return app.getVersion();
    });

    // Get user data path
    ipcMain.handle('get-user-data-path', () => {

```

```

    return app.getPath('userData');
});

// Window control
ipcMain.on('window-minimize', () => {
  if (mainWindow) mainWindow.minimize();
});

ipcMain.on('window-maximize', () => {
  if (mainWindow) {
    if (mainWindow.isMaximized()) {
      mainWindow.unmaximize();
    } else {
      mainWindow.maximize();
    }
  }
});

ipcMain.on('window-close', () => {
  if (mainWindow) mainWindow.close();
});

// App event handlers
app.whenReady().then(() => {
  // Create splash screen
  createSplashWindow();

  // Create main window after a short delay (simulate loading)
  setTimeout(() => {
    createMainWindow();
    createMenu();
    setupIpcHandlers();
  }, 1500);

  app.on('activate', () => {
    // On macOS, re-create window when dock icon is clicked
    if (BrowserWindow.getAllWindows().length === 0) {
      createMainWindow();
    }
  });
});

```

```

app.on('window-all-closed', () => {
  // On macOS, keep app running even when all windows are closed
  if (process.platform !== 'darwin') {
    app.quit();
  }
});

// Security: Prevent new window creation
app.on('web-contents-created', (event, contents) => {
  contents.on('new-window', (event, navigationUrl) => {
    event.preventDefault();
    shell.openExternal(navigationUrl);
  });
});

```

#### 11.13.4 Preload Script (preload.js)

The preload script safely exposes Node.js APIs to the renderer process:

```

const { contextBridge, ipcRenderer } = require('electron');

// Expose protected methods that allow the renderer process
// to use ipcRenderer without exposing the entire object
contextBridge.exposeInMainWorld('electronAPI', {
  // File operations
  readFile: (filePath) => ipcRenderer.invoke('read-file', filePath),
  writeFile: (filePath, data) => ipcRenderer.invoke('write-file',
  filePath, data),

  // App info
  getAppVersion: () => ipcRenderer.invoke('get-app-version'),
  getUserDataPath: () => ipcRenderer.invoke('get-user-data-path'),

  // Window control
  minimizeWindow: () => ipcRenderer.send('window-minimize'),
  maximizeWindow: () => ipcRenderer.send('window-maximize'),
  closeWindow: () => ipcRenderer.send('window-close'),

  // Listen for messages from main process
  onLoadSettings: (callback) => {

```

```

    ipcRenderer.on('load-settings', (event, filePath) =>
callback(filePath));
},
onSaveSettings: (callback) => {
    ipcRenderer.on('save-settings', (event, filePath) =>
callback(filePath));
},

// Remove listeners
removeAllListeners: (channel) => {
    ipcRenderer.removeAllListeners(channel);
}
});

```

## 11.13.5 Advanced Window Configuration

### Window Options Deep Dive

```

const mainWindow = new BrowserWindow({
    // Size and position
    width: 1280,
    height: 720,
    minWidth: 800,
    minHeight: 600,
    maxWidth: 3840,
    maxHeight: 2160,
    x: undefined, // Center if undefined
    y: undefined,
    center: true, // Center on screen

    // Appearance
    frame: true, // Show window frame
    titleBarStyle: 'default', // 'default', 'hidden', 'hiddenInset',
    'customButtonsOnHover'
    transparent: false, // Transparent window (performance impact)
    backgroundColor: '#000000', // Background color before content
    loads
    opacity: 1.0, // Window opacity (0.0 to 1.0)
    vibrancy: 'ultra-dark', // macOS only: 'appearance-based',
    'light', 'dark', etc.
    visualEffectState: 'active', // macOS only: 'active', 'inactive',
    'followsWindowActiveState'
});

```

```

    // Behavior
    show: false, // Don't show until ready
    alwaysOnTop: false, // Keep window on top
    fullscreen: false, // Start in fullscreen
    fullscrenable: true, // Allow fullscreen
    simpleFullscreen: false, // macOS simple fullscreen
    skipTaskbar: false, // Don't show in taskbar
    kiosk: false, // Kiosk mode (fullscreen, no exit)
    closable: true, // Allow closing
    minimizable: true, // Allow minimizing
    maximizable: true, // Allow maximizing
    resizable: true, // Allow resizing
    movable: true, // Allow moving
    focusable: true, // Can receive focus

    // Window state
    autoHideMenuBar: false, // Auto-hide menu bar
    useContentSize: false, // Use content size instead of window size
    title: 'My Cables App', // Window title

    // Icon
    icon: getIconPath(), // Window icon

    // Web preferences
    webPreferences: {
        nodeIntegration: false,
        contextIsolation: true,
        preload: path.join(__dirname, 'preload.js'),
        webSecurity: true,
        allowRunningInsecureContent: false,
        experimentalFeatures: false,
        enableBlinkFeatures: '',
        disableBlinkFeatures: '',
        sandbox: false, // Enable sandbox for extra security
        enableRemoteModule: false,
        backgroundThrottling: true, // Throttle when backgrounded
        offscreen: false, // Use offscreen rendering
        webviewTag: false // Disable webview tag
    }
});

```

## Window State Persistence

Save and restore window position and size:

```
const Store = require('electron-store');

const store = new Store({
  name: 'window-state',
  defaults: {
    width: 1280,
    height: 720,
    x: undefined,
    y: undefined,
    isMaximized: false
  }
});

function createMainWindow() {
  const windowState = store.get('windowState', {});

  const mainWindow = new BrowserWindow({
    width: windowState.width 1280,
    height: windowState.height 720,
    x: windowState.x,
    y: windowState.y,
    // ... other options
  });

  // Restore maximized state
  if (windowState.isMaximized) {
    mainWindow.maximize();
  }

  // Save window state on move/resize
  const saveWindowState = () => {
    const bounds = mainWindow.getBounds();
    store.set('windowState', {
      width: bounds.width,
      height: bounds.height,
      x: bounds.x,
      y: bounds.y,
      isMaximized: mainWindow.isMaximized()
    });
  };
}
```

```
});

mainWindow.on('moved', saveWindowState);
mainWindow.on('resized', saveWindowState);
mainWindow.on('maximize', () => {
  store.set('windowState.isMaximized', true);
});
mainWindow.on('unmaximize', () => {
  store.set('windowState.isMaximized', false);
});

return mainWindow;
}
```

Install electron-store:

```
npm install electron-store
```

### 11.13.6 Inter-Window Communication

Electron supports multiple windows with various communication patterns:

#### Method 1: IPC (Inter-Process Communication)

##### Main Process -> Renderer Process:

```
// In main.js
mainWindow.webContents.send('message-from-main', {
  type: 'update',
  data: { value: 42 }
});
```

```
// In renderer (index.html or your cables patch)
window.electronAPI.onMessage((data) => {
  console.log('Received:', data);
});
```

##### Renderer Process -> Main Process:

```
// In preload.js
contextBridge.exposeInMainWorld('electronAPI', {
  sendToMain: (channel, data) => {
    ipcRenderer.send(channel, data);
  },
  onMessage: (callback) => {
    ipcRenderer.on('message-from-main', (event, data) =>
      callback(data));
  }
});

// In renderer
window.electronAPI.sendToMain('message-from-renderer', {
  action: 'save',
  data: { settings: {...} }
});
```

## Method 2: Multiple Windows Communication

```
// In main.js
let windows = [];

function createWindow(id) {
  const window = new BrowserWindow({
    // ... window options
    webPreferences: {
      // ... web preferences
    }
  });

  window.id = id;
  windows.push(window);

  window.on('closed', () => {
    windows = windows.filter(w => w.id !== id);
  });

  return window;
}

// Broadcast to all windows
```

```
function broadcastToAllWindows(channel, data) {
  windows.forEach(window => {
    if (window && !window.isDestroyed()) {
      window.webContents.send(channel, data);
    }
  });
}

// Send to specific window
function sendToWindow(windowId, channel, data) {
  const window = windows.find(w => w.id === windowId);
  if (window && !window.isDestroyed()) {
    window.webContents.send(channel, data);
  }
}

// Example: Sync settings across windows
ipcMain.on('update-settings', (event, settings) => {
  // Save settings
  store.set('settings', settings);

  // Broadcast to all windows
  broadcastToAllWindows('settings-updated', settings);
});
```

## Method 3: Shared Data via Main Process

```
// In main.js
let sharedData = {
  settings: {},
  state: {}
};

// Get shared data
ipcMain.handle('get-shared-data', (event, key) => {
  return sharedData[key];
});

// Set shared data
ipcMain.handle('set-shared-data', (event, key, value) => {
  sharedData[key] = value;
});
```

```
// Notify all windows
broadcastToAllWindows('shared-data-changed', { key, value });
return true;
});
```

## Method 4: Window-to-Window via Main Process

```
// Window A sends message to Window B
ipcMain.on('send-to-window', (event, targetWindowId, channel, data)
=> {
  sendToWindow(targetWindowId, channel, data);
});

// In preload.js
contextBridge.exposeInMainWorld('electronAPI', {
  sendToWindow: (targetWindowId, channel, data) => {
    ipcRenderer.send('send-to-window', targetWindowId, channel,
data);
  },
  onWindowMessage: (callback) => {
    ipcRenderer.on('window-message', (event, data) =>
callback(data));
  }
});
```

### 11.13.7 Splash Screen Implementation

A professional splash screen improves perceived performance:

#### splash.html

```
<!DOCTYPE html>
<html>
<head>
  <meta charset="UTF-8">
  <style>
    * {
      margin: 0;
      padding: 0;
      box-sizing: border-box;
    }
```

```
body {
  width: 400px;
  height: 300px;
  background: linear-gradient(135deg, #667eea 0%, #764ba2 100%);
  display: flex;
  flex-direction: column;
  justify-content: center;
  align-items: center;
  font-family: -apple-system, BlinkMacSystemFont, 'Segoe UI',
Roboto, sans-serif;
  color: white;
  overflow: hidden;
}

.logo {
  width: 80px;
  height: 80px;
  margin-bottom: 20px;
  animation: pulse 2s ease-in-out infinite;
}

@keyframes pulse {
  0%, 100% { transform: scale(1); opacity: 1; }
  50% { transform: scale(1.1); opacity: 0.8; }
}

.app-name {
  font-size: 24px;
  font-weight: 600;
  margin-bottom: 10px;
}

.version {
  font-size: 12px;
  opacity: 0.8;
  margin-bottom: 30px;
}

.loader {
  width: 200px;
  height: 4px;
```

```

background: rgba(255, 255, 255, 0.2);
border-radius: 2px;
overflow: hidden;
position: relative;
}

.loader-bar {
height: 100%;
background: white;
width: 0%;
animation: loading 2s ease-in-out infinite;
border-radius: 2px;
}

@keyframes loading {
0% { width: 0%; }
50% { width: 70%; }
100% { width: 100%; }
}

.status {
margin-top: 20px;
font-size: 12px;
opacity: 0.7;
}
</style>
</head>
<body>
<div class="logo">
<!-- Your logo SVG or image --&gt;
&lt;svg viewBox="0 0 100 100" fill="white"&gt;
&lt;circle cx="50" cy="50" r="40" stroke="white" stroke-width="2"
fill="none"/&gt;
&lt;path d="M30 50 L45 65 L70 35" stroke="white" stroke-width="3"
fill="none"/&gt;
&lt;/svg&gt;
&lt;/div&gt;
&lt;div class="app-name"&gt;My Cables App&lt;/div&gt;
&lt;div class="version"&gt;Version 1.0.0&lt;/div&gt;
&lt;div class="loader"&gt;
&lt;div class="loader-bar"&gt;&lt;/div&gt;
&lt;/div&gt;
</pre>

```

```

<div class="status" id="status">Loading...</div>

<script>
// Update status from main process
const { ipcRenderer } = require('electron');

ipcRenderer.on('splash-status', (event, message) => {
document.getElementById('status').textContent = message;
});

ipcRenderer.on('splash-progress', (event, percent) => {
document.querySelector('.loader-bar').style.width = percent +
'%';
});
</script>
</body>
</html>

```

### Enhanced main.js with splash screen:

```

function createSplashWindow() {
splashWindow = new BrowserWindow({
width: 400,
height: 300,
frame: false,
transparent: true,
alwaysOnTop: true,
resizable: false,
webPreferences: {
nodeIntegration: true, // Needed for splash screen
contextIsolation: false
}
});
splashWindow.loadFile('splash.html');
splashWindow.center();

// Update splash screen status
const updateSplashStatus = (message) => {
if (splashWindow && !splashWindow.isDestroyed()) {
splashWindow.webContents.send('splash-status', message);
}
}

```

```

};

const updateSplashProgress = (percent) => {
  if (splashWindow && !splashWindow.isDestroyed()) {
    splashWindow.webContents.send('splash-progress', percent);
  }
};

// Simulate loading progress
updateSplashStatus('Initializing...');

setTimeout(() => {
  updateSplashStatus('Loading assets...');

  updateSplashProgress(40);
}, 300);

setTimeout(() => {
  updateSplashStatus('Preparing renderer...');

  updateSplashProgress(70);
}, 800);

setTimeout(() => {
  updateSplashStatus('Almost ready...');

  updateSplashProgress(90);
}, 1200);

return { splashWindow, updateSplashStatus, updateSplashProgress };
}

// In app.whenReady()
app.whenReady().then(() => {
  const { splashWindow: splash, updateSplashStatus } =
createSplashWindow();

  updateSplashStatus('Creating main window...');

  setTimeout(() => {
    createMainWindow();
    createMenu();
    setupIpcHandlers();
  });
}

```

```

// Close splash when main window is ready
mainWindow.once('ready-to-show', () => {
  setTimeout(() => {
    if (splash && !splash.isDestroyed()) {
      splash.close();
    }
    mainWindow.show();
  }, 500); // Small delay for smooth transition
}, 1500);
});

```

## 11.13.8 JSON File Operations

Saving and loading JSON data is essential for app settings, user preferences, and state persistence:

### Method 1: Using IPC Handlers (Recommended)

In `main.js`:

```

const fs = require('fs').promises;
const path = require('path');

// Get user data directory
const getUserDataPath = () => {
  return app.getPath('userData');
};

// Ensure directory exists
async function ensureDirectory(dirPath) {
  try {
    await fs.mkdir(dirPath, { recursive: true });
  } catch (error) {
    console.error('Error creating directory:', error);
  }
}

// IPC Handlers for JSON operations
ipcMain.handle('save-json', async (event, filename, data) => {
  try {

```

```

const userDataPath = getUserDataPath();
const filePath = path.join(userDataPath, filename);

await ensureDirectory(path.dirname(filePath));
await fs.writeFile(filePath, JSON.stringify(data, null, 2),
'utf-8');

return { success: true, path: filePath };
} catch (error) {
  console.error('Error saving JSON:', error);
  return { success: false, error: error.message };
}
});

ipcMain.handle('load-json', async (event, filename) => {
try {
  const userDataPath = getUserDataPath();
  const filePath = path.join(userDataPath, filename);

  const data = await fs.readFile(filePath, 'utf-8');
  return { success: true, data: JSON.parse(data) };
} catch (error) {
  if (error.code === 'ENOENT') {
    // File doesn't exist, return default
    return { success: true, data: null };
  }
  console.error('Error loading JSON:', error);
  return { success: false, error: error.message };
}
});

ipcMain.handle('delete-json', async (event, filename) => {
try {
  const userDataPath = getUserDataPath();
  const filePath = path.join(userDataPath, filename);

  await fs.unlink(filePath);
  return { success: true };
} catch (error) {
  if (error.code === 'ENOENT') {
    return { success: true }; // Already deleted
  }
}
});

```

```

  console.error('Error deleting JSON:', error);
  return { success: false, error: error.message };
}

});

ipcMain.handle('list-json-files', async (event, directory = '') => {
try {
  const userDataPath = getUserDataPath();
  const dirPath = path.join(userDataPath, directory);

  const files = await fs.readdir(dirPath);
  const jsonFiles = files.filter(file => file.endsWith('.json'));

  return { success: true, files: jsonFiles };
} catch (error) {
  console.error('Error listing JSON files:', error);
  return { success: false, error: error.message };
}
});

```

### In preload.js:

```

contextBridge.exposeInMainWorld('electronAPI', {
  // JSON file operations
  saveJSON: async (filename, data) => {
    return await ipcRenderer.invoke('save-json', filename, data);
  },

  loadJSON: async (filename) => {
    return await ipcRenderer.invoke('load-json', filename);
  },

  deleteJSON: async (filename) => {
    return await ipcRenderer.invoke('delete-json', filename);
  },

  listJSONFiles: async (directory = '') => {
    return await ipcRenderer.invoke('list-json-files', directory);
  }
});

```

### In your renderer (cables patch or HTML):

```

// Save settings
async function saveSettings(settings) {
  const result = await window.electronAPI.saveJSON('settings.json', settings);
  if (result.success) {
    console.log('Settings saved to:', result.path);
  } else {
    console.error('Failed to save settings:', result.error);
  }
}

// Load settings
async function loadSettings() {
  const result = await window.electronAPI.loadJSON('settings.json');
  if (result.success) {
    if (result.data) {
      console.log('Settings loaded:', result.data);
      return result.data;
    } else {
      // Return default settings
      return getDefaultSettings();
    }
  } else {
    console.error('Failed to load settings:', result.error);
    return getDefaultSettings();
  }
}

// Example usage with cables.gl patch
async function initializeApp() {
  // Load saved settings
  const settings = await loadSettings();

  // Apply settings to cables patch
  if (window.CABLES && window.CABLES.patch) {
    Object.keys(settings).forEach(key => {
      window.CABLES.patch.setVariable(key, settings[key]);
    });
  }

  // Listen for settings changes and auto-save
  if (window.CABLES && window.CABLES.patch) {

```

```

    window.CABLES.patch.on('variableChanged', async (name, value) =>
{
  const currentSettings = await loadSettings();
  currentSettings[name] = value;
  await saveSettings(currentSettings);
});

}

// Save cables patch state
async function savePatchState() {
  if (!window.CABLES || !window.CABLES.patch) return;

  const state = {
    timestamp: new Date().toISOString(),
    variables: {},
    camera: {
      position: window.CABLES.patch.cgl?.camera?.position ?? null,
      rotation: window.CABLES.patch.cgl?.camera?.rotation ?? null
    }
  };

  // Save all variables
  // (You'll need to track variable names or get them from your patch)
  const variableNames = ['color', 'speed', 'intensity']; // Your
  variable names
  variableNames.forEach(name => {
    state.variables[name] = window.CABLES.patch.getVariable(name);
  });

  await window.electronAPI.saveJSON('patch-state.json', state);
}

// Load patch state
async function loadPatchState() {
  const result = await
  window.electronAPI.loadJSON('patch-state.json');
  if (result.success && result.data) {
    const state = result.data;

    // Restore variables
    Object.keys(state.variables).forEach(name => {

```

```

        window.CABLES.patch.setVariable(name, state.variables[name]);
    });

    // Restore camera if available
    if (state.camera && window.CABLES.patch.cgl?.camera) {
        // Camera restoration depends on your cables setup
    }
}

```

## Method 2: Using electron-store (Simpler)

```
npm install electron-store
```

```

// In main.js
const Store = require('electron-store');

const store = new Store({
    name: 'app-settings',
    defaults: {
        theme: 'dark',
        windowState: {
            width: 1280,
            height: 720
        },
        cablesSettings: {
            color: [1, 0, 0, 1],
            speed: 1.0
        }
    }
});

// Expose store to renderer
ipcMain.handle('store-get', (event, key) => {
    return store.get(key);
});

ipcMain.handle('store-set', (event, key, value) => {
    store.set(key, value);
    return true;
}

```

```

    });

    ipcMain.handle('store-delete', (event, key) => {
        store.delete(key);
        return true;
    });

    ipcMain.handle('store-clear', () => {
        store.clear();
        return true;
    });

    ipcMain.handle('store-all', () => {
        return store.store;
    });
}

```

```

// In preload.js
contextBridge.exposeInMainWorld('electronAPI', {
    store: {
        get: (key) => ipcRenderer.invoke('store-get', key),
        set: (key, value) => ipcRenderer.invoke('store-set', key, value),
        delete: (key) => ipcRenderer.invoke('store-delete', key),
        clear: () => ipcRenderer.invoke('store-clear'),
        all: () => ipcRenderer.invoke('store-all')
    }
});

```

```

// In renderer
// Get setting
const theme = await window.electronAPI.store.get('theme');

// Set setting
await window.electronAPI.store.set('cablesSettings.color', [0, 1, 0, 1]);

// Get all settings
const allSettings = await window.electronAPI.store.all();

```

## 11.13.9 Code Signing for Distribution

Code signing is essential for smooth app distribution on macOS and Windows. Unsigned apps trigger security warnings and may be blocked.

### macOS Code Signing

**Requirements:** - Apple Developer Account (\$99/year) - Valid code signing certificate - Notarization (required for macOS 10.15+)

#### package.json configuration:

```
{  
  "build": {  
    "appId": "com.yourcompany.cablesapp",  
    "mac": {  
      "icon": "assets/icon.icns",  
      "category": "public.app-category.graphics-design",  
      "target": [  
        {  
          "target": "dmg",  
          "arch": ["x64", "arm64"]  
        },  
        {  
          "target": "zip",  
          "arch": ["x64", "arm64"]  
        }  
      ],  
      "hardenedRuntime": true,  
      "gatekeeperAssess": false,  
      "entitlements": "build/mac/entitlements.mac.plist",  
      "entitlementsInherit": "build/mac/entitlements.mac.plist"  
    },  
    "afterSign": "scripts/notarize.js",  
    "notarize": {  
      "teamId": "YOUR_TEAM_ID"  
    }  
  }  
}
```

#### entitlements.mac.plist:

```
<?xml version="1.0" encoding="UTF-8"?>  
<!DOCTYPE plist PUBLIC "-//Apple//DTD PLIST 1.0//EN"  
"http://www.apple.com/DTDs/PropertyList-1.0.dtd">  
<plist version="1.0">  
<dict>  
  <key>com.apple.security.cs.allow-jit</key>  
  <true/>  
  <key>com.apple.security.cs.allow-unsigned-executable-memory</key>  
  <true/>  
  <key>com.apple.security.cs.allow-dyld-environment-variables</key>  
  <true/>  
  <key>com.apple.security.cs.disable-library-validation</key>  
  <true/>  
</dict>  
</plist>
```

#### scripts/notarize.js:

```
const { notarize } = require('@electron/notarize');  
  
exports.default = async function notarizing(context) {  
  const { electronPlatformName, appOutDir } = context;  
  
  if (electronPlatformName !== 'darwin') {  
    return;  
  }  
  
  const appName = context.packager.appInfo.productFilename;  
  
  return await notarize({  
    appBundleId: 'com.yourcompany.cablesapp',  
    appPath: `${appOutDir}/${appName}.app`,  
    appleId: process.env.APPLE_ID,  
    appleIdPassword: process.env.APPLE_ID_PASSWORD,  
    teamId: process.env.APPLE_TEAM_ID  
  });  
};
```

#### Environment variables (.env or export):

```
export APPLE_ID="your@email.com"
export APPLE_ID_PASSWORD="app-specific-password"
export APPLE_TEAM_ID="YOUR_TEAM_ID"
```

## Build command:

```
npm run build:mac
```

## Windows Code Signing

**Requirements:** - Code signing certificate (purchased from certificate authority)  
- Or use self-signed certificate for testing (not recommended for distribution)

### package.json configuration:

```
{
  "build": {
    "win": {
      "icon": "assets/icon.ico",
      "target": [
        {
          "target": "nsis",
          "arch": ["x64", "ia32"]
        },
        {
          "target": "portable",
          "arch": ["x64"]
        }
      ],
      "signingHashAlgorithms": ["sha256"],
      "sign": "build/win/sign.js",
      "certificateFile": "path/to/certificate.pfx",
      "certificatePassword": "${env.CERTIFICATE_PASSWORD}"
    }
  }
}
```

### build/win/sign.js:

```
const path = require('path');

exports.default = async function(configuration) {
  const { path: filePath } = configuration;

  // Only sign on Windows
  if (process.platform !== 'win32') {
    return;
  }

  // Use electron-builder's built-in signing
  // Or use signtool directly
  const { execSync } = require('child_process');

  const certPath = process.env.CERTIFICATE_PATH;
  const certPassword = process.env.CERTIFICATE_PASSWORD;

  if (!certPath || !certPassword) {
    console.warn('Certificate not configured, skipping signing');
    return;
  }

  try {
    execSync(
      `signtool sign /f "${certPath}" /p "${certPassword}" /t
http://timestamp.digicert.com /d "My Cables App" "${filePath}"`,
      { stdio: 'inherit' }
    );
  } catch (error) {
    console.error('Signing failed:', error);
    throw error;
  }
};
```

### Alternative: Using electron-builder's built-in signing:

```
{
  "build": {
    "win": {
      "certificateFile": "path/to/certificate.pfx",
      "certificatePassword": "${env.CERTIFICATE_PASSWORD}",
    }
  }
}
```

```

        "signingHashAlgorithms": ["sha256"],
        "signDlIs": true
    }
}

```

## Build command:

```
npm run build:win
```

## App Registration and Metadata

### package.json - Complete build configuration:

```
{
  "name": "my-cables-app",
  "version": "1.0.0",
  "description": "My amazing Cables.gl application",
  "author": {
    "name": "Your Name",
    "email": "your@email.com"
  },
  "license": "MIT",
  "main": "main.js",
  "build": {
    "appId": "com.yourcompany.cablesapp",
    "productName": "My Cables App",
    "copyright": "Copyright © 2024 Your Company",
    "directories": {
      "output": "dist",
      "buildResources": "build"
    },
    "files": [
      "main.js",
      "preload.js",
      "renderer/**/*",
      "!renderer/**/*.map"
    ],
    "extraResources": [
      {
        "from": "assets/"
      }
    ]
  }
}
```

```

        "to": "assets/",
        "filter": ["**/*"]
    }
],
"mac": {
  "icon": "assets/icon.icns",
  "category": "public.app-category.graphics-design",
  "minimumSystemVersion": "10.13",
  "darkModeSupport": true,
  "target": [
    {
      "target": "dmg",
      "arch": ["x64", "arm64"]
    }
  ],
  "hardenedRuntime": true,
  "entitlements": "build/mac/entitlements.mac.plist",
  "entitlementsInherit": "build/mac/entitlements.mac.plist"
},
"win": {
  "icon": "assets/icon.ico",
  "target": [
    {
      "target": "nsis",
      "arch": ["x64"]
    }
  ],
  "publisherName": "Your Company Name",
  "verifyUpdateCodeSignature": false
},
"linux": {
  "icon": "assets/icon.png",
  "target": [
    {
      "target": "AppImage",
      "arch": ["x64"]
    },
    {
      "target": "deb",
      "arch": ["x64"]
    }
  ],
  "extraResources": [
    {
      "from": "assets/"
    }
  ]
}
}
```

```

    "category": "Graphics"
},
"nsis": {
    "oneClick": false,
    "allowToChangeInstallationDirectory": true,
    "createDesktopShortcut": true,
    "createStartMenuShortcut": true,
    "shortcutName": "My Cables App"
},
"dmg": {
    "title": "${productName} ${version}",
    "icon": "assets/icon.icns",
    "background": "build/mac/dmg-background.png",
    "contents": [
        {
            "x": 410,
            "y": 150,
            "type": "link",
            "path": "/Applications"
        },
        {
            "x": 130,
            "y": 150,
            "type": "file"
        }
    ],
    "window": {
        "width": 540,
        "height": 380
    }
}
}

```

## 11.13.10 Building and Distributing

### Development Build

```
# Start in development mode
npm start
```

### Production Build

```

# Build for current platform
npm run build

# Build for specific platforms
npm run build:mac
npm run build:win
npm run build:linux

# Build for all platforms (requires platform-specific tools)
npm run build:all

```

### Distribution Checklist

**Before Building:** - [] Update version in package.json - [] Test app thoroughly - [ ] Optimize assets - [] Prepare code signing certificates - [] Set up environment variables - [] Test on target platforms

**After Building:** - [] Test installer on clean system - [] Verify code signing - [] Test auto-updater (if implemented) - [] Check file associations - [] Verify menu items work - [] Test file operations - [] Check window state persistence

## 11.13.11 Advanced Electron Features

### Auto-Updater

```
npm install electron-updater
```

```

// In main.js
const { autoUpdater } = require('electron-updater');

autoUpdater.checkForUpdatesAndNotify();

autoUpdater.on('update-available', () => {
    dialog.showMessageBox(mainWindow, {
        type: 'info',
        title: 'Update Available',
        message: 'A new version is available. It will be downloaded in the background.',
        buttons: ['OK']
})

```

```

});  
});  
  
autoUpdater.on('update-downloaded', () => {  
  dialog.showMessageBox(mainWindow, {  
    type: 'info',  
    title: 'Update Ready',  
    message: 'Update downloaded. The application will restart to  
apply the update.',  
    buttons: ['Restart Now', 'Later']  
  }).then(result => {  
    if (result.response === 0) {  
      autoUpdater.quitAndInstall();  
    }  
  });  
});  


```

## System Tray

```

const { Tray, Menu } = require('electron');  
const path = require('path');  
  
let tray = null;  
  
function createTray() {  
  const iconPath = path.join(__dirname, 'assets', 'tray-icon.png');  
  tray = new Tray(iconPath);  
  
  const contextMenu = Menu.buildFromTemplate([  
    {  
      label: 'Show App',  
      click: () => {  
        mainWindow.show();  
      }  
    },  
    {  
      label: 'Quit',  
      click: () => {  
        app.quit();  
      }  
  ]);  


```

```

]);  
  
tray.setToolTip('My Cables App');  
tray.setContextMenu(contextMenu);  
  
tray.on('click', () => {  
  mainWindow.isVisible() ? mainWindow.hide() : mainWindow.show();  
});  


```

## Native Notifications

```

const { Notification } = require('electron');  
  
function showNotification(title, body) {  
  if (Notification.isSupported()) {  
    new Notification({  
      title: title,  
      body: body,  
      icon: getIconPath()  
    }).show();  
  }  
}

```

## 11.13.12 Performance Optimization for Electron

1. **Disable Node Integration in Renderer** - Use contextBridge instead
2. **Enable Context Isolation** - Better security and performance
3. **Use Hardware Acceleration** - Enabled by default
4. **Optimize Asset Loading** - Lazy load when possible
5. **Throttle Background Processes** - Use backgroundThrottling: true
6. **Monitor Memory Usage** - Use DevTools memory profiler

## 11.13.13 Security Best Practices

1. **Never use nodeIntegration: true** - Use preload scripts instead
2. **Always use contextIsolation: true** - Isolates your code
3. **Validate all IPC messages** - Don't trust renderer input
4. **Use Content Security Policy** - Restrict resource loading
5. **Keep Electron updated** - Security patches are important
6. **Sanitize file paths** - Prevent directory traversal attacks

## 11.13.14 Troubleshooting Electron Issues

**App won't start:** - Check main.js for syntax errors - Verify all dependencies are installed - Check console for error messages

**Window is blank:** - Verify file paths are correct - Check DevTools for errors - Ensure renderer files are included in build

**Code signing fails:** - Verify certificate is valid - Check environment variables are set - Ensure certificate password is correct

**App is slow:** - Check for memory leaks - Optimize asset loading - Use performance profiling tools

## 11.14 Troubleshooting

### 11.14.1 Common Issues

**"Assets not loading"** - Check file paths are correct - Ensure CORS headers are set for cross-origin assets - Verify assets are included in export

**"Blank screen"** - Check browser console for errors - Verify all JavaScript files loaded - Test on a local server (not file://)

**"Poor performance"** - Reduce canvas resolution - Lower texture sizes - Simplify shaders - Check for memory leaks

**"Works locally but not on server"** - Check file paths (case-sensitive on Linux) - Verify all files uploaded - Check server MIME types

## 11.15 Featured Videos



<https://youtu.be/hVxrxXhH7vQ>

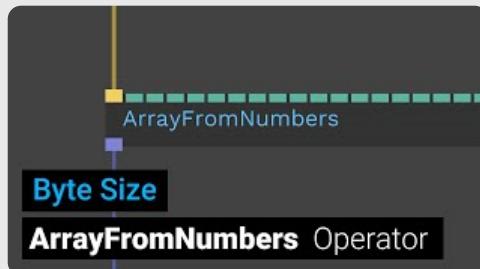
**Cables.gl Standalone (Offline) Build: Create Without Limits!**  
by Decode GL

## 11.16 Exercises

1. Export a simple patch and host it on GitHub Pages
2. Embed a cables patch as a website background
3. Create a loading screen for your patch
4. Set up communication between your patch and external JavaScript
5. **Electron Exercise:** Package your cables.gl export as an Electron app with a custom splash screen
6. **Electron Exercise:** Implement JSON save/load functionality to persist your patch settings
7. **Electron Exercise:** Set up code signing for macOS or Windows (requires developer account/certificate)
8. **Electron Exercise:** Create a multi-window Electron app with inter-window communication
9. **Electron Exercise:** Implement window state persistence (save/restore window position and size)
10. **Electron Exercise:** Add a system tray icon with context menu for your Electron app

# 12 Video Tutorials

## 12.1 Getting Started & Overviews



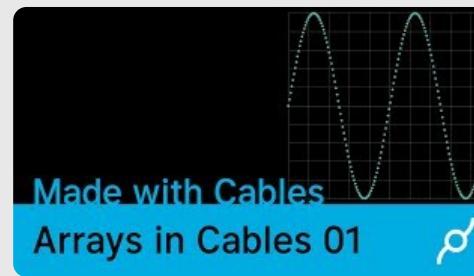
<https://youtu.be/iXKo7mU422M>

**Array from Numbers Operator tutorial - byte size**  
by cables\_gl



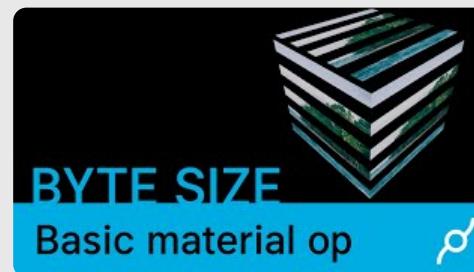
<https://youtu.be/koLSrHFyIUY>

**Arrays in cables - tutorial 03**  
by cables\_gl



<https://youtu.be/FRFfVgWFcs>

**Arrays in cables tutorial 01**  
by cables\_gl



<https://youtu.be/F-CUDHq40Pc>

**Basic material op tutorial - Byte size**  
by cables\_gl



<https://youtu.be/EPFNHYah9F4>

**cables gl introduction**  
by cables\_gl



<https://youtu.be/MOdVmJ6MYQE>

**Creating your own cables.gl operators - custom and user ops tutorial**  
by cables\_gl



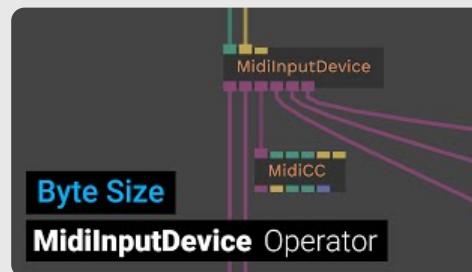
<https://youtu.be/7xlElfbMWgw>

**MeshInstancer tutorial 01**  
by cables\_gl



<https://youtu.be/EzV5CRAMyTA>

**Depth texture op tutorial - Byte size**  
by cables\_gl



<https://youtu.be/XvVBnPakE28>

**Midi Input Device - intro to MIDI in cables - Byte Size**  
by cables\_gl



<https://youtu.be/knGnukutZeM>

**Lights and Shadows Operators - getting started - Video Tutorial**  
by cables\_gl



<https://youtu.be/Ds4fPcxyBvM>

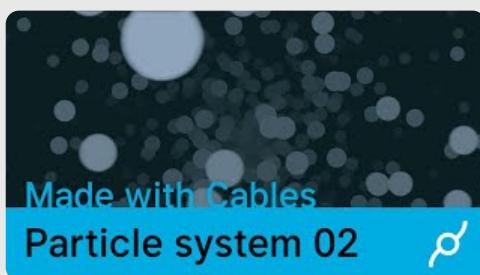
**Noise Texture Operator for generating color palettes for various design techniques - Video Tutorial**  
by cables\_gl



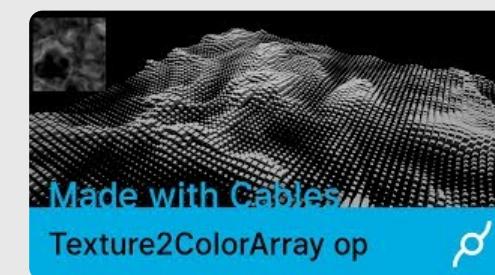
<https://youtu.be/P6esDOFHm6w>  
**Particle system in cables tutorial 01**  
by cables\_gl



<https://youtu.be/z1Qf9dE67-w>  
**Text Texture op tutorial - Byte size**  
by cables\_gl



<https://youtu.be/Nre7LH0OVw4>  
**Particle system in cables tutorial 02**  
by cables\_gl



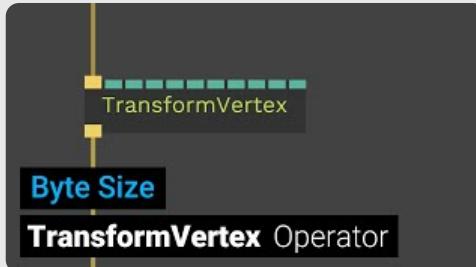
<https://youtu.be/mQN8VtVOLTQ>  
**Texture2ColorArray op tutorial**  
by cables\_gl



<https://youtu.be/x2jKZgmFVq4>  
**Post processing tutorial for beginners**  
by cables\_gl



<https://youtu.be/wzpKR7vbCXg>  
**Timeline - Part 1: Overview**  
by cables\_gl



<https://youtu.be/SaKWF6Rnsyl>

**Transform Vertex Operator tutorial (GPU vs CPU based animation) - byte size**  
by cables\_gl



<https://youtu.be/sbML3B3Vu4g>

**Cables.GL: Tutorial**  
by Creative Tech Talks



<https://youtu.be/B9GyRzov5Bg>

**tutorial demo effect / render2textures world position target tricks**  
by cables\_gl



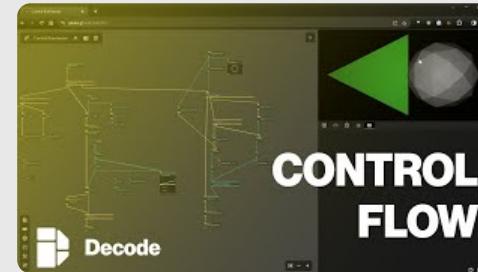
<https://youtu.be/kgXpXsLtv1M>

**Assets (6/13) - Intro to Cables.gl**  
by Decode GL



<https://youtu.be/T0djoWQkBew>

**Cables.GL: Introduction**  
by Creative Tech Talks



<https://youtu.be/vzWrCGfU7uw>

**Control Flow (3/13) - Intro to Cables.gl**  
by Decode GL



<https://youtu.be/2YFB4MuN8y8>  
**Data Types (2/13) - Intro to Cables.gl**  
by Decode GL



<https://youtu.be/Rhbld-kUWig>  
**Texture Effects (8/13) - Intro to Cables.gl**  
by Decode GL



<https://youtu.be/Z4gReZ34SHU>  
**Interactions (5/13) - Intro to Cables.gl**  
by Decode GL



<https://youtu.be/qEno30S8CBc>  
**Glitch Art Tutorial using Cables.gl**  
by Jaalibandar



<https://youtu.be/VsS4gaJ7pMw>  
**Introduction to Cables.gl (1/13)**  
by Decode GL

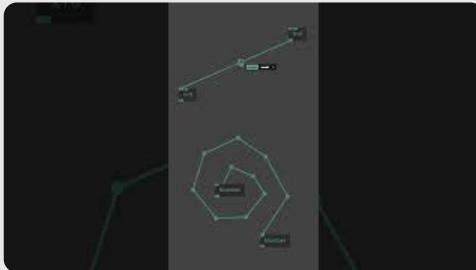


<https://youtu.be/goO3PhuenBl>  
**First Steps in Cables.gl - Tutorial**  
by The Interactive & Immersive HQ

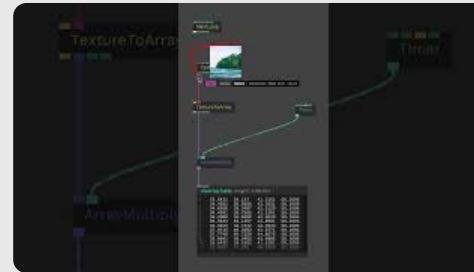
## 12.2 Core Concepts & Workflow



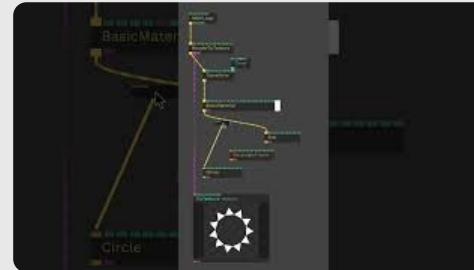
<https://youtu.be/lj6REnNZU0s>  
**converter ops**  
by cables\_gl



<https://youtu.be/M1A8S98UOuI>  
**how to reroute cables #gui #uxdesign #motiondesign**  
by cables\_gl



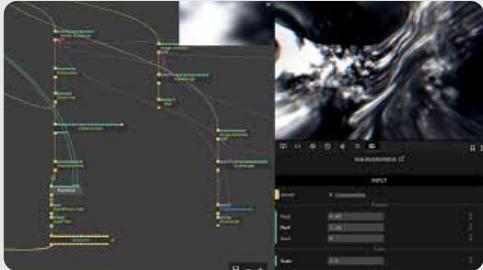
<https://youtu.be/ZCKrhswQiyc>  
**you can cut cables with the [Y] key #animation #motiondesign #design #web #3danimation**  
by cables\_gl



<https://youtu.be/xawlfxKpxRQ>  
**you can replace cables that easy #animation #motiondesign #design #web**  
by cables\_gl



[https://youtu.be/GQc6JF\\_jy6M](https://youtu.be/GQc6JF_jy6M)  
**Debug View in Cables.gl Setting up multiple views in your patch**  
by Jaalibandar



<https://youtu.be/uzqplBUGMWg>  
**01 Jam Sessions : Generative Fluid Graphic in Cables.gl**  
by FahmiMursyid



<https://youtu.be/wERboDg6zOI>  
**Impactful Transitions under 10 minutes using cables.gl Genuary 04: Intersections**  
by Jaalibandar



[https://youtu.be/\\_CltN9uQhoU](https://youtu.be/_CltN9uQhoU)  
**Procedurally generated plants in Cables.gl #genuary**  
by Jaalibandar



<https://youtu.be/5Jc3woVozNc>  
**Cables.gl Generative Poster 05**  
by Karthik Dondeti



<https://youtu.be/DsSPcNSLyAw>  
**Cables.gl Generative Poster 06**  
by Karthik Dondeti



<https://youtu.be/gRV0DqpSd-4>  
**Cables.gl Generative Poster 09**  
by Karthik Dondeti



<https://youtu.be/3tZQtsEiicw>

**February 2022 Release Chat - cables.gl updated - PBR, Geometry from Textures, Teams, EXR support**

by cables\_gl



[https://youtu.be/lOMplXy\\_JV0](https://youtu.be/lOMplXy_JV0)

**Visualize any YouTube playlist in 3D with n8n.io & cables.gl (part 1)**

by Decode GL



<https://youtu.be/a56wk9Xm9dY>

**Using Vertex Displacement with Normal maps in cables.gl**

by cables\_gl



<https://youtu.be/AZrWNl3MwHQ>

**Scrolling Terrain with UFO in 10 minutes using cables.gl**

by Jaalibandar



<https://youtu.be/NjG85QbbI0w>

**Vertex displacement op - byte size**

by cables\_gl



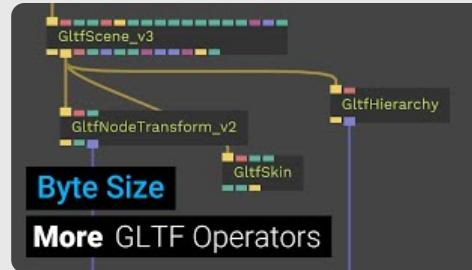
<https://youtu.be/sbqE83ZHiTU>

**Scrolling Terrain with UFO in 10 minutes using cables.gl**

by Jaalibandar



<https://youtu.be/3KSS1nrv6t0>  
**cables.gl web demo - realtime visualizer soundcloud globe Exyl - Ping! Moai**  
by stobelights



[https://youtu.be/l\\_eD5nml\\_5A](https://youtu.be/l_eD5nml_5A)  
**More GLTF operators - animated rig support, position data, separate animation timing - Byte Size**  
by cables\_gl

## 12.3 3D / 3D Meshes



<https://youtu.be/iqIXSb-kAwS>  
**Importing GLTF 3D Scenes with Camera positions and animating them in cables.gl**  
by cables\_gl



<https://youtu.be/DW9U5tv1GHM>  
**Varying Mesh Instances with color, animation and textures - Video Tutorial**  
by cables\_gl



<https://youtu.be/PrkdnENo8wQ>  
**Vertex Textures - Point Clouds and Mesh Instancing from Textures - Introduction**  
by cables\_gl

## 12.4 Textures / Post-Processing



<https://youtu.be/uwoj7R52yU8>

**PBR Material & PBR Environment Light Op - Byte Size - Physically Based Rendering in Cables**

by cables\_gl



<https://youtu.be/cc5Vlmvlq6A>

**Pixel displace op - byte size**

by cables\_gl



<https://youtu.be/YF84KQc9jzU>

**Copy Texture operator deep dive - basics and use cases**

by cables\_gl



<https://youtu.be/rtDA2S9SPQ4>

**Exploring Matcap Creator by bagoof - a new tool made with cables**

by cables\_gl

## 12.5 Shaders / Shadertoy / GLSL



<https://youtu.be/Zfhn8xSM0SE>

**Coding with cables - custom shader op**

by cables\_gl

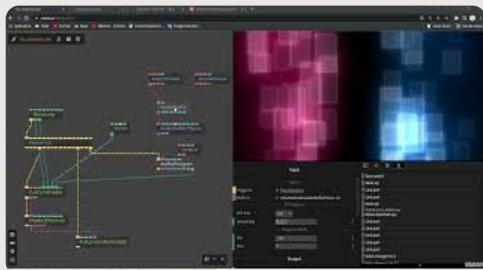


TUTORIAL  
**Shadertoy to cables - 01**

[https://youtu.be/j\\_ins4RW0c8](https://youtu.be/j_ins4RW0c8)  
**Shadertoy to cables - part 01**  
by cables\_gl



<https://youtu.be/h20ZH-xD8Ts>  
**Microphone Input & Audio Reactivity in Cables.gl - Tutorial**  
by The Interactive & Immersive HQ



<https://youtu.be/nil-HkZgNZ8>  
**Programmation d'un shadertoy avec Cables.gl Partie 8.**  
by Meletou1

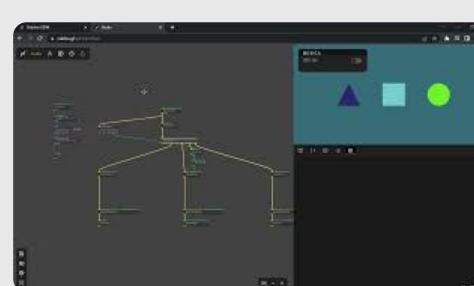


<https://youtu.be/uYk7-9dZ8Ys>  
**MidiFighter cables.gl Vjing**  
by Alberto Barrios L. (nahui-ocelotl.com)

## 12.6 Audio / Music / MIDI



<https://youtu.be/SFXvtm-vkvE>  
**Introduction to Generative Music and Audio Reactive Systems with Cables.gl**  
by Jaalibandar



<https://youtu.be/KZbhVClahv4>  
**Páginas WEB Interactivas con cables.gl 13 Audio**  
by Alberto Barrios L. (nahui-ocelotl.com)



## Audio reactive - Cables

Audio Analyzer op



<https://youtu.be/3m-2F2T1f6w>  
**Audio analyzer op - audio reactive**  
by cables\_gl

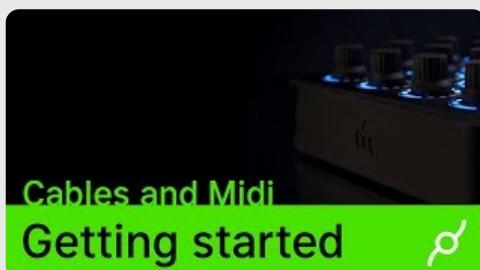


## Audio reactive - Cables

BiQuadFilter op



<https://youtu.be/68iSILnuLnA>  
**BiQuadFilter op- audio reactive tut**  
by cables\_gl



## Cables and Midi

### Getting started



[https://youtu.be/eDlaFD\\_d5lc](https://youtu.be/eDlaFD_d5lc)  
**Connecting Midi controllers to Cables**  
by cables\_gl



meetup talk

## SPATIAL AUDIO

<https://youtu.be/wKQN2BZPtyU>  
**Exploring Spatial Audio in Cables.gl**  
by cables\_gl

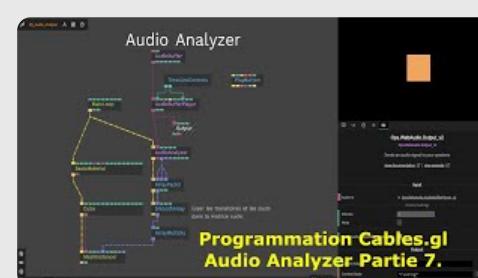


## Let's make a

### BEAT



<https://youtu.be/3owzslzvkdQ>  
**Let's make some noise! Building a drum machine with Cables.gl.**  
by Kirell Benzi

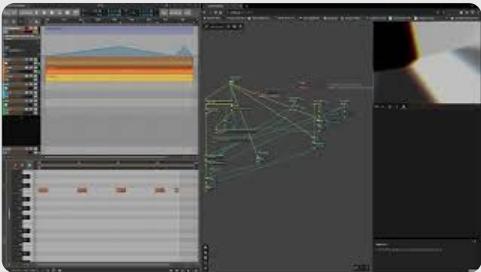


Audio Analyzer

Programmation Cables.gl  
Audio Analyzer Partie 7.

<https://youtu.be/KtREXHa9tS8>  
**Programmation Cables.gl Audio Analyzer Partie 7.**  
by Meletou1

## 12.7 Physics



<https://youtu.be/TyElawM-llo>  
**Syncing Cables.gl with Bitwig Studio**  
by Stefan Sauer



<https://youtu.be/TIDHrXS06-A>  
**[animatic] Better! // bitwig studio, cables.gl**  
by voz-h-kc



<https://youtu.be/S-KyCySVucM>  
**[HD] Sidereal Collapse // cables.gl, Bitwig Studio**  
by voz-h-kc

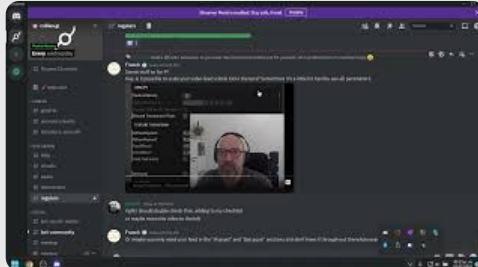


[https://youtu.be/hlmNF\\_42raY](https://youtu.be/hlmNF_42raY)  
**AmmoRaycast Operator - creating a simple 3D menu UI - Tutorial**  
by cables\_gl

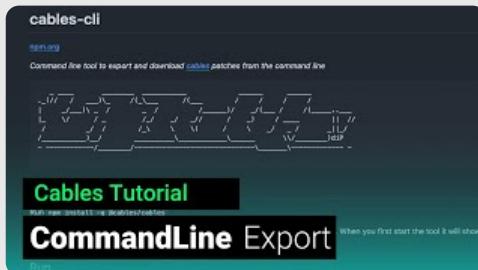


[https://youtu.be/TAhAqgY\\_EEs](https://youtu.be/TAhAqgY_EEs)  
**AmmoWorld and AmmoBody Operators - physics simulations in cables.gl - Video Tutorial**  
by cables\_gl

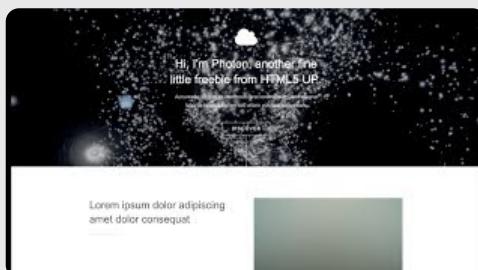
## 12.8 Export / Deployment / Embedding



[https://youtu.be/DX0slSkR\\_Hg](https://youtu.be/DX0slSkR_Hg)  
**Páginas WEB Interactivas con cables.gl 20 Exportación**  
by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/J8yJtcd1Jeg>  
**CABLES Command Line export**  
by cables\_gl



[https://youtu.be/YUAYs\\_NcwTA](https://youtu.be/YUAYs_NcwTA)  
**embed a cables patch into a html website**  
by cables\_gl



<https://youtu.be/B4M9FddXk1I>  
**Exporting your Project - .zip Export - Byte Size**  
by cables\_gl

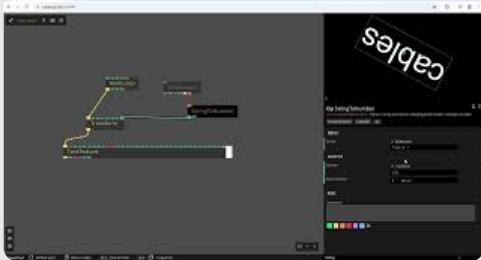


<https://youtu.be/L5BGMs7vKuI>  
**Exporting your Project - Netlify export - Byte Size**  
by cables\_gl



<https://youtu.be/hVxrxXhH7vQ>  
**Cables.gl Standalone (Offline) Build: Create Without Limits!**  
by Decode GL

## 12.9 Hardware / External Tools



<https://youtu.be/vebGfUp9vJ4>

**Getting cables.gl to talk to hardware, using Chataigne!**  
by Rob Duarte



<https://youtu.be/4YsuGFAEvEE>

**Phidget Encoder in cables.gl**  
by wirmachenbunt



[https://youtu.be/FvC3Ec\\_38Jo](https://youtu.be/FvC3Ec_38Jo)

**Inércia 2023 Seminar: Cables.gl as a demo making tool by anticore feat. liqube**  
by Associação Inércia



<https://youtu.be/xLBL06O1kXg>

**cables.gl october meetup**  
by cables\_gl



<https://youtu.be/xRbg1Az0k8k>

**November Update - cables.gl monthly meetup**  
by cables\_gl

## 12.10 Talks / Meetups / Release Notes



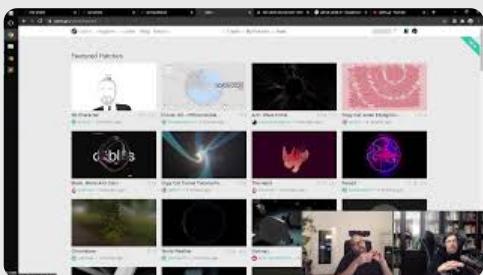
<https://youtu.be/C2FjpdRWPxw>

**Updated Physically Based Rendering Operators - discussion with the developer AMajesticSeaFlapFlap**  
by cables\_gl



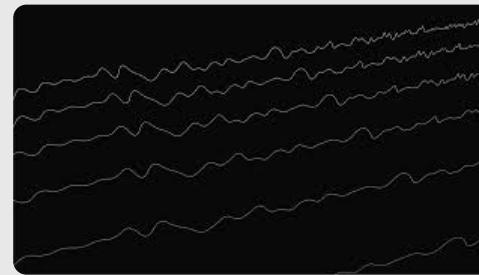
<https://youtu.be/oLPsJd0e4Gc>

**antonymph - vylet pony (avoset remix; cables.gl visualiser)**  
by avoset

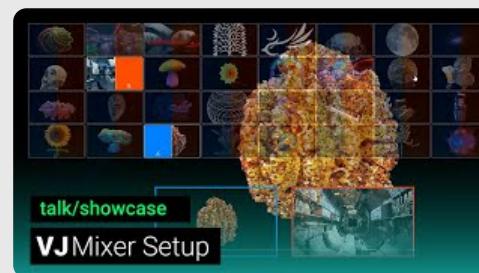


<https://youtu.be/v4rYqHuT-0E>

**Seminar: Making demos with cables.gl (speaker: pandur)**  
by psenough



<https://youtu.be/CfPJZMAXcTU>  
**Lines / Live experience with Cables.gl**  
by BoatBoat\_Station



[https://youtu.be/Zr\\_7wRBmRmA](https://youtu.be/Zr_7wRBmRmA)

**Building a VJ patch mixer with cables.gl**  
by cables\_gl

## 12.11 Showcases / Demos / Visualizers



<https://youtu.be/84pXsmJghdM>  
**demomaking with cables**  
by cables\_gl



<https://youtu.be/auvD8oSxMew>  
**cables.gl - Drifting Apart (FXHash Project)**  
by Creative Exploration /w Purz



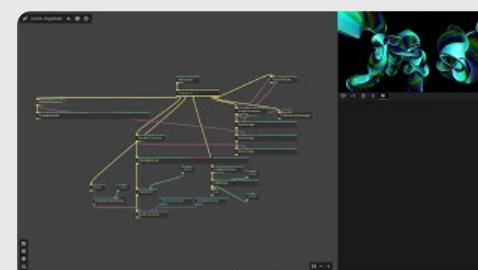
<https://youtu.be/M8ls131LSzE>  
**hydra - demo by mfx**  
by cables\_gl



[https://youtu.be/9vZrrXX\\_2jM](https://youtu.be/9vZrrXX_2jM)  
**cables.gl - purzOS - Low Poly Lavalamp (FXHash Project)**  
by Creative Exploration /w Purz



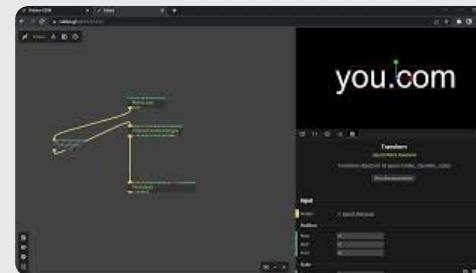
<https://youtu.be/R9-D4SxBd90>  
**Ninja de Gaia - Inércia 2023 - creating a demo with cables.gl**  
by cables\_gl



<https://youtu.be/a0lJ8DF-v8o>  
**cables.gl - purzOS - Ring Worlds (Screensaver)**  
by Creative Exploration /w Purz



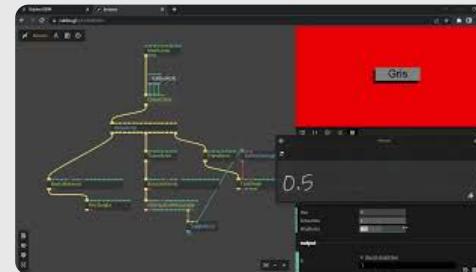
<https://youtu.be/EO3UdeBQ9m0>  
**EroLogo - Visual Demo Length 12:37 made with Cables.gl**  
by faktisProductions



[https://youtu.be/oBoH\\_7uHv-E](https://youtu.be/oBoH_7uHv-E)  
**Páginas WEB Interactivas con cables.gl 02 Enlace**  
by Alberto Barrios L. (nahui-ocelotl.com)

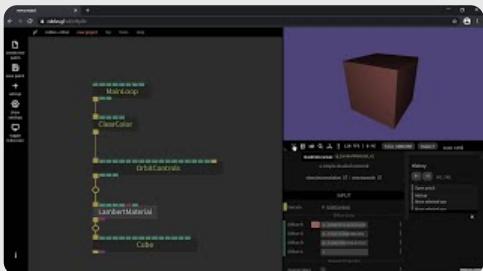


<https://youtu.be/xba3e91Fum4>  
**Design Designs Design - "Smorp" (A Cables.gl demo for Evoke 2022)**  
by Jan-Jozef Tuigstra



<https://youtu.be/-9QrZSoAPpQ>  
**Páginas WEB Interactivas con cables.gl 07 Botones**  
by Alberto Barrios L. (nahui-ocelotl.com)

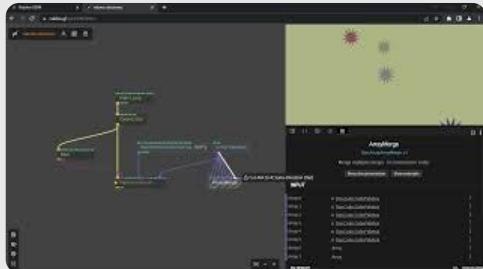
## 12.12 Unsorted (Still cables.gl-related)



<https://youtu.be/1FqBKJ1RXdY>  
**Entornos virtuales WEB con programación visual en cables.gl Parte 1**  
by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/MTel06T-kGw>  
**Páginas WEB Interactivas con cables.gl 08 Menú**  
by Alberto Barrios L. (nahui-ocelotl.com)



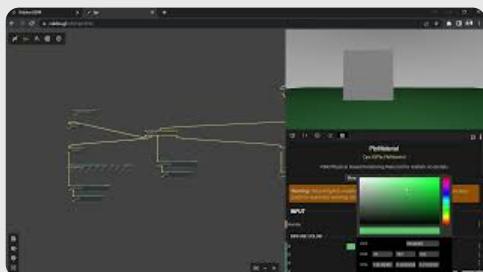
<https://youtu.be/iFDD4tm7-Uw>

**Páginas WEB Interactivas con cables.gl 15 Valores Aleatorios**  
by Alberto Barrios L. (nahui-ocelotl.com)



<https://youtu.be/7BiDxNc7D7g>

**Create awesome Visuals using OpenDAW and cables.gl!**  
by BeatMax\_Prediction



<https://youtu.be/a2H8vk3Ko1M>

**Páginas WEB Interactivas con cables.gl 18 FPS**  
by Alberto Barrios L. (nahui-ocelotl.com)



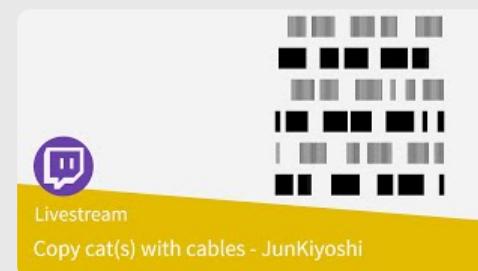
<https://youtu.be/omIK1YOtB70>

**Copy cat with cables- live stream - Inconvergent**  
by cables\_gl



<https://youtu.be/cVpC9IS6kI0>

**Substitution Pattern / Testing / CABLES.GL /**  
by Antiguo Autómata Mexicano



<https://youtu.be/tu49qg8BpBU>

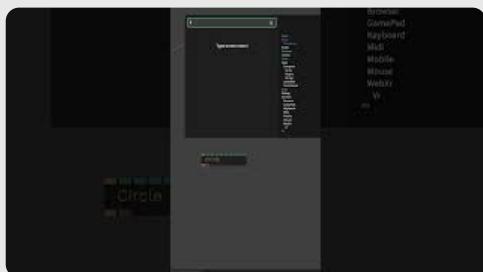
**copy cat(s) with cables live stream - Junkiyoshi**  
by cables\_gl



[https://youtu.be/Gr3iVMUs\\_hA](https://youtu.be/Gr3iVMUs_hA)  
**Copycat with Cables - Tyler hobbs - Untitled**  
by cables\_gl



<https://youtu.be/00Rvb749wrc>  
**Smooth Operator - Byte Size**  
by cables\_gl



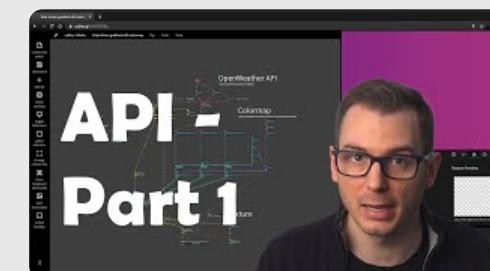
<https://youtu.be/hZQZsh5UHSE>  
**did you know, you can add multiple ops one go**  
by cables\_gl



<https://youtu.be/8LFR8iLLbMA>  
**Infinite Looping Motion Graphic in 10 minutes using cables.gl**  
by Jaalibandar



<https://youtu.be/jiOLZaMUH78>  
**Repeat op tut 01 - Byte size**  
by cables\_gl

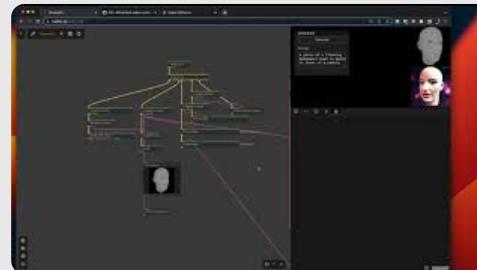


<https://youtu.be/WGoM1AmfW7g>  
**Getting data from an API with cables.gl - data-driven gradient from geo-located weather - part 1**  
by Kirell Benzi



<https://youtu.be/G1HKysL8iVw>

**Présentation du logiciel Cables.gl par les étudiants en UI/UX design**  
by L'École de design Nantes Atlantique

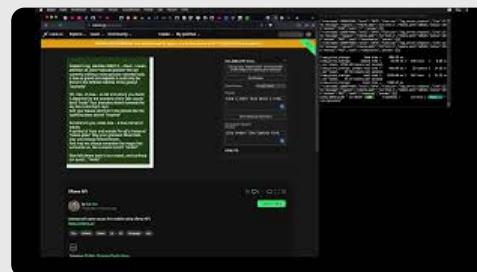


<https://youtu.be/n4UPiZhbcRU>

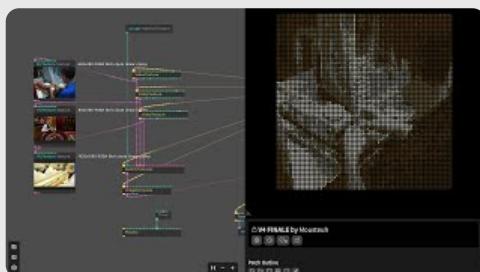
**StableDiffusion and ControlNet in Cables.gl via the WebUI**  
by Neight Allen



<https://youtu.be/4Op74ulzH5c>  
**Retour sur le programme Cables.gl**  
by Meletou1



<https://youtu.be/lIImv9ZJshUE>  
**cables.gl and ollama API**  
by Tobias Hartmann



<https://youtu.be/tdbTTxDu7Qk>  
**Cables.gl**  
by Nathan Sonzogni



<https://youtu.be/vOVKpppw1ds>  
**Class 30: Learning how to mint a cables.gl patch on fx hash w/ Somaticbits**  
by VERTICAL

# 13 Ops.Anim

## 13.1 AnimNumber



**Full Name:** Ops.Anim.AnimNumber

Always animates to the current value.

### > Inputs

- **Exe** (Trigger)
- **Value** (Number)
- **Duration** (Number)
- **Easing Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Result** (Number)
- **Finished** (Trigger)

**Example Patch:** [cables.gl/edit/lntUQx](https://cables.gl/edit/lntUQx)

**Doc:** [cables.gl/op/Ops.Anim.AnimNumber](https://cables.gl/op/Ops.Anim.AnimNumber)

## 13.2 Bang



**Full Name:** Ops.Anim.Bang

Trigger a simple bang animation going from 1 to 0.

### > Inputs

- **Update** (Trigger)
- **Bang** (Trigger)
- **Duration** (Number)
- **Invert** (Number: Boolean)

### < Output

- **Trigger Out** (Trigger)
- **Value** (Number)

**Example Patch:** [cables.gl/edit/TctR5r](https://cables.gl/edit/TctR5r)

**Doc:** [cables.gl/op/Ops.Anim.Bang](https://cables.gl/op/Ops.Anim.Bang)



<https://youtu.be/4PsWzWHsiV4>  
**cables.gl ink spill**  
by Video Art Duo



<https://youtu.be/9UR8upg0g54>  
**Pod005 - Flicker Distortion cables.gl**  
by zuggamasta

## 13.3 BoolAnim



BoolAnim

**Full Name:** Ops.Anim.BoolAnim

Animate between two numbers based on a boolean value.

### > Inputs

- **Exe** (Trigger)
- **Bool** (Number: Boolean)
- **Easing Index** (Number: Integer)
- **Duration** (Number)
- **Direction Index** (Number: Integer)
- **Value False** (Number)
- **Value True** (Number)

### < Output

- **Trigger** (Trigger)
- **Value** (Number)
- **Finished** (booleanNumber)
- **Finished Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/ofPcTo](https://cables.gl/edit/ofPcTo)

**Doc:** [cables.gl/op/Ops.Anim.BoolAnim](https://cables.gl/op/Ops.Anim.BoolAnim)

## 13.4 Crossfade



Crossfade

**Full Name:** Ops.Anim.Crossfade

Crossfade between 2 values.

### > Inputs

- **Crossfade** (Number)
- **Out Min** (Number)
- **Out Max** (Number)
- **Easing Index** (Number: Integer)

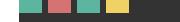
### < Output

- **A** (Number)
- **B** (Number)

**Example Patch:** [cables.gl/edit/U\\_a2d](https://cables.gl/edit/U_a2d)

**Doc:** [cables.gl/op/Ops.Anim.Crossfade](https://cables.gl/op/Ops.Anim.Crossfade)

## 13.5 FrameRangeAnim\_v2



FrameRangeAnim

**Full Name:** Ops.Anim.FrameRangeAnim\_v2

Parses string containing ranges of frames and play as coherent animation.

### > Inputs

- **Time** (Number)
- **Frames** (String)
- **frame range** (ex. "0-10")
- **Loop** (Number: Boolean)
- **Rewind** (Trigger)

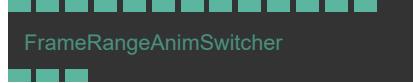
### < Output

- **Result Time** (Number)
- **Expanded Frames** (Array)
- **Finished** (booleanNumber)
- **Finished Trigger** (Trigger)
- **Anim Length** (Number)
- **Progress** (Number)

**Example Patch:** [cables.gl/op/Ops.Anim.FrameRangeAnim\\_v2#example](https://cables.gl/op/Ops.Anim.FrameRangeAnim_v2#example)

**Doc:** [cables.gl/op/Ops.Anim.FrameRangeAnim\\_v2](https://cables.gl/op/Ops.Anim.FrameRangeAnim_v2)

## 13.6 FrameRangeAnimSwitcher



FrameRangeAnimSwitcher

**Full Name:** Ops.Anim.FrameRangeAnimSwitcher

Switch between multiple anim ranges of a keyframed 3d scene.

### > Inputs

- **Index** (Number: Integer)
- **Duration** (Number)
- **Easing Index** (Number: Integer)
- **Value 0** (Number)
- **Value 1** (Number)
- **Value 2** (Number)
- **Value 3** (Number)
- **Value 4** (Number)
- **Value 5** (Number)
- **Value 6** (Number)
- **Value 7** (Number)
- **Value 8** (Number)
- **Value 9** (Number)

### < Output

- **Time 1** (Number)
- **Time Fade** (Number)
- **Time 2** (Number)

**Example Patch:** [cables.gl/edit/HwVRrT](https://cables.gl/edit/HwVRrT)

**Doc:** [cables.gl/op/Ops.Anim.FrameRangeAnimSwitcher](https://cables.gl/op/Ops.Anim.FrameRangeAnimSwitcher)

## 13.7 InOutInAnim



InOutInAnim

**Full Name:** Ops.Anim.InOutInAnim

Animates after a trigger from 1 to 0 to 1.

### > Inputs

- **Update** (Trigger)
- **Duration In** (Number)
- **Easing In Index** (Number: Integer)
- **Value In** (Number)
- **Hold Duration** (Number)
- **Duration Out** (Number)
- **Easing Out Index** (Number: Integer)
- **Value Out** (Number)
- **Start** (Trigger)

### < Output

- **Next** (Trigger)
- **Result** (Number)
- **Started** (Trigger)
- **Middle** (Trigger)
- **Finished** (Trigger)

**Example Patch:** [cables.gl/edit/HwVRrT](https://cables.gl/edit/HwVRrT)

**Doc:** [cables.gl/op/Ops.Anim.InOutInAnim](https://cables.gl/op/Ops.Anim.InOutInAnim)

## 13.8 LFO\_v3



**Full Name:** Ops.Anim.LFO\_v3

Low-frequency oscillation for animations.

### > Inputs

- **Time** (Number)
- **Frequency** (Number)
- **Type Index** (Number: Integer)
- **Phase** (Number)
- **Range Min** (Number)
- **Range Max** (Number)

### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/9EOrS8](https://cables.gl/edit/9EOrS8)

**Doc:** [cables.gl/op/Ops.Anim.LFO\\_v3](https://cables.gl/op/Ops.Anim.LFO_v3)

## 13.9 RandomAnim\_v2



**Full Name:** Ops.Anim.RandomAnim\_v2

Animates between random values defined by a min and max value.

### > Inputs

- **Exe** (Trigger)
- **Min** (Number)
- **Max** (Number)
- **Duration** (Number)
- **Pause Between** (Number)
- **Easing Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Result** (Number)
- **Looped** (Trigger)

**Example Patch:** [cables.gl/edit/nCSoG8](https://cables.gl/edit/nCSoG8)

**Doc:** [cables.gl/op/Ops.Anim.RandomAnim\\_v2](https://cables.gl/op/Ops.Anim.RandomAnim_v2)

## 13.10 SimpleAnim



**Full Name:** Ops.Anim.SimpleAnim

Simple animation between two values.

### > Inputs

- **Exe** (Trigger)
- **Reset** (Trigger)
- **Rewind** (Trigger)
- **Start** (Number)
- **End** (Number)
- **Duration** (Number)
- **Loop** (Number: Boolean)
- **Wait For Reset** (Number: Boolean)
- **Easing Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Result** (Number)
- **Finished** (Number)
- **Finished Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/dOlV9L](https://cables.gl/edit/dOlV9L)

**Doc:** [cables.gl/op/Ops.Anim.SimpleAnim](https://cables.gl/op/Ops.Anim.SimpleAnim)

## 13.11 SineAnim



SineAnim

**Full Name:** Ops.Anim.SineAnim

Animation in the form of a sine/cosine curve (sinus/cos).

### > Inputs

- **Exe** (Trigger)
- **Mode Index** (Number: Integer)
- **Phase** (Number)
- **Frequency** (Number)
- **Amplitude** (Number)

### < Output

- **Trigger Out** (Trigger)
- **Result** (Number)

**Example Patch:** cables.gl/edit/3bbUfp

**Doc:** cables.gl/op/Ops.Anim.SineAnim

## 13.12 Smooth



Smooth

**Full Name:** Ops.Anim.Smooth

Smooths out jumps in values (AverageInterpolation).

### > Inputs

- **Update** (Trigger)
- **Value** (Number)
- **Dec Factor** (Number)

### < Output

- **Next** (Trigger)
- **Result** (Number)

**Example Patch:** cables.gl/edit/c9gqda

**Doc:** cables.gl/op/Ops.Anim.Smooth

## 13.13 Snap



Snap

**Full Name:** Ops.Anim.Snap

Snap at certain points (e.g. while scrolling).

### > Inputs

- **Delta** (Number)
- **Snap At Values** (Array)
- **Snap Distance** (Number)
- **Snap Distance Release** (Number)
- **Slowdown** (Number)
- **Block Input After Snap** (Number)
- **Reset** (Trigger)
- **Min** (Number)
- **Max** (Number)
- **Value Mul** (Number)
- **Enabled** (Number: Boolean)

### < Output

- **Result** (Number)
- **Distance** (Number)
- **Snapped** (Number)
- **Was Snapped** (Number)

**Example Patch:** cables.gl/edit/7B11U6

**Doc:** cables.gl/op/Ops.Anim.Snap

## 13.14 Spring

Spring

**Full Name:** Ops.Anim.Spring

Spring simulation based on input target value.

### > Inputs

- **Exe** (Trigger)
- **Value** (Number)
- **Damping** (Number)
- **Stiffness** (Number)

### < Output

- **Trigger** (Trigger)
- **Result** (Number)

**Example Patch:** [cables.gl/edit/bsbM2y](https://cables.gl/edit/bsbM2y)

**Doc:** [cables.gl/op/Ops.Anim.Spring](https://cables.gl/op/Ops.Anim.Spring)

## 13.15 StringTypeAnimation\_v2

StringTypeAnimation

**Full Name:** Ops.Anim.StringTypeAnimation\_v2

Animates a text/string, like it is being typed out by a person.

### > Inputs

- **Text** (String)
- **Restart** (Trigger)
- **Speed** (Number)
- **Speed Variation** (Number)
- **Show Cursor** (Number: Boolean)

### < Output

- **Result** (String)
- **Changed** (Trigger)
- **Finished** (Trigger)

**Example Patch:** [cables.gl/edit/8dB2eH](https://cables.gl/edit/8dB2eH)

**Doc:** [cables.gl/op/Ops.Anim.StringTypeAnimation\\_v2](https://cables.gl/op/Ops.Anim.StringTypeAnimation_v2)

## 13.16 TimeDelta

TimeDelta

**Full Name:** Ops.Anim.TimeDelta

Measure the time difference between two triggers.

### > Inputs

- **Exe** (Trigger)
- **Smooth** (Number: Boolean)
- **Seconds** (Number: Boolean)

### < Output

- **Trigger** (Trigger)
- **Result** (Number)

**Example Patch:** [cables.gl/edit/omrKQm](https://cables.gl/edit/omrKQm)

**Doc:** [cables.gl/op/Ops.Anim.TimeDelta](https://cables.gl/op/Ops.Anim.TimeDelta)

## 13.17 Timer\_v2

Timer

**Full Name:** Ops.Anim.Timer\_v2

A timer that can be started, paused and reset by triggering.

### > Inputs

- **Speed** (Number)
- **Play** (Number: Boolean)
- **Reset** (Trigger)
- **Sync To Timeline** (Number: Boolean)

### < Output

- **Time** (Number)

**Example Patch:** [cables.gl/edit/YTuOQm](https://cables.gl/edit/YTuOQm)

**Doc:** [cables.gl/op/Ops.Anim.Timer\\_v2](https://cables.gl/op/Ops.Anim.Timer_v2)

# 14 Ops.Array

## 14.1 AnglesBetweenPoints

AnglesBetweenPoints

**Full Name:** Ops.Array.AnglesBetweenPoints

Outputs the angle between points in 3D space (degree).

### > Inputs

- **Points** (Array)
- **Theta** (Number)
- **Phi** (Number)

### < Output

- **Rotations** (Array)

**Example Patch:** cables.gl/edit/Y2\_BIR

**Doc:** cables.gl/op/Ops.Array.AnglesBetweenPoints

## 14.2 AnimArray\_v2

AnimArray

**Full Name:** Ops.Array.AnimArray\_v2

Animate values in an array to another array.

### > Inputs

- **Update** (Trigger)
- **Next Array** (Array)
- **Duration** (Number)
- **Easing Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Matrix** (Array)

**Example Patch:** cables.gl/edit/OwvgkJ

**Doc:** cables.gl/op/Ops.Array.AnimArray\_v2

## 14.3 Array1toX\_v2

Array1toX

**Full Name:** Ops.Array.Array1toX\_v2

convert an array1 to array2,3,4 by choosing content for new axis.

### > Inputs

- **Array1x** (Array)

### < Output

- **Array3x** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/omZrLu

**Doc:** cables.gl/op/Ops.Array.Array1toX\_v2

## 14.4 Array2To3

Array2To3

**Full Name:** Ops.Array.Array2To3

Inserts zeroes every third item.

### > Inputs

- **Array2x** (Array)

### < Output

- **Array3x** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/xAg8P6

**Doc:** cables.gl/op/Ops.Array.Array2To3

## 14.5 Array3

Array3

**Full Name:** Ops.Array.Array3

Create an array of num triplets set to default values xyz.

### > Inputs

- **Num Triplets** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

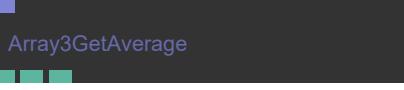
### < Output

- **Array** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/lmn5Og

**Doc:** cables.gl/op/Ops.Array.Array3

## 14.6 Array3GetAverage



Array3GetAverage

**Full Name:** Ops.Array.Array3GetAverage

Average x,y,z values of an array3x.

**> Inputs**

- **Array** (Array)

**< Output**

- **Average X** (Number)
- **Average Y** (Number)
- **Average Z** (Number)

**Example Patch:** cables.gl/edit/lmn5Og

**Doc:** cables.gl/op/Ops.Array.Array3GetAverage

## 14.7 Array3GetNumbers



Array3GetNumbers

**Full Name:** Ops.Array.Array3GetNumbers

Get 3 values XYZ from an array.

**> Inputs**

- **Array** (Array)
- **Index** (Number: Integer)

**< Output**

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** cables.gl/edit/5LhTLJ

**Doc:** cables.gl/op/Ops.Array.Array3GetNumbers

## 14.8 Array3InterpolateDistributed



Array3InterpolateDistributed

**Full Name:** Ops.Array.Array3InterpolateDistributed

Interpolate between two arrays.

**> Inputs**

- **Update** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)

- **Progress** (Number)

**< Output**

- **Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/2UuCa6

**Doc:** cables.gl/op/Ops.Array.Array3InterpolateDistributed

## 14.9 Array3Iterator



Array3Iterator

**Full Name:** Ops.Array.Array3Iterator

Iterate over an array in steps of three and outputs three values.

**> Inputs**

- **Execute** (Trigger)
- **Array** (Array)
- **Step** (Number)

**< Output**

- **Trigger** (Trigger)
- **Triggers for every iteration step** (triplet in the array)
- **Index** (Number)
- **Value 1** (Number)
- **First value of the current triplet** (e.g. x)
- **Value 2** (Number)
- **Second value of the current triplet** (e.g. y)
- **Value 3** (Number)
- **Third value of the current triplet** (e.g. z)

**Example Patch:** cables.gl/edit/Ubk3u

**Doc:** cables.gl/op/Ops.Array.Array3Iterator

## 14.10 Array3Multiply



Array3Multiply

**Full Name:** Ops.Array.Array3Multiply

Multiply every XYZ member of array3x.

**> Inputs**

- **Array3x** (Array)
- **Mul X** (Number)
- **Mul Y** (Number)
- **Mul Z** (Number)

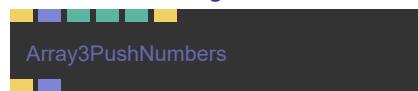
## < Output

- **Result** (Array)

**Example Patch:** [cables.gl/edit/8FxmVJ](https://cables.gl/edit/8FxmVJ)

**Doc:** [cables.gl/op/Ops.Array.Array3Multiply](https://cables.gl/op/Ops.Array.Array3Multiply)

## 14.11 Array3PushNumbers\_v2



**Full Name:** Ops.Array.Array3PushNumbers\_v2

Push three numbers to the end of an array (was ArrayPushValue3x).

### > Inputs

- **Execute** (Trigger)
- **Array** (Array)
- **Value 1** (Number)
- **Value 2** (Number)
- **Value 3** (Number)
- **Reset** (Trigger)

### < Output

- **Next** (Trigger)
- **Result Array** (Array)

**Example Patch:** [cables.gl/edit/uOzMH7](https://cables.gl/edit/uOzMH7)

**Doc:** [cables.gl/op/Ops.Array.Array3PushNumbers\\_v2](https://cables.gl/op/Ops.Array.Array3PushNumbers_v2)

## 14.12 Array3RandomSelection



**Full Name:** Ops.Array.Array3RandomSelection

Extract definable amount of random xyz points from an array.

### > Inputs

- **Array** (Array)
- **Elements** (Number: Integer)
- **Seed** (Number)

### < Output

- **Result** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** [cables.gl/edit/1qNz98](https://cables.gl/edit/1qNz98)

**Doc:** [cables.gl/op/Ops.Array.Array3RandomSelection](https://cables.gl/op/Ops.Array.Array3RandomSelection)

## 14.13 Array3SetNumber



Array3SetNumber

**Full Name:** Ops.Array.Array3SetNumber

Set three numbers at index in an array.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)

### < Output

- **Result** (Array)

**Example Patch:** [cables.gl/edit/t44fQc](https://cables.gl/edit/t44fQc)

**Doc:** [cables.gl/op/Ops.Array.Array3SetNumber](https://cables.gl/op/Ops.Array.Array3SetNumber)

## 14.14 Array3Sum



**Full Name:** Ops.Array.Array3Sum

Add number to every XYZ member of array3x.

### > Inputs

- **Array3x** (Array)
- **Add X** (Number)
- **Add Y** (Number)
- **Add Z** (Number)

### < Output

- **Result** (Array)

**Example Patch:** [cables.gl/edit/D-pQHj](https://cables.gl/edit/D-pQHj)

**Doc:** [cables.gl/op/Ops.Array.Array3Sum](https://cables.gl/op/Ops.Array.Array3Sum)

## 14.15 Array3To2



**Full Name:** Ops.Array.Array3To2

Remove every 3rd item of an array - changes array length.

### > Inputs

- **Array3x** (Array)

## < Output

- **Array2x** (Array)

**Example Patch:** cables.gl/edit/lmn5Og

**Doc:** cables.gl/op/Ops.Array.Array3To2

## 14.16 Array3To4



**Full Name:** Ops.Array.Array3To4

Convert an array3 to an array4 by filling it up with 1.

### > Inputs

- **Array3x** (Array)

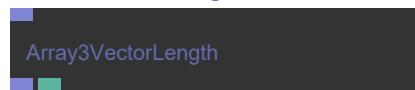
### < Output

- **Array4x** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/h\_Dbm4

**Doc:** cables.gl/op/Ops.Array.Array3To4

## 14.17 Array3VectorLength



**Full Name:** Ops.Array.Array3VectorLength

Return the length of a vector from an array 3.

### > Inputs

- **Array In** (Array)

### < Output

- **Array Out** (Array)
- **Array Lengths** (Number)

**Example Patch:** cables.gl/edit/L9tsRJ

**Doc:** cables.gl/op/Ops.Array.Array3VectorLength

## 14.18 Array4



**Full Name:** Ops.Array.Array4

Create an array of num quadruples set to default values xyz.

### > Inputs

## > Num Quadruplets (Number: Integer)

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

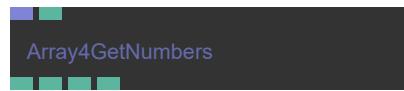
## < Output

- **Array** (Array)
- **Total Quadruplets** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/HjHdQc

**Doc:** cables.gl/op/Ops.Array.Array4

## 14.19 Array4GetNumbers



**Full Name:** Ops.Array.Array4GetNumbers

Get 4 values from an array.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)

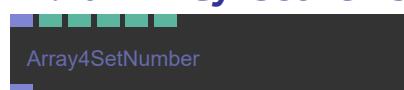
### < Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

**Example Patch:** cables.gl/edit/tl0COg

**Doc:** cables.gl/op/Ops.Array.Array4GetNumbers

## 14.20 Array4SetNumber



**Full Name:** Ops.Array.Array4SetNumber

Set four numbers at index in an array.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)

- **Value W** (Number)

#### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/HjHdQc

**Doc:** cables.gl/op/Ops.Array.Array4SetNumber

## 14.21 Array4toArray3



**Full Name:** Ops.Array.Array4toArray3

Convert an array4 to array3 by dropping every 4th number.

#### > Inputs

- **Array** (Array)

#### < Output

- **Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/SZdOet

**Doc:** cables.gl/op/Ops.Array.Array4toArray3

## 14.22 Array\_v3



**Full Name:** Ops.Array.Array\_v3

Can generate 3 kinds of arrays: Number - 1,2,3,4 - Normalized - (Continuous-NumberArray).

#### > Inputs

- **Array Length** (Number: Integer)
- **Mode Select Index** (Number: Integer)
- **Default Value** (Number)
- **Reverse** (Number: Boolean)

#### < Output

- **Array** (Array)
- **Array Length Out** (Number)

**Example Patch:** cables.gl/edit/P4qAz6

**Doc:** cables.gl/op/Ops.Array.Array\_v3

## 14.23 ArrayAbs



**Full Name:** Ops.Array.ArrayAbs

Converts array contents to absolute values - converts all negative numbers to positive numbers.

#### > Inputs

- **In** (Array)

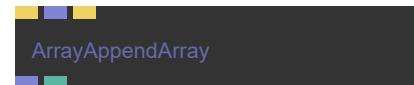
#### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/Jdij7z

**Doc:** cables.gl/op/Ops.Array.ArrayAbs

## 14.24 ArrayAppendArray



**Full Name:** Ops.Array.ArrayAppendArray

Append an array to an existing array.

#### > Inputs

- **Join** (Trigger)
- **Array** (Array)
- **Reset** (Trigger)

#### < Output

- **Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/quYUvH

**Doc:** cables.gl/op/Ops.Array.ArrayAppendArray

## 14.25 ArrayBuffer



**Full Name:** Ops.Array.ArrayBuffer

Store values in an array / fifo array buffer.

#### > Inputs

- **Exec** (Trigger)
- **Value** (Number)
- **Max Length** (Number: Integer)
- **Reset** (Trigger)

#### < Output

- **Trigger Out** (Trigger)
- **Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/\_ZPEnB

**Doc:** cables.gl/op/Ops.Array.ArrayBuffer

## 14.26 ArrayBuffer3



**Full Name:** Ops.Array.ArrayBuffer3

Circular buffer for xyz values.

#### > Inputs

- **Exec** (Trigger)
- **Max Num Elements** (Number)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)
- **Reset** (Trigger)

#### < Output

- **Trigger Out** (Trigger)
- **Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/TNwlZC

**Doc:** cables.gl/op/Ops.Array.ArrayBuffer3

## 14.27 ArrayCeil



**Full Name:** Ops.Array.ArrayCeil

Round numbers up.

#### > Inputs

- **In** (Array)

#### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/7xdJrG

**Doc:** cables.gl/op/Ops.Array.ArrayCeil

## 14.28 ArrayChunk



**Full Name:** Ops.Array.ArrayChunk

Extracts x elements from an array.

#### > Inputs

- **Input Array** (Array)
- **Begin Index** (Number: Integer)
- **Chunk Size** (Number: Integer)
- **Circular** (Number: Boolean)

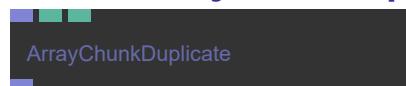
#### < Output

- **Output Array** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/yGR5GA

**Doc:** cables.gl/op/Ops.Array.ArrayChunk

## 14.29 ArrayChunkDuplicate



**Full Name:** Ops.Array.ArrayChunkDuplicate

Repeat chunks of an array multiple times.

#### > Inputs

- **Array** (Array)
- **Chunk Size** (Number: Integer)
- **Repeats** (Number: Integer)

#### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/Vu22bf

**Doc:** cables.gl/op/Ops.Array.ArrayChunkDuplicate

## 14.30 ArrayClamp



**Full Name:** Ops.Array.ArrayClamp

Clamp the values of an array to a min and max value.

#### > Inputs

- **Array In** (Array)
- **Min** (Number)

- **Max** (Number)

**< Output**

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/tyxvSP

**Doc:** cables.gl/op/Ops.Array.ArrayClamp

## 14.31 ArrayContains\_v2



ArrayContains

**Full Name:** Ops.Array.ArrayContains\_v2

Check if an array contains a number (find,search,indexOf).

**> Inputs**

- **Array** (Array)
- **SearchValue** (Number)

**< Output**

- **Found** (booleanNumber)
- **Index** (Number)

**Example Patch:** cables.gl/edit/8pZ8GA

**Doc:** cables.gl/op/Ops.Array.ArrayContains\_v2

## 14.32 ArrayDivide



ArrayDivide

**Full Name:** Ops.Array.ArrayDivide

Divide all values in an array by one number.

**> Inputs**

- **Array In** (Array)
- **Value** (Number)

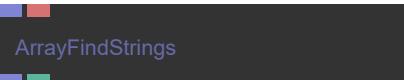
**< Output**

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/uIYNcn

**Doc:** cables.gl/op/Ops.Array.ArrayDivide

## 14.33 ArrayFindStrings



ArrayFindStrings

**Full Name:** Ops.Array.ArrayFindStrings

Return all the indexes of a string in an array.

**> Inputs**

- **Array** (Array)
- **SearchValue** (String)

**< Output**

- **Index** (Array)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/p9sBjH

**Doc:** cables.gl/op/Ops.Array.ArrayFindStrings

## 14.34 ArrayFloor



ArrayFloor

**Full Name:** Ops.Array.ArrayFloor

Round numbers down.

**> Inputs**

- **In** (Array)

**< Output**

- **Result** (Array)

**Example Patch:** cables.gl/edit/7xdJrG

**Doc:** cables.gl/op/Ops.Array.ArrayFloor

## 14.35 ArrayFract



ArrayFract

**Full Name:** Ops.Array.ArrayFract

Return the fractional remainder of all values in an array.

**> Inputs**

- **In** (Array)

**< Output**

- **Result** (Array)

**Example Patch:** cables.gl/edit/uVzlmG

**Doc:** cables.gl/op/Ops.Array.ArrayFract

## 14.36 ArrayFromNumbers



ArrayFromNumbers

**Full Name:** Ops.Array.ArrayFromNumbers

Simple way to create small arrays of numbers.

## > Inputs

- **Update** (Trigger)
- **Limit** (Number: Integer)
- **Slider** (Number: Boolean)
- **Index 0** (Number)
- **Index 1** (Number)
- **Index 2** (Number)
- **Index 3** (Number)
- **Index 4** (Number)
- **Index 5** (Number)
- **Index 6** (Number)
- **Index 7** (Number)
- **Index 8** (Number)
- **Index 9** (Number)
- **Index 10** (Number)
- **Index 11** (Number)
- **Index 12** (Number)
- **Index 13** (Number)
- **Index 14** (Number)
- **Index 15** (Number)
- **Index 16** (Number)
- **Index 17** (Number)
- **Index 18** (Number)
- **Index 19** (Number)
- **Index 20** (Number)
- **Index 21** (Number)
- **Index 22** (Number)
- **Index 23** (Number)
- **Index 24** (Number)
- **Index 25** (Number)
- **Index 26** (Number)
- **Index 27** (Number)
- **Index 28** (Number)
- **Index 29** (Number)

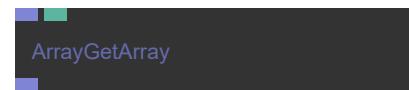
## < Output

- **Next** (Trigger)
- **Array** (Array)

**Example Patch:** [cables.gl/edit/ZNPh2B](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayFromNumbers](#)

## 14.37 ArrayGetArray



**Full Name:** Ops.Array.ArrayGetArray

Get an array from an array of arrays.

### > Inputs

- **Array Of Arrays** (Array)
- **Index** (Number: Integer)

### < Output

- **Result Array** (Array)

**Example Patch:** [cables.gl/edit/yU2Pet](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayGetArray](#)

## 14.38 ArrayGetNumber



**Full Name:** Ops.Array.ArrayGetNumber

Return a value from an array.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Value Invalid Index** (Number)

### < Output

- **Value** (Number)
- **Valid Index** (booleanNumber)

**Example Patch:** [cables.gl/edit/38Alji](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayGetNumber](#)

## 14.39 ArrayGetObject



**Full Name:** Ops.Array.ArrayGetObject

Get an object from an array.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)

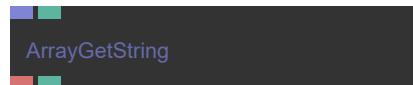
### < Output

- **Value** (Object)

**Example Patch:** cables.gl/edit/7npL\_M

**Doc:** cables.gl/op/Ops.Array.ArrayGetObject

## 14.40 ArrayGetString\_v2



**Full Name:** Ops.Array.ArrayGetString\_v2

Get a string from an array at [index].

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)

### < Output

- **Result** (String)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/aHNk8i

**Doc:** cables.gl/op/Ops.Array.ArrayGetString\_v2

## 14.41 ArrayGetTexture



**Full Name:** Ops.Array.ArrayGetTexture

Get texture from array at index.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)

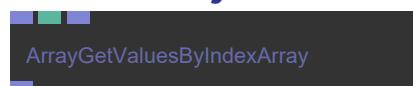
### < Output

- **Value** (Object)

**Example Patch:** cables.gl/edit/jFv097

**Doc:** cables.gl/op/Ops.Array.ArrayGetTexture

## 14.42 ArrayGetValuesByIndexArray



**Full Name:** Ops.Array.ArrayGetValuesByIndexArray

Pick values from input array at given indices and stride.

### > Inputs

- **Array** (Array)
- **Array Stride Index** (Number: Integer)

- **Indices** (Array)

### < Output

- **Results** (Array)

**Example Patch:** cables.gl/edit/bOBgTq

**Doc:** cables.gl/op/Ops.Array.ArrayGetValuesByIndexArray

## 14.43 ArrayIndexBetween



**Full Name:** Ops.Array.ArrayIndexBetween

Output index where value is greater than number and smaller then next number.

### > Inputs

- **Array** (Array)
- **Value** (Number)

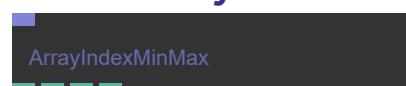
### < Output

- **Index** (Number)

**Example Patch:** cables.gl/edit/kH4xLu

**Doc:** cables.gl/op/Ops.Array.ArrayIndexBetween

## 14.44 ArrayIndexMinMax



**Full Name:** Ops.Array.ArrayIndexMinMax

Find lowest/highest numbers in an array.

### > Inputs

- **Array** (Array)

### < Output

- **Max** (Number)
- **Index Max** (Number)
- **Min** (Number)
- **Index Min** (Number)

**Example Patch:** cables.gl/edit/gamucI

**Doc:** cables.gl/op/Ops.Array.ArrayIndexMinMax

## 14.45 ArrayIteratorArray

ArrayIteratorArray

**Full Name:** Ops.Array.ArrayIteratorArray

Iterate over an array of arrays.

### > Inputs

- **Exe** (Trigger)
- **Array** (Array)

### < Output

- **Trigger** (Trigger)
- **Index** (Number)
- **Result** (Array)

**Example Patch:** cables.gl/edit/xFKQet

**Doc:** cables.gl/op/Ops.Array.ArrayIteratorArray

## 14.46 ArrayIteratorNumbers

ArrayIteratorNumbers

**Full Name:** Ops.Array.ArrayIteratorNumbers

Loop over every element of an array.

### > Inputs

- **Exe** (Trigger)
- **Array** (Array)

### < Output

- **Trigger** (Trigger)
- **Index** (Number)
- **Value** (Number)

**Example Patch:** cables.gl/edit/Ubwk3u

**Doc:** cables.gl/op/Ops.Array.ArrayIteratorNumbers

## 14.47 ArrayIteratorObjects

ArrayIteratorObjects

**Full Name:** Ops.Array.ArrayIteratorObjects

Iterate over an array of objects.

### > Inputs

- **Exe** (Trigger)
- **Array** (Array)

### < Output

- **Trigger** (Trigger)
- **Finished** (Trigger)
- **Index** (Number)
- **Value** (Object)

**Example Patch:** cables.gl/edit/UIL2G1

**Doc:** cables.gl/op/Ops.Array.ArrayIteratorObjects

## 14.48 ArrayIteratorStrings

ArrayIteratorStrings

**Full Name:** Ops.Array.ArrayIteratorStrings

Loop over every element of an array.

### > Inputs

- **Exe** (Trigger)
- **Array** (Array)

### < Output

- **Trigger** (Trigger)
- **Index** (Number)
- **Value** (String)

**Example Patch:** cables.gl/edit/53WCcl

**Doc:** cables.gl/op/Ops.Array.ArrayIteratorStrings

## 14.49 ArrayIteratorTextures

ArrayIteratorTextures

**Full Name:** Ops.Array.ArrayIteratorTextures

Iterate over an array of objects.

### > Inputs

- **Exe** (Trigger)
- **Array** (Array)

### < Output

- **Trigger** (Trigger)
- **Finished** (Trigger)
- **Index** (Number)
- **Value** (Object)

**Example Patch:** cables.gl/edit/vS5fjz

**Doc:** cables.gl/op/Ops.Array.ArrayIteratorTextures

## 14.50 ArrayLength\_v2

ArrayLength

**Full Name:** Ops.Array.ArrayLength\_v2

Number of items in an array.

### > Inputs

- **Array** (Array)

### < Output

- **Length** (Number)

**Example Patch:** cables.gl/edit/P4qAz6

**Doc:** cables.gl/op/Ops.Array.ArrayLength\_v2

## 14.51 ArrayLogic

ArrayLogic

**Full Name:** Ops.Array.ArrayLogic

Performs logical comparison operations on a single array of numbers.

### > Inputs

- **Array 0** (Array)
- **Comparison Mode Index** (Number: Integer)
- **Number For Comparison** (Number)
- **Value If True** (Number)
- **Value If False** (Number)

### < Output

- **Array Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/D3DmbJ

**Doc:** cables.gl/op/Ops.Array.ArrayLogic

## 14.52 ArrayLogicArray

ArrayLogicArray

**Full Name:** Ops.Array.ArrayLogicArray

Performs logical comparison operations on two arrays.

### > Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Value If True** (Number)

- **Value If False** (Number)
- **Comparison Mode Index** (Number: Integer)

### < Output

- **Array Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/T\_-NmJ

**Doc:** cables.gl/op/Ops.Array.ArrayLogicArray

## 14.53 ArrayLogicBetween\_v2

ArrayLogicBetween

**Full Name:** Ops.Array.ArrayLogicBetween\_v2

If value of array is between min and max then the value is 1 else 0.

### > Inputs

- **Array** (Array)
- **Min** (Number)
- **Max** (Number)
- **Pass Value When True** (Number: Boolean)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/jTqRet

**Doc:** cables.gl/op/Ops.Array.ArrayLogicBetween\_v2

## 14.54 ArrayLookup

ArrayLookup

**Full Name:** Ops.Array.ArrayLookup

Create an array that is filled with values looked up by index from another array.

### > Inputs

- **Indices** (Array)
- **Values** (Array)
- **Stride** (Number: Integer)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/cwJBEe

**Doc:** cables.gl/op/Ops.Array.ArrayLookup

## 14.55 ArrayMath

ArrayMath

**Full Name:** Ops.Array.ArrayMath

Pick from multiple mathematical modes which can all be applied to a single array.

### > Inputs

- **Array 0** (Array)
- **Number For Math** (Number)
- **Math Function Index** (Number: Integer)

### < Output

- **Array Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/7E1hqH

**Doc:** cables.gl/op/Ops.Array.ArrayMath

## 14.56 ArrayMathArray

ArrayMathArray

**Full Name:** Ops.Array.ArrayMathArray

Perform a math operations on two arrays.

### > Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Math Function Index** (Number: Integer)

### < Output

- **Array Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/uIYNcn

**Doc:** cables.gl/op/Ops.Array.ArrayMathArray

## 14.57 ArrayMathExpression

ArrayMathExpression

**Full Name:** Ops.Array.ArrayMathExpression

Calculate a user-defined mathematical expression.

### > Inputs

- **A** (Array)

- **B** (Array)
- **C** (Array)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Expression** (String)

### < Output

- **Result Array** (Array)
- **Array Length** (Number)
- **Expression Valid** (booleanNumber)

**Example Patch:** cables.gl/edit/\_o2Mue

**Doc:** cables.gl/op/Ops.Array.ArrayMathExpression

## 14.58 ArrayMathExpressionTrigger

ArrayMathExpressionTrigger

**Full Name:** Ops.Array.ArrayMathExpressionTrigger

Calculate a user-defined mathematical expression.

### > Inputs

- **Update** (Trigger)
- **A** (Array)
- **B** (Array)
- **C** (Array)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Expression** (String)

### < Output

- **Next** (Trigger)
- **Result Array** (Array)
- **Array Length** (Number)
- **Expression Valid** (booleanNumber)

**Example Patch:** cables.gl/edit/\_o2Mue

**Doc:** cables.gl/op/Ops.Array.ArrayMathExpressionTrigger

## 14.59 ArrayMax

ArrayMax

**Full Name:** Ops.Array.ArrayMax

Apply a max operation to all values in an array.

#### > Inputs

- **Array In** (Array)
- **Value** (Number)

#### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/bc0xTn

**Doc:** cables.gl/op/Ops.Array.ArrayMax

## 14.60 ArrayMerge\_v3



**Full Name:** Ops.Array.ArrayMerge\_v3

Merge multiple arrays - in consecutive order.

#### > Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)

#### < Output

- **Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/P7siGA

**Doc:** cables.gl/op/Ops.Array.ArrayMerge\_v3

## 14.61 ArrayMergeTrigger



**Full Name:** Ops.Array.ArrayMergeTrigger

Merge / concatenate arrays by trigger.

#### > Inputs

- **Merge** (Trigger)
- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)

- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)
- **Array 8** (Array)
- **Array 9** (Array)
- **Array 10** (Array)
- **Array 11** (Array)

#### < Output

- **Next** (Trigger)
- **Result** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/op/Ops.Array.ArrayMergeTrigger#example

**Doc:** cables.gl/op/Ops.Array.ArrayMergeTrigger

## 14.62 ArrayMin



**Full Name:** Ops.Array.ArrayMin

Apply a min operation to all values in an array.

#### > Inputs

- **Array In** (Array)
- **Value** (Number)

#### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/bc0xTn

**Doc:** cables.gl/op/Ops.Array.ArrayMin

## 14.63 ArrayModulo



**Full Name:** Ops.Array.ArrayModulo

Apply a modulo operation to all values in an array.

#### > Inputs

- **Array In** (Array)
- **Value** (Number)

#### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/uIYNcn

**Doc:** cables.gl/op/Ops.Array.ArrayModulo

## 14.64 ArrayMultiply

ArrayMultiply

**Full Name:** Ops.Array.ArrayMultiply

Multiply every number in an array.

### > Inputs

- **In** (Array)
- **Value** (Number)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/xmNqci

**Doc:** cables.gl/op/Ops.Array.ArrayMultiply

## 14.65 ArrayNumberRamp\_v2

ArrayNumberRamp

**Full Name:** Ops.Array.ArrayNumberRamp\_v2

Create an array that contains X numbers between start and end values.

### > Inputs

- **Start Value** (Number)
- **End Value** (Number)
- **Entries** (Number: Integer)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/LfNG9t

**Doc:** cables.gl/op/Ops.Array.ArrayNumberRamp\_v2

## 14.66ArrayOfArrays

ArrayOfArrays

**Full Name:** Ops.Array.ArrayOfArrays

Create an array filled with other arrays.

### > Inputs

- **Update** (Trigger)
- **Array 0** (Array)
- **Array 1** (Array)

- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)
- **Array 8** (Array)
- **Array 9** (Array)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/ild8ve

**Doc:** cables.gl/op/Ops.Array.ArrayOfArrays

## 14.67 ArrayOfObjectsFilterByKeyValue\_v3

ArrayOfObjectsFilterByKeyValue

**Full Name:** Ops.Array.ArrayOfObjectsFilterByKeyValue\_v3

Filter key-value pairs in objects in an array of objects.

### > Inputs

- **Array** (Array)
- **Filter Key** (String)
- **Filter Value** (String)
- **Invert Filter** (Number: Boolean)
- **invert result** (discard all objects that have key-value pair)

### < Output

- **ArrayOut** (Array)

**Example Patch:** cables.gl/edit/HFRsU5

**Doc:** cables.gl/op/Ops.Array.ArrayOfObjectsFilterByKeyValue\_v3

## 14.68 ArrayOfObjectsFilterKeys

ArrayOfObjectsFilterKeys

**Full Name:** Ops.Array.ArrayOfObjectsFilterKeys

Remove key-value pairs from objects in an array of objects.

### > Inputs

- **Array** (Array)
- **Keys** (String)
- **Seperator** (String)
- **Invert Filter** (Number: Boolean)

## < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/HFRsU5

**Doc:** cables.gl/op/Ops.Array.ArrayOfObjectsFilterKeys

## 14.69 ArrayOfObjectsToString

ArrayOfObjectsToString

**Full Name:** Ops.Array.ArrayOfObjectsToString

Convert an array of objects into readable string format.

### > Inputs

- **Array In** (Array)

### < Output

- **String** (String)

**Example Patch:** cables.gl/edit/HFRsU5

**Doc:** cables.gl/op/Ops.Array.ArrayOfObjectsToString

## 14.70 ArrayPack

ArrayPack

**Full Name:** Ops.Array.ArrayPack

Pack multiple arrays into a new array.

### > Inputs

- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/fT3AeT

**Doc:** cables.gl/op/Ops.Array.ArrayPack

## 14.71 ArrayPack2

ArrayPack2

**Full Name:** Ops.Array.ArrayPack2

Pack two individual arrays into a new array.

### > Inputs

- **Trigger In** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)

### < Output

- **Trigger Out** (Trigger)
- **Array Out** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/WaPiSP

**Doc:** cables.gl/op/Ops.Array.ArrayPack2

## 14.72 ArrayPack2Simple

ArrayPack2Simple

**Full Name:** Ops.Array.ArrayPack2Simple

Pack 2 individual arrays into an array2 - without needing a trigger.

### > Inputs

- **Array 1** (Array)
- **Array 2** (Array)

### < Output

- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/Udb6eG

**Doc:** cables.gl/op/Ops.Array.ArrayPack2Simple

## 14.73 ArrayPack3

ArrayPack3

**Full Name:** Ops.Array.ArrayPack3

Pack 3 individual arrays into a xyz array.

### > Inputs

- **Trigger In** (Trigger)

- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)

#### < Output

- **Trigger Out** (Trigger)
- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

**Example Patch:** [cables.gl/edit/As6p8i](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayPack3](#)

## 14.74 ArrayPack3Simple



**Full Name:** Ops.Array.ArrayPack3Simple

Pack 3 individual arrays into an array3 - without needing a trigger.

#### > Inputs

- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)

#### < Output

- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

**Example Patch:** [cables.gl/edit/Hx09v4](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayPack3Simple](#)

## 14.75 ArrayPack4



**Full Name:** Ops.Array.ArrayPack4

Pack 4 arrays into one array.

#### > Inputs

- **Trigger In** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)

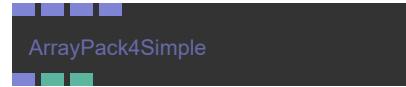
#### < Output

- **Trigger Out** (Trigger)
- **Array Out** (Array)
- **Array Length** (Number)

**Example Patch:** [cables.gl/edit/zgbOqH](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayPack4](#)

## 14.76 ArrayPack4Simple



**Full Name:** Ops.Array.ArrayPack4Simple

Pack 3 individual arrays into an array3 - without needing a trigger.

#### > Inputs

- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)

#### < Output

- **Array Out** (Array)
- **Num Points** (Number)
- **Array Length** (Number)

**Example Patch:** [cables.gl/edit/Hx09v4](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayPack4Simple](#)

## 14.77 ArrayPow



**Full Name:** Ops.Array.ArrayPow

Values below 0 are not accepted. 1 = Array in is unaltered.

#### > Inputs

- **Array In** (Array)
- **Pow Factor** (Number)

#### < Output

- **Array Out** (Array)

**Example Patch:** [cables.gl/edit/nakc7z](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayPow](#)

## 14.78 ArrayPushString

ArrayPushString

**Full Name:** Ops.Array.ArrayPushString

Push/Append a string to the end of an array.

### > Inputs

- **Array** (Array)
- **String** (String)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Array.ArrayPushString#example

**Doc:** cables.gl/op/Ops.Array.ArrayPushString

## 14.79 ArrayQuantizer

ArrayQuantizer

**Full Name:** Ops.Array.ArrayQuantizer

Quantize input to nearest number in array.

### > Inputs

- **Value** (Number)
- **Constraints Array Input** (Array)

### < Output

- **Quantized Value** (Number)
- **Quantization Error** (Number)

**Example Patch:** cables.gl/edit/0yr3cu

**Doc:** cables.gl/op/Ops.Array.ArrayQuantizer

## 14.80 ArrayRandomSelection

ArrayRandomSelection

**Full Name:** Ops.Array.ArrayRandomSelection

Extract a definable amount of values from an array.

### > Inputs

- **Array** (Array)
- **Elements** (Number: Integer)
- **Seed** (Number)

### < Output

- **Result** (Array)

- **Array Length** (Number)

**Example Patch:** cables.gl/edit/ZYDYpH

**Doc:** cables.gl/op/Ops.Array.ArrayRandomSelection

## 14.81 ArrayRemoveFalsy

ArrayRemoveFalsy

**Full Name:** Ops.Array.ArrayRemoveFalsy

Remove falsy items from an array.

### > Inputs

- **Array** (Array)
- **Remove Falsy** (Number: Boolean)

### < Output

- **Result Array** (Array)

**Example Patch:** cables.gl/edit/s6p6iO

**Doc:** cables.gl/op/Ops.Array.ArrayRemoveFalsy

## 14.82 ArrayReverse

ArrayReverse

**Full Name:** Ops.Array.ArrayReverse

Reverse an array.

### > Inputs

- **Active** (Number: Boolean)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/UGUp8i

**Doc:** cables.gl/op/Ops.Array.ArrayReverse

## 14.83 ArrayRound

ArrayRound

**Full Name:** Ops.Array.ArrayRound

Round numbers up.

### > Inputs

- **In** (Array)
- **Method Index** (Number: Integer)
- **Decimal Places** (Number: Integer)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/7xdJrG

**Doc:** cables.gl/op/Ops.Array.ArrayRound

## 14.84 ArraySetNumber\_v3



**Full Name:** Ops.Array.ArraySetNumber\_v3

Set a number at index in an array.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Number** (Number)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/bJrH16

**Doc:** cables.gl/op/Ops.Array.ArraySetNumber\_v3

## 14.85 ArrayGetString



**Full Name:** Ops.Array.ArrayGetString

Set a string at index in an array.

### > Inputs

- **Array** (Array)
- **Index** (Number: Integer)
- **Value** (String)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/b0vNrh

**Doc:** cables.gl/op/Ops.Array.ArrayGetString

## 14.86 ArraySin



**Full Name:** Ops.Array.ArraySin

Perform a sin or cos operation on the contents of an array.

### > Inputs

- **Array In** (Array)
- **Math Function Index** (Number: Integer)
- **Phase** (Number)
- **Frequency** (Number)
- **Amplitude** (Number)

### < Output

- **Array Result** (Array)

**Example Patch:** cables.gl/edit/x1Hqrq

**Doc:** cables.gl/op/Ops.Array.ArraySin

## 14.87 ArraySmoothStep



**Full Name:** Ops.Array.ArraySmoothStep

The fancy way of saying it is Perform Hermite interpolation between two values.

### > Inputs

- **Array In** (Array)
- **Min** (Number)
- **Max** (Number)

### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/Cyvm7z

**Doc:** cables.gl/op/Ops.Array.ArraySmoothStep

## 14.88 ArraySqrt



**Full Name:** Ops.Array.ArraySqrt

Return the square root of all values in the array.

### > Inputs

- **In** (Array)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/g7ulSP

**Doc:** cables.gl/op/Ops.Array.ArraySqrt

## 14.89 ArraysToArrayMultiPort

ArraysToArrayMultiPort

**Full Name:** Ops.Array.ArraysToArrayMultiPort

Create an array from multiple string.

### > Inputs

- **Arrays\_0** (Array)
- **Arrays\_1** (Array)
- **Add Port** (Array)

### < Output

- **Result** (Array)
- **Num Values** (Number)

**Example Patch:** cables.gl/op/Ops.Array.ArraysToArrayMultiPort#example

**Doc:** cables.gl/op/Ops.Array.ArraysToArrayMultiPort

## 14.90 ArraySubtract

ArraySubtract

**Full Name:** Ops.Array.ArraySubtract

Subtract one number from all values in an array.

### > Inputs

- **Array In** (Array)
- **Value** (Number)

### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/uIYNcn

**Doc:** cables.gl/op/Ops.Array.ArraySubtract

## 14.91 ArraySum

ArraySum

**Full Name:** Ops.Array.ArraySum

Add one number to all values in an array.

### > Inputs

- **In** (Array)
- **Value** (Number)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/uIYNcn

**Doc:** cables.gl/op/Ops.Array.ArraySum

## 14.92 ArraySumPrevious

ArraySumPrevious

**Full Name:** Ops.Array.ArraySumPrevious

Sum up every number in an array with the sum of the previous.

### > Inputs

- **Array** (Array)
- **Padding** (Number)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/udsVlu

**Doc:** cables.gl/op/Ops.Array.ArraySumPrevious

## 14.93 ArraySumUp

ArraySumUp

**Full Name:** Ops.Array.ArraySumUp

Sum of every number in an array.

### > Inputs

- **Array** (Array)

### < Output

- **Sum** (Number)

**Example Patch:** cables.gl/edit/U4M4J5

**Doc:** cables.gl/op/Ops.Array.ArraySumUp

## 14.94 ArraySwizzle

ArraySwizzle

**Full Name:** Ops.Array.ArraySwizzle

Manage/re-order components of an array (stride).

### > Inputs

- **Array** (Array)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/MFv6cy

**Doc:** [cables.gl/op/Ops.Array.ArraySwizzle](#)

## 14.95 ArrayToArrays

ArrayToArrays

**Full Name:** Ops.Array.ArrayToArrays

Split an array up into an array of arrays.

### > Inputs

- **Array** (Array)
- **Stride** (Number: Integer)

### < Output

- **Result** (Array)

**Example Patch:** [cables.gl/edit/Bpx7ck](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayToArrays](#)

## 14.96 ArrayToByteBuffer

ArrayToByteBuffer

**Full Name:** Ops.Array.ArrayToByteBuffer

Convert an array to a byte buffer (Uint8ClampedArray).

### > Inputs

- **Array** (Array)

### < Output

- **Buffer** (Object)

**Example Patch:** [cables.gl/op/Ops.Array.ArrayToByteBuffer#example](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayToByteBuffer](#)

## 14.97 ArrayToString\_v3

ArrayToString

**Full Name:** Ops.Array.ArrayToString\_v3

Join array values to a string (concat).

### > Inputs

- **Array** (Array)
- **Separator** (String)
- **New Line** (Number: Boolean)

### < Output

- **Result** (String)

**Example Patch:** [cables.gl/edit/U4M4J5](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayToString\\_v3](#)

## 14.98 ArrayTrigger

ArrayTrigger

**Full Name:** Ops.Array.ArrayTrigger

Trigger an array.

### > Inputs

- **Exec** (Trigger)
- **Array** (Array)

### < Output

- **Trigger Out** (Trigger)
- **Result** (Array)

**Example Patch:** [cables.gl/op/Ops.Array.ArrayTrigger#example](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayTrigger](#)

## 14.99 ArrayUnique

ArrayUnique

**Full Name:** Ops.Array.ArrayUnique

Filter an array for duplicate items and returns all unique items in a new array.

### > Inputs

- **Array** (Array)
- **Format Index** (Number: Integer)
- **Format** (String)

### < Output

- **ArrayOut** (Array)
- **Array Length Out** (Number)

**Example Patch:** [cables.gl/edit/vIQlS-](#)

**Doc:** [cables.gl/op/Ops.Array.ArrayUnique](#)

## 14.100 ArrayUniqueItemInfo

ArrayUniqueItemInfo

**Full Name:** Ops.Array.ArrayUniqueItemInfo

Return information about the count of “duplicates” in an array, as an object.

### > Inputs

- **Array** (Array)

#### < Output

- **ObjectOut** (Object)

**Example Patch:** cables.gl/edit/72VpS-

**Doc:** cables.gl/op/Ops.Array.ArrayUniqueItemInfo

## 14.101 ArrayUnpack2

ArrayUnpack2

**Full Name:** Ops.Array.ArrayUnpack2

Unpack an xy array into separate arrays.

#### > Inputs

- **Array In Xyz** (Array)

#### < Output

- **Array 1 Out** (Array)
- **Array 2 Out** (Array)
- **Array Lengths** (Number)

**Example Patch:** cables.gl/edit/N00tci

**Doc:** cables.gl/op/Ops.Array.ArrayUnpack2

## 14.102 ArrayUnpack3

ArrayUnpack3

**Full Name:** Ops.Array.ArrayUnpack3

Split an xyz array into 3 individual arrays.

#### > Inputs

- **Array In Xyz** (Array)

#### < Output

- **Array 1 Out** (Array)
- **Array 2 Out** (Array)
- **Array 3 Out** (Array)
- **Array Lengths** (Number)

**Example Patch:** cables.gl/edit/lmn5Og

**Doc:** cables.gl/op/Ops.Array.ArrayUnpack3

## 14.103 ArrayUnpack4

ArrayUnpack4

**Full Name:** Ops.Array.ArrayUnpack4

Split an xyzw array into 4 individual arrays.

#### > Inputs

- **Array In Xyzw** (Array)

#### < Output

- **Array 1 Out** (Array)
- **Array 2 Out** (Array)
- **Array 3 Out** (Array)
- **Array 4 Out** (Array)
- **Array Lengths** (Number)

**Example Patch:** cables.gl/edit/vl1N\_M

**Doc:** cables.gl/op/Ops.Array.ArrayUnpack4

## 14.104 ArrayUnshiftString

ArrayUnshiftString

**Full Name:** Ops.Array.ArrayUnshiftString

Insert/add/unshift a string to the beginning of an array.

#### > Inputs

- **Array** (Array)
- **String** (String)

#### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/Ckkk7M

**Doc:** cables.gl/op/Ops.Array.ArrayUnshiftString

## 14.105 AverageArray

AverageArray

**Full Name:** Ops.Array.AverageArray

Smooth/average values in an array.

#### > Inputs

- **Array** (Array)
- **Iterations** (Number: Integer)
- **Mode Index** (Number: Integer)

## < Output

- **Smoothed Array** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/t8uSdn

**Doc:** cables.gl/op/Ops.Array.AverageArray

## 14.106 BoolStateArray



**Full Name:** Ops.Array.BoolStateArray

Array filled with 0, only one can be 1.

### > Inputs

- **Array Length** (Number)
- **Active Index** (Number)
- **Inactive Value** (Number)
- **Active Value** (Number)

### < Output

- **State Array** (Array)

**Example Patch:** cables.gl/edit/9oowlJ

**Doc:** cables.gl/op/Ops.Array.BoolStateArray

## 14.107 CopyArray



**Full Name:** Ops.Array.CopyArray

Copy an array with a trigger, reset to use a default array.

### > Inputs

- **Exec** (Trigger)
- **Array** (Array)
- **Reset** (Trigger)
- **Default** (Array)

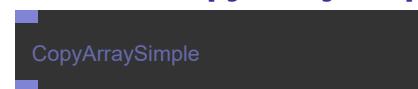
### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/JqSoH-

**Doc:** cables.gl/op/Ops.Array.CopyArray

## 14.108 CopyArraySimple



**Full Name:** Ops.Array.CopyArraySimple

Create a copy of an array.

### > Inputs

- Visit *Ops.Array.CopyArraySimple documentation* for input port details

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Array.CopyArraySimple#example

**Doc:** cables.gl/op/Ops.Array.CopyArraySimple

## 14.109 CropArray



**Full Name:** Ops.Array.CropArray

The array to crop.

### > Inputs

- **Source Array** (Array)
- **Start Index** (Number: Integer)
- **New Length** (Number: Integer)

### < Output

- **Cropped Array** (Array)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/UuuJH-

**Doc:** cables.gl/op/Ops.Array.CropArray

## 14.110 CutArray



**Full Name:** Ops.Array.CutArray

Remove elements from an array from the beginning and/or the end.

### > Inputs

- **Source Array** (Array)
- **Remove From Start** (Number: Integer)
- **Remove From End** (Number: Integer)

### < Output

- **Cut Array** (Array)

- **Array Length** (Number)

**Example Patch:** [cables.gl/edit/VbqZTh](#)

**Doc:** [cables.gl/op/Ops.Array.CutArray](#)

## 14.111 EaseArray



**Full Name:** Ops.Array.EaseArray

Apply easing curve to numbers in an array.

› **Inputs**

- **Array** (Array)
- **Min** (Number)
- **Max** (Number)
- **Easing Index** (Number: Integer)

‹ **Output**

- **Result Array** (Array)

**Example Patch:** [cables.gl/edit/Mbwkf6](#)

**Doc:** [cables.gl/op/Ops.Array.EaseArray](#)

## 14.112 EmptyArray



**Full Name:** Ops.Array.EmptyArray

*Visit documentation for details.*

› **Inputs**

- Visit *Ops.Array.EmptyArray* documentation for input port details

‹ **Output**

- **Result** (Array)

**Example Patch:** [cables.gl/op/Ops.Array.EmptyArray#example](#)

**Doc:** [cables.gl/op/Ops.Array.EmptyArray](#)

## 14.113 FillArrayRandomDuplicates\_v2



**Full Name:** Ops.Array.FillArrayRandomDuplicates\_v2

Fill an array with random duplicates.

› **Inputs**

- **Array** (Array)

- **Num Elements** (Number: Integer)

- **Random Seed** (Number)

‹ **Output**

- **Result** (Array)

**Example Patch:** [cables.gl/edit/z4S3dz](#)

**Doc:** [cables.gl/op/Ops.Array.FillArrayRandomDuplicates\\_v2](#)

## 14.114 FilterArray



**Full Name:** Ops.Array.FilterArray

Compare elements from an array and remove not matching ones.

› **Inputs**

- **Array** (Array)
- **Stride Index** (Number: Integer)
- **the type of the array** (Array3, Array2, ...)
- **Compare Element Index** (Number: Integer)
- **which element to compare** (see stride)
- **Filter Method Index** (Number: Integer)
- **Compare To** (Number)

‹ **Output**

- **Result** (Array)

**Example Patch:** [cables.gl/edit/Z2dVoX](#)

**Doc:** [cables.gl/op/Ops.Array.FilterArray](#)

## 14.115 FilterValidArray



**Full Name:** Ops.Array.FilterValidArray

Filter valid arrays.

› **Inputs**

- **Array** (Array)
- **Invalid When Length Is 0** (Number: Boolean)

‹ **Output**

- **Last Valid Array** (Array)
- **Is Valid** (booleanNumber)

**Example Patch:** [cables.gl/op/Ops.Array.FilterValidArray#example](#)

**Doc:** [cables.gl/op/Ops.Array.FilterValidArray](#)

## 14.116 FlattenArray

FlattenArray

**Full Name:** Ops.Array.FlattenArray

Create a new array with all sub-array elements concatenated into it.

➢ **Inputs**

- **Array** (Array)

◀ **Output**

- **Result** (Array)

**Example Patch:** cables.gl/edit/x6HFeT

**Doc:** cables.gl/op/Ops.Array.FlattenArray

## 14.117 FreezeArray

FreezeArray

**Full Name:** Ops.Array.FreezeArray

Capture the current input and copy it to the output, even after a reload.

➢ **Inputs**

- **Number** (Array)
- **Button** (Trigger)

◀ **Output**

- **Frozen Array** (Array)

**Example Patch:** cables.gl/edit/MuPepX

**Doc:** cables.gl/op/Ops.Array.FreezeArray

## 14.118 GateArray\_v2

GateArray

**Full Name:** Ops.Array.GateArray\_v2

Only allow an array through if pass through is true.

➢ **Inputs**

- **Array In** (Array)
- **Pass Through** (Number: Boolean)

◀ **Output**

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/gOaDAH

**Doc:** cables.gl/op/Ops.Array.GateArray\_v2

## 14.119 GetValuesFromArrayOfObjects

GetValuesFromArrayOfObjects

**Full Name:** Ops.Array.GetValuesFromArrayOfObjects

Get an array of values by key of objects in an array.

➢ **Inputs**

- **Array** (Array)
- **Key** (String)
- **Numbers Only** (Number: Boolean)

◀ **Output**

- **Result** (Array)

**Example Patch:** cables.gl/edit/KQGGGeT

**Doc:** cables.gl/op/Ops.Array.GetValuesFromArrayOfObjects

## 14.120 HSBtoRGBArray

HSBtoRGBArray

**Full Name:** Ops.Array.HSBtoRGBArray

Generate an RGBA array from up to 4 arrays (HSBA).

➢ **Inputs**

- **Trigger Input** (Trigger)
- **In Hue Array** (Array)
- **In Saturation Array** (Array)
- **In Brightness Array** (Array)
- **In Alpha Array** (Array)

◀ **Output**

- **Trigger Output** (Trigger)
- **Result Array** (Array)
- **Array Length** (Number)
- **RGBA Tuple Length** (Number)

**Example Patch:** cables.gl/edit/jFyRM-

**Doc:** cables.gl/op/Ops.Array.HSBtoRGBArray

## 14.121 InfoArray

InfoArray

**Full Name:** Ops.Array.InfoArray

Min, Max and Average value from an array.

#### > Inputs

- **Array** (Array)

#### < Output

- **Min** (Number)
- **Max** (Number)
- **Average** (Number)

**Example Patch:** [cables.gl/edit/qySZQx](#)

**Doc:** [cables.gl/op/Ops.Array.InfoArray](#)

## 14.122 InfoArray2



**Full Name:** Ops.Array.InfoArray2

Min, Max and Average values of an array2.

#### > Inputs

- **Array** (Array)

#### < Output

- **Num Items** (Number)
- **Min X** (Number)
- **Max X** (Number)
- **Average X** (Number)
- **Min Y** (Number)
- **Max Y** (Number)
- **Average Y** (Number)

**Example Patch:** [cables.gl/op/Ops.Array.InfoArray2#example](#)

**Doc:** [cables.gl/op/Ops.Array.InfoArray2](#)

## 14.123 InfoArray3



**Full Name:** Ops.Array.InfoArray3

Min, Max and Average values of an array3.

#### > Inputs

- **Array** (Array)

#### < Output

- **Num Items** (Number)
- **Min X** (Number)
- **Min Y** (Number)
- **Min Z** (Number)

- **Max X** (Number)

- **Max Y** (Number)

- **Max Z** (Number)

- **Average X** (Number)

- **Average Y** (Number)

- **Average Z** (Number)

- **Center X** (Number)

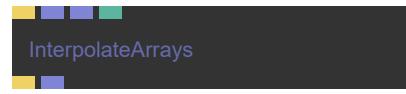
- **Center Y** (Number)

- **Center Z** (Number)

**Example Patch:** [cables.gl/edit/tg7cRx](#)

**Doc:** [cables.gl/op/Ops.Array.InfoArray3](#)

## 14.124 InterpolateArrays



**Full Name:** Ops.Array.InterpolateArrays

Interpolate between two arrays (lerp) - linear interpolation.

#### > Inputs

- **Exe** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Perc** (Number)

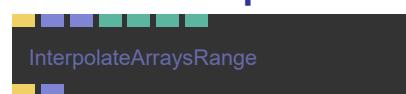
#### < Output

- **Next** (Trigger)
- **Result** (Array)

**Example Patch:** [cables.gl/edit/qU2GB3](#)

**Doc:** [cables.gl/op/Ops.Array.InterpolateArrays](#)

## 14.125 InterpolateArraysRange



**Full Name:** Ops.Array.InterpolateArraysRange

Interpolate between two arrays, only a few numbers at the same time.

#### > Inputs

- **Exe** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Pos** (Number)
- **Width** (Number)
- **Easing Index** (Number: Integer)

- **Reverse** (Number: Boolean)

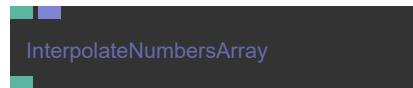
#### < Output

- **Next** (Trigger)
- **Result** (Array)

**Example Patch:** cables.gl/edit/3GIOe6

**Doc:** cables.gl/op/Ops.Array.InterpolateArraysRange

## 14.126 InterpolateNumbersArray



**Full Name:** Ops.Array.InterpolateNumbersArray

Interpolate between all values of an array.

#### > Inputs

- **Index Position** (Number)
- **Array** (Array)

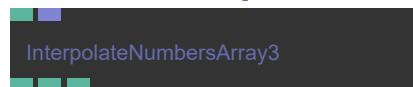
#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/dbUc-L

**Doc:** cables.gl/op/Ops.Array.InterpolateNumbersArray

## 14.127 InterpolateNumbersArray3



**Full Name:** Ops.Array.InterpolateNumbersArray3

Get interpolated values between the indices of an array3x.

#### > Inputs

- **Index Position** (Number)
- **Array** (Array)

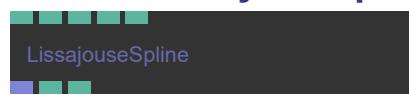
#### < Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** cables.gl/edit/Oqy2n7

**Doc:** cables.gl/op/Ops.Array.InterpolateNumbersArray3

## 14.128 LissajouseSpline



**Full Name:** Ops.Array.LissajouseSpline

Generate spline using lissajous formulas.

#### > Inputs

- **Formula Index** (Number: Integer)
- **A** (Number: Integer)
- **B** (Number: Integer)
- **C** (Number: Integer)
- **D** (Number: Integer)

#### < Output

- **Result** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/Wa8TS3

**Doc:** cables.gl/op/Ops.Array.LissajouseSpline

## 14.129 LoopArray3



**Full Name:** Ops.Array.LoopArray3

Make the 1st and last point of an array the same, good for closing splines and shapes.

#### > Inputs

- **Array In** (Array)

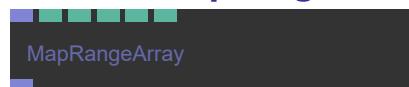
#### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/-x\_dxN

**Doc:** cables.gl/op/Ops.Array.LoopArray3

## 14.130 MapRangeArray



**Full Name:** Ops.Array.MapRangeArray

Map values in an array from one range into another.

#### > Inputs

- **Array** (Array)

- **Old Min** (Number)
- **Old Max** (Number)
- **New Min** (Number)
- **New Max** (Number)
- **Easing Index** (Number: Integer)

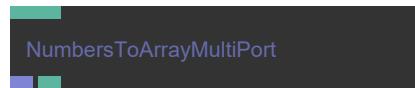
**< Output**

- **Result** (Array)

**Example Patch:** cables.gl/edit/ZQI6sU

**Doc:** cables.gl/op/Ops.Array.MapRangeArray

## 14.131 NumbersToArrayMultiPort\_v2



**Full Name:** Ops.Array.NumbersToArrayMultiPort\_v2

Create an array from multiple number inputs.

**> Inputs**

- **Numbers\_0** (Number)
- **Add Port** (Number)

**< Output**

- **Result** (Array)
- **Num Values** (Number)

**Example Patch:** cables.gl/edit/mCTLrh

**Doc:** cables.gl/op/Ops.Array.NumbersToArrayMultiPort\_v2

## 14.132 ObjectIteratorKeys



**Full Name:** Ops.Array.ObjectIteratorKeys

Iterate over an array of objects.

**> Inputs**

- **Exe** (Trigger)
- **Array** (Array)

**< Output**

- **Trigger** (Trigger)
- **Finished** (Trigger)
- **Index** (Number)
- **Value** (Object)

**Example Patch:** cables.gl/op/Ops.Array.ObjectIteratorKeys#example

**Doc:** cables.gl/op/Ops.Array.ObjectIteratorKeys

## 14.133 PaletteLibrary



**Full Name:** Ops.Array.PaletteLibrary

Contains a collection of color palettes in groups of 5 in an array.

**> Inputs**

- Visit *Ops.Array.PaletteLibrary documentation for input port details*

**< Output**

- **Palette Array Out** (Array)

**Example Patch:** cables.gl/edit/zpLrSP

**Doc:** cables.gl/op/Ops.Array.PaletteLibrary

## 14.134 PerlinArray



**Full Name:** Ops.Array.PerlinArray

Create an array filled with Perlin noise values.

**> Inputs**

- **Array In X** (Array)
- **Array Time** (Array)
- **Time In Y** (Number)
- **Seed 0-1** (Number)
- **Frequency** (Number)

**< Output**

- **Array Out** (Array)
- **Array Length Out** (Number)

**Example Patch:** cables.gl/edit/Vm8fhL

**Doc:** cables.gl/op/Ops.Array.PerlinArray

## 14.135 Phyllotaxis



**Full Name:** Ops.Array.Phyllotaxis

Coordinate generation like arrangement of leaves in some plants.

**> Inputs**

- **Render** (Trigger)
- **Num** (Number: Integer)
- **Scale** (Number)

- **Param** (Number)

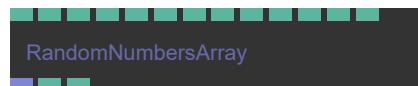
#### < Output

- **Coordinates** (Array)

**Example Patch:** cables.gl/edit/1Pu9Tb

**Doc:** cables.gl/op/Ops.Array.Phyllotaxis

## 14.136 RandomNumbersArray\_v4



**Full Name:** Ops.Array.RandomNumbersArray\_v4

Create a random array of 1 to 4 dimensions.

#### > Inputs

- **Num Values** (Number: Integer)
- **Mode Index** (Number: Integer)
- **Random Seed** (Number)
- **Integer** (Number: Boolean)
- **Min A** (Number)
- **Max A** (Number)
- **Min B** (Number)
- **Max B** (Number)
- **Min C** (Number)
- **Max C** (Number)
- **Min D** (Number)
- **Max D** (Number)

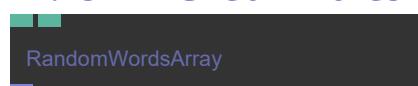
#### < Output

- **Array Out** (Array)
- **Chunks Amount** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/jmm7N-

**Doc:** cables.gl/op/Ops.Array.RandomNumbersArray\_v4

## 14.137 RandomWordsArray



**Full Name:** Ops.Array.RandomWordsArray

Generate an array filled with random english words.

#### > Inputs

- **Random Seed** (Number)
- **Content Index** (Number: Integer)

#### < Output

- **Words** (Array)

**Example Patch:** cables.gl/edit/VHW78i

**Doc:** cables.gl/op/Ops.Array.RandomWordsArray

## 14.138 ReduceArray3\_v3



**Full Name:** Ops.Array.ReduceArray3\_v3

Remove points from an array, e.g. xth points, random, duplicates.

#### > Inputs

- **Array** (Array)
- **Remove Index** (Number: Integer)
- **Every Xth Item** (Number: Integer)
- **Threshold** (Number)
- **Seed** (Number)

#### < Output

- **Result Array** (Array)

**Example Patch:** cables.gl/edit/vgRDeT

**Doc:** cables.gl/op/Ops.Array.ReduceArray3\_v3

## 14.139 ReverseArray3



**Full Name:** Ops.Array.ReverseArray3

Reverse an array with value triplets [x, y, z, ...].

#### > Inputs

- **Array** (Array)
- **The Array you want to reverse** (containing triplets)

#### < Output

- **Reversed Array** (Array)

**Example Patch:** cables.gl/edit/1QJiVJ

**Doc:** cables.gl/op/Ops.Array.ReverseArray3

## 14.140 RingBuffer



**Full Name:** Ops.Array.RingBuffer

Array of fixed size, index is automatically incremented and restarts after reaching the end.

**> Inputs**

- **Value** (Number)
- **Write** (Trigger)
- **Length** (Number: Integer)
- **Reset Index** (Trigger)

**< Output**

- **Result** (Array)
- **Index** (Number)

**Example Patch:** cables.gl/edit/NwwS97

**Doc:** cables.gl/op/Ops.Array.RingBuffer

## 14.141 RotateArray



**Full Name:** Ops.Array.RotateArray

Shift array contents based upon rotate amount.

**> Inputs**

- **Array In** (Array)
- **Rotate Amount** (Number: Integer)

**< Output**

- **ArrayOut** (Array)

**Example Patch:** cables.gl/edit/r7Av7z

**Doc:** cables.gl/op/Ops.Array.RotateArray

## 14.142 RouteArray



**Full Name:** Ops.Array.RouteArray

Route an array to an output port.

**> Inputs**

- **Index** (Number: Integer)
- **Array In** (Array)
- **Default Array** (Array)

**< Output**

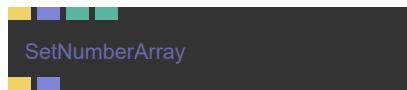
- **Index 0 Array** (Array)
- **Index 1 Array** (Array)

- **Index 2 Array** (Array)
- **Index 3 Array** (Array)
- **Index 4 Array** (Array)
- **Index 5 Array** (Array)
- **Index 6 Array** (Array)
- **Index 7 Array** (Array)
- **Index 8 Array** (Array)
- **Index 9 Array** (Array)

**Example Patch:** cables.gl/edit/pDYxX8

**Doc:** cables.gl/op/Ops.Array.RouteArray

## 14.143 SetNumberArray



**Full Name:** Ops.Array.SetNumberArray

Change the number of an array at an index.

**> Inputs**

- **Exe** (Trigger)
- **Array** (Array)
- **Index** (Number: Integer)
- **Value** (Number)

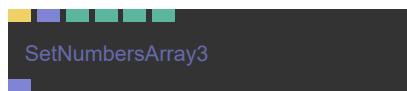
**< Output**

- **Next** (Trigger)
- **Values** (Array)

**Example Patch:** cables.gl/edit/WRrXSn

**Doc:** cables.gl/op/Ops.Array.SetNumberArray

## 14.144 SetNumbersArray3



**Full Name:** Ops.Array.SetNumbersArray3

Set three values at position index in an array.

**> Inputs**

- **Exe** (Trigger)
- **Array** (Array)
- **Index** (Number: Integer)
- **Value 1** (Number)
- **Value 2** (Number)
- **Value 3** (Number)

## < Output

- **Values** (Array)

**Example Patch:** [cables.gl/edit/EI3nIJ](#)

**Doc:** [cables.gl/op/Ops.Array.SetNumbersArray3](#)

## 14.145 ShuffleArray3\_v3



**Full Name:** Ops.Array.ShuffleArray3\_v3

Shuffle/Randomize the order of an array of triplets.

### > Inputs

- **Array3** (Array)
- **Seed** (Number)

### < Output

- **Result** (Array)

**Example Patch:** [cables.gl/edit/tbdwsh](#)

**Doc:** [cables.gl/op/Ops.Array.ShuffleArray3\\_v3](#)

## 14.146 ShuffleArray\_v3



**Full Name:** Ops.Array.ShuffleArray\_v3

Randomize the order of elements inside an array.

### > Inputs

- **Array3** (Array)
- **Seed** (Number)

### < Output

- **Result** (Array)

**Example Patch:** [cables.gl/edit/doUssh](#)

**Doc:** [cables.gl/op/Ops.Array.ShuffleArray\\_v3](#)

## 14.147 SimplexArray



**Full Name:** Ops.Array.SimplexArray

Create an array filled with Simplex noise values (Range: -1, 1).

### > Inputs

- **Array In X** (Array)

### > Outputs

- **Array Time** (Array)
- **Time In Y** (Number)
- **Seed 0-1** (Number)
- **Frequency** (Number)

## < Output

- **Array Out** (Array)
- **Array Length Out** (Number)

**Example Patch:** [cables.gl/edit/rNALhL](#)

**Doc:** [cables.gl/op/Ops.Array.SimplexArray](#)

## 14.148 SmoothArray



**Full Name:** Ops.Array.SmoothArray

Smooth out changes in values of an array.

### > Inputs

- **Execute** (Trigger)
- **Array In** (Array)
- **Inc Factor** (Number)
- **Dec Factor** (Number)

### < Output

- **Next** (Trigger)
- **Array Out** (Array)

**Example Patch:** [cables.gl/edit/BgtGZK](#)

**Doc:** [cables.gl/op/Ops.Array.SmoothArray](#)

## 14.149 SortArray



**Full Name:** Ops.Array.SortArray

Sort an array of numbers with one of two modes - ascending or descending.

### > Inputs

- **Array To Sort** (Array)

### < Output

- **Sorted Array** (Array)

**Example Patch:** [cables.gl/edit/M2f7RJ](#)

**Doc:** [cables.gl/op/Ops.Array.SortArray](#)

## 14.150 SortArray3



**Full Name:** Ops.Array.SortArray3

Sort an array with the lowest values of the selected component.

### > Inputs

- **Array** (Array)
- **What Index** (Number: Integer)

### < Output

- **Result** (Array)
- **The sorted array** (new array)

**Example Patch:** cables.gl/edit/QS8qVJ

**Doc:** cables.gl/op/Ops.Array.SortArray3

## 14.151 SortArrayOfObjects



**Full Name:** Ops.Array.SortArrayOfObjects

Sort an array of objects by the values of a key.

### > Inputs

- **Array** (Array)
- **Key** (String)
- **Reverse** (Number: Boolean)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/shtaz1

**Doc:** cables.gl/op/Ops.Array.SortArrayOfObjects

## 14.152 SortArrayWithIndices\_v2



**Full Name:** Ops.Array.SortArrayWithIndices\_v2

Sort an array of numbers and also get sorted indices.

### > Inputs

- **Array To Sort** (Array)
- **Sorting Mode Index** (Number: Integer)

### < Output

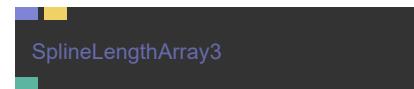
- **Sorted Array** (Array)

- **Sorted Indices** (Array)

**Example Patch:** cables.gl/op/Ops.Array.SortArrayWithIndices\_v2#example

**Doc:** cables.gl/op/Ops.Array.SortArrayWithIndices\_v2

## 14.153 SplineLengthArray3



**Full Name:** Ops.Array.SplineLengthArray3

Return a number with the total distance between the points/items in an array3.

### > Inputs

- **Array3x** (Array)
- **Calculate** (Trigger)

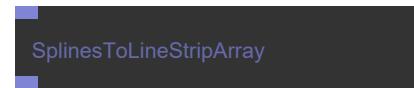
### < Output

- **Length** (Number)

**Example Patch:** cables.gl/edit/uOzMH7

**Doc:** cables.gl/op/Ops.Array.SplineLengthArray3

## 14.154 SplinesToLineStripArray



**Full Name:** Ops.Array.SplinesToLineStripArray

Convert an array of splines to one "line stripped" array.

### > Inputs

- **Array** (Array)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/\_UiSmX

**Doc:** cables.gl/op/Ops.Array.SplinesToLineStripArray

## 14.155 StringToArray\_v2



**Full Name:** Ops.Array.StringToArray\_v2

Parse a string into an array (create, split string, stringToArray).

### > Inputs

- **Text** (String)
- **Separator** (String)
- **Numbers** (Number: Boolean)

- **Trim** (Number: Boolean)
- **Split Lines** (Number: Boolean)

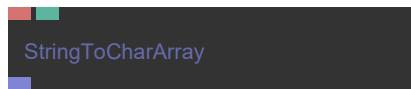
#### ◀ Output

- **Array** (Array)
- **Parsed** (Trigger)
- **Length** (Number)

**Example Patch:** cables.gl/edit/U4M4J5

**Doc:** cables.gl/op/Ops.Array.StringToArray\_v2

## 14.156 StringToArray



**Full Name:** Ops.Array.StringToArray

Turn a string into an array of single characters or ASCII numbers.

#### ▶ Inputs

- **String** (String)
- **Convert To Numbers** (Number: Boolean)

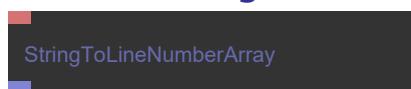
#### ◀ Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/30a1rn

**Doc:** cables.gl/op/Ops.Array.StringToArray

## 14.157 StringToLineNumberArray



**Full Name:** Ops.Array.StringToLineNumberArray

Output an array containing a line number for every character.

#### ▶ Inputs

- **String** (String)

#### ◀ Output

- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Array.StringToLineNumberArray#example

**Doc:** cables.gl/op/Ops.Array.StringToLineNumberArray

## 14.158 SubdivideArray1



SubdivideArray1

**Full Name:** Ops.Array.SubdivideArray1

For subdividing splines, smoothing lines using cubic bezier interpolation.

#### ▶ Inputs

- **Points** (Array)
- **Num Subdivs** (Number: Integer)
- **Smooth** (Number: Boolean)

#### ◀ Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/RJiCqH

**Doc:** cables.gl/op/Ops.Array.SubdivideArray1

## 14.159 SwitchArray



**Full Name:** Ops.Array.SwitchArray

Switch between multiple arrays.

#### ▶ Inputs

- **Index** (Number: Integer)
- **Array 0** (Array)
- **Array 1** (Array)
- **Array 2** (Array)
- **Array 3** (Array)
- **Array 4** (Array)
- **Array 5** (Array)
- **Array 6** (Array)
- **Array 7** (Array)
- **Array 8** (Array)
- **Array 9** (Array)

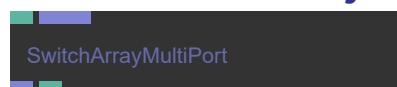
#### ◀ Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/4J2o8i

**Doc:** cables.gl/op/Ops.Array.SwitchArray

## 14.160 SwitchArrayMultiPort\_v2



**Full Name:** Ops.Array.SwitchArrayMultiPort\_v2

Switch between multiple input arrays.

#### ▶ Inputs

- **Index** (Number: Integer)
- **Arrays\_0** (Array)
- **Add Port** (Array)

#### < Output

- **Number** (Array)
- **Num Values** (Number)

**Example Patch:** cables.gl/edit/L7sKrh

**Doc:** cables.gl/op/Ops.Array.SwitchArrayMultiPort\_v2

## 14.161 SwitchArrayOnTrigger



**Full Name:** Ops.Array.SwitchArrayOnTrigger

Switch between multiple arrays on trigger.

#### > Inputs

- **Trigger 1** (Trigger)
- **Array 1** (Array)
- **Trigger 2** (Trigger)
- **Array 2** (Array)
- **Trigger 3** (Trigger)
- **Array 3** (Array)
- **Trigger 4** (Trigger)
- **Array 4** (Array)
- **Trigger 5** (Trigger)
- **Array 5** (Array)
- **Trigger 6** (Trigger)
- **Array 6** (Array)
- **Trigger 7** (Trigger)
- **Array 7** (Array)
- **Trigger 8** (Trigger)
- **Array 8** (Array)

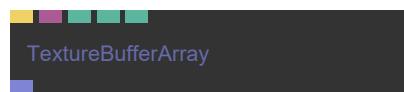
#### < Output

- **Out Array** (Array)

**Example Patch:** cables.gl/op/Ops.Array.SwitchArrayOnTrigger#example

**Doc:** cables.gl/op/Ops.Array.SwitchArrayOnTrigger

## 14.162 TextureBufferArray



TextureBufferArray

**Full Name:** Ops.Array.TextureBufferArray

Store various textures in an array, starts at the beginning again when end reached.

#### > Inputs

- **Write** (Trigger)
- **Texture** (Object:Texture)
- **Num** (Number: Integer)
- **The size of the ring buffer** (how many textures it can hold)
- **Order** (Number: Boolean)
- **Clear** (Number: Boolean)

#### < Output

- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Array.TextureBufferArray#example

**Doc:** cables.gl/op/Ops.Array.TextureBufferArray

## 14.163 WeaveArrays



**Full Name:** Ops.Array.WeaveArrays

Weave two arrays together (combine, join, merge).

#### > Inputs

- **Array 1** (Array)
- **Array 2** (Array)
- **Chunk Size** (Number)

#### < Output

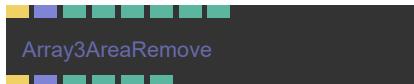
- **Combined Array** (Array)

**Example Patch:** cables.gl/edit/HSGq8i

**Doc:** cables.gl/op/Ops.Array.WeaveArrays

# 15 Ops.Array.PointArray

## 15.1 Array3AreaRemove



**Full Name:** Ops.Array.PointArray.Array3AreaRemove

Remove points from an array3 with different shapes.

### > Inputs

- **In Trigger** (Trigger)
- **In Array** (Array)
- **Mode Index** (Number: Integer)
- **Size** (Number)
- **Invert** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

### < Output

- **Out Trigger** (Trigger)
- **Out Array** (Array)
- **Array Length** (Number)
- **Out X** (Number)
- **Out Y** (Number)
- **Out Z** (Number)

**Example Patch:** cables.gl/edit/sfikWi

**Doc:** cables.gl/op/Ops.Array.PointArray.Array3AreaRemove

## 15.2 Array3PointEditor



**Full Name:** Ops.Array.PointArray.Array3PointEditor

Visually edit positions in an array of point coordinates.

### > Inputs

- **Execute** (Trigger)
- **Total Points** (Number: Integer)
- **Edit** (Number: Boolean)
- **Index** (Number: Integer)
- **Copy From Index** (Number: Integer)
- **Copy Coordinates** (Trigger)
- **Reset** (Trigger)

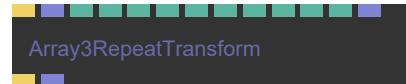
### < Output

- **Next** (Trigger)
- **Coordinates** (Array)

**Example Patch:** cables.gl/edit/2Bhet7

**Doc:** cables.gl/op/Ops.Array.PointArray.Array3PointEditor

## 15.3 Array3RepeatTransform



**Full Name:** Ops.Array.PointArray.Array3RepeatTransform

Repeat an array by transforming it x times.

### > Inputs

- **Trigger** (Trigger)
- **Array** (Array)
- **Times** (Number: Integer)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)
- **Position Array** (Array)

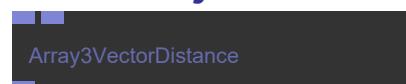
### < Output

- **Next** (Trigger)
- **Result** (Array)

**Example Patch:** cables.gl/edit/9nSWVj

**Doc:** cables.gl/op/Ops.Array.PointArray.Array3RepeatTransform

## 15.4 Array3VectorDistance



**Full Name:** Ops.Array.PointArray.Array3VectorDistance

Return the distance between 2 points from an array.

### > Inputs

- **Array In 1** (Array)
- **Array In 2** (Array)

## < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/Tbb8xN

**Doc:** cables.gl/op/Ops.Array.PointArray.Array3VectorDistance

## 15.5 ArraySpray



**Full Name:** Ops.Array.PointArray.ArraySpray

Particle spray simulation.

### > Inputs

- **Exe** (Trigger)
- **Time** (Number)
- **Num** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Movement X** (Number)
- **Movement Y** (Number)
- **Movement Z** (Number)
- **Center X** (Number: Boolean)
- **Center Y** (Number: Boolean)
- **Center Z** (Number: Boolean)
- **Reset** (Trigger)
- **Lifetime** (Number)
- **Lifetime Minimum** (Number)

## < Output

- **Trigger Out** (Trigger)
- **Positions** (Array)
- **Lifetime** (Array)

**Example Patch:** cables.gl/edit/hY5lAw

**Doc:** cables.gl/op/Ops.Array.PointArray.ArraySpray

## 15.6 CircularPoints\_v2



**Full Name:** Ops.Array.PointArray.CircularPoints\_v2

Create arrays for circular shapes, helix, circle, etc.

### > Inputs

- **Radius** (Number)
- **Round Segments** (Number)
- **Rounds** (Number)
- **Radius Add Round** (Number)
- **Radius Add Point** (Number)
- **Offset** (Number)
- **Point Offset XY** (Number)
- **Point Offset Z** (Number)
- **Offset Rotation** (Number)
- **Loop** (Number: Boolean)

## < Output

- **Points** (Array)
- **Rotation** (Array)
- **Total Points** (Number)
- **Array Lengths** (Number)

**Example Patch:** cables.gl/edit/V34dYh

**Doc:** cables.gl/op/Ops.Array.PointArray.CircularPoints\_v2

## 15.7 FillPointArrayDuplicates



**Full Name:** Ops.Array.PointArray.FillPointArrayDuplicates

Fill an XYZ array with existing duplicate points until it reaches the length.

### > Inputs

- **Array** (Array)
- **Num Elements** (Number: Integer)
- **Calculate** (Trigger)

## < Output

- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Array.PointArray.FillPointArrayDuplicates#exam

**Doc:** cables.gl/op/Ops.Array.PointArray.FillPointArrayDuplicates

## 15.8 PointsCube



**Full Name:** Ops.Array.PointArray.PointsCube

Generate a 3d point field with controllable amount of xyz points (was PointsField3d).

### > Inputs

- **Num X** (Number: Integer)
- **Num Y** (Number: Integer)
- **Num Z** (Number: Integer)
- **Mul** (Number)
- **Center** (Number: Boolean)

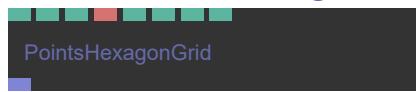
#### ◀ Output

- **Array Out** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/\_SC2JB

**Doc:** cables.gl/op/Ops.Array.PointArray.PointsCube

## 15.9 PointsHexagonGrid



PointsHexagonGrid

**Full Name:** Ops.Array.PointArray.PointsHexagonGrid

Generate coordinates for a hexagon grid, outputs array3x.

#### ▶ Inputs

- **Rows** (Number: Integer)
- **Columns** (Number: Integer)
- **Hex Facing Index** (Number: Integer)
- **Hex Facing** (String)
- **Flip Corners** (Number: Boolean)
- **Tile X Offset** (Number)
- **Tile Y Offset** (Number)
- **Multiplier** (Number)

#### ◀ Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/GLLdrn

**Doc:** cables.gl/op/Ops.Array.PointArray.PointsHexagonGrid

## 15.10 PointsPlane\_v2



PointsPlane

**Full Name:** Ops.Array.PointArray.PointsPlane\_v2

Generate coordinates for a rectangular field / grid of points.

#### ▶ Inputs

- **Rows** (Number: Integer)
- **Columns** (Number: Integer)

- **Width** (Number)
- **Height** (Number)
- **Row Offset** (Number)
- **Center** (Number: Boolean)

#### ◀ Output

- **Result** (Array)
- **Total Points** (Number)
- **Array Length** (Number)
- **Row Numbers** (Array)
- **Column Numbers** (Array)

**Example Patch:** cables.gl/edit/icchV5

**Doc:** cables.gl/op/Ops.Array.PointArray.PointsPlane\_v2

## 15.11 PointsRectangle\_v2



PointsRectangle

**Full Name:** Ops.Array.PointArray.PointsRectangle\_v2

Generate an array of XYZ coordinates of an rectangle.

#### ▶ Inputs

- **Line Strip** (Number: Boolean)
- **Segments** (Number: Integer)
- **Width** (Number)
- **Height** (Number)
- **Border Radius** (Number)
- **Loop** (Number: Boolean)
- **Top Left** (Number: Boolean)
- **Top Right** (Number: Boolean)
- **Bottom Left** (Number: Boolean)
- **Bottom Right** (Number: Boolean)

#### ◀ Output

- **Points** (Array)

**Example Patch:** cables.gl/edit/l1KQN8

**Doc:** cables.gl/op/Ops.Array.PointArray.PointsRectangle\_v2

## 15.12 PointsRectangleRounded\_v2



PointsRectangleRounded

**Full Name:** Ops.Array.PointArray.PointsRectangleRounded\_v2

Generate an array of points of a rectangle with rounded corners.

#### > Inputs

- **Render** (Trigger)
- **Segments** (Number: Integer)
- **Width** (Number)
- **Height** (Number)
- **Border Radius** (Number)
- **Top Left** (Number: Boolean)
- **Top Right** (Number: Boolean)
- **Bottom Left** (Number: Boolean)
- **Bottom Right** (Number: Boolean)
- **Draw** (Number: Boolean)

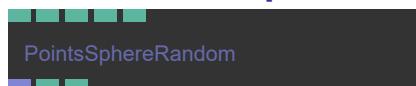
#### < Output

- **Trigger** (Trigger)
- **Points** (Array)

**Example Patch:** cables.gl/edit/A7nLgQ

**Doc:** cables.gl/op/Ops.Array.PointArray.PointsRectangleRounded\_v2

## 15.13 PointsSphereRandom



**Full Name:** Ops.Array.PointArray.PointsSphereRandom

Generate a point field mapped to the surface of a sphere.

#### > Inputs

- **Amount Of Points** (Number: Integer)
- **Sphere Size** (Number)
- **Random Seed** (Number)
- **Random Distance From Sphere** (Number)
- **Distribution Index** (Number: Integer)

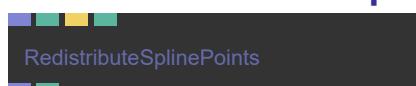
#### < Output

- **Array Out** (Array)
- **Total Points** (Number)
- **Array Length** (Number)

**Example Patch:** cables.gl/edit/yBeQuy

**Doc:** cables.gl/op/Ops.Array.PointArray.PointsSphereRandom

## 15.14 RedistributeSplinePoints



**Full Name:** Ops.Array.PointArray.RedistributeSplinePoints

Recalculate a spline / change number of points of a spline.

#### > Inputs

- **Array3x** (Array)
- **Num Points** (Number: Integer)
- **Calculate** (Trigger)
- **Normalized** (Number: Boolean)

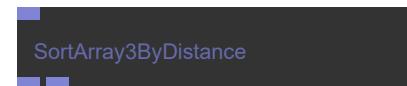
#### < Output

- **Result** (Array)
- **Spline Length** (Number)

**Example Patch:** cables.gl/op/Ops.Array.PointArray.RedistributeSplinePoints#example

**Doc:** cables.gl/op/Ops.Array.PointArray.RedistributeSplinePoints

## 15.15 SortArray3ByDistance



**Full Name:** Ops.Array.PointArray.SortArray3ByDistance

Sort an array3, by the distance of each point to the previous point.

#### > Inputs

- **Array** (Array)

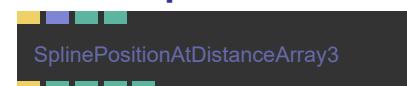
#### < Output

- **Result** (Array)
- **Result Index** (Array)

**Example Patch:** cables.gl/edit/7C6DLJ

**Doc:** cables.gl/op/Ops.Array.PointArray.SortArray3ByDistance

## 15.16 SplinePositionAtDistanceArray3



**Full Name:** Ops.Array.PointArray.SplinePositionAtDistanceArray3

Get position in array3/spline at distance from start.

#### > Inputs

- **Calculate** (Trigger)
- **Array3x** (Array)
- **Distance** (Number)
- **Normalized** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **X** (Number)
- **Y** (Number)

- **Z** (Number)
- **Spline Length** (Number)

**Example Patch:** [cables.gl/edit/6XhHR7](#)

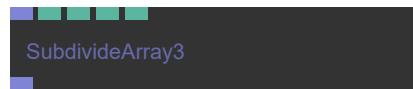
**Doc:** [cables.gl/op/Ops.Array.PointArray.SplinePositionAtDistanceArray3](#)

- **Result** (Array)

**Example Patch:** [cables.gl/edit/NenSet](#)

**Doc:** [cables.gl/op/Ops.Array.PointArray.TransformArray3](#)

## 15.17 SubdivideArray3\_v2



**Full Name:** Ops.Array.PointArray.SubdivideArray3\_v2

For subdividing splines, smoothing lines using cubic bezier interpolation.

### ➤ Inputs

- **Points** (Array)
- **Num Subdivs** (Number: Integer)
- **Smooth** (Number: Boolean)
- **Loop** (Number: Boolean)

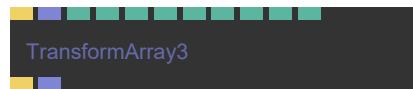
### ◀ Output

- **Result** (Array)

**Example Patch:** [cables.gl/edit/uywtvc](#)

**Doc:** [cables.gl/op/Ops.Array.SubdivideArray3\\_v2](#)

## 15.18 TransformArray3



**Full Name:** Ops.Array.PointArray.TransformArray3

Transform (translate, rotate, scale) positions in an array3x.

### ➤ Inputs

- **Transform** (Trigger)
- **Array** (Array)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)

### ◀ Output

- **Next** (Trigger)

# 16 Ops.Audio

## 16.1 BpmTap



**Full Name:** Ops.Audio.BpmTap

Let's you tap in a beat, useful to synchronise visuals to music (VJ, sync, sound).

### > Inputs

- **Exe** (Trigger)
- **Tap** (Trigger)
- **Sync** (Trigger)
- **NudgeLeft** (Trigger)
- **NudgeRight** (Trigger)
- **Active** (Number: Boolean)

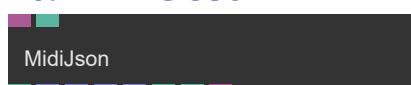
### < Output

- **Beat** (Trigger)
- **Bpm** (Number)
- **The resulting BPM** (beats per minute)
- **States** (Array)
- **Beat Index** (Number)

**Example Patch:** cables.gl/edit/vwdfqX

**Doc:** cables.gl/op/Ops.Audio.BpmTap

## 16.2 MidiJson



**Full Name:** Ops.Audio.MidiJson

read MIDI information at time x.

### > Inputs

- **MidiJson** (Object)
- **Time** (Number)

### < Output

- **Beat** (Number)
- **Track Names** (Array)
- **Names** (Array)
- **Progress** (Array)
- **Velocity** (Array)
- **Num Tracks** (Number)
- **BPM** (Number)

- **Data** (Object)

**Example Patch:** cables.gl/edit/yJPMCV

**Doc:** cables.gl/op/Ops.Audio.MidiJson

## 16.3 MidiJsonNote\_v2



**Full Name:** Ops.Audio.MidiJsonNote\_v2

Filter MidiJson for notes.

### > Inputs

- **Data** (Object)
- **Note** (String)
- **Channel** (Number: String)
- **Beat Start** (Number: Integer)
- **Beat End** (Number: Integer)

### < Output

- **Count** (Number)
- **Progress** (Number)
- **Time Since Last** (Number)
- **Trigger** (Trigger)
- **Reseted** (Trigger)

**Example Patch:** cables.gl/op/Ops.Audio.MidiJsonNote\_v2#example

**Doc:** cables.gl/op/Ops.Audio.MidiJsonNote\_v2

# 17 Ops.Boolean

## 17.1 And



**Full Name:** Ops.Boolean.And

Outputs true if both input values are true (boolean).

### > Inputs

- **Bool 1** (Number: Boolean)
- **Bool 2** (Number: Boolean)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/\_B91Ms

**Doc:** cables.gl/op/Ops.Boolean.And

## 17.2 AndMultiPort\_v2



**Full Name:** Ops.Boolean.AndMultiPort\_v2

Outputs true if all input values are true (boolean).

### > Inputs

- **Booleans\_0** (Number: Boolean)
- **Add Port** (Number: Boolean)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Boolean.AndMultiPort\_v2#example

**Doc:** cables.gl/op/Ops.Boolean.AndMultiPort\_v2

## 17.3 BoolByTrigger



**Full Name:** Ops.Boolean.BoolByTrigger

Trigger true or false values.

### > Inputs

- **True** (Trigger)
- **False** (Trigger)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/1UEVu1

**Doc:** cables.gl/op/Ops.Boolean.BoolByTrigger

## 17.4 Boolean



**Full Name:** Ops.Boolean.Boolean

Stores a boolean value.

### > Inputs

- **Value** (Number: Boolean)

### < Output

- **Result** (booleanNumber)

**Example Patch:** cables.gl/edit/1dAfW2

**Doc:** cables.gl/op/Ops.Boolean.Boolean

## 17.5 BoolToColor



**Full Name:** Ops.Boolean.BoolToColor

Convert boolean to RGB color.

### > Inputs

- **Boolean** (Number: Boolean)
- **R True** (Number)
- **G True** (Number)
- **B True** (Number)
- **A True** (Number)
- **R False** (Number)
- **G False** (Number)
- **B False** (Number)
- **A False** (Number)

### < Output

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

**Example Patch:** cables.gl/op/Ops.Boolean.BoolToColor#example

**Doc:** cables.gl/op/Ops.Boolean.BoolToColor

## 17.6 BoolToNumber\_v2



**Full Name:** Ops.Boolean.BoolToNumber\_v2

Switches two number values using a boolean.

### > Inputs

- **Use Value 1** (Number: Boolean)
- **Value 0** (Number)
- **Value 1** (Number)

### < Output

- **Out Value** (Number)

**Example Patch:** cables.gl/op/Ops.Boolean.BoolToNumber\_v2#example

**Doc:** cables.gl/op/Ops.Boolean.BoolToNumber\_v2

## 17.7 BoolToString



**Full Name:** Ops.Boolean.BoolToString

convert boolean to string.

### > Inputs

- **Boolean** (Number: Boolean)
- **False** (String)
- **True** (String)

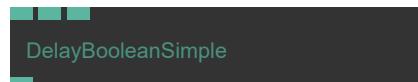
### < Output

- **String** (String)

**Example Patch:** cables.gl/edit/kmXcm6

**Doc:** cables.gl/op/Ops.Boolean.BoolToString

## 17.8 DelayBooleanSimple



**Full Name:** Ops.Boolean.DelayBooleanSimple

Delay the input/output of a boolean by x seconds.

### > Inputs

- **Value** (Number)
- **Delay True** (Number)
- **Delay False** (Number)

### < Output

- **Out Value** (Number)

**Example Patch:** cables.gl/edit/VBa0ft

**Doc:** cables.gl/op/Ops.Boolean.DelayBooleanSimple

## 17.9 IfFalseThen



**Full Name:** Ops.Boolean.IfFalseThen

Triggers if input value is false.

### > Inputs

- **Exe** (Trigger)
- **Boolean** (Number: Boolean)

### < Output

- **Exe** (Trigger)
- **Boolean** (Number: Boolean)
- **Then** (Trigger)
- **Else** (Trigger)

**Example Patch:** cables.gl/op/Ops.Boolean.IfFalseThen#example

**Doc:** cables.gl/op/Ops.Boolean.IfFalseThen

## 17.10 IfTrueThen\_v2



**Full Name:** Ops.Boolean.IfTrueThen\_v2

Switch, trigger one or the other trigger port based on the input value.

### > Inputs

- **Exe** (Trigger)
- **Boolean** (Number: Boolean)

### < Output

- **Then** (Trigger)
- **Else** (Trigger)

**Example Patch:** cables.gl/edit/F9tjX8

**Doc:** cables.gl/op/Ops.Boolean.IfTrueThen\_v2

## 17.11 IsOne



**Full Name:** Ops.Boolean.IsOne

Returns true if input value is 1.

**> Inputs**

- **Value** (Number)

**< Output**

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Boolean.IsOne#example

**Doc:** cables.gl/op/Ops.Boolean.IsOne

## 17.12 IsZero

A small icon consisting of a dark grey rectangle with a thin green horizontal bar at the top and a single green square below it.

**Full Name:** Ops.Boolean.IsZero

Returns true if input value is 0.

**> Inputs**

- **Value** (Number)

**< Output**

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Boolean.IsZero#example

**Doc:** cables.gl/op/Ops.Boolean.IsZero

## 17.13 MonoFlop

A small icon consisting of a dark grey rectangle with a thin yellow horizontal bar at the top and two yellow squares below it.

**Full Name:** Ops.Boolean.MonoFlop

Sets output to 1 when triggered, turns back to 0 automatically after x seconds.

**> Inputs**

- **Trigger** (Trigger)
- **Duration** (Number)
- **Value True** (Number)
- **Value False** (Number)
- **Reset** (Trigger)

**< Output**

- **Activated** (Trigger)
- **Ended** (Trigger)
- **Result** (Number)

**Example Patch:** cables.gl/edit/F3r9L5

**Doc:** cables.gl/op/Ops.Boolean.MonoFlop

## 17.14 Not

A small icon consisting of a dark grey rectangle with a thin green horizontal bar at the top and a single green square below it.

**Full Name:** Ops.Boolean.Not

result is false if input is true and vice versa (negate/toggle/switch/!=).

**> Inputs**

- **Boolean** (Number: Boolean)

**< Output**

- **Result** (Number)

**Example Patch:** cables.gl/edit/1dAfW2

**Doc:** cables.gl/op/Ops.Boolean.Not

## 17.15 Or

A small icon consisting of a dark grey rectangle with a thin yellow horizontal bar at the top and two yellow squares below it.

**Full Name:** Ops.Boolean.Or

Returns true if one or more of the input booleans are true.

**> Inputs**

- **Bool 1** (Number: Boolean)
- **Bool 2** (Number: Boolean)
- **Bool 3** (Number: Boolean)
- **Bool 4** (Number: Boolean)
- **Bool 5** (Number: Boolean)
- **Bool 6** (Number: Boolean)
- **Bool 7** (Number: Boolean)
- **Bool 8** (Number: Boolean)
- **Bool 9** (Number: Boolean)
- **Bool 10** (Number: Boolean)

**< Output**

- **Result** (booleanNumber)

**Example Patch:** cables.gl/edit/1dAfW2

**Doc:** cables.gl/op/Ops.Boolean.Or

## 17.16 OrNumber\_v2

A small icon consisting of a dark grey rectangle with a thin yellow horizontal bar at the top and two yellow squares below it.

**Full Name:** Ops.Boolean.OrNumber\_v2

Output another number if input number is zero.

#### > Inputs

- **Number** (Number)
- **Number 2** (Number)
- **Number 3** (Number)
- **Number 4** (Number)
- **Number 5** (Number)
- **Number 6** (Number)
- **Number 7** (Number)
- **Number 8** (Number)

#### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/J4cYet](#)

**Doc:** [cables.gl/op/Ops.Boolean.OrNumber\\_v2](#)

## 17.17 ParseBoolean\_v2



**Full Name:** Ops.Boolean.ParseBoolean\_v2

parse boolean from string/number.

#### > Inputs

- **String** (String)

#### < Output

- **Result** (booleanNumber)

**Example Patch:** [cables.gl/edit/2nXYet](#)

**Doc:** [cables.gl/op/Ops.Boolean.ParseBoolean\\_v2](#)

## 17.18 RouteBoolean



**Full Name:** Ops.Boolean.RouteBoolean

Route a boolean to an output port.

#### > Inputs

- **Index** (Number: Integer)
- **Boolean In** (Number: Boolean)
- **Default Boolean** (Number: Boolean)

#### < Output

- **Index 0 Boolean** (booleanNumber)
- **Index 1 Boolean** (booleanNumber)
- **Index 2 Boolean** (booleanNumber)

- **Index 3 Boolean** (booleanNumber)
- **Index 4 Boolean** (booleanNumber)
- **Index 5 Boolean** (booleanNumber)
- **Index 6 Boolean** (booleanNumber)
- **Index 7 Boolean** (booleanNumber)
- **Index 8 Boolean** (booleanNumber)
- **Index 9 Boolean** (booleanNumber)

**Example Patch:** [cables.gl/edit/mS8CX8](#)

**Doc:** [cables.gl/op/Ops.Boolean.RouteBoolean](#)

## 17.19 ToggleBool\_v2



**Full Name:** Ops.Boolean.ToggleBool\_v2

Toggle a boolean value by triggering.

#### > Inputs

- **Trigger** (Trigger)
- **Reset** (Trigger)
- **Default** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Result** (booleanNumber)

**Example Patch:** [cables.gl/edit/UxJNHj](#)

**Doc:** [cables.gl/op/Ops.Boolean.ToggleBool\\_v2](#)

## 17.20 TriggerChangedFalse



**Full Name:** Ops.Boolean.TriggerChangedFalse

Triggers next only after value has changed to false.

#### > Inputs

- **Value** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/UWCvS8](#)

**Doc:** [cables.gl/op/Ops.Boolean.TriggerChangedFalse](#)

## 17.21 TriggerChangedTrue

TriggerChangedTrue

**Full Name:** Ops.Boolean.TriggerChangedTrue

Triggers next only after value has changed to true.

**> Inputs**

- **Value** (Number: Boolean)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/UWCvS8

**Doc:** cables.gl/op/Ops.Boolean.TriggerChangedTrue

## 17.22 TriggerOnChangeBoolean\_v2

TriggerOnChangeBoolean

**Full Name:** Ops.Boolean.TriggerOnChangeBoolean\_v2

Triggers when boolean value has changed.

**> Inputs**

- **Value** (Number: Boolean)

**< Output**

- **True** (Trigger)
- **False** (Trigger)

**Example Patch:** cables.gl/edit/UWCvS8

**Doc:** cables.gl/op/Ops.Boolean.TriggerOnChangeBoolean\_v2

# 18 Ops.Cables

## 18.1 AssetPathURL

AssetPathURL

**Full Name:** Ops.Cables.AssetPathURL

outputs the path to the assets.

**> Inputs**

- **Filename** (String)

**< Output**

- **Path** (String)

**Example Patch:** cables.gl/edit/mwhthf

**Doc:** cables.gl/op/Ops.Cables.AssetPathURL

## 18.2 CablesInfo

CablesInfo

**Full Name:** Ops.Cables.CablesInfo

Output the cables URL of the current editor environment.

**> Inputs**

- Visit *Ops.Cables.CablesInfo documentation for input port details*

**< Output**

- **URL** (String)

**Example Patch:** cables.gl/edit/vaK7iO

**Doc:** cables.gl/op/Ops.Cables.CablesInfo

## 18.3 CallBack\_v2

CallBack

**Full Name:** Ops.Cables.CallBack\_v2

Useful when a cables patch is embedded into a website. All parameters (Value 1, Value 2, Value 3) will be send as a parameter array. So e.g. if Callback Name is foo cables would call: CABLES.patch.config.foo([Value 1, Value 2, Value 3]).

**> Inputs**

- **Exe** (Trigger)
- **Callback Name** (String)
- **Parameter 1** (String)

- **Parameter 2** (String)
- **Parameter 3** (String)
- **Public** (7): LANDINGPORTAFOLIO
- **LOGICX BED** (PUBLIC): wirmachenbunt - Published Sep 30, 2021 at 12:25

#### < Output

- Visit *Ops.Cables.CallBack\_v2 documentation for output port details*

**Example Patch:** cables.gl/op/Ops.Cables.CallBack\_v2#example

**Doc:** cables.gl/op/Ops.Cables.CallBack\_v2

## 18.4 FPS\_v2



**Full Name:** Ops.Cables.FPS\_v2

output current frames per second.

#### > Inputs

- Visit *Ops.Cables.FPS\_v2 documentation for input port details*

#### < Output

- **FPS** (Number)
- **MS** (Number)

**Example Patch:** cables.gl/edit/KhFA8i

**Doc:** cables.gl/op/Ops.Cables.FPS\_v2

## 18.5 Function\_v2



**Full Name:** Ops.Cables.Function\_v2

trigger from external function when embedded into a website.

#### > Inputs

- **Function Name** (String)
- **Trigger** (Trigger)
- **Default Parameter 1** (String)
- **Default Parameter 2** (String)
- **Default Parameter 3** (String)

#### < Output

- **Next** (Trigger)
- **Parameter 1** (String)
- **Parameter 2** (String)
- **Parameter 3** (String)

**Example Patch:** cables.gl/op/Ops.Cables.Function\_v2#example

**Doc:** cables.gl/op/Ops.Cables.Function\_v2

## 18.6 GetOpName



**Full Name:** Ops.Cables.GetOpName

Get op name by id.

#### > Inputs

- **OpId** (String)

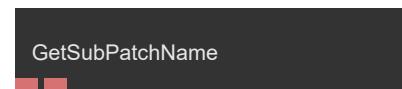
#### < Output

- **Found** (booleanNumber)
- **Name** (String)
- **Shortname** (String)
- **Version** (Number)

**Example Patch:** cables.gl/edit/Hmk7iO

**Doc:** cables.gl/op/Ops.Cables.GetOpName

## 18.7 GetSubPatchName



**Full Name:** Ops.Cables.GetSubPatchName

Outputs the current subpatch op name.

#### > Inputs

- Visit *Ops.Cables.GetSubPatchName documentation for input port details*

#### < Output

- **Name** (String)
- **ShortName** (String)

**Example Patch:** cables.gl/edit/20tMrh

**Doc:** cables.gl/op/Ops.Cables.GetSubPatchName

## 18.8 LoadingJob



**Full Name:** Ops.Cables.LoadingJob

Create a loading job while input is true.

#### > Inputs

- **Loading Active** (Number: Boolean)

#### < Output

- Visit [Ops.Cables.LoadingJob](#) documentation for output port details

**Example Patch:** [cables.gl/edit/bzn9z1](#)

**Doc:** [cables.gl/op/Ops.Cables.LoadingJob](#)

## 18.9 LoadingStatus\_v2



**Full Name:** Ops.Cables.LoadingStatus\_v2

trigger events / get information about asset-loading status.

**> Inputs**

- **Exe** (Trigger)
- **Play Timeline** (Number: Boolean)

**< Output**

- **Next** (Trigger)
- **Finished Initial Loading** (booleanNumber)
- **Loading** (booleanNumber)
- **Progress** (Number)
- **Jobs** (Array)
- **Trigger Loading Finished** (Trigger)

**Example Patch:** [cables.gl/edit/5FQ08W](#)

**Doc:** [cables.gl/op/Ops.Cables.LoadingStatus\\_v2](#)

## 18.10 PatchInfo\_v2



**Full Name:** Ops.Cables.PatchInfo\_v2

read patch config when embedding on another page.

**> Inputs**

- Visit [Ops.Cables.PatchInfo\\_v2](#) documentation for input port details

**< Output**

- **Config** (Object)
- **Name** (String)
- **Patch Id** (String)
- **Namespace** (String)
- **Last Saved** (Number)
- **Last Exported** (Number)

**Example Patch:** [cables.gl/edit/3hkdqX](#)

**Doc:** [cables.gl/op/Ops.Cables.PatchInfo\\_v2](#)

## 18.11 UIMode



**Full Name:** Ops.Cables.UIMode

Outputs true if patch is executed in the cables editor (UI).

**> Inputs**

- Visit [Ops.Cables.UIMode](#) documentation for input port details

**< Output**

- **UI** (booleanNumber)
- **Overlay Mode** (booleanNumber)
- **Remote Viewer** (booleanNumber)
- **Is Standalone** (booleanNumber)
- **Canvas Mode** (Number)
- **Patch Field Visible** (booleanNumber)

**Example Patch:** [cables.gl/edit/vyqgR3](#)

**Doc:** [cables.gl/op/Ops.Cables.UIMode](#)

## 18.12 UploadAsset



**Full Name:** Ops.Cables.UploadAsset

Upload a file into the cables patch assets using a base64 string.

**> Inputs**

- **Filename** (String)
- **Base64 String** (String)
- **Upload** (Trigger)

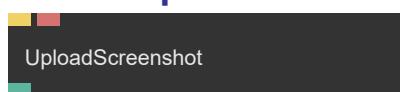
**< Output**

- **Result** (String)
- **Error** (booleanNumber)
- **Finished** (Trigger)

**Example Patch:** [cables.gl/edit/6vDCsh](#)

**Doc:** [cables.gl/op/Ops.Cables.UploadAsset](#)

## 18.13 UploadScreenshot



**Full Name:** Ops.Cables.UploadScreenshot

Upload an image as screenshot in cables.

> Inputs

- **Trigger** (Trigger)
- **DataUrl** (String)

< Output

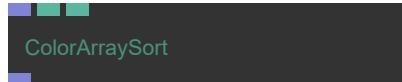
- **Result** (Number)

**Example Patch:** [cables.gl/op/Ops.Cables.UploadScreenshot#example](https://cables.gl/op/Ops.Cables.UploadScreenshot#example)

**Doc:** [cables.gl/op/Ops.Cables.UploadScreenshot](https://cables.gl/op/Ops.Cables.UploadScreenshot)

# 19 Ops.Color

## 19.1 ColorArraySort



**Full Name:** Ops.Color.ColorArraySort

Sort an array of colors by saturation/lightness etc.

> Inputs

- **Colors** (Array)

< Output

- **New Colors** (Array)

**Example Patch:** [cables.gl/edit/zKfluu](https://cables.gl/edit/zKfluu)

**Doc:** [cables.gl/op/Ops.Color.ColorArraySort](https://cables.gl/op/Ops.Color.ColorArraySort)

## 19.2 ColorPalettes



**Full Name:** Ops.Color.ColorPalettes

Contains a collection of nice color palettes output to texture or array via index.

> Inputs

- **Index** (Number: Integer)
- **Smooth** (Number: Boolean)

< Output

- **Texture** (Object)
- **Color Array** (Array)
- **The color array containing 5 colors** (15 values in total, 3 values per color – r, g and b)

**Example Patch:** [cables.gl/edit/xRvD98](https://cables.gl/edit/xRvD98)

**Doc:** [cables.gl/op/Ops.Color.ColorPalettes](https://cables.gl/op/Ops.Color.ColorPalettes)

## 19.3 ColorValue



**Full Name:** Ops.Color.ColorValue

Use a color value on multiple places.

> Inputs

- **R** (Number)
- **G** (Number)

- **B** (Number)
- **A** (Number)

#### < Output

- **Outr** (Number)
- **Outg** (Number)
- **Outb** (Number)
- **Outa** (Number)
- **Hex** (Number)
- **Array** (Array)

**Example Patch:** [cables.gl/edit/19KZet](#)

**Doc:** [cables.gl/op/Ops.Color.ColorValue](#)

## 19.4 EyeDropper



**Full Name:** Ops.Color.EyeDropper

Native color picker.

#### > Inputs

- **Open** (Trigger)

#### < Output

- **Hex** (String)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Supported** (booleanNumber)

**Example Patch:** [cables.gl/edit/kYsAkv](#)

**Doc:** [cables.gl/op/Ops.Color.EyeDropper](#)

## 19.5 Gradient



**Full Name:** Ops.Color.Gradient

gradient editor, outputs an objects with gradient information.

#### > Inputs

- **Gradient** (Number)
- **Randomize Colors** (Trigger)

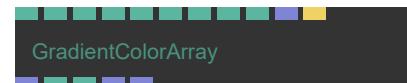
#### < Output

- **Gradient Object** (Object)

**Example Patch:** [cables.gl/edit/QB7br5](#)

**Doc:** [cables.gl/op/Ops.Color.Gradient](#)

## 19.6 GradientColorArray



**Full Name:** Ops.Color.GradientColorArray

texture containing a colour gradient that can be altered with an editor.

#### > Inputs

- **Gradient** (Number)
- **Direction Index** (Number: Integer)
- **Smoothstep** (Number: Boolean)
- **Step** (Number: Boolean)
- **Flip** (Number: Boolean)
- **SRGB** (Number: Boolean)
- **Oklab** (Number: Boolean)
- **Size** (Number: Integer)
- **Dither** (Number)
- **Gradient Array** (Array)
- **Randomize Colors** (Trigger)

#### < Output

- **Color Array** (Array)
- **Width** (Number)
- **Height** (Number)
- **Colors** (Array)
- **Colors Pos** (Array)

**Example Patch:** [cables.gl/edit/xAdV8x](#)

**Doc:** [cables.gl/op/Ops.Color.GradientColorArray](#)

## 19.7 HexToRGB\_v2



**Full Name:** Ops.Color.HexToRGB\_v2

Converts a hex color like #ff0000 to number values.

#### > Inputs

- **Hex** (String)
- **Bytes** (Number: Boolean)

#### < Output

- **R** (Number)
- **G** (Number)
- **B** (Number)

- **RGB Array** (Array)

**Example Patch:** cables.gl/edit/IBX1ft

**Doc:** cables.gl/op/Ops.Color.HexToRGB\_v2

## 19.8 HSLtoRGB



**Full Name:** Ops.Color.HSLtoRGB

Convert HSL to RGB.

### > Inputs

- **Hue** (Number)
- **Saturation** (Number)
- **Lightness** (Number)

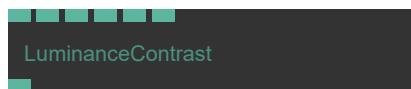
### < Output

- **R** (Number)
- **G** (Number)
- **B** (Number)

**Example Patch:** cables.gl/edit/3fOpvs

**Doc:** cables.gl/op/Ops.Color.HSLtoRGB

## 19.9 LuminanceContrast



**Full Name:** Ops.Color.LuminanceContrast

Calculate the luminance contrast between two colors.

### > Inputs

- **R 1** (Number)
- **G 1** (Number)
- **B 1** (Number)
- **R 2** (Number)
- **G 2** (Number)
- **B 2** (Number)

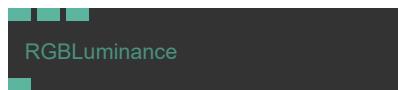
### < Output

- **Contrast** (Number)

**Example Patch:** cables.gl/edit/lFzrvs

**Doc:** cables.gl/op/Ops.Color.LuminanceContrast

## 19.10 RGBLuminance



**Full Name:** Ops.Color.RGBLuminance

Calculate the luminance of a RGB color.

### > Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)

### < Output

- **Luminance** (Number)

**Example Patch:** cables.gl/edit/Du0rvs

**Doc:** cables.gl/op/Ops.Color.RGBLuminance

## 19.11 RGBToCMYK



**Full Name:** Ops.Color.RGBToCMYK

Output the CMYK value of a RGB color.

### > Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)

### < Output

- **C** (Number)
- **M** (Number)
- **Y** (Number)
- **K** (Number)

**Example Patch:** cables.gl/edit/Du0rvs

**Doc:** cables.gl/op/Ops.Color.RGBToCMYK

## 19.12 RgbToHex



**Full Name:** Ops.Color.RgbToHex

convert RGB float values to HEX color String.

### > Inputs

- **R** (Number)

- **G** (Number)
- **B** (Number)

#### ◀ Output

- **Result** (String)

**Example Patch:** [cables.gl/edit/Up7r8i](#)

**Doc:** [cables.gl/op/Ops.Color.RgbToHex](#)

## 19.13 RGBtoHSB



**Full Name:** Ops.Color.RGBtoHSB

convert RGB color to HSB Hue, Saturation, Brightness.

#### ▶ Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)

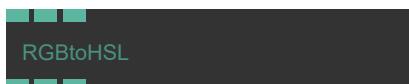
#### ◀ Output

- **Hue** (Number)
- **Saturation** (Number)
- **Brightness** (Number)

**Example Patch:** [cables.gl/edit/Up7r8i](#)

**Doc:** [cables.gl/op/Ops.Color.RGBtoHSB](#)

## 19.14 RGBtoHSL



**Full Name:** Ops.Color.RGBtoHSL

Convert RGB color to HSL values.

#### ▶ Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)

#### ◀ Output

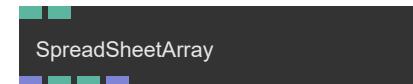
- **Hue** (Number)
- **Saturation** (Number)
- **Lightness** (Number)

**Example Patch:** [cables.gl/edit/Du0rvs](#)

**Doc:** [cables.gl/op/Ops.Color.RGBtoHSL](#)

# 20 Ops.Data

## 20.1 SpreadSheetArray



**Full Name:** Ops.Data.SpreadSheetArray

Enter data in a spreadsheet table.

#### ▶ Inputs

- Visit [Ops.Data.SpreadSheetArray documentation for input port details](#)

#### ◀ Output

- **Array** (Array)
- **Width** (Number)
- **Height** (Number)
- **Column Names** (Array)

**Example Patch:** [cables.gl/edit/wDITt1](#)

**Doc:** [cables.gl/op/Ops.Data.SpreadSheetArray](#)

# 21 Ops.Data.Compose.Array

## 21.1 CompArray



**Full Name:** Ops.Data.Compose.Array.CompArray

Compose an Array.

### > Inputs

- **Update** (Trigger)
- **Active** (Number: Boolean)
- **Clear** (Number: Boolean)
- **Reset** (Trigger)

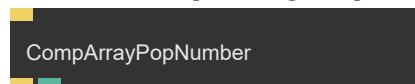
### < Output

- **Next** (Trigger)
- **Result** (Array)

**Example Patch:** cables.gl/edit/RLvmjz

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArray

## 21.2 CompArrayPopNumber



**Full Name:** Ops.Data.Compose.Array.CompArrayPopNumber

pop/remove the last number from an array.

### > Inputs

- **Update** (Trigger)

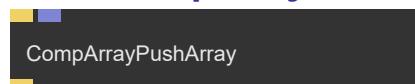
### < Output

- **Next** (Trigger)
- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPopNumber#exampleNext (Trigger)

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPopNumber

## 21.3 CompArrayPushArray



**Full Name:** Ops.Data.Compose.Array.CompArrayPushArray

push/append an array to an array.

### > Inputs

- **Update** (Trigger)

- **Array** (Array)

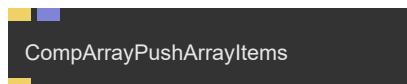
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushArray#exampleNext (Trigger)

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushArray

## 21.4 CompArrayPushArrayItems



**Full Name:** Ops.Data.Compose.Array.CompArrayPushArrayItems

push/append an array to an array.

### > Inputs

- **Update** (Trigger)
- **Array** (Array)

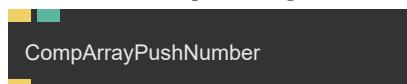
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/ADSKWn

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushArrayItems

## 21.5 CompArrayPushNumber



**Full Name:** Ops.Data.Compose.Array.CompArrayPushNumber

push/append a number to an array.

### > Inputs

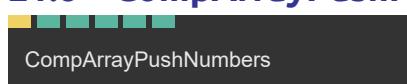
- **Update** (Trigger)
- **Number** (Number)

### < Output

**Example Patch:** cables.gl/edit/RLvmjz

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushNumber

## 21.6 CompArrayPushNumbers



**Full Name:** Ops.Data.Compose.Array.CompArrayPushNumbers

push/append multiple numbers to an array.

### > Inputs

- **Update** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushNumbers#example  
**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushNumbers

## 21.7 CompArrayPushObject

CompArrayPushObject

**Full Name:** Ops.Data.Compose.Array.CompArrayPushObject  
push/append an object to an array.

**> Inputs**

- **Update** (Trigger)
- **Object** (Object)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/SCFZJK

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushObject

## 21.8 CompArrayPushString

CompArrayPushString

**Full Name:** Ops.Data.Compose.Array.CompArrayPushString  
push/append a string to an array.

**> Inputs**

- **Update** (Trigger)
- **String** (String)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushString#example  
**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushString

## 21.9 CompArrayPushTexture

CompArrayPushTexture

**Full Name:** Ops.Data.Compose.Array.CompArrayPushTexture  
push/append a texture to an array.

**> Inputs**

- **Update** (Trigger)
- **Object** (Object)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushTexture#example

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayPushTexture

## 21.10 CompArraySetNumber

CompArraySetNumber

**Full Name:** Ops.Data.Compose.Array.CompArraySetNumber  
set a number to an array at index.

**> Inputs**

- **Update** (Trigger)
- **Index** (Number)
- **Number** (Number)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArraySetNumber#example

**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArraySetNumber

## 21.11 CompArraySetObject

CompArraySetObject

**Full Name:** Ops.Data.Compose.Array.CompArraySetObject  
push/append a number to an array.

**> Inputs**

- **Update** (Trigger)
- **Index** (Number)
- **Object** (Object)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArraySetObject#example  
**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArraySetObject

## 21.12 CompArrayShiftNumber

CompArrayShiftNumber

**Full Name:** Ops.Data.Compose.Array.CompArrayShiftNumber  
shift/remove the first number from an array.

### > Inputs

- **Update** (Trigger)

### < Output

- **Next** (Trigger)
- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArrayShiftNumber#example  
**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArrayShiftNumber

## 21.13 CompArraySnapshot

CompArraySnapshot

**Full Name:** Ops.Data.Compose.Array.CompArraySnapshot  
get a copy of the current state of an array.

### > Inputs

- **Update** (Trigger)

### < Output

- **Next** (Trigger)
- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Array.CompArraySnapshot#example  
**Doc:** cables.gl/op/Ops.Data.Compose.Array.CompArraySnapshot

# 22 Ops.Data.Compose.Object

## 22.1 CompObject

CompObject

**Full Name:** Ops.Data.Compose.Object.CompObject  
Compose an Object.

### > Inputs

- **Update** (Trigger)
- **Clear** (Number: Boolean)
- **Reset** (Trigger)

### < Output

- **Next** (Trigger)
- **Result** (Object)

**Example Patch:** cables.gl/edit/Theojz

**Doc:** cables.gl/op/Ops.Data.Compose.Object.CompObject

## 22.2 CompObjectFromObject

CompObjectFromObject

**Full Name:** Ops.Data.Compose.Object.CompObjectFromObject  
Set key/values to the current ObjectCompose from an existing object.

### > Inputs

- **Update** (Trigger)
- **Object** (Object)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/9ORqOg

**Doc:** cables.gl/op/Ops.Data.Compose.Object.CompObjectFromObject

## 22.3 CompObjectSetArray

CompObjectSetArray

**Full Name:** Ops.Data.Compose.Object.CompObjectSetArray  
set array as object property.

### > Inputs

- **Update** (Trigger)
- **Key** (String)

- **Array** (Array)

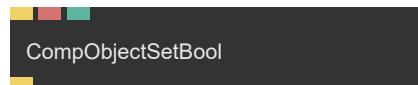
#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/Theojz

**Doc:** cables.gl/op/Ops.Data.Compose.Object.CompObjectSetArray

## 22.4 CompObjectSetBool



**Full Name:** Ops.Data.Compose.Object.CompObjectSetBool

set a boolean as object property.

#### > Inputs

- **Update** (Trigger)
- **Key** (String)
- **Boolean** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/ggd-JK

**Doc:** cables.gl/op/Ops.Data.Compose.Object.CompObjectSetBool

## 22.5 CompObjectSetNumber



**Full Name:** Ops.Data.Compose.Object.CompObjectSetNumber

set number as object property.

#### > Inputs

- **Update** (Trigger)
- **Key** (String)
- **Number** (Number)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/Theojz

**Doc:** cables.gl/op/Ops.Data.Compose.Object.CompObjectSetNumber

## 22.6 CompObjectSetObject



**Full Name:** Ops.Data.Compose.Object.CompObjectSetObject  
set object as object property.

#### > Inputs

- **Update** (Trigger)
- **Key** (String)
- **Object** (Object)

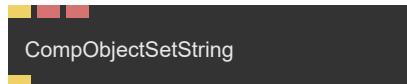
#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Data.Compose.Object.CompObjectSetObject#e

**Doc:** cables.gl/op/Ops.Data.Compose.Object.CompObjectSetObject

## 22.7 CompObjectSetString



**Full Name:** Ops.Data.Compose.Object.CompObjectSetString

set string as object property.

#### > Inputs

- **Update** (Trigger)
- **Key** (String)
- **String** (String)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/Theojz

**Doc:** cables.gl/op/Ops.Data.Compose.Object.CompObjectSetString

# 23 Ops.Data.Compose.String

## 23.1 CompString



**Full Name:** Ops.Data.Compose.String.CompString

Compose a string.

### > Inputs

- **Update** (Trigger)
- **Clear** (Number: Boolean)
- **Reset** (Trigger)

### < Output

- **Next** (Trigger)
- **Result** (String)

**Example Patch:** cables.gl/edit/GUpzJB

**Doc:** cables.gl/op/Ops.Data.Compose.String.CompString

- **Direction Index** (Number: Integer)
- **Num Chars** (Number: Integer)

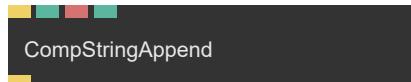
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/Yqj7eG

**Doc:** cables.gl/op/Ops.Data.Compose.String.CompStringShorten

## 23.2 CompStringAppend



**Full Name:** Ops.Data.Compose.String.CompStringAppend

Append a string to a string.

### > Inputs

- **Update** (Trigger)
- **String** (String)
- **Add Break** (Number: Boolean)

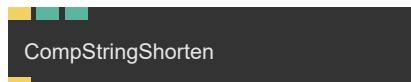
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/Yqj7eG

**Doc:** cables.gl/op/Ops.Data.Compose.String.CompStringAppend

## 23.3 CompStringShorten



**Full Name:** Ops.Data.Compose.String.CompStringShorten

Remove characters from the beginning or end of a string.

### > Inputs

- **Update** (Trigger)

# 24 Ops.Data.JsonPath

## 24.1 ArrayGetArrayByPath

ArrayGetArrayByPath

**Full Name:** Ops.Data.JsonPath.ArrayGetArrayByPath

returns the array at the position defined by a path.

### > Inputs

- **Array** (Array)
- **Path** (String)
- **path to array** (i.e. data.numbers)

### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/uqXSWr

**Doc:** cables.gl/op/Ops.Data.JsonPath.ArrayGetArrayByPath

## 24.2 ArrayGetArrayValuesByPath

ArrayGetArrayValuesByPath

**Full Name:** Ops.Data.JsonPath.ArrayGetArrayValuesByPath

Outputs all the values of the properties of an array of objects given a path.

### > Inputs

- **Array** (Array)
- **Path** (String)
- **path to first array field** (i.e. "data.0.firstName")

### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/Y3pXWr

**Doc:** cables.gl/op/Ops.Data.JsonPath.ArrayGetArrayValuesByPath

## 24.3 ArrayGetNumberByPath

ArrayGetNumberByPath

**Full Name:** Ops.Data.JsonPath.ArrayGetNumberByPath

finds a number at a position in an array defined by path.

### > Inputs

- **Array** (Array)
- **Path** (String)

- **the past** (i.e. person.age)

### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/7kSVWr

**Doc:** cables.gl/op/Ops.Data.JsonPath.ArrayGetNumberByPath

## 24.4 ArrayGetObjectByPath

ArrayGetObjectByPath

**Full Name:** Ops.Data.JsonPath.ArrayGetObjectByPath

Returns the object at the position defined by a path.

### > Inputs

- **Array** (Array)
- **Path** (String)

### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/AapUWr

**Doc:** cables.gl/op/Ops.Data.JsonPath.ArrayGetObjectByPath

## 24.5 ArrayGetStringByPath\_v2

ArrayGetStringByPath

**Full Name:** Ops.Data.JsonPath.ArrayGetStringByPath\_v2

Finds a string at a position in an array defined by path.

### > Inputs

- **Array** (Array)
- **Path** (String)
- **the path** (i.e. data.names)
- **Return Path If Missing** (Number: Boolean)

### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/rs0XWr

**Doc:** cables.gl/op/Ops.Data.JsonPath.ArrayGetStringByPath\_v2

## 24.6 ObjectGetArrayByPath

ObjectGetArrayByPath

**Full Name:** Ops.Data.JsonPath.ObjectGetArrayByPath  
returns the array at the position defined by a path.

#### > Inputs

- **Object** (Object)
- **Path** (String)
- **path to array** (i.e. data.numbers)

#### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/oghmln

**Doc:** cables.gl/op/Ops.Data.JsonPath.ObjectGetArrayByPath

## 24.7 ObjectGetArrayValuesByPath

ObjectGetArrayValuesByPath

**Full Name:** Ops.Data.JsonPath.ObjectGetArrayValuesByPath

Outputs all the values of the properties of an array of objects given a path.

#### > Inputs

- **Object** (Object)
- **Path** (String)
- **path to first array field** (i.e. "data.0.firstName")

#### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/fBcgln

**Doc:** cables.gl/op/Ops.Data.JsonPath.ObjectGetArrayValuesByPath

## 24.8 ObjectGetNumberByPath

ObjectGetNumberByPath

**Full Name:** Ops.Data.JsonPath.ObjectGetNumberByPath

finds a number at a position in an object defined by path.

#### > Inputs

- **Object** (Object)
- **Path** (String)
- **the past** (i.e. person.age)

#### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/RrYnln

**Doc:** cables.gl/op/Ops.Data.JsonPath.ObjectGetNumberByPath

## 24.9 ObjectGetObjectByPath

ObjectGetObjectByPath

**Full Name:** Ops.Data.JsonPath.ObjectGetObjectByPath

Returns the object at the position defined by a path.

#### > Inputs

- **Object** (Object)
- **Path** (String)

#### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/-Zlrln

**Doc:** cables.gl/op/Ops.Data.JsonPath.ObjectGetObjectByPath

## 24.10 ObjectGetStringByPath\_v2

ObjectGetStringByPath

**Full Name:** Ops.Data.JsonPath.ObjectGetStringByPath\_v2

Finds a string at a position in an object defined by path.

#### > Inputs

- **Object** (Object)
- **Path** (String)
- **the path** (i.e. data.names)
- **Output Path If Missing** (Number: Boolean)

#### < Output

- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/eJlqln

**Doc:** cables.gl/op/Ops.Data.JsonPath.ObjectGetStringByPath\_v2

# 25 Ops.Data.StackValues

## 25.1 StackGetArray



**Full Name:** Ops.Data.StackValues.StackGetArray  
read a value from the stack to use it later in the trigger branch.

### > Inputs

- **Trigger** (Trigger)
- **Name** (String)

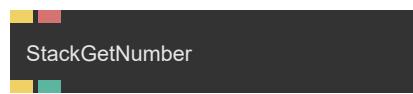
### < Output

- **Next** (Trigger)
- **Array** (Array)

**Example Patch:** cables.gl/edit/NT30kP

**Doc:** cables.gl/op/Ops.Data.StackValues.StackGetArray

## 25.2 StackGetNumber



**Full Name:** Ops.Data.StackValues.StackGetNumber  
read a value from the stack to use it later in the trigger branch.

### > Inputs

- **Exec** (Trigger)
- **Name** (String)

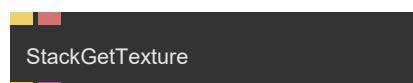
### < Output

- **Next** (Trigger)
- **Value** (Number)

**Example Patch:** cables.gl/edit/NT30kP

**Doc:** cables.gl/op/Ops.Data.StackValues.StackGetNumber

## 25.3 StackGetTexture



**Full Name:** Ops.Data.StackValues.StackGetTexture  
read a value from the stack to use it later in the trigger branch.

### > Inputs

- **Exec** (Trigger)
- **Name** (String)

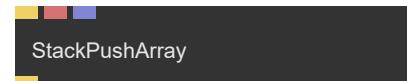
### < Output

- **Next** (Trigger)
- **Texture** (Object)

**Example Patch:** cables.gl/edit/NT30kP

**Doc:** cables.gl/op/Ops.Data.StackValues.StackGetTexture

## 25.4 StackPushArray



**Full Name:** Ops.Data.StackValues.StackPushArray  
push a value on to the stack to use it later in the trigger branch.

### > Inputs

- **Trigger** (Trigger)
- **Name** (String)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/NT30kP

**Doc:** cables.gl/op/Ops.Data.StackValues.StackPushArray

## 25.5 StackPushNumber



**Full Name:** Ops.Data.StackValues.StackPushNumber  
push a value on to the stack to use it later in the trigger branch.

### > Inputs

- **Exec** (Trigger)
- **Name** (String)
- **Value** (Number)

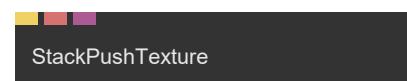
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/NT30kP

**Doc:** cables.gl/op/Ops.Data.StackValues.StackPushNumber

## 25.6 StackPushTexture



**Full Name:** Ops.Data.StackValues.StackPushTexture  
push a value on to the stack to use it later in the trigger branch.

#### > Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Texture** (Object:Texture)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/NT30kP](#)

**Doc:** [cables.gl/op/Ops.Data.StackValues.StackPushTexture](#)

# 26 Ops.Date

## 26.1 DateAndTime



**Full Name:** Ops.Date.DateAndTime

Returns current date and time and timestamp.

#### > Inputs

- **Update Rate** (Number)
- **How often the op should update the output** (in milliseconds)

#### < Output

- **Year** (Number)
- **Month** (Number)
- **Day** (Number)
- **Hours** (Number)
- **Minutes** (Number)
- **Seconds** (Number)
- **Timestamp** (Number)

**Example Patch:** [cables.gl/edit/GuzKSD](#)

**Doc:** [cables.gl/op/Ops.Date.DateAndTime](#)

## 26.2 DateCalc



**Full Name:** Ops.Date.DateCalc

Perform date calculations.

#### > Inputs

- **Timestamp** (Number)
- **Difference** (Number: Integer)
- **Type Index** (Number: Integer)
- **Update** (Trigger)
- **Update time value** (not needed if an timestamp input is used)

#### < Output

- **Date** (Object)
- **Timestamp** (Number)

**Example Patch:** [cables.gl/edit/mzfGGI](#)

**Doc:** [cables.gl/op/Ops.Date.DateCalc](#)

## 26.3 DateDifference

DateDifference

**Full Name:** Ops.Date.DateDifference

Calculates the difference between two timestamps.

### > Inputs

- **Timestamp 1** (Number)
- **Timestamp 2** (Number)
- **Stop At 0** (Number: Boolean)

### < Output

- **Year** (Number)
- **Month** (Number)
- **Day** (Number)
- **Hours** (Number)
- **Minutes** (Number)
- **Seconds** (Number)
- **Milliseconds** (Number)
- **Diff** (Number)

**Example Patch:** cables.gl/edit/d1NUet

**Doc:** cables.gl/op/Ops.Date.DateDifference

## 26.4 DateFormatter

DateFormatter

**Full Name:** Ops.Date.DateFormatter

String representation of a date.

### > Inputs

- **Timestamp** (Number)
- **Date** (Object)
- **Format** (String)

### < Output

- **StringDate** (String)

**Example Patch:** cables.gl/edit/mzfGGI

**Doc:** cables.gl/op/Ops.Date.DateFormatter

## 26.5 DateIsoToTimestamp

DateIsoToTimestamp

**Full Name:** Ops.Date.DateIsoToTimestamp

parses a date and time in iso format and outputs a millisecond timestamp.

### > Inputs

- **Datetime** (String)

### < Output

- **Timestamp** (Number)

**Example Patch:** cables.gl/edit/nsSRrU

**Doc:** cables.gl/op/Ops.Date.DateIsoToTimestamp

## 26.6 DateTimestamp

DateTimestamp

**Full Name:** Ops.Date.DateTimestamp

Calculates the timestamp of a date by year / month / day / hour / minute.

### > Inputs

- **Year** (Number: Integer)
- **Month** (Number: Integer)
- **Day** (Number: Integer)
- **Hour** (Number: Integer)
- **Minute** (Number: Integer)

### < Output

- **Timestamp** (Number)

**Example Patch:** cables.gl/op/Ops.Date.DateTimestamp#example

**Doc:** cables.gl/op/Ops.Date.DateTimestamp

## 26.7 Milliseconds

Milliseconds

**Full Name:** Ops.Date.Milliseconds

Value since the time origin in milliseconds (performance.now()).

### > Inputs

- **Update** (Trigger)

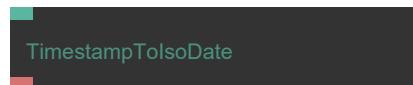
### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/dJzVbI

**Doc:** cables.gl/op/Ops.Date.Milliseconds

## 26.8 TimestampToIsoDate



**Full Name:** Ops.Date.TimestampToIsoDate  
convert a timestamp to an ISO date string.

### > Inputs

- **Timestamp** (Number)

### < Output

- **ISO Date** (String)

**Example Patch:** cables.gl/edit/MqNl8i

**Doc:** cables.gl/op/Ops.Date.TimestampToIsoDate

# 27 Ops.Debug

## 27.1 Console



**Full Name:** Ops.Debug.Console  
Shows console log output on the screen.

### > Inputs

- **Visible** (Number: Boolean)
- **Clear** (Trigger)

### < Output

- **Element** (Object)

**Example Patch:** cables.gl/edit/TVIL7F

**Doc:** cables.gl/op/Ops.Debug.Console

## 27.2 ConsoleLog



**Full Name:** Ops.Debug.ConsoleLog  
Log incoming values to the console/dev tools.

### > Inputs

- **Number** (Number)
- **String** (String)

### < Output

• Visit *Ops.Debug.ConsoleLog documentation for output port details*

**Example Patch:** cables.gl/op/Ops.Debug.ConsoleLog#example

**Doc:** cables.gl/op/Ops.Debug.ConsoleLog

## 27.3 CrashOp



**Full Name:** Ops.Debug.CrashOp  
Crash the editor in many ways.

### > Inputs

- **Async Crash** (Trigger)
- **Undefined Crash** (Trigger)
- **Throw Exception** (Trigger)
- **Float** (Number)

- **Array Exception** (Trigger)
- **Promise Fail** (Trigger)
- **Shader Error** (Trigger)

#### < Output

- **Nan** (Number)
- **Infinity** (Number)

**Example Patch:** [cables.gl/edit/9TvUBq](#)

**Doc:** [cables.gl/op/Ops.Debug.CrashOp](#)

## 27.4 GlLogErrors

 GlLogErrors

**Full Name:** Ops.Debug.GlLogErrors

execute glGetError after every gl command and log to browser console.

#### > Inputs

- **Exec** (Trigger)
- **Limit Error Logs Num** (Number: Integer)
- **Stop Trigger After Limit** (Number: Boolean)
- **Show Gl History** (Trigger)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Debug.GlLogErrors#example](#)

**Doc:** [cables.gl/op/Ops.Debug.GlLogErrors](#)

## 27.5 GlStates

 GlStates

**Full Name:** Ops.Debug.GlStates

see current gl states and error message.

#### > Inputs

- **Update** (Trigger)

#### < Output

- **Next** (Trigger)
- **GlGetError** (Number)
- **Depthtest** (Number)
- **Stack Depthtest** (Number)
- **Depth Writing** (Number)
- **Stack Depth Writing** (Number)
- **DepthFunc** (Number)

- **Stack DepthFunc** (Number)
- **Blend** (Number)
- **Blend Stack** (Number)
- **Cull Mode** (Number)
- **Face Culling** (Number)
- **Is Shadowpass** (booleanNumber)

**Example Patch:** [cables.gl/op/Ops.Debug.GlStates#example](#)

**Doc:** [cables.gl/op/Ops.Debug.GlStates](#)

## 27.6 ProfileGL

 ProfileGL

**Full Name:** Ops.Debug.ProfileGL

dump all gl commands of one frame to console.

#### > Inputs

- **Exec** (Trigger)
- **Debug One Frame** (Trigger)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Debug.ProfileGL#example](#)

**Doc:** [cables.gl/op/Ops.Debug.ProfileGL](#)

## 27.7 StopWatch

 StopWatch

**Full Name:** Ops.Debug.StopWatch

Measure the time used to render all child nodes in milliseconds.

#### > Inputs

- **Exec** (Trigger)

#### < Output

- **Next** (Trigger)
- **Time Used** (Number)
- **Times** (Array)

**Example Patch:** [cables.gl/op/Ops.Debug.StopWatch#example](#)

**Doc:** [cables.gl/op/Ops.Debug.StopWatch](#)

# 28 Ops.Devices

## 28.1 TouchGesture



**Full Name:** Ops.Devices.TouchGesture  
detect touch gestures like swipe and pan.

### > Inputs

- **Active** (Number: Boolean)
- **Vertical Swipe** (Number: Boolean)
- **Vertical Pan** (Number: Boolean)

### < Output

- **Press** (Trigger)
- **Press Up** (Trigger)
- **Pan Left** (Trigger)
- **Pan Right** (Trigger)
- **Swipe Left** (Trigger)
- **Swipe Right** (Trigger)
- **Swipe Up** (Trigger)
- **Swipe Down** (Trigger)
- **Event** (Object)

**Example Patch:** <cables.gl/op/Ops.Devices.TouchGesture#example>

**Doc:** <cables.gl/op/Ops.Devices.TouchGesture>

- **Finger 1 X** (Number)
- **Finger 1 Y** (Number)
- **Finger 1 Force** (Number)
- **Finger 2 X** (Number)
- **Finger 2 Y** (Number)
- **Finger 2 Force** (Number)
- **Events** (Array)
- **Touch Start** (Trigger)
- **Touch End** (Trigger)

**Example Patch:** <cables.gl/op/Ops.Devices.TouchScreen#example>

**Doc:** <cables.gl/op/Ops.Devices.TouchScreen>

## 28.2 TouchScreen



**Full Name:** Ops.Devices.TouchScreen  
touch screen input: e.g. position of fingers.

### > Inputs

- **Disable Scaling** (Number: Boolean)
- **Disable Scroll** (Number: Boolean)
- **HDPI Coordinates** (Number: Boolean)
- **Active** (Number: Boolean)
- **Normalize Coordinates** (Number: Boolean)
- **Flip Y** (Number: Boolean)

### < Output

- **Touched** (Number)
- **Fingers** (Number)

# 29 Ops.Devices.Browser

## 29.1 BrowserInfo\_v3



**Full Name:** Ops.Devices.Browser.BrowserInfo\_v3

Reports the browser being used.

### > Inputs

- Visit [Ops.Devices.Browser.BrowserInfo\\_v3 documentation](#) for input port details

### < Output

- **Is Mobile** (booleanNumber)
- **Is Touchscreen** (booleanNumber)
- **Is IE** (booleanNumber)
- **Is Edge** (booleanNumber)
- **Is Chrome** (booleanNumber)
- **Is Firefox** (booleanNumber)
- **Is Opera** (booleanNumber)
- **Is Safari** (booleanNumber)
- **True if the browser is Safari** (iOS & macOS & OS X)
- **Is Windows** (booleanNumber)
- **Is Linux** (booleanNumber)
- **Is Mac** (booleanNumber)
- **Is IOS** (booleanNumber)
- **Is Android** (booleanNumber)
- **Is Electron** (booleanNumber)
- **Operating System** (String)
- **Browser Name** (String)
- **Browser Version** (String)
- **OS Version** (String)
- **Language** (String)
- **User Agent** (String)
- **Platform Object** (Object)

**Example Patch:** [cables.gl/edit/YOJilk](https://cables.gl/edit/YOJilk)

**Doc:** [cables.gl/op/Ops.Devices.Browser.BrowserInfo\\_v3](https://cables.gl/op/Ops.Devices.Browser.BrowserInfo_v3)

## 29.2 ColorScheme



**Full Name:** Ops.Devices.Browser.ColorScheme

Get light/dark color scheme preference of the browser.

### > Inputs

- Visit [Ops.Devices.Browser.ColorScheme documentation](#) for input port details

### < Output

- **Color Scheme** (String)
- **Dark Mode** (booleanNumber)
- **Light Mode** (booleanNumber)
- **Supported** (booleanNumber)

**Example Patch:** [cables.gl/edit/An48HJ](https://cables.gl/edit/An48HJ)

**Doc:** [cables.gl/op/Ops.Devices.Browser.ColorScheme](https://cables.gl/op/Ops.Devices.Browser.ColorScheme)

## 29.3 History



**Full Name:** Ops.Devices.Browser.History

Move back or forward in the browser navigation history.

### > Inputs

- **Back** (Trigger)
- **Forward** (Trigger)

### < Output

- Visit [Ops.Devices.Browser.History documentation](#) for output port details

**Example Patch:** [cables.gl/op/Ops.Devices.Browser.History#example](https://cables.gl/op/Ops.Devices.Browser.History#example)

**Doc:** [cables.gl/op/Ops.Devices.Browser.History](https://cables.gl/op/Ops.Devices.Browser.History)

## 29.4 JsExpression



**Full Name:** Ops.Devices.Browser.JsExpression

evaluate a javascript expression.

### > Inputs

- **JS Expression** (String)

### < Output

- **Result String** (String)
- **Result Number** (Number)
- **Result Array** (Array)
- **Result Object** (Object)
- **Error** (booleanNumber)

**Example Patch:** cables.gl/edit/gpp408

**Doc:** cables.gl/op/Ops.Devices.Browser.JsExpression

## 29.5 JsMemory



**Full Name:** Ops.Devices.Browser.JsMemory

browser js memory consumption.

### > Inputs

- **Update** (Trigger)

### < Output

- **Used Heap Size** (Number)
- **Total Heap Size** (Number)

**Example Patch:** cables.gl/edit/\_UySOf

**Doc:** cables.gl/op/Ops.Devices.Browser.JsMemory

- **Text** (String)

- **URL** (String)

- **Base64 File** (String)

- **Data URL** (String)

- **Filetype** (String)

- **Filename** (String)

- **Share** (Trigger)

### < Output

- **Status** (String)

- **Supported** (Number)

**Example Patch:** cables.gl/edit/pQ49m4

**Doc:** cables.gl/op/Ops.Devices.Browser.WebShare

## 29.6 UserActivation



**Full Name:** Ops.Devices.Browser.UserActivation

detect if the user interacted with or activated the page.

### > Inputs

- **Update** (Trigger)

### < Output

- **Next** (Trigger)
- **User Is Or Was Active** (booleanNumber)
- **User Has Been Active** (booleanNumber)
- **User Is Active** (booleanNumber)
- **Supported** (booleanNumber)

**Example Patch:** cables.gl/edit/3S26Qc

**Doc:** cables.gl/op/Ops.Devices.Browser.UserActivation

## 29.7 WebShare



**Full Name:** Ops.Devices.Browser.WebShare

Opens a sharing dialog to share text and images.

### > Inputs

# 30 Ops.Devices.GamePad

## 30.1 GamePad



**Full Name:** Ops.Devices.GamePad.GamePad

Outputs the button states of a gamepad.

### > Inputs

- **GamePad Data** (Object)
- **Analog To Digital** (Number: Boolean)

### < Output

- **ID** (String)
- **Axes** (Array)
- **Pad Left** (booleanNumber)
- **Pad Right** (booleanNumber)
- **Pad Up** (booleanNumber)
- **Pad Down** (booleanNumber)
- **Button 1** (booleanNumber)
- **Button 2** (booleanNumber)
- **Button 3** (booleanNumber)
- **Button 4** (booleanNumber)
- **Left Shoulder** (Number)
- **Left Shoulder Bottom** (Number)
- **Right Shoulder** (Number)
- **Right Shoulder Bottom** (Number)

**Example Patch:** cables.gl/edit/XHK7NH

**Doc:** cables.gl/op/Ops.Devices.GamePad.GamePad

- **DeadZone** (Number)
- **Angle** (Number)

**Example Patch:** cables.gl/edit/bDqHdN

**Doc:** cables.gl/op/Ops.Devices.GamePad.GamePadJoystickAxis

## 30.3 GamePads



**Full Name:** Ops.Devices.GamePad.GamePads

list connected gamepads - press a button to connect.

### > Inputs

- **Exe** (Trigger)

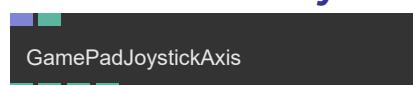
### < Output

- **Num Gamepads** (Number)
- **Pad 0** (Object)
- **Pad 1** (Object)
- **Pad 2** (Object)
- **Pad 3** (Object)

**Example Patch:** cables.gl/edit/XHK7NH

**Doc:** cables.gl/op/Ops.Devices.GamePad.GamePads

## 30.2 GamePadJoystickAxis



**Full Name:** Ops.Devices.GamePad.GamePadJoystickAxis

get axis and angle of a joystick/thumbstick.

### > Inputs

- **Axis** (Array)
- **Index** (Number: Integer)

### < Output

- **X** (Number)
- **Y** (Number)

# 31 Ops.Devices.Keyboard

## 31.1 CursorKeys



**Full Name:** Ops.Devices.Keyboard.CursorKeys

get the state of your keyboards arrow keys.

### > Inputs

- **Canvas Only** (Number: Boolean)
- **Cursor Keys** (Number: Boolean)
- **WASD** (Number: Boolean)
- **Active** (Number: Boolean)

### < Output

- **Degree** (Number)
- **Up** (booleanNumber)
- **Up Pressed** (Trigger)
- **Down** (booleanNumber)
- **Down Pressed** (Trigger)
- **Left** (booleanNumber)
- **Left Pressed** (Trigger)
- **Right** (booleanNumber)
- **Right Pressed** (Trigger)
- **Any Button Pressed** (Number)

**Example Patch:** cables.gl/edit/m5V6VB

**Doc:** cables.gl/op/Ops.Devices.Keyboard.CursorKeys

## 31.2 KeyPress\_v2



**Full Name:** Ops.Devices.Keyboard.KeyPress\_v2

Triggers when a key is pressed.

### > Inputs

- **Area Index** (Number: Integer)
- **Prevent Default** (Number: Boolean)
- **Enabled** (Number: Boolean)

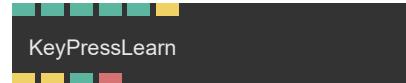
### < Output

- **On Press** (Trigger)
- **Key Code** (Number)
- **Key** (String)

**Example Patch:** cables.gl/edit/lmGgPZ

**Doc:** cables.gl/op/Ops.Devices.Keyboard.KeyPress\_v2

## 31.3 KeyPressLearn



**Full Name:** Ops.Devices.Keyboard.KeyPressLearn

Triggers when certain key is pressed or released.

### > Inputs

- **Key Code** (Number: Integer)
- **Canvas Only** (Number: Boolean)
- **Mod Key Index** (Number: Integer)
- **Enabled** (Number: Boolean)
- **Prevent Default** (Number: Boolean)
- **Learn** (Trigger)

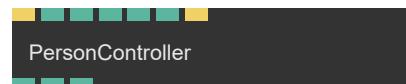
### < Output

- **On Press** (Trigger)
- **On Release** (Trigger)
- **Pressed** (booleanNumber)
- **Key** (String)

**Example Patch:** cables.gl/edit/ZRY-x3

**Doc:** cables.gl/op/Ops.Devices.Keyboard.KeyPressLearn

## 31.4 PersonController



**Full Name:** Ops.Devices.Keyboard.PersonController

simple controller example op for game characters.

### > Inputs

- **Exe** (Trigger)
- **Speed** (Number)
- **North** (Number: Boolean)
- **East** (Number: Boolean)
- **South** (Number: Boolean)
- **West** (Number: Boolean)
- **Reset** (Trigger)

### < Output

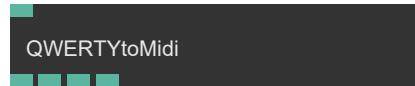
- **X** (Number)
- **Y** (Number)

- Dir (Number)

**Example Patch:** [cables.gl/edit/m5V6VB](#)

**Doc:** [cables.gl/op/Ops.Devices.Keyboard.PersonController](#)

## 31.5 QWERTYtoMidi



**Full Name:** Ops.Devices.Keyboard.QWERTYtoMidi

Emulates a MIDI keyboard using your regular keyboard.

### > Inputs

- Canvas Only (Number: Boolean)

### < Output

- Note Number (Number)
- Velocity (Number)
- Channel (Number)
- Command (Number)

**Example Patch:** [cables.gl/edit/PfZk-4](#)

**Doc:** [cables.gl/op/Ops.Devices.Keyboard.QWERTYtoMidi](#)

# 32 Ops.Devices.Midi

## 32.1 DeviceList



**Full Name:** Ops.Devices.Midi.DeviceList

list of midi devices.

### > Inputs

- Visit *Ops.Devices.Midi.DeviceList documentation* for input port details

### < Output

- Num Devices (Number)
- Midi Support (booleanNumber)
- Device Names (Array)

**Example Patch:** [cables.gl/edit/EEHSI5](#)

**Doc:** [cables.gl/op/Ops.Devices.Midi.DeviceList](#)

## 32.2 MidiCC\_v3



**Full Name:** Ops.Devices.Midi.MidiCC\_v3

read CC value from Midi controller.

### > Inputs

- MIDI Event In (Object)
- MIDI Channel Index (Number: Integer)
- CC Index (Number: Integer)
- Speed (Number)
- Learn (Trigger)
- Clear (Trigger)

### < Output

- CC Value Out (Number)
- Event (Object)
- Trigger Out (Trigger)
- CC Index Out (Number)

**Example Patch:** [cables.gl/edit/dfF3DI](#)

**Doc:** [cables.gl/op/Ops.Devices.Midi.MidiCC\\_v3](#)

## 32.3 MidiCCOut\_v2

MidiCCOut

**Full Name:** Ops.Devices.Midi.MidiCCOut\_v2  
send MIDI CC data to a midi output.

### > Inputs

- **Send** (Trigger)
- **MIDI Channel Index** (Number: Integer)
- **CC Index** (Number: Integer)
- **CC Value** (Number: Integer)
- **Auto Send Value Change** (Number: Boolean)

### < Output

- **MIDI Event Out** (Object)

**Example Patch:** cables.gl/edit/VbaQXU

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiCCOut\_v2

## 32.4 MidiChord3

MidiChord3

**Full Name:** Ops.Devices.Midi.MidiChord3

Map 3 midi notes to values.

### > Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Note 1 Index** (Number: Integer)
- **Note 2 Index** (Number: Integer)
- **Note 3 Index** (Number: Integer)
- **Normalize Velocity Index** (Number: Integer)
- **Learn** (Trigger)
- **Reset** (Trigger)

### < Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)
- **Note Out 1** (Number)
- **Velocity 1** (Number)
- **Gate 1** (booleanNumber)
- **Note Out 2** (Number)
- **Velocity 2** (Number)
- **Gate 2** (booleanNumber)
- **Note Out 3** (Number)

- **Velocity 3** (Number)
- **Gate 3** (booleanNumber)

**Example Patch:** cables.gl/edit/dfF3DI

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiChord3

## 32.5 MidiClock

MidiClock

**Full Name:** Ops.Devices.Midi.MidiClock  
sends out midi clock signals as triggers.

### > Inputs

- **MIDI Event In** (Object)
- **Timing Index** (Number: Integer)

### < Output

- **MIDI Event Out** (Object)
- **Tick Out** (Trigger)
- **Clock Start** (Trigger)
- **Clock Stop** (Trigger)
- **Clock Continue** (Trigger)
- **BPM** (Number)
- **Tick Duration** (Number)
- **Sub Tick** (Number)
- **current subtick** (value between 0 - 24)
- **outputs a trigger every bar** (dotted: 1.5 bars, triplet: full-note triplet)
- **outputs a trigger every half note** (dotted: trigger every 3/4, triplet: half-note triplet)
- **outputs a trigger every quarter note** (dotted: trigger every 3/8, triplet: quarter-note triplet)
- **outputs a trigger every eighth note** (dotted: trigger every 3/16, triplet: eighth-note triplet)
- **outputs a trigger every sixteenth note** (dotted: trigger every 3/32, triplet: sixteenth-note triplet)

**Example Patch:** cables.gl/edit/dfF3DI

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiClock

## 32.6 MidilInputDevice\_v2

MidilInputDevice

**Full Name:** Ops.Devices.Midi.MidilInputDevice\_v2  
connect to MIDI device output port.

#### > Inputs

- **Device Index** (Number: Integer)
- **Learn** (Trigger)

#### < Output

- **Event** (Object)
- **Note** (Object)
- **CC** (Object)
- **NRPN** (Object)
- **Program Change** (Object)
- **Clock** (Object)

**Example Patch:** [cables.gl/edit/dfF3DI](#)

**Doc:** [cables.gl/op/Ops.Devices.Midi.MidiInputDevice\\_v2](#)

## 32.7 MidiMonitor



**Full Name:** Ops.Devices.Midi.MidiMonitor

detailed information about Midi events being sent.

#### > Inputs

- **Event** (Object)

#### < Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)
- **Device** (Number)
- **MIDI Channel** (Number)
- **Message Type** (Number)
- **the type of the message** (CC, Note, NRPN, Clock, ...)
- **Note** (Number)
- **Note Velocity** (Number)
- **CC Number** (Number)
- **CC Value** (Number)
- **Pitch Bend Value** (Number)
- **NRPN Number** (Number)
- **NRPN Value** (Number)
- **Program Change Value** (Number)

**Example Patch:** [cables.gl/edit/dfF3DI](#)

**Doc:** [cables.gl/op/Ops.Devices.Midi.MidiMonitor](#)

## 32.8 MidiNote



**Full Name:** Ops.Devices.Midi.MidiNote

Read a single midi note.

#### > Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Note Index** (Number: Integer)
- **Normalize Velocity Index** (Number: Integer)
- **Toggle Gate** (Number: Boolean)
- **Learn** (Trigger)
- **Clear** (Trigger)

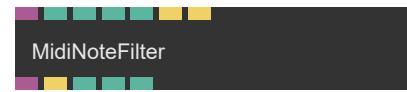
#### < Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)
- **Current Note** (Number)
- **Velocity** (Number)
- **Gate** (booleanNumber)
- **Velocity Array** (Array)

**Example Patch:** [cables.gl/edit/dfF3DI](#)

**Doc:** [cables.gl/op/Ops.Devices.Midi.MidiNote](#)

## 32.9 MidiNoteFilter



**Full Name:** Ops.Devices.Midi.MidiNoteFilter

Only read a range of notes (e.g. C1 to C2).

#### > Inputs

- **MIDI Event** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Note Start Index** (Number: Integer)
- **Note End Index** (Number: Integer)
- **Normalize Velocity Index** (Number: Integer)
- **Learn** (Trigger)
- **Reset** (Trigger)

#### < Output

- **Event** (Object)
- **Trigger Out** (Trigger)
- **Current Note** (Number)

- **Velocity** (Number)
- **Gate** (booleanNumber)

**Example Patch:** cables.gl/edit/dfF3DI

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiNoteFilter

## 32.10 MidiNoteOut



**Full Name:** Ops.Devices.Midi.MidiNoteOut

send midi note data to a midi output.

### ➢ Inputs

- **MIDI Channel Index** (Number: Integer)
- **Note Index** (Number: Integer)
- **Note Number** (Number: Integer)
- **Velocity** (Number: Integer)
- **Min In Velocity** (Number)
- **Max In Velocity** (Number)
- **Velocity Array In** (Array)

### ◀ Output

- **MIDI Event Out** (Object)

**Example Patch:** cables.gl/edit/VbaQXU

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiNoteOut

## 32.11 MidiNRPN



**Full Name:** Ops.Devices.Midi.MidiNRPN

read NRPN value from controller.

### ➢ Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **NRPN Index** (Number: Integer)
- **Normalize Index** (Number: Integer)
- **Learn** (Trigger)
- **Clear** (Trigger)

### ◀ Output

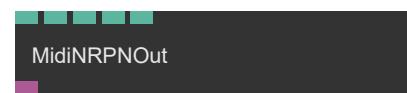
- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)
- **NRPN Index Out** (Number)

- **NRPN Value** (Number)

**Example Patch:** cables.gl/edit/dfF3DI

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiNRPN

## 32.12 MidiNRPNOout



**Full Name:** Ops.Devices.Midi.MidiNRPNOout

send midi NRPN data to a midi output.

### ➢ Inputs

- **MIDI Channel Index** (Number: Integer)
- **NRPN Index** (Number: Integer)
- **NRPN Value** (Number: Integer)
- **Min In Value** (Number)
- **Max In Value** (Number)

### ◀ Output

- **MIDI Event Out** (Object)

**Example Patch:** cables.gl/edit/VbaQXU

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiNRPNOout

## 32.13 MidiOutputDevice



**Full Name:** Ops.Devices.Midi.MidiOutputDevice

Connect to MIDI device input port.

### ➢ Inputs

- **Device Index** (Number: Integer)
- **Note** (Object)
- **CC** (Object)
- **NRPN** (Object)

### ◀ Output

- Visit *Ops.Devices.Midi.MidiOutputDevice documentation* for output port details

**Example Patch:** cables.gl/edit/VbaQXU

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiOutputDevice

## 32.14 MidiTranspose

MidiTranspose

**Full Name:** Ops.Devices.Midi.MidiTranspose  
transpose incoming midi notes.

### > Inputs

- **MIDI Event In** (Object)
- **MIDI Channel Index** (Number: Integer)
- **Transpose Amount** (Number: Integer)
- **Learn** (Trigger)

### < Output

- **MIDI Event Out** (Object)
- **Trigger Out** (Trigger)

**Example Patch:** cables.gl/edit/dff3DI

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiTranspose

## 32.15 MidiValueToNote\_v2

MidiValueToNote

**Full Name:** Ops.Devices.Midi.MidiValueToNote\_v2

Converts a MIDI value to a note string.

### > Inputs

- **Midi Value** (Number)

### < Output

- **Note** (String)

**Example Patch:** cables.gl/edit/PfZk-4

**Doc:** cables.gl/op/Ops.Devices.Midi.MidiValueToNote\_v2

## 33 Ops.Devices.Mobile

### 33.1 DeviceVibrate

DeviceVibrate

**Full Name:** Ops.Devices.Mobile.DeviceVibrate  
vibrating a mobile device.

### > Inputs

- **Vibrate** (Trigger)

### < Output

- **Supported** (Number)

**Example Patch:** cables.gl/edit/H4NGFU

**Doc:** cables.gl/op/Ops.Devices.Mobile.DeviceVibrate

### 33.2 GeoLocation

GeoLocation

**Full Name:** Ops.Devices.Mobile.GeoLocation

tries to get the geo coordinates from the mobile device/browser.

### > Inputs

- Visit *Ops.Devices.Mobile.GeoLocation documentation for input port details*

### < Output

- **Browser Support** (booleanNumber)
- **Latitude** (Number)
- **Longitude** (Number)
- **Data** (Object)

**Example Patch:** cables.gl/edit/kIZ3Ms

**Doc:** cables.gl/op/Ops.Devices.Mobile.GeoLocation

### 33.3 LockOrientation

LockOrientation

**Full Name:** Ops.Devices.Mobile.LockOrientation  
locks orientation to landscape or portrait mode.

### > Inputs

- **Portrait** (Number: Boolean)
- **Landscape** (Number: Boolean)

### < Output

- **Supported** (Number)
- **Locked** (Number)

**Example Patch:** cables.gl/op/Ops.Devices.Mobile.LockOrientation#example

**Doc:** cables.gl/op/Ops.Devices.Mobile.LockOrientation

## 33.4 MotionSensor\_v2



**Full Name:** Ops.Devices.Mobile.MotionSensor\_v2

get values from the device motion sensor mobile.

### > Inputs

- **Mul Orientation** (Number)
- **Request Permissions** (Trigger)

### < Output

- **Orientation Alpha** (Number)
- **Orientation Beta** (Number)
- **Orientation Gamma** (Number)
- **Acceleration X** (Number)
- **Acceleration Y** (Number)
- **Acceleration Z** (Number)
- **Acceleration X No Gravity** (Number)
- **Acceleration Y No Gravity** (Number)
- **Acceleration Z No Gravity** (Number)
- **Rotation Rate Alpha** (Number)
- **Rotation Rate Beta** (Number)
- **Rotation Rate Gamma** (Number)
- **Permissions** (String)
- **Object** (Object)

**Example Patch:** cables.gl/edit/dZ8wQ0

**Doc:** cables.gl/op/Ops.Devices.Mobile.MotionSensor\_v2

## 33.5 Pinch



**Full Name:** Ops.Devices.Mobile.Pinch

detect two finger pinch gestures on touchscreens.

### > Inputs

- **Enabled** (Number: Boolean)
- **Min Scale** (Number)
- **Max Scale** (Number)

- **Reset Scale** (Trigger)
- **Limit** (Number: Boolean)

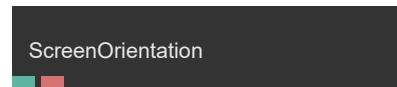
### < Output

- **Scale** (Number)
- **Event Details** (Object)
- **Delta** (Number)

**Example Patch:** cables.gl/op/Ops.Devices.Mobile.Pinch#example

**Doc:** cables.gl/op/Ops.Devices.Mobile.Pinch

## 33.6 ScreenOrientation\_v2



**Full Name:** Ops.Devices.Mobile.ScreenOrientation\_v2

get orientation of the physical screen.

### > Inputs

- Visit [Ops.Devices.Mobile.ScreenOrientation\\_v2 documentation](#) for input port details

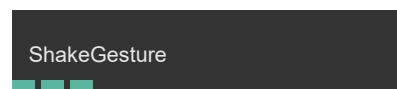
### < Output

- **Angle** (Number)
- **Type** (String)

**Example Patch:** cables.gl/edit/Zc398i

**Doc:** cables.gl/op/Ops.Devices.Mobile.ScreenOrientation\_v2

## 33.7 ShakeGesture



**Full Name:** Ops.Devices.Mobile.ShakeGesture

Reads the accelerometer data from a mobile device.

### > Inputs

- Visit [Ops.Devices.Mobile.ShakeGesture documentation](#) for input port details

### < Output

- **Acceleration X** (Number)
- **Acceleration Y** (Number)
- **Acceleration Z** (Number)

**Example Patch:** cables.gl/op/Ops.Devices.Mobile.ShakeGesture#example

**Doc:** cables.gl/op/Ops.Devices.Mobile.ShakeGesture

# 34 Ops.Devices.Mouse

## 34.1 Mouse\_v4



**Full Name:** Ops.Devices.Mouse.Mouse\_v4

Get mouse/touchscreen/pointer coordinates and events.

### > Inputs

- **Area Index** (Number: Integer)
- **Flip Y** (Number: Boolean)
- **Right Click Prevent Default** (Number: Boolean)
- **Passive Events** (Number: Boolean)
- **Element** (Object)
- **Active** (Number: Boolean)

### < Output

- **X** (Number)
- **Y** (Number)
- **Click** (Trigger)
- **Click Right** (Trigger)
- **Button Is Down** (booleanNumber)
- **Mouse Is Hovering** (booleanNumber)
- **Movement X** (Number)
- **Movement Y** (Number)
- **Event** (Object)

**Example Patch:** cables.gl/edit/mDiCq6

**Doc:** cables.gl/op/Ops.Devices.Mouse.Mouse\_v4

## 34.2 MouseButtons



**Full Name:** Ops.Devices.Mouse.MouseButtons

Get the state of mouse buttons.

### > Inputs

- **Area Index** (Number: Integer)
- **Active** (Number: Boolean)

### < Output

- **Click Left** (Trigger)
- **Click Right** (Trigger)
- **Double Click** (Trigger)

- **Button Pressed Left** (Number)
- **Button Pressed Middle** (Number)
- **Button Pressed Right** (Number)
- **Mouse Down Left** (Trigger)
- **Mouse Down Middle** (Trigger)
- **Mouse Down Right** (Trigger)
- **Mouse Up Left** (Trigger)
- **Mouse Up Middle** (Trigger)
- **Mouse Up Right** (Trigger)

**Example Patch:** cables.gl/edit/cLtJLO

**Doc:** cables.gl/op/Ops.Devices.Mouse.MouseButtons

## 34.3 MouseDrag



**Full Name:** Ops.Devices.Mouse.MouseDrag

get delta of mouse position while dragging.

### > Inputs

- **Active** (Number: Boolean)
- **Speed** (Number)
- **Input Type Index** (Number: Integer)
- **Area Index** (Number: Integer)

### < Output

- **Delta X** (Number)
- **Delta Y** (Number)
- **Is Dragging** (Number)

**Example Patch:** cables.gl/edit/hH8f\_6

**Doc:** cables.gl/op/Ops.Devices.Mouse.MouseDrag

## 34.4 MouseWheel\_v2



**Full Name:** Ops.Devices.Mouse.MouseWheel\_v2

outputs delta values controlled by the mousewheel (scroll, zoom).

### > Inputs

- **Speed** (Number)
- **Prevent Scroll** (Number: Boolean)
- **Flip Direction** (Number: Boolean)
- **Simple Delta** (Number: Boolean)
- **Active** (Number: Boolean)

#### < Output

- **Delta** (Number)
- **Delta X** (Number)
- **Browser Event Delta** (Number)
- **Wheel Action** (Trigger)

**Example Patch:** cables.gl/edit/hH8f\_6

**Doc:** cables.gl/op/Ops.Devices.Mouse.MouseWheel\_v2

## 34.5 PointerLock



**Full Name:** Ops.Devices.Mouse.PointerLock

locks the pointer to the canvas and hides the cursor.

#### > Inputs

- **Render** (Trigger)
- **Start** (Trigger)

#### < Output

- **Next** (Trigger)
- **Supported** (booleanNumber)
- **Is Locked** (booleanNumber)

**Example Patch:** cables.gl/edit/ds6IV2

**Doc:** cables.gl/op/Ops.Devices.Mouse.PointerLock

# 35 Ops.Devices.WebXr.Vr

## 35.1 Vr



**Full Name:** Ops.Devices.WebXr.Vr.Vr

rendering on webxr virtual reality immersive devices.

#### > Inputs

- **Mainloop** (Trigger)
- **Stop** (Trigger)
- **Show Button** (Number: Boolean)
- **Button Style** (String)
- **Render To Texture** (Number: Boolean)
- **Shader** (Object:Shader)

#### < Output

- **Next** (Trigger)
- **Render After Eyes** (Trigger)
- **Viewer Pose** (Object)
- **Eye Index** (Number)
- **VR Support** (booleanNumber)
- **Matrix** (Array)
- **DOM Overlay Ele** (Object)
- **In Session** (booleanNumber)
- **Ms Per Eye** (Array)
- **Texture** (Object)
- **Texture Depth** (Object)

**Example Patch:** cables.gl/edit/lzKYx5

**Doc:** cables.gl/op/Ops.Devices.WebXr.Vr.Vr

## 35.2 VrController



**Full Name:** Ops.Devices.WebXr.Vr.VrController

tracking of vr hand controller.

#### > Inputs

- **Update** (Trigger)
- **Handedness Index** (Number: Integer)

#### < Output

- **Next** (Trigger)

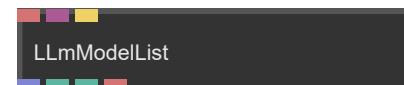
- **Axis 1** (Number)
- **Axis 2** (Number)
- **Axis 3** (Number)
- **Axis 4** (Number)
- **Button 1 Pressed** (Number)
- **Button 2 Pressed** (Number)
- **Button 3 Pressed** (Number)
- **Button 4 Pressed** (Number)
- **Button 5 Pressed** (Number)
- **Button 6 Pressed** (Number)
- **Button 7 Pressed** (Number)
- **Button 1 Touched** (Number)
- **Button 2 Touched** (Number)
- **Button 3 Touched** (Number)
- **Button 4 Touched** (Number)
- **Button 5 Touched** (Number)
- **Button 6 Touched** (Number)
- **Button 7 Touched** (Number)
- **Position X** (Number)
- **Position Y** (Number)
- **Position Z** (Number)
- **Gamepad Values** (Object)
- **Transformed Position** (Trigger)
- **Found** (Number)

**Example Patch:** [cables.gl/edit/IzKYx5](https://cables.gl/edit/IzKYx5)

**Doc:** [cables.gl/op/Ops.Devices.WebXr.VrController](https://cables.gl/op/Ops.Devices.WebXr.VrController)

# 36 Ops.Extension.Ai

## 36.1 LLmModelList



**Full Name:** Ops.Extension.Ai.LLmModelList

*Visit documentation for details.*

### > Inputs

- **String1** (String)
- **Headers** (Object)
- **Reload** (Trigger)

### < Output

- **Z2gtag4y7** (Array)
- **Jcju8npa2** (booleanNumber)
- **Ozg9pnd1z** (String)

**Example Patch:** [cables.gl/op/Ops.Extension.Ai.LLmModelList#example](https://cables.gl/op/Ops.Extension.Ai.LLmModelList#example)

**Doc:** [cables.gl/op/Ops.Extension.Ai.LLmModelList](https://cables.gl/op/Ops.Extension.Ai.LLmModelList)

## 36.2 LlmPrompt



**Full Name:** Ops.Extension.Ai.LlmPrompt

*Visit documentation for details.*

### > Inputs

- **Prompt** (String)
- **Value** (String)
- **API URL** (String)
- **Authentication** (String)
- **Run** (Trigger)
- **Auto Request** (Number: Boolean)

### < Output

- **I4feefw9n** (Object)
- **Klu6r35ga** (booleanNumber)
- **Xs18z73z0** (booleanNumber)
- **Aosval1gx** (String)

**Example Patch:** [cables.gl/op/Ops.Extension.Ai.LlmPrompt#example](https://cables.gl/op/Ops.Extension.Ai.LlmPrompt#example)

**Doc:** [cables.gl/op/Ops.Extension.Ai.LlmPrompt](https://cables.gl/op/Ops.Extension.Ai.LlmPrompt)

# 37 Ops.Extension.AmmoPhysics

## 37.1 AmmoBody



**Full Name:** Ops.Extension.AmmoPhysics.AmmoBody

Create a physics body/collision shape using any geometry or select a shape.

### > Inputs

- **Update** (Trigger)
- **Name** (String)
- **Mass** (Number)
- **Friction** (Number)
- **Rolling Friction** (Number)
- **Restitution** (Number)
- **Shape Index** (Number: Integer)
- **Geometry** (Object:Geometry)
- **Simplify Max Triangles** (Number: Integer)
- **Radius** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Positions** (Array)
- **Append Index To Name** (Number: Boolean)
- **Never Deactivate** (Number: Boolean)
- **Ghost Object** (Number: Boolean)
- **Active** (Number: Boolean)
- **Reset** (Trigger)
- **Activate** (Trigger)

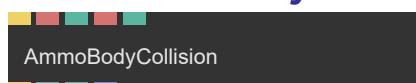
### < Output

- **Next** (Trigger)
- **Ray Hit** (booleanNumber)
- **Transformed** (Trigger)

**Example Patch:** cables.gl/edit/S\_jPZ4

**Doc:** cables.gl/op/Ops.Extension.AmmoPhysics.AmmoBody

## 37.2 AmmoBodyCollision



**Full Name:** Ops.Extension.AmmoPhysics.AmmoBodyCollision

Check if physics bodies are colliding.

### > Inputs

- **Update** (Trigger)
- **Name 1** (String)
- **Match Name 1 Index** (Number: Integer)
- **Name 2** (String)
- **name of physics object** (optional)
- **Match Name 2 Index** (Number: Integer)
- **match name 2** (if set)

### < Output

- **Next** (Trigger)
- **Colliding** (Number)
- **collision detected** (Boolean)
- **Num Collisions** (Number)
- **Collisions** (Array)

**Example Patch:** cables.gl/edit/S\_jPZ4

**Doc:** cables.gl/op/Ops.Extension.AmmoPhysics.AmmoBodyCollision

## 37.3 AmmoCharacter



**Full Name:** Ops.Extension.AmmoPhysics.AmmoCharacter

Control and move a character in a physics environment.

### > Inputs

- **Update** (Trigger)
- **Radius** (Number)
- **View Index** (Number: Integer)
- **Height** (Number)
- **Mass** (Number)
- **Name** (String)
- **Activate** (Trigger)
- **Move X-** (Number: Boolean)
- **Move Y-** (Number: Boolean)
- **Move Z-** (Number: Boolean)
- **Dir X** (Number)
- **X axis rotation value** (from AmmoCharacterFpsCamera for example)
- **Dir Y** (Number)
- **Y axis rotation value** (from AmmoCharacterFpsCamera for example)
- **Dir Z** (Number)
- **Z axis rotation value** (from AmmoCharacterFpsCamera for example)
- **Set Pos X** (Number)
- **Set Pos Y** (Number)

- **Set Pos Z** (Number)
- **Reset** (Trigger)
- **Speed** (Number)
- **Add Velocity Y** (Number)

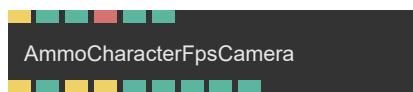
#### < Output

- **Next** (Trigger)
- **Position X** (Number)
- **Position Y** (Number)
- **Position Z** (Number)
- **Transformed** (Trigger)

**Example Patch:** [cables.gl/edit/psyNZ4](#)

**Doc:** [cables.gl/op/Ops.Extension.AmmoPhysics.AmmoCharacter](#)

## 37.4 AmmoCharacterFpsCamera



**Full Name:** Ops.Extension.AmmoPhysics.AmmoCharacterFpsCamera

First person camera to use with AmmoCharacter.

#### > Inputs

- **Render** (Trigger)
- **Enable Pointer Lock** (Number: Boolean)
- **Height** (Number)
- **Character Name** (String)
- **Mouse Speed** (Number)
- **Active** (Number: Boolean)

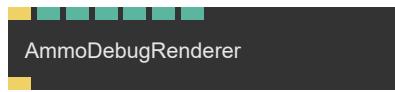
#### < Output

- **Trigger** (Trigger)
- **IsLocked** (Number)
- **has the mouse cursor been locked** (Boolean)
- **Mouse Left** (Trigger)
- **Mouse Right** (Trigger)
- **Dir X** (Number)
- **Dir Y** (Number)
- **Dir Z** (Number)
- **Rot X** (Number)
- **Rot Y** (Number)

**Example Patch:** [cables.gl/edit/psyNZ4](#)

**Doc:** [cables.gl/op/Ops.Extension.AmmoPhysics.AmmoCharacterFpsCamera](#)

## 37.5 AmmoDebugRenderer



AmmoDebugRenderer

**Full Name:** Ops.Extension.AmmoPhysics.AmmoDebugRenderer

Visualize the physical bodies as lines and points.

#### > Inputs

- **Render** (Trigger)
- **Draw Wireframe** (Number: Boolean)
- **Draw AABB** (Number: Boolean)
- **Draw Contact Points** (Number: Boolean)
- **Draw Constraints** (Number: Boolean)
- **Depth** (Number: Boolean)
- **Active** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/psyNZ4](#)

**Doc:** [cables.gl/op/Ops.Extension.AmmoPhysics.AmmoDebugRenderer](#)

## 37.6 AmmoEmitter



AmmoEmitter

**Full Name:** Ops.Extension.AmmoPhysics.AmmoEmitter

Emit Ammo physics bodies by triggering.

#### > Inputs

- **Exec** (Trigger)
- **Limit Bodies** (Number: Integer)
- **Radius** (Number)
- **Mass** (Number)
- **Add Index To Name** (Number: Boolean)
- **Name** (String)
- **Friction** (Number)
- **Rolling Friction** (Number)
- **Restitution** (Number)
- **Dir X** (Number)
- **Dir Y** (Number)
- **Dir Z** (Number)
- **Speed** (Number)
- **Spawn One** (Trigger)
- **Remove All** (Trigger)
- **Activate All** (Trigger)

#### < Output

- **Next** (Trigger)
- **Total Bodies** (Number)
- **Positions** (Array)
- **Rotations Quats** (Array)

**Example Patch:** cables.gl/edit/5hQROe

**Doc:** cables.gl/op/Ops.Extension.AmmoPhysics.AmmoEmitter

## 37.7 AmmoRaycast



**Full Name:** Ops.Extension.AmmoPhysics.AmmoRaycast

Cast a ray and detect colliding bodies.

#### > Inputs

- **Update** (Trigger)
- **Screen X** (Number)
- **Normalize screencoordinates on X Axis** (0-1)
- **Screen Y** (Number)
- **Normalize screencoordinates on Y Axis** (0-1)
- **Ray Points** (Array)
- **Active** (Number: Boolean)
- **Change Cursor** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)
- **Hit X** (Number)
- **Hit Y** (Number)
- **Hit Z** (Number)

**Example Patch:** cables.gl/edit/Gh2f\_4

**Doc:** cables.gl/op/Ops.Extension.AmmoPhysics.AmmoRaycast

## 37.8 AmmoWorld



**Full Name:** Ops.Extension.AmmoPhysics.AmmoWorld

Simulate physical world.

#### > Inputs

- **Update** (Trigger)

- **Simulate** (Number: Boolean)

- **Auto Remove Inactive** (Number: Boolean)
- **Gravity X** (Number)
- **Gravity Y** (Number)
- **Gravity Z** (Number)
- **Activate All** (Trigger)
- **Reset** (Trigger)

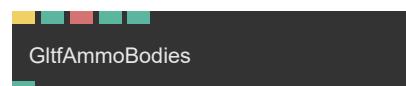
#### < Output

- **Next** (Trigger)
- **Total Bodies** (Number)
- **Debug Points** (Array)
- **Bodies Meta** (Array)
- **Collisions** (Array)

**Example Patch:** cables.gl/edit/psyNZ4

**Doc:** cables.gl/op/Ops.Extension.AmmoPhysics.AmmoWorld

## 37.9 GltfAmmoBodies



**Full Name:** Ops.Extension.AmmoPhysics.GltfAmmoBodies

Create physics bodies from a GLTF File.

#### > Inputs

- **Exec** (Trigger)
- **Shape Index** (Number: Integer)
- **Filter Meshes** (String)
- **Mass Kg** (Number)
- **Active** (Number: Boolean)

#### < Output

- **Meshes** (Number)

**Example Patch:** cables.gl/edit/Gh2f\_4

**Doc:** cables.gl/op/Ops.Extension.AmmoPhysics.GltfAmmoBodies

# 38 Ops.Extension.DetectGpu

## 38.1 DetectGPU

DetectGPU

**Full Name:** Ops.Extension.DetectGpu.DetectGPU

Use the detect-gpu library to assess performance of the client running the patch.

### > Inputs

- **Run** (Trigger)

### < Output

- **Finished** (Trigger)
- **Tier** (Number)
- **Is Mobile** (booleanNumber)
- **GPU Name** (String)
- **FPS** (Number)

**Example Patch:** cables.gl/op/Ops.Extension.DetectGpu.DetectGPU#example

**Doc:** cables.gl/op/Ops.Extension.DetectGpu.DetectGPU

# 39 Ops.Extension.ECharts

## 39.1 ECharts

ECharts

**Full Name:** Ops.Extension.ECharts.ECharts

wrapper for echarts-library.

### > Inputs

- **Create** (Trigger)
- **Parent DOM Element** (Object)
- **Id** (String)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Chart Object** (Object)
- **Merge Options** (Object)
- **Renderer Index** (Number: Integer)
- **Renderer** (String)
- **Theme Index** (Number: Integer)
- **Theme** (String)
- **Custom Theme Obj** (Object)
- **Init Extra Options** (Object)
- **Style** (Number: String)
- **Visible** (Number: Boolean)

### < Output

- **DOM Element** (Object)
- **ECharts Instance** (Object)
- **Chart Updated** (Trigger)
- **Theme Changed** (Trigger)

**Example Patch:** cables.gl/edit/iY6lbl

**Doc:** cables.gl/op/Ops.Extension.ECharts.ECharts

## 39.2 EChartsEvent

EChartsEvent

**Full Name:** Ops.Extension.ECharts.EChartsEvent

capture echart-library-events.

### > Inputs

- **ECharts Instance** (Object)
- **Event Name** (String)

- **Query String** (String)
- **Query Object** (Object)
- **Refresh Event Binding** (Trigger)

**< Output**

- **Out Chart** (Object)
- **Trigger** (Trigger)
- **Event Params** (Object)

**Example Patch:** cables.gl/edit/iY6lbl

**Doc:** cables.gl/op/Ops.Extension.ECharts.EChartsEvent

## 40 Ops.Extension.FxHash

### 40.1 FxHash



**Full Name:** Ops.Extension.FxHash.FxHash

FxHash simulator / generator of seeded random numbers.

**> Inputs**

- **Hash** (String)
- **Randomize Hash** (Trigger)

**< Output**

- **Fxhash** (String)
- **Fxrand 1** (Number)
- **Fxrand 2** (Number)
- **Fxrand 3** (Number)
- **Fxrand 4** (Number)
- **Random Numbers** (Array)
- **Fxhash Environment** (booleanNumber)

**Example Patch:** cables.gl/edit/dnDl82

**Doc:** cables.gl/op/Ops.Extension.FxHash.FxHash

# 41 Ops.Extension.GlParticles

## 41.1 VelocityBoundaries

VelocityBoundaries

**Full Name:** Ops.Extension.GlParticles.VelocityBoundaries

*Visit documentation for details.*

### > Inputs

- **Render** (Trigger)
- **Area Index** (Number: Integer)
- **Method Index** (Number: Integer)
- **Invert Area** (Number: Boolean)
- **Strength** (Number)
- **Size** (Number)
- **Falloff** (Number)
- **Bounciness** (Number)
- **Collision Fade** (Number)
- **Dir Randomness** (Number)
- **InForceOutwards** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Velocity Dir X** (Number)
- **Velocity Dir Y** (Number)
- **Velocity Dir Z** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Multiply** (Object:Texture)
- **Age Start** (Number)
- **Age End** (Number)
- **Age Fade** (Number)

### < Output

- **Trigger** (Trigger)
- **Velocity** (Object)
- **Collision** (Object)

**Example Patch:** cables.gl/op/Ops.Extension.GlParticles.VelocityBoundaries#example

**Doc:** cables.gl/op/Ops.Extension.GlParticles.VelocityBoundaries

# 42 Ops.Extension.HtmlElementArray

## 42.1 DivElements

DivElements

**Full Name:** Ops.Extension.HtmlElementArray.DivElements

create an array of div elements.

### > Inputs

- **Class** (String)
- **Parent** (Object:Element)
- **Num** (Number: Integer)
- **Active** (Number: Boolean)
- **Text** (Array)
- **Reset Hover** (Trigger)

### < Output

- **Elements** (Array)
- **Index Clicked** (Number)
- **Element Clicked** (Trigger)
- **Pointer Up** (Trigger)
- **Index Hovered** (Number)

**Example Patch:** cables.gl/edit/lYLMwk

**Doc:** cables.gl/op/Ops.Extension.HtmlElementArray.DivElements

## 42.2 ElementArrayCssPropertyName

ElementArrayCssPropertyName

**Full Name:** Ops.Extension.HtmlElementArray.ElementArrayCssPropertyName

Set css style properties of a html element.

### > Inputs

- **Element** (Object)
- **Update** (Trigger)
- **Property** (String)
- **Value** (Number)
- **Value Suffix** (String)

### < Output

- **HTML Element** (Object)

**Example Patch:** cables.gl/op/Ops.Extension.HtmlElementArray.ElementArrayCssP

**Doc:** cables.gl/op/Ops.Extension.HtmlElementArray.ElementArrayCssPropert

## 42.3 ElementArrayCssPropertyString

ElementArrayCssPropertyString

**Full Name:** Ops.Extension.HtmlElementArray.ElementArrayCssPropertyString  
set css properties.

### > Inputs

- **Element** (Object)
- **Update** (Trigger)
- **Property** (String)
- **Value** (String)
- **Value Suffix** (String)

### < Output

- **HTML Element** (Object)

**Example Patch:** cables.gl/op/Ops.Extension.HtmlElementArray.ElementArrayCssPropertyString

**Doc:** cables.gl/op/Ops.Extension.HtmlElementArray.ElementArrayCssPropertyString

## 43 Ops.Extension.HtmlToTexture

### 43.1 HtmlToTexture

HtmlToTexture

**Full Name:** Ops.Extension.HtmlToTexture.HtmlToTexture

*Visit documentation for details.*

### > Inputs

- **Element** (Object:Element)
- **Update** (Trigger)

### < Output

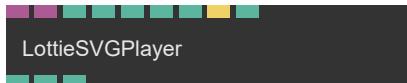
- **Image DataUrl** (String)
- **Progress** (Number)
- **Finished** (Trigger)

**Example Patch:** cables.gl/edit/fPPga2

**Doc:** cables.gl/op/Ops.Extension.HtmlToTexture.HtmlToTexture

# 44 Ops.Extension.Lottie

## 44.1 LottieSVGPlayer



LottieSVGPlayer

**Full Name:** Ops.Extension.Lottie.LottieSVGPlayer

Play Bodymovin/Lottie animations as SVG in a HTML element.

### > Inputs

- **HTML Element** (Object:Element)
- **JSON Data** (Object)
- **Render Frame** (Number)
- **Loop** (Number: Boolean)
- **Play** (Number: Boolean)
- **Play Backward** (Number: Boolean)
- **Rewind** (Trigger)
- **Active** (Number: Boolean)

### < Output

- **Completed** (booleanNumber)
- **Progress** (Number)
- **Total Frames** (Number)

**Example Patch:** cables.gl/edit/3ezRZH

**Doc:** cables.gl/op/Ops.Extension.Lottie.LottieSVGPlayer

- **Wrap Index** (Number: Integer)
- **Scale Index** (Number: Integer)

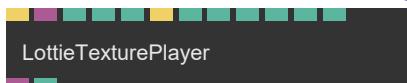
### < Output

- **Texture** (Object)
- **Total Frames** (Number)

**Example Patch:** cables.gl/edit/zW0RFn

**Doc:** cables.gl/op/Ops.Extension.Lottie.TexturePlayer\_v2

## 44.2 LottieTexturePlayer\_v2



LottieTexturePlayer

**Full Name:** Ops.Extension.Lottie.LottieTexturePlayer\_v2

Play a Lottie animation in a texture.

### > Inputs

- **Exe** (Trigger)
- **JSON Data** (Object)
- **Play Mode Index** (Number: Integer)
- **Frame** (Number)
- **Play** (Number: Boolean)
- **Rewind** (Trigger)
- **Speed** (Number)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Filter Index** (Number: Integer)

## 45 Ops.Extension.LSystem

### 45.1 Lsystem\_v2



**Full Name:** Ops.Extension.LSystem.Lsystem\_v2

Lsystem generator.

#### > Inputs

- **Trigger** (Trigger)
- **Iterations** (Number: Integer)
- **Step Length** (Number)
- **Step Scale Multiplier** (Number)
- **Default Angle** (Number)
- **Rotation Multiplier** (Number)
- **Random Seed** (Number)
- **Random Strength** (Number)

#### < Output

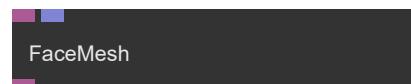
- **Out Trigger Geometry** (Trigger)
- **Points Out** (Array)
- **Max Size** (Number)
- **Final Generated String** (String)

**Example Patch:** [cables.gl/edit/xk724p](#)

**Doc:** [cables.gl/op/Ops.Extension.LSystem.Lsystem\\_v2](#)

## 46 Ops.Extension.Mediapipe

### 46.1 FaceMesh



**Full Name:** Ops.Extension.Mediapipe.FaceMesh

Generate an animated geometry from MpFaceTracking Point Coordinates.

#### > Inputs

- **Geom** (Object)
- **Points** (Array)

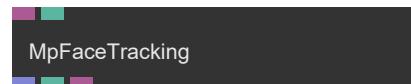
#### < Output

- **Result Geom** (Object)

**Example Patch:** [cables.gl/edit/by9Tq4](#)

**Doc:** [cables.gl/op/Ops.Extension.Mediapipe.FaceMesh](#)

### 46.2 MpFaceTracking



**Full Name:** Ops.Extension.Mediapipe.MpFaceTracking

Get face mesh from webcam/video using mediapipe library.

#### > Inputs

- **Element** (Object)
- **Refine LandMarks** (Number: Boolean)

#### < Output

- **Points** (Array)
- **Found** (Number)
- **Result** (Object)

**Example Patch:** [cables.gl/edit/wznlp4](#)

**Doc:** [cables.gl/op/Ops.Extension.Mediapipe.MpFaceTracking](#)

### 46.3 MpHand



**Full Name:** Ops.Extension.Mediapipe.MpHand

Get points and lines for left/right hand from mediapipe.

#### > Inputs

- **Hands Result** (Object)
- **Hand Index** (Number: Integer)

- **Min Score** (Number)

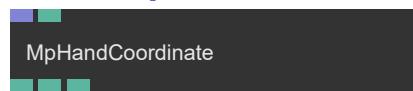
#### < Output

- **Points** (Array)
- **Lines** (Array)
- **Data** (Object)
- **Found Hand** (Number)
- **Score** (Number)

**Example Patch:** cables.gl/edit/a5xfp4

**Doc:** cables.gl/op/Ops.Extension.Mediapipe.MpHand

## 46.4 MpHandCoordinate



**Full Name:** Ops.Extension.Mediapipe.MpHandCoordinate

Get individual coordinates of fingers or wrist from an array of mediapipe data.

#### > Inputs

- **Hand Points** (Array)
- **Joint Index** (Number: Integer)

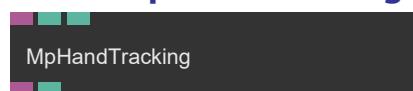
#### < Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** cables.gl/edit/a5xfp4

**Doc:** cables.gl/op/Ops.Extension.Mediapipe.MpHandCoordinate

## 46.5 MpHandTracking



**Full Name:** Ops.Extension.Mediapipe.MpHandTracking

Get hand data from mediapipe library, use with MpHand.

#### > Inputs

- **Element** (Object:Element)
- **Min Confidence Detect** (Number)
- **Min Confidence Tracking** (Number)

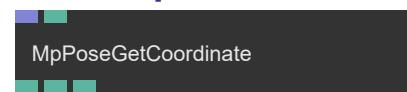
#### < Output

- **Result** (Object)
- **Found Hands** (Number)

**Example Patch:** cables.gl/edit/a5xfp4

**Doc:** cables.gl/op/Ops.Extension.Mediapipe.MpHandTracking

## 46.6 MpPoseGetCoordinate



**Full Name:** Ops.Extension.Mediapipe.MpPoseGetCoordinate

Get coordinates of specific body parts from mediapipe data.

#### > Inputs

- **Landmarks** (Array)
- **Landmark Index** (Number: Integer)

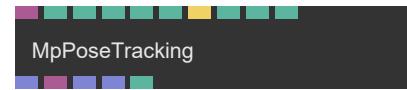
#### < Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** cables.gl/edit/uepop4

**Doc:** cables.gl/op/Ops.Extension.Mediapipe.MpPoseGetCoordinate

## 46.7 MpPoseTracking



**Full Name:** Ops.Extension.Mediapipe.MpPoseTracking

Get pose-data (points/landmarks/lines) from webcam using mediapipe library.

#### > Inputs

- **Element** (Object:Element)
- **Smooth Landmarks** (Number: Boolean)
- **Min Detection Confidence** (Number)
- **Min Tracking Confidence** (Number)
- **Enable Segmentation** (Number: Boolean)
- **Update Texture** (Trigger)
- **Smooth Segmentation** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)

#### < Output

- **Points** (Array)
- **Segmentation Mask** (Object)
- **Landmarks** (Array)
- **Lines** (Array)
- **Found** (Number)

**Example Patch:** cables.gl/edit/uepop4

**Doc:** cables.gl/op/Ops.Extension.Mediapipe.MpPoseTracking

## 47 Ops.Extension.OpenType

### 47.1 OpentypeFont

OpentypeFont

**Full Name:** Ops.Extension.OpenType.OpentypeFont

Load OTF & TTF fonts via OpenType library.

#### > Inputs

- **Font File** (String)

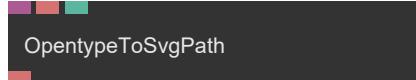
#### < Output

- **Opentype Font** (Object)

**Example Patch:** cables.gl/edit/Cp5VS3

**Doc:** cables.gl/op/Ops.Extension.OpenType.OpentypeFont

### 47.2 OpentypeToSvgPath

OpentypeToSvgPath

**Full Name:** Ops.Extension.OpenType.OpentypeToSvgPath

get svg path from (OTF) OpentypeFont using the opentype library.

#### > Inputs

- **Opentype Font** (Object)
- **Text** (String)
- **Letter Spacing** (Number)

#### < Output

- **Path String** (String)

**Example Patch:** cables.gl/edit/Cp5VS3

**Doc:** cables.gl/op/Ops.Extension.OpenType.OpentypeToSvgPath

## 48 Ops.Extension.Osc2Ws

### 48.1 Osc2WsArray

Osc2WsArray

**Full Name:** Ops.Extension.Osc2Ws.Osc2WsArray

Outputs an array of data from a user defined OSC address.

#### > Inputs

- **Message** (Object)
- **Address** (String)
- **Learn** (Trigger)

#### < Output

- **Result Message** (Object)
- **Array Out** (Array)
- **Array Length** (Number)
- **Received** (Trigger)

**Example Patch:** cables.gl/edit/F77YvQ

**Doc:** cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsArray

### 48.2 Osc2WsMessage

Osc2WsMessage

**Full Name:** Ops.Extension.Osc2Ws.Osc2WsMessage

Shows the current active address of an incoming OSC message.

#### > Inputs

- **Message** (Object)

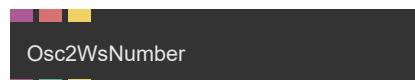
#### < Output

- **Address** (String)
- **Arguments** (Array)
- **Total Arguments** (Number)

**Example Patch:** cables.gl/edit/F77YvQ

**Doc:** cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsMessage

### 48.3 Osc2WsNumber

Osc2WsNumber

**Full Name:** Ops.Extension.Osc2Ws.Osc2WsNumber

Outputs a single number from a user defined OSC address.

#### > Inputs

- **Message** (Object)
- **Address** (String)
- **Learn** (Trigger)

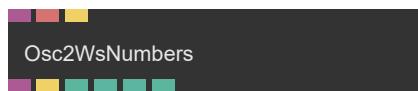
#### < Output

- **Result Message** (Object)
- **Value** (Number)
- **Received** (Trigger)

**Example Patch:** [cables.gl/edit/F77YvQ](#)

**Doc:** [cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsNumber](#)

## 48.4 Osc2WsNumbers



**Full Name:** Ops.Extension.Osc2Ws.Osc2WsNumbers

Outputs up to 4 numbers from a user defined OSC address.

#### > Inputs

- **Message In** (Object)
- **Osc Address** (String)
- **Learn** (Trigger)

#### < Output

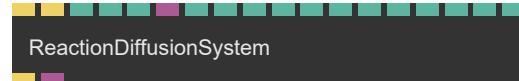
- **Message Through** (Object)
- **Received** (Trigger)
- **Number 0** (Number)
- **Number 1** (Number)
- **Number 2** (Number)
- **Number 3** (Number)

**Example Patch:** [cables.gl/edit/F77YvQ](#)

**Doc:** [cables.gl/op/Ops.Extension.Osc2Ws.Osc2WsNumbers](#)

# 49 Ops.Extension.ReactionDiffusion

## 49.1 ReactionDiffusionSystem\_v2



**Full Name:** Ops.Extension.ReactionDiffusion.ReactionDiffusionSystem\_v2

Cellular automata system as feedback loop texture.

#### > Inputs

- **Render** (Trigger)
- **Reset** (Trigger)
- **Use Viewport Size** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Texture In** (Object:Texture)
- **Speed** (Number: Integer)
- **Seed** (Number)
- **Presets Index** (Number: Integer)
- **Feed** (Number)
- **Feed Variation** (Number)
- **Kill** (Number)
- **Kill Variation** (Number)
- **Diffusion Scale** (Number)
- **Diffusion Scale Variation** (Number)
- **Anisotropy** (Number)
- **Noise Scale** (Number)
- **Separate Fields** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Texture Out** (Object)

**Example Patch:** [cables.gl/edit/XLCybK](#)

**Doc:** [cables.gl/op/Ops.Extension.ReactionDiffusion.ReactionDiffusionSystem\\_v2](#)

# 50 Ops.Extension.SocketCluster

## 50.1 SocketClusterClient\_v2

SocketClusterClient

**Full Name:** Ops.Extension.SocketCluster.SocketClusterClient\_v2

connect to a socketcluster server and manage the connection.

### > Inputs

- **Channel** (String)
- **Server Hostname** (String)
- **Server Port** (Number)
- **Use SSL** (Number: Boolean)
- **enable encryption** (needs to be supported by server)
- **Server Path** (String)
- **Allow Send** (Number: Boolean)
- **Allow Multiple Senders** (Number: Boolean)
- **Additional Serverdata** (Object)
- **additional data send with every message** (can be used for auth-token)
- **Active** (Number: Boolean)

### < Output

- **Ready** (booleanNumber)
- **Socket** (Object)
- **Own Client Id** (String)
- **Can Send** (booleanNumber)
- **Error** (String)

**Example Patch:** cables.gl/edit/EJvr0a

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.SocketClusterClient\_v2

## 50.2 SocketClusterReceiveObject

SocketClusterReceiveObject

**Full Name:** Ops.Extension.SocketCluster.SocketClusterReceiveObject

Receives object from the socketcluster socket/topic.

### > Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Receive Own Data** (Number: Boolean)

### < Output

- **Client Id** (String)

- **Data** (Object)
- **Received** (Trigger)

**Example Patch:** cables.gl/edit/EJvr0a

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.SocketClusterReceiveObject

## 50.3 SocketClusterReceiveTrigger

SocketClusterReceiveTrigger

**Full Name:** Ops.Extension.SocketCluster.SocketClusterReceiveTrigger

Receives trigger from the socketcluster socket/topic.

### > Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Receive Own Data** (Number: Boolean)
- **Use Named Trigger** (Number: Boolean)

### < Output

- **Client Id** (String)
- **Trigger Name** (String)
- **Received** (Trigger)

**Example Patch:** cables.gl/edit/mecjP3

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.SocketClusterReceiveTrigger

## 50.4 SocketClusterSendObject

SocketClusterSendObject

**Full Name:** Ops.Extension.SocketCluster.SocketClusterSendObject

sends an object via socketcluster/websocket.

### > Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Data** (Object)
- **Send** (Trigger)

### < Output

- **Sent Data** (Trigger)

**Example Patch:** cables.gl/edit/EJvr0a

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.SocketClusterSendObject

## 50.5 SocketClusterSendTrigger

SocketClusterSendTrigger

**Full Name:** Ops.Extension.SocketCluster.SocketClusterSendTrigger  
sends a trigger via socketcluster/websocket.

### > Inputs

- **Data** (Trigger)
- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Trigger Name** (String)
- **the name of the trigger** (created with TriggerSend)

### < Output

- Visit *Ops.Extension.SocketCluster.SocketClusterSendTrigger documentation for output port details*

**Example Patch:** cables.gl/edit/mecJP3

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.SocketClusterSendTrigger

## 50.6 SocketClusterTopicInfo\_v2

SocketClusterTopicInfo

**Full Name:** Ops.Extension.SocketCluster.SocketClusterTopicInfo\_v2  
get info for clients listening on a socketcluster topic.

### > Inputs

- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Timeout Seconds** (Number: Integer)
- **Soft Timeout Seconds** (Number: Integer)
- **Retain Messages** (Number: Integer)
- **Update** (Trigger)
- **Receive My Data** (Number: Boolean)

### < Output

- **Active Clients** (Array)
- **Will Time Out** (Object)
- **Timed Out Clients** (Array)
- **Messages** (Object)
- **Updated** (Trigger)

**Example Patch:** cables.gl/edit/EJvr0a

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.SocketClusterTopicInfo\_v2

## 51 Ops.Extension.SocketCluster.Deprecated

### 51.1 SocketClusterReceiveArray

SocketClusterReceiveArray

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveArray  
receive an array from the socketcluster topic.

### > Inputs

- **Socket** (Object)
- **Topic** (String)

### < Output

- **Client Id** (String)
- **Data** (Array)
- **Received** (Trigger)

**Example Patch:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClus

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveA

### 51.2 SocketClusterReceiveBoolean

SocketClusterReceiveBoolean

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveBoole  
Receive boolean value from the socketcluster socket/topic.

### > Inputs

- **Socket** (Object)
- **Topic** (String)

### < Output

- **Client Id** (String)
- **Data** (booleanNumber)
- **Received** (Trigger)

**Example Patch:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClus

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveB

### 51.3 SocketClusterReceiveNumber

SocketClusterReceiveNumber

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveNumbe  
receive number from the socketcluster socket/topic.

### > Inputs

- **Socket** (Object)
- **Topic** (String)

**< Output**

- **Client Id** (String)
- **Data** (Number)
- **Received** (Trigger)

**Example Patch:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray#example

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray

## 51.4 SocketClusterReceiveString

SocketClusterReceiveString

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveString

receives string from the socketcluster socket/topic.

**> Inputs**

- **Socket** (Object:Socketcluster)
- **Topic** (String)

**< Output**

- **Data** (String)
- **Client Id** (String)
- **Received** (Trigger)

**Example Patch:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveString#example

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterReceiveString

## 51.5 SocketClusterSendArray

SocketClusterSendArray

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray

sends an array via socketcluster/websocket.

**> Inputs**

- **Send** (Trigger)
- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Data** (Array)
- **Public** (2): MOUSE MOVEMENT SEND

**< Output**

- Visit [Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray documentation for output port details](#)

**Example Patch:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArray#example

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendArr...

## 51.6 SocketClusterSendBoolean

SocketClusterSendBoolean

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterSendBoolean

Sends boolean value via socketcluster/websocket.

**> Inputs**

- **Send** (Trigger)
- **Socket** (Object)
- **Topic** (String)
- **Data** (Number: Boolean)

**< Output**

- Visit [Ops.Extension.SocketCluster.Deprecated.SocketClusterSendBoolean documentation for output port details](#)

**Example Patch:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClus...

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendBo...

## 51.7 SocketClusterSendNumber

SocketClusterSendNumber

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterSendNumber

sends a number via socketcluster/websocket.

**> Inputs**

- **Send** (Trigger)
- **Socket** (Object)
- **Topic** (String)
- **Data** (Number)

**< Output**

- Visit [Ops.Extension.SocketCluster.Deprecated.SocketClusterSendNumber documentation for output port details](#)

**Example Patch:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClus...

**Doc:** cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendNu...

## 51.8 SocketClusterSendString

SocketClusterSendString

**Full Name:** Ops.Extension.SocketCluster.Deprecated.SocketClusterSendString

sends a string via socketcluster/websocket.

#### > Inputs

- **Send** (Trigger)
- **Socket** (Object:Socketcluster)
- **Topic** (String)
- **Data** (String)

#### < Output

- Visit [Ops.Extension.SocketCluster.Deprecated.SocketClusterSendString documentation for output port details](#)

**Example Patch:** [cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendString#example](#)

**Doc:** [cables.gl/op/Ops.Extension.SocketCluster.Deprecated.SocketClusterSendString](#)

# 52 Ops.Extension.Standalone

## 52.1 Ffmpeg



**Full Name:** Ops.Extension.Standalone.Ffmpeg

FFmpeg video converter toolbox op.

#### > Inputs

**Source Video** (String)

- **Destination File** (String)
- **Set Bitrate** (Number: Boolean)
- **Bitrate** (String)
- **Constant** (Number: Boolean)
- **Set Codec** (Number: Boolean)
- **Codec** (String)
- **Set Size** (Number: Boolean)
- **Size** (String)
- **Crop Time** (Number: Boolean)
- **Start Time** (String)
- **Duration** (String)
- **Process** (Trigger)

#### < Output

- **Processing** (booleanNumber)

**Example Patch:** [cables.gl/op/Ops.Extension.Standalone.Ffmpeg#example](#)

**Doc:** [cables.gl/op/Ops.Extension.Standalone.Ffmpeg](#)

# 53 Ops.Extension.Standalone.Files

## 53.1 CreateFile



**Full Name:** Ops.Extension.Standalone.Files.CreateFile

Create a new empty file on your local harddrive.

### > Inputs

- **Default Path** (String)
- **Create File** (Trigger)

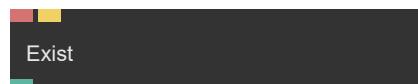
### < Output

- **Path** (String)
- **Next** (Trigger)

**Example Patch:** cables.gl/edit/dhvNAs

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.CreateFile

## 53.2 Exist



**Full Name:** Ops.Extension.Standalone.Files.Exist

Check if a file exists on the local file system.

### > Inputs

- **Path** (String)
- **Execute** (Trigger)

### < Output

- **Exists** (booleanNumber)

**Example Patch:** cables.gl/edit/XlQrun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.Exist

## 53.3 FileUrlToPath



**Full Name:** Ops.Extension.Standalone.Files.FileUrlToPath

convert file-url to path.

### > Inputs

- **FileUrl** (String)

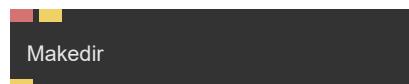
### < Output

- **Path** (String)

**Example Patch:** cables.gl/edit/upnVAs

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.FileUrlToPath

## 53.4 Makedir



**Full Name:** Ops.Extension.Standalone.Files.Makedir

Create a directory on the local file system.

### > Inputs

- **Path** (String)
- **Create** (Trigger)

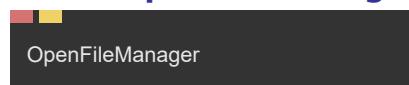
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/q5evun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.Makedir

## 53.5 OpenFileManager



**Full Name:** Ops.Extension.Standalone.Files.OpenFileManager

Open the native file manager application using that path.

### > Inputs

- **Path** (String)
- **Open File Manager** (Trigger)

### < Output

- Visit *Ops.Extension.Standalone.Files.OpenFileManager documentation for output port details*

**Example Patch:** cables.gl/op/Ops.Extension.Standalone.Files.OpenFileManager#e

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.OpenFileManager

## 53.6 PathToFileUrl



**Full Name:** Ops.Extension.Standalone.Files.PathToFileUrl

convert local path to file-url.

### > Inputs

- **Path** (String)

#### < Output

- **FileUrl** (String)

**Example Patch:** cables.gl/edit/pekPAs

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.PathToFileUrl

## 53.7 ReadDir



**Full Name:** Ops.Extension.Standalone.Files.ReadDir

Read all entries in a directory.

#### > Inputs

- **Path** (String)
- **Reload** (Trigger)

#### < Output

- **Entries** (Array)
- **Has Error** (booleanNumber)
- **Error** (String)

**Example Patch:** cables.gl/edit/l6buun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.ReadDir

## 53.8 ResolvePath



**Full Name:** Ops.Extension.Standalone.Files.ResolvePath

Resolves a paths into an absolute path.

#### > Inputs

- **Path** (String)

#### < Output

- **Result** (String)

**Example Patch:** cables.gl/op/Ops.Extension.Standalone.Files.ResolvePath#example

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.ResolvePath

## 53.9 SelectDir



**Full Name:** Ops.Extension.Standalone.Files.SelectDir

Choose a directory on your hard drive.

#### > Inputs

- **Default Path** (String)

- **Select Directory** (Trigger)

#### < Output

- **Path** (String)
- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Extension.Standalone.Files.SelectDir#example

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.SelectDir

## 53.10 SelectFile



**Full Name:** Ops.Extension.Standalone.Files.SelectFile

Choose a file on your hard drive.

#### > Inputs

- **Default Path** (String)
- **Select File** (Trigger)

#### < Output

- **Path** (String)
- **Next** (Trigger)

**Example Patch:** cables.gl/edit/M58UAs

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.SelectFile

## 53.11 Stat



**Full Name:** Ops.Extension.Standalone.Files.Stat

Get statistics about a file on the local file system.

#### > Inputs

- **Path** (String)

#### < Output

- **Stats** (Object)
- **Is Directory** (booleanNumber)
- **Is File** (booleanNumber)
- **Has Error** (booleanNumber)
- **Error** (String)

**Example Patch:** cables.gl/op/Ops.Extension.Standalone.Files.Stat#example

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.Stat

## 53.12 SystemDirs

SystemDirs

**Full Name:** Ops.Extension.Standalone.Files.SystemDirs

Get Default System Directories Paths.

### > Inputs

- Visit *Ops.Extension.Standalone.Files.SystemDirs* documentation for input port details

### < Output

- **Home** (String)
- **Downloads** (String)
- **Documents** (String)
- **Desktop** (String)
- **Exe** (String)

**Example Patch:** cables.gl/edit/7hftun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.SystemDirs

## 53.13 Watch

Watch

**Full Name:** Ops.Extension.Standalone.Files.Watch

Watch a directory, get a trigger when a file changes.

### > Inputs

- **Path** (String)
- **Read** (Trigger)

### < Output

- **Event Type** (String)
- **Event Filename** (String)
- **Event Happened** (Trigger)
- **Content** (String)
- **Has Error** (booleanNumber)
- **Error** (String)

**Example Patch:** cables.gl/edit/PT9Aun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.Watch

## 53.14 WriteBinaryFileFromBase64

WriteBinaryFileFromBase64

**Full Name:** Ops.Extension.Standalone.Files.WriteBinaryFileFromBase64

Create a binary file on the local file system from a base64 string.

### > Inputs

- **Trigger** (Trigger)
- **Base64** (String)
- **Filename** (String)

### < Output

- Visit *Ops.Extension.Standalone.Files.WriteBinaryFileFromBase64* documentation for output port details

**Example Patch:** cables.gl/op/Ops.Extension.Standalone.Files.WriteBinaryFileFromBase64

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.WriteBinaryFileFromBase64

## 53.15 WriteTextFile

WriteTextFile

**Full Name:** Ops.Extension.Standalone.Files.WriteTextFile

Write a string to a text file on the local file system.

### > Inputs

- **Filename** (String)
- **Content** (String)
- **Write** (Trigger)

### < Output

- **Next** (Trigger)
- **Has Error** (booleanNumber)
- **Error** (String)

**Example Patch:** cables.gl/edit/PT9Aun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Files.WriteTextFile

# 54 Ops.Extension.Standalone.Net

## 54.1 HttpServer



**Full Name:** Ops.Extension.Standalone.Net.HttpServer

Create a Web/Http server locally.

### > Inputs

- **Hostname** (String)
- **Port** (Number: Integer)

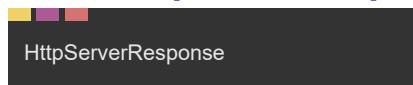
### < Output

- **Trigger Request** (Trigger)
- **Response** (Object)
- **Request URL** (String)
- **Request** (Object)
- **Running** (booleanNumber)

**Example Patch:** cables.gl/edit/lke9pn

**Doc:** cables.gl/op/Ops.Extension.Standalone.Net.HttpServer

## 54.2 HttpServerResponse



**Full Name:** Ops.Extension.Standalone.Net.HttpServerResponse

Answer http requests by sending string to the browser/client.

### > Inputs

- **Trigger** (Trigger)
- **Response** (Object)
- **Body** (String)

### < Output

- Visit *Ops.Extension.Standalone.Net.HttpServerResponse documentation for output port details*

**Example Patch:** cables.gl/edit/lke9pn

**Doc:** cables.gl/op/Ops.Extension.Standalone.Net.HttpServerResponse

## 54.3 IpAddress



**Full Name:** Ops.Extension.Standalone.Net.IpAddress

Outputs your local IP Adress.

### > Inputs

- Visit *Ops.Extension.Standalone.Net.IpAddress documentation for input port details*

### < Output

- **Local IP** (String)
- **Interface** (String)
- **Data** (Object)

**Example Patch:** cables.gl/edit/lCYxun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Net.IpAddress

## 54.4 Osc\_v2



**Full Name:** Ops.Extension.Standalone.Net.Osc\_v2

Visit documentation for details.

### > Inputs

- **Port** (Number: Integer)

### < Output

- **Message Received** (Trigger)
- **Message** (Object)
- **Connection** (Object)
- **Status** (String)

**Example Patch:** cables.gl/edit/PCZCun

**Doc:** cables.gl/op/Ops.Extension.Standalone.Net.Osc\_v2

## 54.5 OscSend



**Full Name:** Ops.Extension.Standalone.Net.OscSend

send data to a OSC device.

### > Inputs

- **Connection** (Object)
- **Net Address** (String)
- **Port** (Number: Integer)
- **OSC Address** (String)
- **Number** (Number)
- **Send** (Trigger)

- **Public** (1): OSC: READ / SEND

#### < Output

- Visit *Ops.Extension.Standalone.Net.OscSend* documentation for output port details

**Example Patch:** [cables.gl/op/Ops.Extension.Standalone.Net.OscSend#example](#)

**Doc:** [cables.gl/op/Ops.Extension.Standalone.Net.OscSend](#)

## 54.6 ReadTextFile



**Full Name:** Ops.Extension.Standalone.Net.ReadTextFile

Read a text file as string from the local file system.

#### > Inputs

- **Filename** (String)
- **Read** (Trigger)

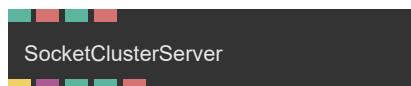
#### < Output

- **Next** (Trigger)
- **Content** (String)
- **Has Error** (booleanNumber)
- **Error** (String)

**Example Patch:** [cables.gl/edit/PT9Aun](#)

**Doc:** [cables.gl/op/Ops.Extension.Standalone.Net.ReadTextFile](#)

## 54.7 SocketClusterServer



**Full Name:** Ops.Extension.Standalone.Net.SocketClusterServer

start a socketcluster server.

#### > Inputs

- **Active** (Number: Boolean)
- **Hostname** (String)
- **Port** (Number: Integer)
- **Path** (String)

#### < Output

- **Receiving** (Trigger)
- **Data** (Object)
- **Listening** (booleanNumber)
- **Clients** (Number)
- **Error** (String)

**Example Patch:** [cables.gl/op/Ops.Extension.Standalone.Net.SocketClusterServer#example](#)

**Doc:** [cables.gl/op/Ops.Extension.Standalone.Net.SocketClusterServer](#)

# 55 Ops.Extension.SuperShapes

## 55.1 SuperShapesCpu

SuperShapesCpu

**Full Name:** Ops.Extension.SuperShapes.SuperShapesCpu

*Visit documentation for details.*

### > Inputs

- **Update** (Trigger)
- **Shape Index** (Number: Integer)
- **Tesselation** (Number: Integer)
- **Param 0** (Number)
- **Param 1** (Number)
- **Param 2** (Number)
- **Param 3** (Number)
- **Param 4** (Number)
- **Param 5** (Number)
- **Param 6** (Number)
- **Param 7** (Number)
- **Param 8** (Number)
- **Param 9** (Number)
- **Param 10** (Number)
- **Param 11** (Number)
- **Param 12** (Number)
- **Param 13** (Number)
- **Param 14** (Number)
- **Param 15** (Number)

### < Output

- **Next** (Trigger)
- **Coords** (Array)
- **Faces** (Array)
- **TexCoords** (Array)

**Example Patch:** cables.gl/edit/LgcEiq

**Doc:** cables.gl/op/Ops.Extension.SuperShapes.SuperShapesCpu

## 55.2 SuperShapesGpu

SuperShapesGpu

**Full Name:** Ops.Extension.SuperShapes.SuperShapesGpu

*Visit documentation for details.*

### > Inputs

- **Update** (Trigger)
- **Render** (Number: Boolean)
- **Shape Index** (Number: Integer)
- **Tesselation** (Number: Integer)
- **Param 0** (Number)
- **Param 1** (Number)
- **Param 2** (Number)
- **Param 3** (Number)
- **Param 4** (Number)
- **Param 5** (Number)
- **Param 6** (Number)
- **Param 7** (Number)
- **Param 8** (Number)
- **Param 9** (Number)
- **Param 10** (Number)
- **Param 11** (Number)
- **Param 12** (Number)
- **Param 13** (Number)
- **Param 14** (Number)
- **Param 15** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/ka9Vxq

**Doc:** cables.gl/op/Ops.Extension.SuperShapes.SuperShapesGpu

# 56 Ops.Extension.TeachableMachines

## 56.1 AudioClassifier



**Full Name:** Ops.Extension.TeachableMachines.AudioClassifier

Use the Teachable Machines audio classifier for your microphone. Insert the uploaded model URL.

### > Inputs

- **Trigger In** (Trigger)
- **Initialize** (Trigger)
- **Model URL** (String)

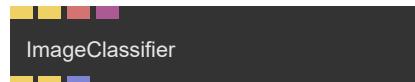
### < Output

- **Trigger** (Trigger)
- **Initialized** (Trigger)
- **Classifier** (Array)

**Example Patch:** [cables.gl/edit/-kzrrn](https://cables.gl/edit/-kzrrn)

**Doc:** [cables.gl/op/Ops.Extension.TeachableMachines.AudioClassifier](https://cables.gl/op/Ops.Extension.TeachableMachines.AudioClassifier)

## 56.2 ImageClassifier\_v2



**Full Name:** Ops.Extension.TeachableMachines.ImageClassifier\_v2

Use the Teachable Machines image classifier. Insert the uploaded model URL.

### > Inputs

- **Trigger In** (Trigger)
- **Initialize** (Trigger)
- **Model URL** (String)
- **Webcam Element** (Object)

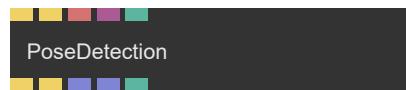
### < Output

- **Trigger** (Trigger)
- **Initialized** (Trigger)
- **Classifier** (Array)

**Example Patch:** [cables.gl/edit/raewrn](https://cables.gl/edit/raewrn)

**Doc:** [cables.gl/op/Ops.Extension.TeachableMachines.ImageClassifier\\_v2](https://cables.gl/op/Ops.Extension.TeachableMachines.ImageClassifier_v2)

## 56.3 PoseDetection\_v2



**Full Name:** Ops.Extension.TeachableMachines.PoseDetection\_v2

Use the Teachable Machines pose detection with your webcam. Insert the uploaded model URL.

### > Inputs

- **Render** (Trigger)
- **Initialize** (Trigger)
- **Model URL** (String)
- **Webcam Element** (Object)
- **Flip Image** (Number: Boolean)

### < Output

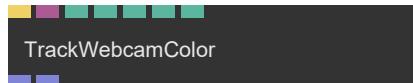
- **Trigger** (Trigger)
- **Initialized** (Trigger)
- **Classifier** (Array)
- **Pose Positions** (Array)
- **Image Flipped** (Number)

**Example Patch:** [cables.gl/edit/xOStrn](https://cables.gl/edit/xOStrn)

**Doc:** [cables.gl/op/Ops.Extension.TeachableMachines.PoseDetection\\_v2](https://cables.gl/op/Ops.Extension.TeachableMachines.PoseDetection_v2)

## 57 Ops.Extension.Trackingjs

### 57.1 TrackWebcamColor



**Full Name:** Ops.Extension.Trackingjs.TrackWebcamColor

Track a position of a specific color in the current webcam stream.

#### > Inputs

- **Update** (Trigger)
- **Video Element** (Object)
- **Threshold** (Number)
- **Resize Video** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)

#### < Output

- **Positions** (Array)
- **Sizes** (Array)

**Example Patch:** [cables.gl/edit/vSwLsT](https://cables.gl/edit/vSwLsT)

**Doc:** [cables.gl/op/Ops.Extension.Trackingjs.TrackWebcamColor](https://cables.gl/op/Ops.Extension.Trackingjs.TrackWebcamColor)

## 58 Ops.Extension.Voice

### 58.1 MeSpeak



**Full Name:** Ops.Extension.Voice.MeSpeak

uses mespeak.js to convert text-to-speech.

#### > Inputs

- **Text** (String)
- **Say** (Trigger)
- **Amplitude** (Number)
- **Pitch** (Number)
- **Voice Index** (Number: Integer)
- **Word Gap** (Number: Integer)
- **Variants Index** (Number: Integer)
- **Line-Break Length** (Number: Integer)
- **Capitals** (Number: Integer)
- **Punctuation** (String)
- **No Stop** (Number: Boolean)
- **UTF16** (Number: Boolean)
- **SSML** (Number: Boolean)
- **Log Console** (Number: Boolean)
- **Pan** (Number)

#### < Output

- **Audio Out** (Object)
- **Speaking** (booleanNumber)
- **Voice Loaded** (booleanNumber)

**Example Patch:** [cables.gl/op/Ops.Extension.Voice.MeSpeak#example](https://cables.gl/op/Ops.Extension.Voice.MeSpeak#example)

**Doc:** [cables.gl/op/Ops.Extension.Voice.MeSpeak](https://cables.gl/op/Ops.Extension.Voice.MeSpeak)

### 58.2 Say\_v2



**Full Name:** Ops.Extension.Voice.Say\_v2

Text-to-Speech, speaks different languages (speech synthesis).

#### > Inputs

- **Update State** (Trigger)
- **Text** (String)
- **Say** (Trigger)

- **Voice** (Number: Select Box)
- **Pitch** (Number)
- **Rate** (Number)
- **Volume** (Number)
- **Say On Text Change** (Number: Boolean)
- **Pause** (Trigger)
- **Resume** (Trigger)
- **Cancel** (Trigger)

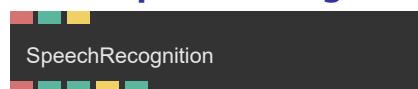
#### < Output

- **Next** (Trigger)
- **Speaking** (Number)
- **Pending** (Number)
- **Paused** (Number)

**Example Patch:** [cables.gl/edit/WubOWc](#)

**Doc:** [cables.gl/op/Ops.Extension.Voice.Say\\_v2](#)

## 58.3 SpeechRecognition



**Full Name:** Ops.Extension.Voice.SpeechRecognition  
speech to text recognition.

#### > Inputs

- **Language** (String)
- **Active** (Number: Boolean)
- **Start** (Trigger)

#### < Output

- **Result** (String)
- **Confidence** (Number)
- **Supported** (booleanNumber)
- **New Result** (Trigger)
- **Started** (booleanNumber)

**Example Patch:** [cables.gl/edit/9p7kw4](#)

**Doc:** [cables.gl/op/Ops.Extension.Voice.SpeechRecognition](#)

## 59 Ops.Extension.WebGpu

### 59.1 ArrayToGpuBuffer



**Full Name:** Ops.Extension.WebGpu.ArrayToGpuBuffer

Upload an array to the GPU as a GpuBuffer.

#### > Inputs

- **Arr** (Array)

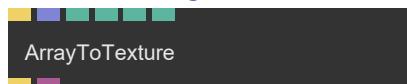
#### < Output

- **GPUBuffer** (Object)

**Example Patch:** [cables.gl/edit/VShX3I](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.ArrayToGpuBuffer](#)

### 59.2 ArrayToTexture



**Full Name:** Ops.Extension.WebGpu.ArrayToTexture

Convert an array of numbers to a webgpu texture.

#### > Inputs

- **Update** (Trigger)
- **Array** (Array)
- **Wrap Index** (Number: Integer)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

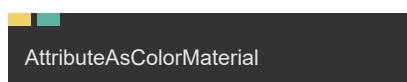
#### < Output

- **Next** (Trigger)
- **Texture** (Object)

**Example Patch:** [cables.gl/edit/hYt34I](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.ArrayToTexture](#)

### 59.3 AttributeAsColorMaterial



**Full Name:** Ops.Extension.WebGpu.AttributeAsColorMaterial

Render mesh attributes as color.

#### > Inputs

- **Render** (Trigger)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/ FM4hQB](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.AttributeAsColorMaterial](#)

## 59.4 BasicMaterial



BasicMaterial

**Full Name:** Ops.Extension.WebGpu.BasicMaterial

A simple material without shading.

#### > Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Colorize Texture** (Number: Boolean)
- **DiffuseRepeatX** (Number)
- **DiffuseRepeatY** (Number)
- **Tex Offset X** (Number)
- **Tex Offset Y** (Number)
- **Texture** (Object:Texture)
- **Mask** (Object:Texture)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/ J0HjQB](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.BasicMaterial](#)

## 59.5 ColorTexture



ColorTexture

**Full Name:** Ops.Extension.WebGpu.ColorTexture

A texture containing only one color.

#### > Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

#### < Output

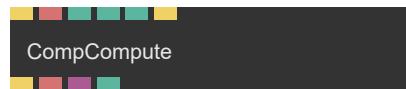
- **Next** (Trigger)

**Texture\_out** (Object)

**Example Patch:** [cables.gl/edit/ 13IW3I](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.ColorTexture](#)

## 59.6 CompCompute



CompCompute

**Full Name:** Ops.Extension.WebGpu.CompCompute

Compose a compute shader.

#### > Inputs

- **Compute** (Trigger)
- **Source** (String)
- **Workgroups 1** (Number: Integer)
- **Workgroups 2** (Number: Integer)
- **Workgroups 3** (Number: Integer)
- **Force Update** (Trigger)

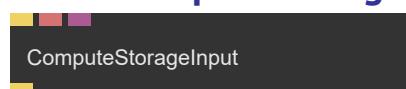
#### < Output

- **Next** (Trigger)
- **Code** (String)
- **Buffer** (Object)
- **Length** (Number)

**Example Patch:** [cables.gl/edit/ 1ff0dH](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.CompCompute](#)

## 59.7 ComputeStorageInput



ComputeStorageInput

**Full Name:** Ops.Extension.WebGpu.ComputeStorageInput

Compute shader GPU buffer storage input.

#### > Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Buffer** (Object)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Extension.WebGpu.ComputeStorageInput#example](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.ComputeStorageInput](#)

## 59.8 ComputeStorageOutput

ComputeStorageOutput

**Full Name:** Ops.Extension.WebGpu.ComputeStorageOutput

Compute shader GPU buffer storage output.

### > Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Length** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Buffer** (Object)
- **Buffer Length** (Number)

**Example Patch:** cables.gl/edit/1ff0dH

**Doc:** cables.gl/op/Ops.Extension.WebGpu.ComputeStorageOutput

## 59.9 ComputeUniform

ComputeUniform

**Full Name:** Ops.Extension.WebGpu.ComputeUniform

Add a uniform input to a compute shader composition.

### > Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Extension.WebGpu.ComputeUniform#example

**Doc:** cables.gl/op/Ops.Extension.WebGpu.ComputeUniform

## 59.10 DefaultTextures

DefaultTextures

**Full Name:** Ops.Extension.WebGpu.DefaultTextures

Outputs textures.

### > Inputs

- Visit *Ops.Extension.WebGpu.DefaultTextures documentation for input port details*

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/nQEVKB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.DefaultTextures

## 59.11 FaceCulling

FaceCulling

**Full Name:** Ops.Extension.WebGpu.FaceCulling

cull (do not draw) back or front facing faces/triangles.

### > Inputs

- **Render** (Trigger)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/zKLQ3I

**Doc:** cables.gl/op/Ops.Extension.WebGpu.FaceCulling

## 59.12 FrontBacksideMaterial

FrontBacksideMaterial

**Full Name:** Ops.Extension.WebGpu.FrontBacksideMaterial

Show direction of faces as color.

### > Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **R 2** (Number)
- **G 2** (Number)
- **B 2** (Number)
- **A 2** (Number)

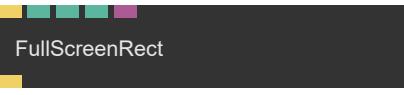
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/1Jm1LB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.FrontBacksideMaterial

## 59.13 FullScreenRect



FullScreenRect

**Full Name:** Ops.Extension.WebGpu.FullScreenRect

Render a rectangle that fills the whole canvas.

### > Inputs

- **Render** (Trigger)
- **Flip Y** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Texture** (Object:Texture)

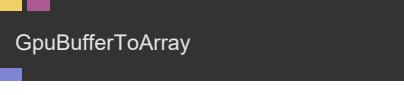
### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/PNx2LB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.FullScreenRect

## 59.14 GpuBufferToArray



GpuBufferToArray

**Full Name:** Ops.Extension.WebGpu.GpuBufferToArray

Convert a GpuBuffer to a CPU Array.

### > Inputs

- **Trigger** (Trigger)
- **Pos Buffer** (Object)

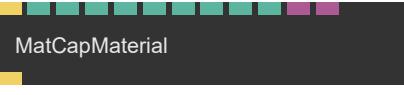
### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/bQQYKB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.GpuBufferToArray

## 59.15 MatCapMaterial



MatCapMaterial

**Full Name:** Ops.Extension.WebGpu.MatCapMaterial

Image based material that uses a matcap environment texture.

### > Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)

- **A** (Number)
- **Colorize Texture** (Number: Boolean)
- **DiffuseRepeatX** (Number)
- **DiffuseRepeatY** (Number)
- **Tex Offset X** (Number)
- **Tex Offset Y** (Number)
- **Matcap** (Object:Texture)
- **Diffuse** (Object:Texture)

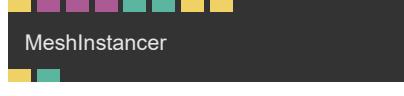
### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/WwXZKB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.MatCapMaterial

## 59.16 MeshInstancer



MeshInstancer

**Full Name:** Ops.Extension.WebGpu.MeshInstancer

Draw the same mesh many times very fast.

### > Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Pos Buffer** (Object)
- **Scale Buffer** (Object)
- **Num Instances** (Number: Integer)
- **Reset** (Trigger)
- **Test** (Trigger)

### < Output

- **Next** (Trigger)
- **Total Instances** (Number)

**Example Patch:** cables.gl/edit/bQQYKB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.MeshInstancer

## 59.17 Pipeline



Pipeline

**Full Name:** Ops.Extension.WebGpu.Pipeline

show content of last used pipeline for debugging.

### > Inputs

- **Trigger** (Trigger)

- **Force Rebuild** (Trigger)

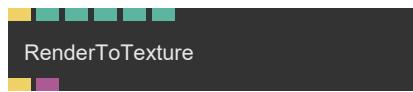
#### < Output

- **Next** (Trigger)
- **Pipeline** (Object)
- **Shader Info** (Object)
- **Shader Source** (String)
- **Compile Count** (Number)
- **Shader Id** (String)
- **Defines** (Array)

**Example Patch:** cables.gl/op/Ops.Extension.WebGpu.Pipeline#example

**Doc:** cables.gl/op/Ops.Extension.WebGpu.Pipeline

## 59.18 RenderToTexture



**Full Name:** Ops.Extension.WebGpu.RenderToTexture  
render into a texture.

#### > Inputs

- **Trigger** (Trigger)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Clear** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Texture** (Object)

**Example Patch:** cables.gl/edit/pyXXKB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.RenderToTexture

## 59.19 SaselHund



**Full Name:** Ops.Extension.WebGpu.SaselHund

*Visit documentation for details.*

#### > Inputs

- Visit [Ops.Extension.WebGpu.SaselHund documentation](#) for input port details

#### < Output

- Visit [Ops.Extension.WebGpu.SaselHund documentation](#) for output port details

**Example Patch:** cables.gl/op/Ops.Extension.WebGpu.SaselHund#example  
**Doc:** cables.gl/op/Ops.Extension.WebGpu.SaselHund

## 59.20 Texture



**Full Name:** Ops.Extension.WebGpu.Texture

Load an image file as a texture.

#### > Inputs

- **File** (String)
- **Wrap Index** (Number: Integer)

#### < Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **PixelFormat** (Number)

**Example Patch:** cables.gl/edit/08iWKB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.Texture

## 59.21 VizTexture



**Full Name:** Ops.Extension.WebGpu.VizTexture

Vizualize a webgpu texture on the patchfield.

#### > Inputs

- **Texture In** (Object:Texture)

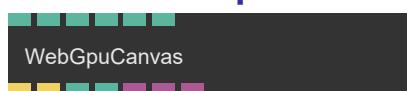
#### < Output

- Visit [Ops.Extension.WebGpu.VizTexture documentation](#) for output port details

**Example Patch:** cables.gl/edit/tk5uLB

**Doc:** cables.gl/op/Ops.Extension.WebGpu.VizTexture

## 59.22 WebGpuCanvas



**Full Name:** Ops.Extension.WebGpu.WebGpuCanvas

Create a canvas for WebGPU.

#### > Inputs

- **Active** (Number: Boolean)
- **Catch Errors** (Number: Boolean)
- **Stop On Errors** (Number: Boolean)
- **Profile** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Next2** (Trigger)
- **Supported** (booleanNumber)
- **MS Frame** (Number)
- **Canvas** (Object)
- **Canvas Prev** (Object)
- **Profiler Data** (Object)

**Example Patch:** [cables.gl/edit/ALyYKB](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.WebGpuCanvas](#)

## 59.23 WebGpuInfo



**Full Name:** Ops.Extension.WebGpu.WebGpuInfo

Output information about WebGPU adapter and implementation.

#### > Inputs

- **Trigger** (Trigger)

#### < Output

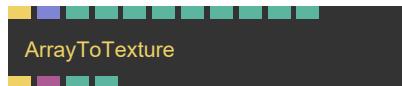
- **Next** (Trigger)
- **Limits** (Object)
- **Vendor** (String)
- **Architecture** (String)
- **Presentation Format** (String)

**Example Patch:** [cables.gl/edit/UTES3I](#)

**Doc:** [cables.gl/op/Ops.Extension.WebGpu.WebGpuInfo](#)

# 60 Ops.Gl

## 60.1 ArrayToTexture\_v2



**Full Name:** Ops.Gl.ArrayToTexture\_v2

create a texture from an array of number values.

#### > Inputs

- **Update** (Trigger)
- **Array** (Array)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Fill Up** (Number: Boolean)
- **Flip** (Number: Boolean)
- **PixelFormat Index** (Number: Integer)
- **Wrap Index** (Number: Integer)

#### < Output

- **Next** (Trigger)
- **Texture Out** (Object)
- **Tex Width** (Number)
- **Tex Height** (Number)

**Example Patch:** [cables.gl/edit/cOlh\\_C](#)

**Doc:** [cables.gl/op/Ops.Gl.ArrayToTexture\\_v2](#)

## 60.2 BlendMode



**Full Name:** Ops.Gl.BlendMode

change how colors are mixed (blending/mixing modes).

#### > Inputs

- **Render** (Trigger)
- **Blendmode Index** (Number: Integer)
- **Premultiplied** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/x1-Fvc](#)

**Doc:** [cables.gl/op/Ops.Gl.BlendMode](#)

## 60.3 CanvasFocus



CanvasFocus

**Full Name:** Ops.Gl.CanvasFocus  
is canvas focussed ?.

**> Inputs**

- **Focus** (Trigger)

**< Output**

- **Has Focus** (booleanNumber)

**Example Patch:** cables.gl/edit/vGwM7f

**Doc:** cables.gl/op/Ops.Gl.CanvasFocus

## 60.4 CanvasInfo\_v3



CanvasInfo

**Full Name:** Ops.Gl.CanvasInfo\_v3

the size of the canvas in pixels, aspect ratio and pixel density.

**> Inputs**

- Visit *Ops.Gl.CanvasInfo\_v3 documentation* for input port details

**< Output**

- **CSS Width** (Number)
- **CSS Height** (Number)
- **Pixel Ratio** (Number)
- **Pixel Width** (Number)
- **Pixel Height** (Number)
- **Aspect Ratio** (Number)
- **Landscape** (booleanNumber)
- **Canvas** (Object)
- **Canvas Parent** (Object)
- **Resized** (Trigger)

**Example Patch:** cables.gl/edit/2yaD8i

**Doc:** cables.gl/op/Ops.Gl.CanvasInfo\_v3

## 60.5 CanvasToTexture



CanvasToTexture

**Full Name:** Ops.Gl.CanvasToTexture

convert a canvas to texture.

## > Inputs

- **Canvas** (Object)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Force Update** (Trigger)

## < Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)

**Example Patch:** cables.gl/edit/QjlEo-

**Doc:** cables.gl/op/Ops.Gl.CanvasToTexture

## 60.6 ClearColor



ClearColor

**Full Name:** Ops.Gl.ClearColor

sets all cleared pixels to one colour. Use to change the background colour.

**> Inputs**

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/\_UEjvr

**Doc:** cables.gl/op/Ops.Gl.ClearColor

## 60.7 ClearDepth



ClearDepth

**Full Name:** Ops.Gl.ClearDepth

Clears the depth buffer (zbuffer, z buffer).

**> Inputs**

- **Render** (Trigger)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/rEesag

**Doc:** cables.gl/op/Ops.Gl.ClearDepth

## 60.8 ColorMask

ColorMask

**Full Name:** Ops.Gl.ColorMask

enable/disable RGBA color channels of your entire scene.

### > Inputs

- **Execute** (Trigger)
- **Red** (Number: Boolean)
- **Green** (Number: Boolean)
- **Blue** (Number: Boolean)
- **Alpha** (Number: Boolean)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/MqQSR7

**Doc:** cables.gl/op/Ops.Gl.ColorMask

## 60.9 ColorPick

ColorPick

**Full Name:** Ops.Gl.ColorPick

pick a color at x,y coordinates of canvas.

### > Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)

### < Output

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

**Example Patch:** cables.gl/edit/YEjkgg

**Doc:** cables.gl/op/Ops.Gl.ColorPick

## 60.10 DirectionalTranslate

DirectionalTranslate

**Full Name:** Ops.Gl.DirectionnalTranslate

translate away from a point in space.

### > Inputs

- **Exec** (Trigger)
- **Center Model Matrix** (Array)
- **Amount** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/5gL9On

**Doc:** cables.gl/op/Ops.Gl.DirectionnalTranslate

## 60.11 DownloadTexture\_v3

DownloadTexture

**Full Name:** Ops.Gl.DownloadTexture\_v3

Download a texture as an image file.

### > Inputs

- **Texture** (Object:Texture)
- **Quality** (Number)
- **Filename** (String)
- **Download** (Trigger)

### < Output

- **Jcrmz8mnz** (Trigger)

**Example Patch:** cables.gl/edit/15LaTs

**Doc:** cables.gl/op/Ops.Gl.DownloadTexture\_v3

## 60.12 DrawTextureMapping

DrawTextureMapping

**Full Name:** Ops.Gl.DrawTextureMapping

draw texture mapping coordinates.

### > Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Num Points** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/Nu7dJ5

**Doc:** cables.gl/op/Ops.Gl.DrawTextureMapping

## 60.13 ElementInBrowserViewport



ElementInBrowserViewport

**Full Name:** Ops.Gl.ElementInBrowserViewport

check if webgl canvas element is in the current browser viewport.

**> Inputs**

- **Update** (Trigger)
- **Element** (Object:Element)

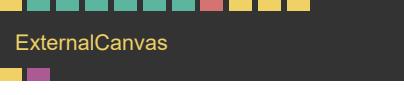
**< Output**

- **Next** (Trigger)
- **Fully Visible** (booleanNumber)
- **Partly Visible** (booleanNumber)

**Example Patch:** cables.gl/op/Ops.Gl.ElementInBrowserViewport#example

**Doc:** cables.gl/op/Ops.Gl.ElementInBrowserViewport

## 60.14 ExternalCanvas



ExternalCanvas

**Full Name:** Ops.Gl.ExternalCanvas

Open a new window that shows a copy of the patch canvas.

**> Inputs**

- **Update** (Trigger)
- **Pos X** (Number: Integer)
- **Pos Y** (Number: Integer)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Smoothing** (Number: Boolean)
- **Stretch** (Number: Boolean)
- **Title** (String)
- **Open Window** (Trigger)
- **Fullscreen** (Trigger)
- **Close** (Trigger)

**< Output**

- **Next** (Trigger)
- **Element** (Object)

**Example Patch:** cables.gl/edit/HnG3fB

**Doc:** cables.gl/op/Ops.Gl.ExternalCanvas

## 60.15 FaceCulling\_v2



FaceCulling

**Full Name:** Ops.Gl.FaceCulling\_v2

Disable the rendering of front or back facing triangles with culling.

**> Inputs**

- **Render** (Trigger)
- **Active** (Number: Boolean)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/mPwnD-

**Doc:** cables.gl/op/Ops.Gl.FaceCulling\_v2

## 60.16 FontMSDF\_v2



FontMSDF

**Full Name:** Ops.Gl.FontMSDF\_v2

Load MSDF Font data and texture to use.

**> Inputs**

- **Font Name** (String)
- **Font Data** (String)
- **Font Image** (String)
- **Font Image 1** (String)
- **Font Image 2** (String)
- **Font Image 3** (String)

**< Output**

- **Loaded** (booleanNumber)
- **Total Chars** (Number)
- **Chars** (String)

**Example Patch:** cables.gl/edit/9COr26

**Doc:** cables.gl/op/Ops.Gl.FontMSDF\_v2

## 60.17 ForceCanvasSize



ForceCanvasSize

**Full Name:** Ops.Gl.ForceCanvasSize

Resize canvas element to a specific pixel size or aspect ratio.

**> Inputs**

- **Trigger** (Trigger)
- **Active** (Number: Boolean)
- **Center In Parent** (Number: Boolean)
- **Scale To Fit Parent** (Number: Boolean)
- **Set Width** (Number: Integer)
- **Set Height** (Number: Integer)
- **Aspect Ratio Index** (Number: Integer)
- **Ratio** (Number)
- **Fill Parent Index** (Number: Integer)

#### ◀ Output

- **Next** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Margin Left** (Number)
- **Margin Top** (Number)

**Example Patch:** [cables.gl/edit/f9UbD-](#)

**Doc:** [cables.gl/op/Ops.Gl.ForceCanvasSize](#)

## 60.18 GateTexture



**Full Name:** Ops.Gl.GateTexture

Will only allow an Object to be output if the pass through parameter evaluates to true.

#### ▶ Inputs

- **Object In** (Object:Texture)
- **Pass Through** (Number: Boolean)
- **Only Valid Textures** (Number: Boolean)

#### ◀ Output

- **Object Out** (Object)

**Example Patch:** [cables.gl/op/Ops.Gl.GateTexture#example](#)

**Doc:** [cables.gl/op/Ops.Gl.GateTexture](#)

## 60.19 GBlendFunc



**Full Name:** Ops.Gl.GBlendFunc

set gl blendmodes directly.

#### ▶ Inputs

- **Exec** (Trigger)
- **Src RGB Index** (Number: Integer)
- **Dst RGB Index** (Number: Integer)
- **Src Alpha Index** (Number: Integer)
- **Dst Alpha Index** (Number: Integer)
- **Blend Equation Index** (Number: Integer)

#### ◀ Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/24qZz7](#)

**Doc:** [cables.gl/op/Ops.Gl.GBlendFunc](#)

## 60.20 GlInfo\_v2



**Full Name:** Ops.Gl.GlInfo\_v2

information about the webgl context.

#### ▶ Inputs

- Visit [Ops.Gl.GlInfo\\_v2 documentation for input port details](#)

#### ◀ Output

- **WebGL Version Short** (Number)
- **WebGL Version** (String)
- **GLSL Version** (String)
- **Max Frag Uniforms** (Number)
- **Max Vert Uniforms** (Number)
- **Max Texture Size** (Number)
- **Max Texture Units** (Number)
- **Max Varying Vectors** (Number)
- **Max MSAA Samples** (Number)
- **Extensions** (Array)
- **Vendor** (String)
- **Renderer** (String)

**Example Patch:** [cables.gl/edit/0zHu8i](#)

**Doc:** [cables.gl/op/Ops.Gl.GlInfo\\_v2](#)

## 60.21 GlPrimitive



**Full Name:** Ops.Gl.GlPrimitive

force rendering of meshes using points, lines or triangles.

#### > Inputs

- **Execute** (Trigger)
- **Primitive Index** (Number: Integer)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/a5Mz8i](#)

**Doc:** [cables.gl/op/Ops.Gl.GlPrimitive](#)

## 60.22 GradientTexture



**Full Name:** Ops.Gl.GradientTexture

texture containing a colour gradient that can be altered with an editor.

#### > Inputs

- **Gradient** (Number)
- **Direction Index** (Number: Integer)
- **Smoothstep** (Number: Boolean)
- **Step** (Number: Boolean)
- **Flip** (Number: Boolean)
- **SRGB** (Number: Boolean)
- **Oklab** (Number: Boolean)
- **Size** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Dither** (Number)
- **Gradient Array** (Array)
- **Randomize Colors** (Trigger)

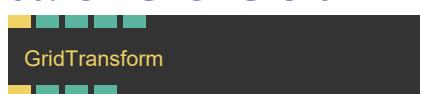
#### < Output

- **Texture** (Object)
- **Alpha Mask** (Object)
- **Colors** (Array)
- **Colors Pos** (Array)

**Example Patch:** [cables.gl/edit/\\_wQNDW](#)

**Doc:** [cables.gl/op/Ops.Gl.GradientTexture](#)

## 60.23 GridTransform



**Full Name:** Ops.Gl.GridTransform

transform and arrange elements into a grid.

#### > Inputs

- **Render** (Trigger)
- **Num X** (Number: Integer)
- **Num Y** (Number: Integer)
- **Space X** (Number)
- **Space Y** (Number)

#### < Output

- **Next** (Trigger)
- **Index** (Number)
- **X Index** (Number)
- **Y Index** (Number)

**Example Patch:** [cables.gl/edit/J-XMΝQ](#)

**Doc:** [cables.gl/op/Ops.Gl.GridTransform](#)

## 60.24 Identity



**Full Name:** Ops.Gl.Identity

reset all transforms (modelmatrix).

#### > Inputs

- **Exe** (Trigger)

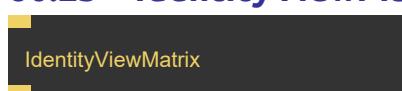
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/KUVJ8i](#)

**Doc:** [cables.gl/op/Ops.Gl.Identity](#)

## 60.25 IdentityViewMatrix



**Full Name:** Ops.Gl.IdentityViewMatrix

reset the view matrix (cameras etc.).

#### > Inputs

- **Exe** (Trigger)

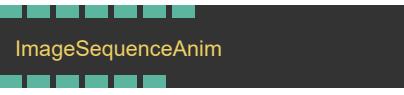
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/H01Ici](#)

**Doc:** [cables.gl/op/Ops.Gl.IdentityViewMatrix](#)

## 60.26 ImageSequenceAnim\_v2



ImageSequenceAnim

**Full Name:** Ops.Gl.ImageSequenceAnim\_v2

play a image sprite animation.

### > Inputs

- **Time** (Number)
- **FPS** (Number)
- **Num X** (Number)
- **Num Y** (Number)
- **Max Frames** (Number: Integer)
- **Flip Y** (Number: Boolean)

### < Output

- **Repeat X** (Number)
- **Repeat Y** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Frame** (Number)
- **Progress** (Number)

**Example Patch:** [cables.gl/edit/n0iMSq](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageSequenceAnim\\_v2](#)

## 60.27 InteractiveRectangle\_v2



InteractiveRectangle

**Full Name:** Ops.Gl.InteractiveRectangle\_v2

An area which is interactive.

### > Inputs

- **Trigger In** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **ID** (String)
- **Class** (String)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)
- **Axis Index** (Number: Integer)
- **Is Interactive** (Number: Boolean)
- **Render Rectangle** (Number: Boolean)
- **Show Boundings** (Number: Boolean)
- **Cursor Index** (Number: Integer)

- **Active** (Number: Boolean)

### < Output

- **Trigger Out** (Trigger)
- **Geometry** (Object)
- **Pointer Hover** (booleanNumber)
- **Pointer Down** (booleanNumber)
- **Pointer X** (Number)
- **Pointer Y** (Number)
- **Top** (Number)
- **Left** (Number)
- **Right** (Number)
- **Bottom** (Number)
- **Left Click** (Trigger)
- **Dom Element** (Object)

**Example Patch:** [cables.gl/edit/P\\_SED0](#)

**Doc:** [cables.gl/op/Ops.Gl.InteractiveRectangle\\_v2](#)

## 60.28 LayerSequence



LayerSequence

**Full Name:** Ops.Gl.LayerSequence

Render Multiple Layers in a specific order.

### > Inputs

- **Exe** (Trigger)

### < Output

- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)

**Example Patch:** cables.gl/edit/VH4Oxj  
**Doc:** cables.gl/op/Ops.Gl.LayerSequence

## 60.29 LineFont\_v2



**Full Name:** Ops.Gl.LineFont\_v2

A Simple way to write text on the screen.

### > Inputs

- **Render** (Trigger)
- **Text** (String)
- **Letter Spacing** (Number)

### < Output

- **Lines** (Array)

**Example Patch:** cables.gl/edit/1JzPLu

**Doc:** cables.gl/op/Ops.Gl.LineFont\_v2

## 60.30 MainLoop\_v2



**Full Name:** Ops.Gl.MainLoop\_v2

Trigger other ops once every frame to create smooth animations.

### > Inputs

- **FPS Limit** (Number)
- **Reduce FPS Unfocussed** (Number: Boolean)
- **Transparent** (Number: Boolean)
- **Active** (Number: Boolean)
- **Focus Canvas** (Number: Boolean)

### < Output

- **Trigger** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Pixel Density** (Number)

**Example Patch:** cables.gl/edit/uZxfQc

**Doc:** cables.gl/op/Ops.Gl.MainLoop\_v2

## 60.31 MediaRecorder\_v2



**Full Name:** Ops.Gl.MediaRecorder\_v2

Record the renderer-output to video.

### > Inputs

- **Recording** (Number: Boolean)
- **Filename** (String)
- **Download Video** (Number: Boolean)
- **Mimetype Index** (Number: Integer)
- **MBit** (Number)
- **Max FPS** (Number)
- **Force FPS** (Number)
- **Audio In** (Object:AudioNode)
- **Video Canvas Id** (String)

### < Output

- **State** (String)
- **Error** (String)
- **Final Mimetype** (String)
- **Valid Mimetypes** (Array)
- **Duration** (Number)
- **Finished Recording** (Trigger)
- **Video DataUrl** (String)

**Example Patch:** cables.gl/edit/ioiDIR

**Doc:** cables.gl/op/Ops.Gl.MediaRecorder\_v2

## 60.32 MeshInstancer\_v4



**Full Name:** Ops.Gl.MeshInstancer\_v4

Draw the same mesh multiple times on the GPU.

### > Inputs

- **Exe** (Trigger)
- **Geom** (Object:Geometry)
- **Scale** (Number)
- **Limit Instances** (Number: Boolean)
- **Limit** (Number: Integer)
- **Positions** (Array)
- **Scale Array** (Array)
- **Rotations** (Array)

- **Colors** (Array)
- **TexCoords** (Array)

#### < Output

- **Trigger Out** (Trigger)
- **Num** (Number)

**Example Patch:** [cables.gl/edit/oOsJ5](#)

**Doc:** [cables.gl/op/Ops.Gl.MeshInstancer\\_v4](#)

## 60.33 MeshMorph



**Full Name:** Ops.Gl.MeshMorph  
morph from one geometry to another.

#### > Inputs

- **Render** (Trigger)
- **Geometry** (Number: Integer)
- **Duration** (Number)
- **Index** (Number)
- **Index 2** (Number)
- **Fade** (Number)
- **Easing Index** (Number: Integer)
- **Geometry 0** (Object)
- **Geometry 1** (Object)
- **Geometry 2** (Object)
- **Geometry 3** (Object)
- **Geometry 4** (Object)
- **Geometry 5** (Object)
- **Geometry 6** (Object)
- **Geometry 7** (Object)
- **Geometry 8** (Object)
- **Geometry 9** (Object)
- **Geometry 10** (Object)
- **Geometry 11** (Object)
- **Geometry 12** (Object)
- **Geometry 13** (Object)
- **Geometry 14** (Object)
- **Geometry 15** (Object)

#### < Output

- **Finished** (booleanNumber)
- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/PdhglN](#)

**Doc:** [cables.gl/op/Ops.Gl.MeshMorph](#)

## 60.34 NormalizeScreenCoordinates



**Full Name:** Ops.Gl.NormalizeScreenCoordinates  
convert screen pixel coordinates to range 0-1.

#### > Inputs

- **X** (Number)
- **Y** (Number)

#### < Output

- **Result X** (Number)
- **Result Y** (Number)

**Example Patch:** [cables.gl/op/Ops.Gl.NormalizeScreenCoordinates#example](#)

**Doc:** [cables.gl/op/Ops.Gl.NormalizeScreenCoordinates](#)

## 60.35 OrTexture



**Full Name:** Ops.Gl.OrTexture  
outputs the first valid texture of the.

#### > Inputs

- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)
- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)

#### < Output

- **Result** (Object)

**Example Patch:** [cables.gl/edit/oKRY7i](#)

**Doc:** [cables.gl/op/Ops.Gl.OrTexture](#)

## 60.36 Orthogonal\_v2

Orthogonal

**Full Name:** Ops.Gl.Orthogonal\_v2

Orthogonal projection / objects in distance don't appear smaller (isometric).

### > Inputs

- **Render** (Trigger)
- **Bounds** (Number)
- **Axis Index** (Number: Integer)
- **Frustum Near** (Number)
- **Frustum Far** (Number)

### < Output

- **Trigger** (Trigger)
- **Ratio** (Number)
- **Width** (Number)
- **Height** (Number)

**Example Patch:** [cables.gl/edit/94Aycg](#)

**Doc:** [cables.gl/op/Ops.Gl.Orthogonal\\_v2](#)

## 60.37 OverwriteViewportSize

OverwriteViewportSize

**Full Name:** Ops.Gl.OverwriteViewportSize

Force a manually set viewport size for connected ops.

### > Inputs

- **Exec** (Trigger)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.OverwriteViewportSize#example](#)

**Doc:** [cables.gl/op/Ops.Gl.OverwriteViewportSize](#)

## 60.38 Performance

Performance

**Full Name:** Ops.Gl.Performance

Show WebGL Performance Statistics.

## > Inputs

- **Exe** (Trigger)
- **Active** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Measure GPU** (Number: Boolean)
- **Open** (Number: Boolean)
- **Smooth Graph** (Number: Boolean)
- **Scale** (Number)
- **Size** (Number)

## < Output

- **Childs** (Trigger)
- **Canvas** (Object)
- **FPS** (Number)

**Example Patch:** [cables.gl/edit/zFR8z5](#)

**Doc:** [cables.gl/op/Ops.Gl.Performance](#)

## 60.39 PerformanceMeasure

PerformanceMeasure

**Full Name:** Ops.Gl.PerformanceMeasure

Measure the time used to execute all child ops.

### > Inputs

- **Execute** (Trigger)
- **Name** (String)

### < Output

- **Childs** (Trigger)
- **Time Used** (Number)

**Example Patch:** [cables.gl/op/Ops.Gl.PerformanceMeasure#example](#)

**Doc:** [cables.gl/op/Ops.Gl.PerformanceMeasure](#)

## 60.40 Perspective

Perspective

**Full Name:** Ops.Gl.Perspective

Adjust FOV, field of view, and frustum clipping.

### > Inputs

- **Render** (Trigger)
- **FOV Degrees** (Number)
- **Frustum Near** (Number)

- **Frustum Far** (Number)
- **Auto Aspect Ratio** (Number: Boolean)
- **Aspect Ratio** (Number)

**< Output**

- **Trigger** (Trigger)
- **Aspect** (Number)

**Example Patch:** [cables.gl/edit/RJXV7i](#)

**Doc:** [cables.gl/op/Ops.Gl.Perspective](#)

## 60.41 PixelProjection\_v3



**Full Name:** Ops.Gl.PixelProjection\_v3

Remaps world co-ordinates to a pixel co-ordinate system.

**> Inputs**

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Frustum Near** (Number)
- **Frustum Far** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Zero Y** (Number: Boolean)

**< Output**

- **Trigger** (Trigger)
- **Size Width** (Number)
- **Size Height** (Number)

**Example Patch:** [cables.gl/edit/fsOPNS](#)

**Doc:** [cables.gl/op/Ops.Gl.PixelProjection\\_v3](#)

## 60.42 PointCollector



**Full Name:** Ops.Gl.PointCollector

save points/coordinates in an array.

**> Inputs**

- **Render** (Trigger)
- **Absolute** (Number: Boolean)

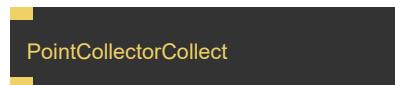
**< Output**

- **Trigger** (Trigger)
- **Points** (Array)

**Example Patch:** [cables.gl/op/Ops.Gl.PointCollector#example](#)

**Doc:** [cables.gl/op/Ops.Gl.PointCollector](#)

## 60.43 PointCollectorCollect



**Full Name:** Ops.Gl.PointCollectorCollect

collect world space coordinates into an array.

**> Inputs**

- **Render** (Trigger)

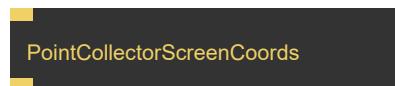
**< Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.PointCollectorCollect#example](#)

**Doc:** [cables.gl/op/Ops.Gl.PointCollectorCollect](#)

## 60.44 PointCollectorScreenCoords



**Full Name:** Ops.Gl.PointCollectorScreenCoords

collect screen pixel coordinates into an array.

**> Inputs**

- **Render** (Trigger)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.PointCollectorScreenCoords#example](#)

**Doc:** [cables.gl/op/Ops.Gl.PointCollectorScreenCoords](#)

## 60.45 RandomCluster



**Full Name:** Ops.Gl.RandomCluster

Transforms objects randomly in space.

**> Inputs**

- **Exe** (Trigger)
- **Num** (Number: Integer)
- **Random Seed** (Number)

- **Round** (Number: Boolean)
- **Size** (Number)
- **ScaleX** (Number)
- **ScaleY** (Number)
- **ScaleZ** (Number)
- **Rotate X** (Number)
- **Rotate Y** (Number)
- **Rotate Z** (Number)
- **Scroll X** (Number)

**< Output**

- **Trigger** (Trigger)
- **Index** (Number)
- **Rnd** (Number)

**Example Patch:** [cables.gl/edit/Ah6Rj6](#)

**Doc:** [cables.gl/op/Ops.Gl.RandomCluster](#)

## 60.46 RenderAnim\_v2



**Full Name:** Ops.Gl.RenderAnim\_v2

record, render an animation and save as webm video file or png image sequence.

**> Inputs**

- **Render** (Trigger)
- **File Type Index** (Number: Integer)
- **ZIP Multiple Files** (Number: Boolean)
- **Download Files** (Number: Boolean)
- **Filename** (String)
- **Quality** (Number)
- **Duration** (Number: Integer)
- **FPS** (Number: Integer)
- **Transparency** (Number: Boolean)
- **Use Canvas Size** (Number: Boolean)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Start** (Trigger)

**< Output**

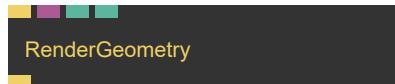
- **Next** (Trigger)
- **Progress** (Number)
- **Frame** (Number)
- **Status** (String)

- **Started** (booleanNumber)
- **Data URL** (String)
- **Finished** (Trigger)

**Example Patch:** [cables.gl/edit/bQhm8i](#)

**Doc:** [cables.gl/op/Ops.Gl.RenderAnim\\_v2](#)

## 60.47 RenderGeometry\_v2



**Full Name:** Ops.Gl.RenderGeometry\_v2

Render a geometry as mesh.

**> Inputs**

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Add Vertex Numbers** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/w6QYIH](#)

**Doc:** [cables.gl/op/Ops.Gl.RenderGeometry\\_v2](#)

## 60.48 RenderToTexture\_v3



**Full Name:** Ops.Gl.RenderToTexture\_v3

Render into an Image.

**> Inputs**

- **Render** (Trigger)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Auto Aspect** (Number: Boolean)
- **Pixel Format Index** (Number: Integer)
- **Depth** (Number: Boolean)
- **Clear** (Number: Boolean)

**< Output**

- **Trigger** (Trigger)
- **Texture** (Object)
- **TextureDepth** (Object)

**Example Patch:** [cables.gl/edit/G2\\_my7](#)

**Doc:** cables.gl/op/Ops.Gl.RenderToTexture\_v3

## 60.49 RenderToTextures\_v3

RenderToTextures

**Full Name:** Ops.Gl.RenderToTextures\_v3

render to multiple textures at the same time.

### > Inputs

- **Render** (Trigger)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)
- **Auto Aspect** (Number: Boolean)
- **Pixel Format Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Clear** (Number: Boolean)
- **Texture 0 Index** (Number: Integer)
- **Texture 1 Index** (Number: Integer)
- **Texture 2 Index** (Number: Integer)
- **Texture 3 Index** (Number: Integer)
- **Texture 4 Index** (Number: Integer)
- **Texture 5 Index** (Number: Integer)
- **Texture 6 Index** (Number: Integer)
- **Texture 7 Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Result Texture 0** (Object)
- **Result Texture 1** (Object)
- **Result Texture 2** (Object)
- **Result Texture 3** (Object)
- **Result Texture 4** (Object)
- **Result Texture 5** (Object)
- **Result Texture 6** (Object)
- **Result Texture 7** (Object)
- **TextureDepth** (Object)

**Example Patch:** cables.gl/edit/muH2jG

**Doc:** cables.gl/op/Ops.Gl.RenderToTextures\_v3

## 60.50 ResetTransform

ResetTransform

**Full Name:** Ops.Gl.ResetTransform

reset current transforms to initial value (identity).

### > Inputs

- **Exe** (Trigger)
- **Reset Model Transform** (Number: Boolean)
- **Reset View Transform** (Number: Boolean)
- **Default View** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/kY3J8i

**Doc:** cables.gl/op/Ops.Gl.ResetTransform

## 60.51 SaveScreenShot\_v3

SaveScreenShot

**Full Name:** Ops.Gl.SaveScreenShot\_v3

Download the current screen content as png file.

### > Inputs

- **Filename** (String)
- **Use Canvas Size** (Number: Boolean)
- **Screenshot** (Trigger)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

### < Output

- **Finished** (Trigger)

**Example Patch:** cables.gl/edit/OB0Qmi

**Doc:** cables.gl/op/Ops.Gl.SaveScreenShot\_v3

## 60.52 ShowNormals\_v2

ShowNormals

**Full Name:** Ops.Gl.ShowNormals\_v2

visualize normals, tangents or bitangents.

### > Inputs

- **Render** (Trigger)

- **Draw** (Number: Boolean)
- **Geometry** (Object:Geometry)
- **Length** (Number)
- **Colorize** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

#### < Output

- **Trigger** (Trigger)
- **Line Geom** (Object)

**Example Patch:** <cables.gl/edit/4NeG02>

**Doc:** [cables.gl/op/Ops.Gl.ShowNormals\\_v2](cables.gl/op/Ops.Gl.ShowNormals_v2)

## 60.53 SurfaceScatter\_v2



**Full Name:** Ops.Gl.SurfaceScatter\_v2

Scatter an object on the surface of a mesh with different distribution methods.

#### > Inputs

- **Render** (Trigger)
- **Draw** (Number: Boolean)
- **Num** (Number: Integer)
- **Geom Surface** (Object)
- **Distribution Index** (Number: Integer)
- **Selection Index** (Number: Integer)
- **Random Seed** (Number)
- **Size Min** (Number)
- **Size Max** (Number)
- **Limit** (Number: Boolean)
- **Limit Num** (Number: Integer)
- **Random Rotate** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Positions** (Array)
- **Scale** (Array)
- **Quaternions** (Array)

**Example Patch:** <cables.gl/edit/cfUzre>

**Doc:** [cables.gl/op/Ops.Gl.SurfaceScatter\\_v2](cables.gl/op/Ops.Gl.SurfaceScatter_v2)

## 60.54 TextMeshMSDF\_v2



**Full Name:** Ops.Gl.TextMeshMSDF\_v2

draw text using the FontMSDF operator.

#### > Inputs

- **Render** (Trigger)
- **Text** (String)
- **Scale** (Number)
- **Letter Spacing** (Number)
- **Line Height** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **SDF** (Number: Boolean)
- **Smoothing** (Number)
- **Border** (Number: Boolean)
- **Border Width** (Number)
- **Smoothness** (Number)
- **Border R** (Number)
- **Border G** (Number)
- **Border B** (Number)
- **Shadow** (Number: Boolean)
- **Texture Color** (Object:Texture)
- **Texture Mask** (Object:Texture)
- **Positions** (Array)
- **Scalings** (Array)
- **Rotations** (Array)
- **Colors** (Array)
- **Premultiply** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Positions Original** (Array)
- **Scales** (Array)
- **Num Lines** (Number)
- **Width** (Number)
- **Height** (Number)
- **Start Y** (Number)
- **Num Chars** (Number)

**Example Patch:** <cables.gl/edit/9COr26>

**Doc:** [cables.gl/op/Ops.Gl.TextMeshMSDF\\_v2](#)

## 60.55 Texture\_v2



**Full Name:** Ops.Gl.Texture\_v2

Load an image as a texture.

### > Inputs

- **File** (String)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **Active** (Number: Boolean)
- **Save Memory** (Number: Boolean)
- **Add Cachebuster** (Number: Boolean)
- **Reload** (Trigger)

### < Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **Aspect Ratio** (Number)
- **Loaded** (booleanNumber)
- **Loading** (booleanNumber)

**Example Patch:** [cables.gl/edit/iRKrD-](#)

**Doc:** [cables.gl/op/Ops.Gl.Texture\\_v2](#)

## 60.56 TextureArray



**Full Name:** Ops.Gl.TextureArray

create an array of textures.

### > Inputs

- **Texture 0** (Object:Texture)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)
- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)

- **Texture 9** (Object:Texture)
- **Texture 10** (Object:Texture)
- **Texture 11** (Object:Texture)
- **Texture 12** (Object:Texture)
- **Texture 13** (Object:Texture)
- **Texture 14** (Object:Texture)

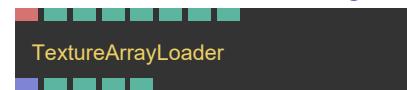
### < Output

- **Array** (Array)
- **Count** (Number)

**Example Patch:** [cables.gl/edit/vS5fjz](#)

**Doc:** [cables.gl/op/Ops.Gl.TextureArray](#)

## 60.57 TextureArrayLoader\_v2



**Full Name:** Ops.Gl.TextureArrayLoader\_v2

load multiple images into an array.

### > Inputs

- **Url** (String)
- **Left Pad** (Number: Boolean)
- **Index Start** (Number: Integer)
- **Index End** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **UnpackPreMultipliedAlpha** (Number: Boolean)

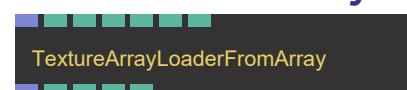
### < Output

- **TextureArray** (Array)
- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)
- **AspectRatio** (Number)

**Example Patch:** [cables.gl/edit/OeGdjT](#)

**Doc:** [cables.gl/op/Ops.Gl.TextureArrayLoader\\_v2](#)

## 60.58 TextureArrayLoaderFromArray\_v3



**Full Name:** Ops.Gl.TextureArrayLoaderFromArray\_v3

load multiple texture from filenames given as an array.

#### > Inputs

- **Urls** (Array)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **UnpackPreMultipliedAlpha** (Number: Boolean)
- **Caching** (Number: Boolean)
- **Asset In Patch** (Number: Boolean)

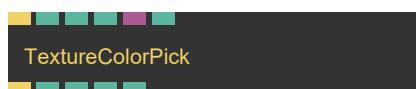
#### < Output

- **TextureArray** (Array)
- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)
- **Aspect Ratio** (Number)

**Example Patch:** cables.gl/edit/jFv097

**Doc:** cables.gl/op/Ops.Gl.TextureArrayLoaderFromArray\_v3

## 60.59 TextureColorPick



**Full Name:** Ops.Gl.TextureColorPick

get the color of a pixel in a texture.

#### > Inputs

- **Update** (Trigger)
- **X** (Number: Integer)
- **Y** (Number: Integer)
- **Texture** (Object:Texture)
- **Active** (Number: Boolean)

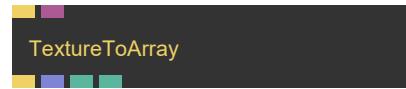
#### < Output

- **Trigger** (Trigger)
- **Red** (Number)
- **Green** (Number)
- **Blue** (Number)
- **Alpha** (Number)

**Example Patch:** cables.gl/edit/bzVSwn

**Doc:** cables.gl/op/Ops.Gl.TextureColorPick

## 60.60 TextureToArray\_v4



**Full Name:** Ops.Gl.TextureToArray\_v4

extract colors from a texture.

#### > Inputs

- **Update** (Trigger)
- **Texture** (Object)

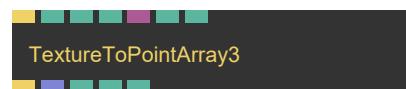
#### < Output

- **Trigger** (Trigger)
- **Colors** (Array)
- **Floating Point** (booleanNumber)
- **Num Pixel** (Number)

**Example Patch:** cables.gl/edit/uZkd3x

**Doc:** cables.gl/op/Ops.Gl.TextureToArray\_v4

## 60.61 TextureToPointArray3



**Full Name:** Ops.Gl.TextureToPointArray3

generate an array3 of grid positions from a texture.

#### > Inputs

- **Update** (Trigger)
- **Center** (Number: Boolean)
- **Threshold Remove** (Number)
- **Z Multiply** (Number)
- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)

#### < Output

- **Trigger** (Trigger)
- **Points** (Array)
- **Total Points** (Number)
- **Min Z** (Number)
- **Max Z** (Number)

**Example Patch:** cables.gl/edit/U8IO1k

**Doc:** cables.gl/op/Ops.Gl.TextureToPointArray3

## 60.62 TextureToRandomPoints

TextureToRandomPoints

**Full Name:** Ops.Gl.TextureToRandomPoints

Create points by sampling texture.

### > Inputs

- **Update** (Trigger)
- **Num Points** (Number: Integer)
- **Seed** (Number)
- **Z Position Index** (Number: Integer)
- **Z Multiply** (Number)
- **Texture** (Object)

### < Output

- **Trigger** (Trigger)
- **Points** (Array)
- **NumPoints** (Number)

**Example Patch:** cables.gl/edit/LAoKVJ

**Doc:** cables.gl/op/Ops.Gl.TextureToRandomPoints

## 60.63 TriggerOnCanvasResize

TriggerOnCanvasResize

**Full Name:** Ops.Gl.TriggerOnCanvasResize

will trigger when canvas was resized.

### > Inputs

- Visit *Ops.Gl.TriggerOnCanvasResize documentation* for input port details

### < Output

- **Resized** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.TriggerOnCanvasResize#example

**Doc:** cables.gl/op/Ops.Gl.TriggerOnCanvasResize

## 60.64 ValidTexture

ValidTexture

**Full Name:** Ops.Gl.ValidTexture

output current input texture or a default texture.

### > Inputs

- **Texture** (Object:Texture)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Gl.ValidTexture#example

**Doc:** cables.gl/op/Ops.Gl.ValidTexture

## 60.65 ViewPortSize

ViewPortSize

**Full Name:** Ops.Gl.ViewPortSize

Outputs current viewport size.

### > Inputs

- **Exec** (Trigger)

### < Output

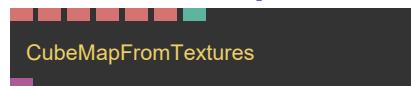
- **Next** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Width** (Number)
- **Height** (Number)

**Example Patch:** cables.gl/op/Ops.Gl.ViewPortSize#example

**Doc:** cables.gl/op/Ops.Gl.ViewPortSize

# 61 Ops.Gl.CubeMap

## 61.1 CubeMapFromTextures\_v2



**Full Name:** Ops.Gl.CubeMap.CubeMapFromTextures\_v2

generate a cubemap from 6 textures.

### > Inputs

- **Posx** (String)
- **Negx** (String)
- **Posy** (String)
- **Negy** (String)
- **Posz** (String)
- **Negz** (String)
- **Flip Y** (Number: Boolean)

### < Output

- **Cubemap** (Object)

**Example Patch:** cables.gl/edit/-QPF26

**Doc:** cables.gl/op/Ops.Gl.CubeMap.CubeMapFromTextures\_v2

## 61.2 CubeMapMaterial\_v2



**Full Name:** Ops.Gl.CubeMap.CubeMapMaterial\_v2

use a cubemap or equirectangular texture as a material.

### > Inputs

- **Render** (Trigger)
- **Cubemap** (Object)
- **Use Reflection** (Number: Boolean)
- **Blur** (Number)
- **Rotation** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Flip Z** (Number: Boolean)
- **Colorize** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/u5y0Z5

**Doc:** cables.gl/op/Ops.Gl.CubeMap.CubeMapMaterial\_v2

## 61.3 CubemapToEquirectangularTexture\_v2



**Full Name:** Ops.Gl.CubeMap.CubemapToEquirectangularTexture\_v2

visualize cubemap as folded texture or equirectangular texture.

### > Inputs

- **In Trigger** (Trigger)
- **Cubemap** (Object)
- **Projection Index** (Number: Integer)
- **Format Index** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

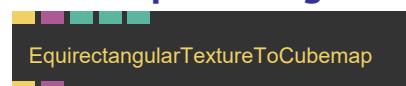
### < Output

- **Out Trigger** (Trigger)
- **Result** (Object)

**Example Patch:** cables.gl/edit/pNZHYa

**Doc:** cables.gl/op/Ops.Gl.CubeMap.CubemapToEquirectangularTexture\_v2

## 61.4 EquirectangularTextureToCubemap



**Full Name:** Ops.Gl.CubeMap.EquirectangularTextureToCubemap

convert an equirectangular map to a cubemap.

### > Inputs

- **Trigger In** (Trigger)
- **Equirectangular Map** (Object:Texture)
- **Cubemap Size Index** (Number: Integer)
- **Advanced** (Number: Boolean)
- **Filter Index** (Number: Integer)

### < Output

- **Trigger Out** (Trigger)
- **Cubemap Projection** (Object)

**Example Patch:** cables.gl/edit/O1NBYa

**Doc:** cables.gl/op/Ops.Gl.CubeMap.EquirectangularTextureToCubemap

## 61.5 RenderToCubemap\_v3

RenderToCubemap

**Full Name:** Ops.Gl.CubeMap.RenderToCubemap\_v3  
render a scene into a cubemap.

### > Inputs

- **Render** (Trigger)
- **Size Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)
- **MSAA Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Cubemap** (Object)

**Example Patch:** cables.gl/edit/Z3KuUQ

**Doc:** cables.gl/op/Ops.Gl.CubeMap.RenderToCubemap\_v3

## 61.6 Skybox

Skybox

**Full Name:** Ops.Gl.CubeMap.Skybox

render an equirectangular map or a cubemap as scene background.

### > Inputs

- **Trigger In** (Trigger)
- **Render** (Number: Boolean)
- **Skybox** (Object:Texture)
- **Rotate** (Number)
- **RGBe Format** (Number: Boolean)
- **Exposure** (Number)
- **Gamma** (Number)

### < Output

- **Trigger Out** (Trigger)

**Example Patch:** cables.gl/edit/40hoYa

**Doc:** cables.gl/op/Ops.Gl.CubeMap.Skybox

## 62 Ops.Gl.Geometry

### 62.1 BoundingBoxVisible

BoundingBoxVisible

**Full Name:** Ops.Gl.Geometry.BoundingBoxVisible

Test if a boundingbox could be visible in the current viewport.

### > Inputs

- **Exec** (Trigger)
- **Bindings** (Object)
- **Active** (Number: Boolean)
- **Draw** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Length** (Number)

### < Output

- **Next** (Trigger)
- **Visible** (booleanNumber)

**Example Patch:** cables.gl/edit/DAhGve

**Doc:** cables.gl/op/Ops.Gl.Geometry.BoundingBoxVisible

### 62.2 GeometryBoundingBox

GeometryBoundingBox

**Full Name:** Ops.Gl.Geometry.GeometryBoundingBox

Calculate a bounding box from a geometry.

### > Inputs

- **Geometry** (Object)

### < Output

- **Bindings** (Object)
- **Min X** (Number)
- **Min Y** (Number)
- **Min Z** (Number)
- **Max X** (Number)
- **Max Y** (Number)
- **Max Z** (Number)
- **MaxMin Points** (Array)

**Example Patch:** cables.gl/edit/DAhGve

**Doc:** cables.gl/op/Ops.Gl.Geometry.GeometryBoundingBox

# 63 Ops.Gl.GLTF

## 63.1 GltfAnimationArray



**Full Name:** Ops.Gl.GLTF.GltfAnimationArray

Convert an animation into an array of coordinates.

### > Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Steps** (Number: Integer)
- **Full Animation** (Number: Boolean)
- **Start** (Number)
- **Length** (Number)

### < Output

- **Next** (Trigger)
- **Found** (booleanNumber)
- **Positions** (Array)

**Example Patch:** cables.gl/edit/py-JK0

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfAnimationArray

## 63.2 GltfCameraViewMatrix



**Full Name:** Ops.Gl.GLTF.GltfCameraViewMatrix

get view matrix from a gltf camera.

### > Inputs

- **Update** (Trigger)
- **Node Name** (String)

### < Output

- **Matrix** (Array)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/klpdcl

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfCameraViewMatrix

## 63.3 GltfDracoCompression

### GltfDracoCompression

**Full Name:** Ops.Gl.GLTF.GltfDracoCompression  
gltf draco compression library.

### > Inputs

- Visit *Ops.Gl.GLTF.GltfDracoCompression documentation* for input port details

### < Output

- Visit *Ops.Gl.GLTF.GltfDracoCompression documentation* for output port details

**Example Patch:** cables.gl/edit/WFva2K

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfDracoCompression

## 63.4 GltfGeometry



**Full Name:** Ops.Gl.GLTF.GltfGeometry

expose geometry from gltf meshes, also possible to expose submaterial geometries.

### > Inputs

- **Update** (Trigger)
- **Name** (String)
- **Submesh** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Geometry** (Object)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/XKXmf6

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfGeometry

## 63.5 GltfHierarchy



**Full Name:** Ops.Gl.GLTF.GltfHierarchy

export array of positions from a hierarchy of a branch structure in a gltf, e.g. a skeleton bones.

### > Inputs

- **Trigger** (Trigger)
- **Node Name** (String)

#### < Output

- **Next** (Trigger)
- **Bones Lines** (Array)

**Example Patch:** [cables.gl/edit/3t\\_mJR](#)

**Doc:** [cables.gl/op/Ops.Gl.GLTF.GltfHierarchy](#)

## 63.6 GltfInfo



**Full Name:** Ops.Gl.GLTF.GltfInfo

output some infos about the current parent GLTF scene.

#### > Inputs

- **Exec** (Trigger)

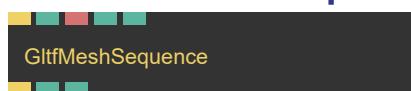
#### < Output

- **Num Nodes** (Number)
- **Num Cams** (Number)
- **FileUrl** (String)
- **FileName** (String)
- **Camera Names** (Array)

**Example Patch:** [cables.gl/edit/Z7tacy](#)

**Doc:** [cables.gl/op/Ops.Gl.GLTF.GltfInfo](#)

## 63.7 GltfMeshSequence\_v2



**Full Name:** Ops.Gl.GLTF.GltfMeshSequence\_v2

switch between meshes e.g. like a stop motion animation.

#### > Inputs

- **Render** (Trigger)
- **Index** (Number: Integer)
- **Node Name** (String)
- **Transformation** (Number: Boolean)
- **Ignore Material** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Found** (Number)
- **Current Index** (Number)

**Example Patch:** [cables.gl/edit/FiJsxn](#)

**Doc:** [cables.gl/op/Ops.Gl.GLTF.GltfMeshSequence\\_v2](#)

## 63.8 GltfMorphTargets



**Full Name:** Ops.Gl.GLTF.GltfMorphTargets

render weighted morph targets/shape keys from a gltf file.

#### > Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Scene Time** (Number: Boolean)
- **Time** (Number)
- **Submesh** (Number: Integer)
- **Target Weights** (Array)

#### < Output

- **Found Node** (booleanNumber)
- **Found Skin** (booleanNumber)
- **Target Names** (Array)
- **MorphTargets Tex** (Object)
- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/zon4xF](#)

**Doc:** [cables.gl/op/Ops.Gl.GLTF.GltfMorphTargets](#)

## 63.9 GltfNode\_v2



**Full Name:** Ops.Gl.GLTF.GltfNode\_v2

Control a single node from the GLTFscene op.

#### > Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Transformation** (Number: Boolean)
- **Draw Mesh** (Number: Boolean)
- **Draw Childs** (Number: Boolean)
- **Ignore Material** (Number: Boolean)
- **Use Scene Time** (Number: Boolean)
- **Time** (Number)

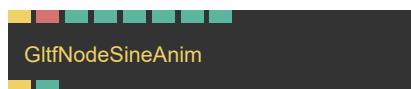
#### < Output

- **Next** (Trigger)
- **Geometry** (Object)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/op/Ops.Gl.GLTF.GltfNode\_v2#example

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfNode\_v2

## 63.10 GltfNodeSineAnim



**Full Name:** Ops.Gl.GLTF.GltfNodeSineAnim

sine animate gltf nodes by a filter.

### › Inputs

- **Update** (Trigger)
- **Filter** (String)
- **Time** (Number)
- **Offset** (Number)
- **Amplitude** (Number)
- **Axis X** (Number)
- **Axis Y** (Number)
- **Axis Z** (Number)

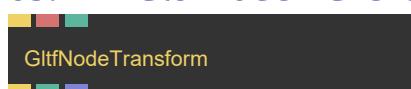
### ◀ Output

- **Next** (Trigger)
- **Found** (Number)

**Example Patch:** cables.gl/edit/w1SPcl

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfNodeSineAnim

## 63.11 GltfNodeTransform\_v2



**Full Name:** Ops.Gl.GLTF.GltfNodeTransform\_v2

Get the transform from the GLTFscene op.

### › Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Set Matrix** (Number: Boolean)

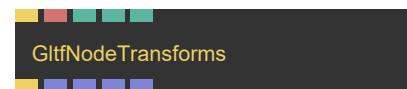
### ◀ Output

- **Next** (Trigger)
- **Found** (booleanNumber)
- **Matrix** (Array)

**Example Patch:** cables.gl/edit/yrOJve

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfNodeTransform\_v2

## 63.12 GltfNodeTransforms\_v3



**Full Name:** Ops.Gl.GLTF.GltfNodeTransforms\_v3

output all transformations of nodes starting with [search].

### › Inputs

- **Render** (Trigger)
- **Search** (String)
- **Order Index** (Number: Integer)
- **Space Index** (Number: Integer)
- **Time** (Number)

### ◀ Output

- **Next** (Trigger)
- **Positions** (Array)
- **Scale** (Array)
- **Rotation** (Array)
- **Names** (Array)

**Example Patch:** cables.gl/op/Ops.Gl.GLTF.GltfNodeTransforms\_v3#example

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfNodeTransforms\_v3

## 63.13 GltfScene\_v4



**Full Name:** Ops.Gl.GLTF.GltfScene\_v4

Load GLTF/GLB 3d files.

### › Inputs

- **Render** (Trigger)
- **Glb File** (String)
- **Draw** (Number: Boolean)
- **Camera Index** (Number: Integer)
- **Animation** (String)
- **Show Structure** (Trigger)
- **Rescale** (Number: Boolean)
- **Rescale Size** (Number)
- **Time** (Number)
- **Sync To Timeline** (Number: Boolean)
- **Loop** (Number: Boolean)

- **Materials** (Object)
- **Hide Nodes** (Array)
- **Use Material Properties** (Number: Boolean)
- **Active** (Number: Boolean)

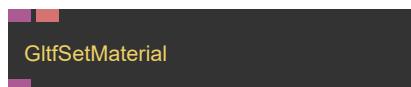
#### < Output

- **Render Before** (Trigger)
- **Next** (Trigger)
- **Generator** (String)
- **GLTF Version** (Number)
- **GLTF Extensions Used** (Array)
- **Anim Length** (Number)
- **Anim Time** (Number)
- **Json** (Object)
- **Anims** (Array)
- **BoundingPoints** (Array)
- **Bounds** (Object)
- **Finished** (Trigger)
- **Loading** (booleanNumber)

**Example Patch:** cables.gl/edit/XmL8GY

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfScene\_v4

## 63.14 GltfSetMaterial



**Full Name:** Ops.Gl.GLTF.GltfSetMaterial

Assigns a material to a node inside of the gltfScene op.

#### > Inputs

- **Shader** (Object:Shader)
- **Material Name** (String)

#### < Output

- **Material** (Object)

**Example Patch:** cables.gl/edit/Mk3Dv2

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfSetMaterial

## 63.15 GltfSkin



**Full Name:** Ops.Gl.GLTF.GltfSkin

render a skinned mesh (bone/rigging/rigged animation).

#### > Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Scene Time** (Number: Boolean)
- **Time** (Number)
- **Blend Anims** (Array)

#### < Output

- **Found Node** (booleanNumber)
- **Found Skin** (booleanNumber)
- **Next** (Trigger)

**Example Patch:** cables.gl/edit/TWBC-N

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfSkin

## 63.16 GltfTexture



**Full Name:** Ops.Gl.GLTF.GltfTexture

Load textures from inside a .glb file.

#### > Inputs

- **Render** (Trigger)
- **Name** (String)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Anisotropic Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **Pre Multiplied Alpha** (Number: Boolean)

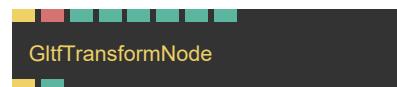
#### < Output

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **Type** (String)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/PBGKve

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfTexture

## 63.17 GltfTransformNode



**Full Name:** Ops.Gl.GLTF.GltfTransformNode

set transformation of a gltf node.

#### > Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)

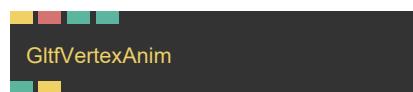
#### < Output

- **Next** (Trigger)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/op/Ops.Gl.GLTF.GltfTransformNode#example

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfTransformNode

## 63.18 GltfVertexAnim



**Full Name:** Ops.Gl.GLTF.GltfVertexAnim

play gltf vertex anim directly with its own timing.

#### > Inputs

- **Render** (Trigger)
- **Node Name** (String)
- **Scene Time** (Number: Boolean)
- **Time** (Number)

#### < Output

- **Found Node** (Number)
- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.GLTF.GltfVertexAnim#example

**Doc:** cables.gl/op/Ops.Gl.GLTF.GltfVertexAnim

## 64 Ops.Gl.ImageCompose

### 64.1 Alpha



**Full Name:** Ops.Gl.ImageCompose.Alpha

Modify current alpha-opacity.

#### > Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Clamp** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/y6f1ei

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Alpha

### 64.2 AlphaMask\_v2



**Full Name:** Ops.Gl.ImageCompose.AlphaMask\_v2

Set alphachannel of current imagecompose via a texture mask.

#### > Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Invert** (Number: Boolean)
- **Image** (Object:Texture)
- **Method Index** (Number: Integer)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.ImageCompose.AlphaMask\_v2#example

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.AlphaMask\_v2

### 64.3 BarrelDistortion\_v3



**Full Name:** Ops.Gl.ImageCompose.BarrelDistortion\_v3

Simulate fisheye effect.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Intensity** (Number)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/qIOrS-

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.BarrelDistortion\_v3

## 64.4 Blur



**Full Name:** Ops.Gl.ImageCompose.Blur

Blur the pixels of an image.

**> Inputs**

- **Render** (Trigger)
- **Amount** (Number)
- **Direction Index** (Number: Integer)
- **Direction** (String)
- **Fast** (Number: Boolean)
- **Mask** (Object:Texture)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/1T9f7g

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Blur

## 64.5 Border\_v2



**Full Name:** Ops.Gl.ImageCompose.Border\_v2

Draws a Border (rectangular frame) around the current ImageCompose.

**> Inputs**

- **Render** (Trigger)
- **Width** (Number)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Smooth** (Number: Boolean)
- **R** (Number)

- **G** (Number)
- **B** (Number)
- **Side A** (Number)
- **Side B** (Number)
- **Side C** (Number)
- **Side D** (Number)

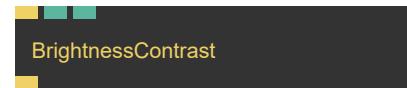
**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/ctPnT6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Border\_v2

## 64.6 BrightnessContrast



**Full Name:** Ops.Gl.ImageCompose.BrightnessContrast

adjust image brightness and contrast.

**> Inputs**

- **Render** (Trigger)
- **Contrast** (Number)
- **Brightness** (Number)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/8p4mT6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.BrightnessContrast

## 64.7 BulgePinch



**Full Name:** Ops.Gl.ImageCompose.BulgePinch

bulge and pinch an image (deform,stretch,distort).

**> Inputs**

- **Render** (Trigger)
- **Radius** (Number)
- **Strength** (Number)
- **Center X** (Number)
- **Center Y** (Number)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/2lC9W6

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.BulgePinch](#)

## 64.8 CheckerBoard\_v2

CheckerBoard

**Full Name:** Ops.Gl.ImageCompose.CheckerBoard\_v2

Draw a checkerboard pattern.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Square** (Number: Boolean)
- **Num X** (Number)
- **Num Y** (Number)
- **Rotate** (Number)
- **Centered** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/J4KL\\_4](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.CheckerBoard\\_v2](#)

## 64.9 ChromaticAberration\_v2

ChromaticAberration

**Full Name:** Ops.Gl.ImageCompose.CromaticAberration\_v2

simulating lens effect by shifting rgb channels.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Pixel** (Number)
- **Lens Distort** (Number)
- **Smooth** (Number: Boolean)
- **Mask** (Object:Texture)

### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/X0WkT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.CromaticAberration\\_v2](#)

## 64.10 CircleTexture\_v4

CircleTexture

**Full Name:** Ops.Gl.ImageCompose.CircleTexture\_v4

Draw 2d circle into texture.

### > Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Size** (Number)
- **Inner** (Number)
- **Stretch X** (Number)
- **Stretch Y** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Falloff Index** (Number: Integer)
- **Fade Out** (Number)
- **Warn Overflow** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/asslT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.CircleTexture\\_v4](#)

## 64.11 ClampTexture\_v2

ClampTexture

**Full Name:** Ops.Gl.ImageCompose.ClampTexture\_v2

Clamps a texture to min and max values - Also has remap modes.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Mode Index** (Number: Integer)
- **R** (Number: Boolean)
- **R Min** (Number)

- **R Max** (Number)
- **G** (Number: Boolean)
- **G Min** (Number)
- **G Max** (Number)
- **B** (Number: Boolean)
- **B Min** (Number)
- **B Max** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/eYNP7-](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ClampTexture\\_v2](#)

## 64.12 Clarity



**Full Name:** Ops.Gl.ImageCompose.Clarity

Increase contrast in midtones.

#### > Inputs

- **Render** (Trigger)
- **Amount** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.ImageCompose.Clarity#example](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Clarity](#)

## 64.13 Color\_v2



**Full Name:** Ops.Gl.ImageCompose.Color\_v2

fill image using a color (overlay).

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Mask** (Object:Texture)
- **Mask Invert** (Number: Boolean)
- **R** (Number)
- **G** (Number)

- **B** (Number)
- **A** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/AnqmT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Color\\_v2](#)

## 64.14 ColorBalance\_v2



**Full Name:** Ops.Gl.ImageCompose.ColorBalance\_v2

change intensity of r,g,b channels.

#### > Inputs

- **Render** (Trigger)
- **Tone Index** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/FGVncy](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ColorBalance\\_v2](#)

## 64.15 ColorChannel\_v2



**Full Name:** Ops.Gl.ImageCompose.ColorChannel\_v2

enable disable RGB color channels.

#### > Inputs

- **Render** (Trigger)
- **ChannelR** (Number: Boolean)
- **ChannelG** (Number: Boolean)
- **ChannelB** (Number: Boolean)
- **ChannelA** (Number: Boolean)
- **Mono** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.ImageCompose.ColorChannel\\_v2#example](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ColorChannel\\_v2](#)

## 64.16 ColorMap\_v2

ColorMap

**Full Name:** Ops.Gl.ImageCompose.ColorMap\_v2  
colorize a black and white image using a gradient texture.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Gradient** (Object:Texture)
- **Method Index** (Number: Integer)
- **Min** (Number)
- **Max** (Number)
- **Position** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/E7Dou7

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.ColorMap\_v2

## 64.17 Denoise

Denoise

**Full Name:** Ops.Gl.ImageCompose.Denoise

Denoise texture effect - used to smooth out noisy images.

### > Inputs

- **Render** (Trigger)
- **Exponent** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/4vWud8

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Denoise

## 64.18 DepthTexture\_v2

DepthTexture

**Full Name:** Ops.Gl.ImageCompose.DepthTexture\_v2  
draw the content of a depth texture.

### > Inputs

- **Render** (Trigger)
- **Image** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Farplane** (Number)
- **Nearplane** (Number)
- **Invert** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/tmLbW6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.DepthTexture\_v2

## 64.19 DepthTextureFocus\_v2

DepthTextureFocus

**Full Name:** Ops.Gl.ImageCompose.DepthTextureFocus\_v2

draws a gradient from white to black back to white over distance of the scene.

### > Inputs

- **Render** (Trigger)
- **Depth Texture** (Object)
- **Focus** (Number)
- **focus distance** (in world space)
- **Width** (Number)
- **width of the focus** (in world space)
- **Invert** (Number: Boolean)
- **Nearplane** (Number)
- **Farplane** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/6Z8zJm

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.DepthTextureFocus\_v2

## 64.20 Desaturate

Desaturate

**Full Name:** Ops.Gl.ImageCompose.Desaturate

Remove colors from image / greyscale.

### > Inputs

- **Render** (Trigger)

- **Amount** (Number)
- **Mask** (Object)
- **Invert Mask** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/g1kmT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Desaturate](#)

## 64.21 Dither\_v2



**Full Name:** Ops.Gl.ImageCompose.Dither\_v2

convert color to black and white patterns.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Threshold** (Number)
- **Strength** (Number)
- **Mask** (Object:Texture)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/eECnT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Dither\\_v2](#)

## 64.22 DrawImage\_v3



**Full Name:** Ops.Gl.ImageCompose.DrawImage\_v3

Draws an image into a composition.

#### > Inputs

- **Render** (Trigger)
- **BlendMode Index** (Number: Integer)
- **Amount** (Number)
- **Image** (Object:Texture)
- **Premultiplied** (Number: Boolean)
- **Alpha Mask** (Number: Boolean)
- **RemoveAlphaSrc** (Number: Boolean)
- **Mask** (Object:Texture)

- **Mask Src Index** (Number: Integer)
- **Invert Alpha Channel** (Number: Boolean)
- **Aspect Ratio** (Number: Boolean)
- **Stretch Axis Index** (Number: Integer)
- **Position** (Number)
- **Crop** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Transform** (Number: Boolean)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Position X** (Number)
- **Position Y** (Number)
- **Rotation** (Number)
- **Clip Repeat** (Number: Boolean)

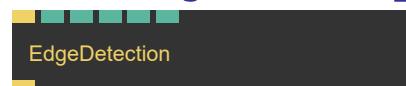
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/k6ttde](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.DrawImage\\_v3](#)

## 64.23 EdgeDetection\_v4



**Full Name:** Ops.Gl.ImageCompose.EdgeDetection\_v4

Draw only the edges of an image.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Strength** (Number)
- **Width** (Number)
- **Mul Color** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/dK8td8](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.EdgeDetection\\_v4](#)

## 64.24 Emboss

Emboss

**Full Name:** Ops.Gl.ImageCompose.Emboss

Emboss / bevel effect.

### > Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Clear** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/xsRcay

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Emboss

## 64.25 FastBlur\_v2

FastBlur

**Full Name:** Ops.Gl.ImageCompose.FastBlur\_v2

Blurs a texture - simple and fast.

### > Inputs

- **Render** (Trigger)
- **Passes** (Number: Integer)
- **Clamp** (Number: Boolean)
- **Direction Index** (Number: Integer)
- **Mask** (Object:Texture)
- **Mask Invert** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/wl2T7i

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.FastBlur\_v2

## 64.26 Flip

Flip

**Full Name:** Ops.Gl.ImageCompose.Flip

flip the image on x or y axis.

### > Inputs

- **Render** (Trigger)

- **X** (Number: Boolean)
- **Y** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/179Jjr

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Flip

## 64.27 Float32ToRgbeTexture

Float32ToRgbeTexture

**Full Name:** Ops.Gl.ImageCompose.Float32ToRgbeTexture

Convert a Float32 bit/HDR texture to RGBE format (only positive numbers).

### > Inputs

- **Render** (Trigger)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/dXLhW2

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Float32ToRgbeTexture

## 64.28 Fog\_v4

Fog

**Full Name:** Ops.Gl.ImageCompose.Fog\_v4

add post processing fog (nebula) to a scene.

### > Inputs

- **Render** (Trigger)
- **BlendMode Index** (Number: Integer)
- **Amount** (Number)
- **Depth Texture** (Object:Texture)
- **Gradient Texture** (Object:Texture)
- **Background Texture** (Object:Texture)
- **Fog Start** (Number)
- **Fog End** (Number)
- **Fog Density** (Number)
- **Ignore Infinity** (Number: Boolean)
- **Nearplane** (Number)
- **Farplane** (Number)
- **Fog R** (Number)
- **Fog G** (Number)

- **Fog B** (Number)
- **Fog A** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/l6pZnO](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Fog\\_v4](#)

## 64.29 FXAA



**Full Name:** Ops.Gl.ImageCompose.FXAA

post processing antialiasing.

#### ▶ Inputs

- **Render** (Trigger)
- **Span Index** (Number: Integer)
- **ReduceMin** (Number)
- **ReduceMul** (Number)
- **Use Viewport Size** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)

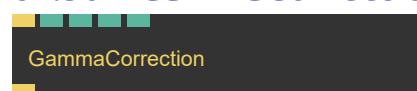
#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/c5uYnO](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.FXAA](#)

## 64.30 GammaCorrection\_v2



**Full Name:** Ops.Gl.ImageCompose.GammaCorrection\_v2

Allows for Gamma correction of a texture.

#### ▶ Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Multiply Texture** (Number)
- **Gamma Correction** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/WugPbx](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.GammaCorrection\\_v2](#)

## 64.31 Gradient\_v2



**Full Name:** Ops.Gl.ImageCompose.Gradient\_v2

Draws a simple gradient between three colors.

#### ▶ Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Width** (Number)
- **Type Index** (Number: Integer)
- **Pos** (Number)
- **Smoothstep** (Number: Boolean)
- **SRGB** (Number: Boolean)
- **Color Space Index** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **R2** (Number)
- **G2** (Number)
- **B2** (Number)
- **R3** (Number)
- **G3** (Number)
- **B3** (Number)
- **Randomize** (Trigger)

#### ◀ Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/dlSpQ6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Gradient\\_v2](#)

## 64.32 GridTexture\_v2



**Full Name:** Ops.Gl.ImageCompose.GridTexture\_v2

Creates a grid texture.

#### ▶ Inputs

- **Render** (Trigger)

- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Line Thickness X** (Number)
- **Line Thickness Y** (Number)
- **Cells X** (Number)
- **Cells Y** (Number)
- **Rotate** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Invert Color** (Number: Boolean)
- **Line Red** (Number)
- **Line Green** (Number)
- **Line Blue** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/pG\\_qUH](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.GridTexture\\_v2](#)

## 64.33 GrowPixels\_v2



**Full Name:** Ops.Gl.ImageCompose.GrowPixels\_v2

Make one pixel lines thicker via postprocessing.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Strength** (Number)
- **Iterations** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/3WSXCU](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.GrowPixels\\_v2](#)

## 64.34 Hue



**Full Name:** Ops.Gl.ImageCompose.Hue

Adjust Hue of current ImageCompose.

#### > Inputs

- **Render** (Trigger)
- **Hue** (Number)
- **Mask** (Object:Texture)
- **Offset** (Object:Texture)

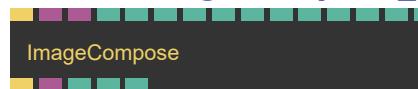
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/kubmT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Hue](#)

## 64.35 ImageCompose\_v4



**Full Name:** Ops.Gl.ImageCompose.ImageCompose\_v4

Compose Images and effects as layers to generate new Images.

#### > Inputs

- **Render** (Trigger)
- **Base Texture** (Object:Texture)
- **UV Texture** (Object:Texture)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)
- **Clear** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

#### < Output

- **Next** (Trigger)
- **Texture\_out** (Object)
- **Aspect Ratio** (Number)
- **Texture Width** (Number)
- **Texture Height** (Number)

**Example Patch:** [cables.gl/edit/dNv2r1](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ImageCompose\\_v4](#)

## 64.36 ImageComposeAspectRatio

ImageComposeAspectRatio

**Full Name:** Ops.Gl.ImageCompose.ImageComposeAspectRatio

Adjust aspect ratio of an image compose branch.

### > Inputs

- **Update** (Trigger)
- **Aspect** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/iwX7v4](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ImageComposeAspectRatio](#)

## 64.37 ImageComposeSnapshot

ImageComposeSnapshot

**Full Name:** Ops.Gl.ImageCompose.ImageComposeSnapshot

capture the current state of an imageCompose branch by copying the texture.

### > Inputs

- **Update** (Trigger)

### < Output

- **Trigger** (Trigger)
- **Texture** (Object)

**Example Patch:** [cables.gl/edit/Dc1a-W](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ImageComposeSnapshot](#)

## 64.38 Interlace

Interlace

**Full Name:** Ops.Gl.ImageCompose.Interlace

Tv scanlines effect.

### > Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Lumi Scale** (Number)
- **X Or Y** (Number: Boolean)

- **Line Size** (Number)
- **Displacement** (Number)
- **Add** (Number)
- **Scroll** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/MCpnT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Interlace](#)

## 64.39 Invert\_v2

Invert

**Full Name:** Ops.Gl.ImageCompose.Invert\_v2

Invert image colors.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Mask Invert** (Number: Boolean)
- **Mask** (Object:Texture)
- **Invert R** (Number: Boolean)
- **Invert G** (Number: Boolean)
- **Invert B** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/Ld3nT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Invert\\_v2](#)

## 64.40 Kaleidoscope\_v2

Kaleidoscope

**Full Name:** Ops.Gl.ImageCompose.Kaleidoscope\_v2

Kaleidoscope effect.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Sides** (Number)
- **Angle** (Number)

- **Slide X** (Number)
- **Slide Y** (Number)
- **Center X** (Number)
- **Center Y** (Number)
- **Aspect Ratio** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/n4DaW6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Kaleidoscope\_v2

## 64.41 LensDirt\_v2



**Full Name:** Ops.Gl.ImageCompose.LensDirt\_v2

Creates a lens dirt like texture.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Zoom** (Number)
- **Iterations** (Number: Integer)
- **Seed** (Number: Integer)
- **Spot Edge** (Number)
- **Gamma** (Number)

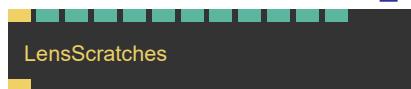
#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/vwgWMX

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.LensDirt\_v2

## 64.42 LensScratches\_v2



**Full Name:** Ops.Gl.ImageCompose.LensScratches\_v2

Creates a procedural texture simulating scratches on a lens.

#### > Inputs

- **Render** (Trigger)

- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Wavyness** (Number)
- **Scale** (Number)
- **Layers** (Number: Integer)
- **AA Iterations** (Number)
- **Frequency** (Number)
- **Frequency Step Size** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/ucr5NX

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.LensScratches\_v2

## 64.43 Levels\_v2



**Full Name:** Ops.Gl.ImageCompose.Levels\_v2

adjust levels to correct the tonal range of an image.

#### > Inputs

- **Render** (Trigger)
- **In Min** (Number)
- **Midpoint** (Number)
- **In Max** (Number)
- **Out Min** (Number)
- **Out Max** (Number)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/F8M9W6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Levels\_v2

## 64.44 LumaKey\_v3



**Full Name:** Ops.Gl.ImageCompose.LumaKey\_v3

Remove darkest or brightest parts of the image.

#### > Inputs

- **Render** (Trigger)
- **Invert** (Number: Boolean)
- **Black White** (Number: Boolean)
- **Remove Alpha** (Number: Boolean)
- **Remap** (Number: Boolean)
- **Threshold Low** (Number)
- **Threshold High** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/ukO5qe](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.LumaKey\\_v3](#)

## 64.45 LUTMap



**Full Name:** Ops.Gl.ImageCompose.LUTMap

apply color filter/effects by using a lookup texture.

#### > Inputs

- **Render** (Trigger)
- **LUT Image** (Object:Texture)
- **Amount** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/2\\_nZX7](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.LUTMap](#)

## 64.46 Mirror



**Full Name:** Ops.Gl.ImageCompose.Mirror

mirroring image effect.

#### > Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Width** (Number)
- **Offset** (Number)
- **Flip** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/MVFoT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Mirror](#)

## 64.47 Mix



**Full Name:** Ops.Gl.ImageCompose.Mix

simple mix/fade of two input images.

#### > Inputs

- **Render** (Trigger)
- **Texture 1** (Object:Texture)
- **Fade** (Number)
- **Texture 2** (Object:Texture)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/CDaQK2](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Mix](#)

## 64.48 MultiDrawImage



**Full Name:** Ops.Gl.ImageCompose.MultiDrawImage

draw multiple images at once.

#### > Inputs

- **Render** (Trigger)
- **Mask Invert** (Number: Boolean)
- **Texture 1** (Object:Texture)
- **Blendmode 1 Index** (Number: Integer)
- **Mask 1** (Object:Texture)
- **Mask Source 1 Index** (Number: Integer)
- **Opacity 1 Index** (Number: Integer)
- **Amount 1** (Number)
- **Texture 2** (Object:Texture)
- **Blendmode 2 Index** (Number: Integer)
- **Mask 2** (Object:Texture)
- **Mask Source 2 Index** (Number: Integer)
- **Opacity 2 Index** (Number: Integer)
- **Amount 2** (Number)
- **Texture 3** (Object:Texture)
- **Blendmode 3 Index** (Number: Integer)

- **Mask 3** (Object:Texture)
- **Mask Source 3 Index** (Number: Integer)
- **Opacity 3 Index** (Number: Integer)
- **Amount 3** (Number)
- **Texture 4** (Object:Texture)
- **Blendmode 4 Index** (Number: Integer)
- **Mask 4** (Object:Texture)
- **Mask Source 4 Index** (Number: Integer)
- **Opacity 4 Index** (Number: Integer)
- **Amount 4** (Number)
- **Texture 5** (Object:Texture)
- **Blendmode 5 Index** (Number: Integer)
- **Mask 5** (Object:Texture)
- **Mask Source 5 Index** (Number: Integer)
- **Opacity 5 Index** (Number: Integer)
- **Amount 5** (Number)
- **Texture 6** (Object:Texture)
- **Blendmode 6 Index** (Number: Integer)
- **Mask 6** (Object:Texture)
- **Mask Source 6 Index** (Number: Integer)
- **Opacity 6 Index** (Number: Integer)
- **Amount 6** (Number)
- **Texture 7** (Object:Texture)
- **Blendmode 7 Index** (Number: Integer)
- **Mask 7** (Object:Texture)
- **Mask Source 7 Index** (Number: Integer)
- **Opacity 7 Index** (Number: Integer)
- **Amount 7** (Number)
- **Texture 8** (Object:Texture)
- **Blendmode 8 Index** (Number: Integer)
- **Mask 8** (Object:Texture)
- **Mask Source 8 Index** (Number: Integer)
- **Opacity 8 Index** (Number: Integer)
- **Amount 8** (Number)

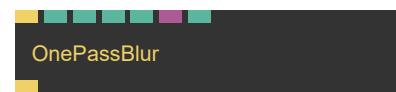
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/dr8EeE](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.MultiDrawImage](#)

## 64.49 OnePassBlur



**Full Name:** Ops.Gl.ImageCompose.OnePassBlur

*Visit documentation for details.*

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Radius** (Number)
- **Mask** (Object:Texture)
- **Mask Invert** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/xHp9eG](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.OnePassBlur](#)

## 64.50 PatternLookup



**Full Name:** Ops.Gl.ImageCompose.PatternLookup

map a pattern to value levels of your texture.

#### > Inputs

- **Render** (Trigger)
- **Multiplier** (Object)
- **Blend Mode** (Number: String)
- **Amount** (Number)
- **Width** (Number)
- **Height** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/lj31ZO](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.PatternLookup](#)

## 64.51 Pixelate\_v2



**Full Name:** Ops.Gl.ImageCompose.Pixelate\_v2

Pixelate an image.

#### ► Inputs

- **Render** (Trigger)
- **Multiplier** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Width** (Number)
- **Height** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/1w\\_9W6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Pixelate\\_v2](#)

## 64.52 PixelColor



**Full Name:** Ops.Gl.ImageCompose.PixelColor

fill image with one color picked at a position.

#### ► Inputs

- **Render** (Trigger)
- **Source Texture** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/qbilbk](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.PixelColor](#)

## 64.53 PixelDifference



**Full Name:** Ops.Gl.ImageCompose.PixelDifference

visualize the difference of neighbouring pixels (slope).

#### ► Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Step** (Number)

- **Red Index** (Number: Integer)
- **Red Flip** (Number: Boolean)
- **Green Index** (Number: Integer)
- **Green Flip** (Number: Boolean)
- **Blue Index** (Number: Integer)
- **Blue Flip** (Number: Boolean)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/LEMBZ4](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.PixelDifference](#)

## 64.54 PixelDisplacement\_v4



**Full Name:** Ops.Gl.ImageCompose.PixelDisplacement\_v4

Changes color lookup for every pixel using a displacement map.

#### ► Inputs

- **Render** (Trigger)
- **DisplaceTex** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Amount X** (Number)
- **Amount Y** (Number)
- **Input Index** (Number: Integer)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/Qxb9W6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.PixelDisplacement\\_v4](#)

## 64.55 Plasma\_v2



**Full Name:** Ops.Gl.ImageCompose.Plasma\_v2

Renders a plasma effect.

#### ► Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)

- **Width** (Number)
- **Height** (Number)
- **Aspect** (Number: Boolean)
- **Mul** (Number)
- **X** (Number)
- **Y** (Number)
- **Time** (Number)
- **Greyscale** (Number: Boolean)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Time Index** (Number: Integer)
- **Mask** (Object:Texture)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/dD6aW6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Plasma\\_v2](#)

## 64.56 PolarCoords



**Full Name:** Ops.Gl.ImageCompose.PolarCoords

display texture using polar/radial coordinate system.

#### > Inputs

- **Render** (Trigger)
- **Radius Inner** (Number)
- **Radius Outer** (Number)
- **Crop** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/cM2nB2](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.PolarCoords](#)

## 64.57 Posterize\_v2



**Full Name:** Ops.Gl.ImageCompose.Posterize\_v2

reduce number of colors.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Levels** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/\\_MMoT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Posterize\\_v2](#)

## 64.58 PseudoLensFlares



**Full Name:** Ops.Gl.ImageCompose.PseudoLensFlares

simulate lens flare effect.

#### > Inputs

- **Render** (Trigger)
- **Ghosts** (Number)
- **Num Ghosts** (Number: Integer)
- **Dispersal** (Number)
- **Halo** (Number)
- **Halo Width** (Number)
- **Color Lookup** (Object)

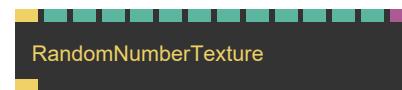
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/P8heur](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.PseudoLensFlares](#)

## 64.59 RandomNumberTexture



**Full Name:** Ops.Gl.ImageCompose.RandomNumberTexture

Set random numbers into an imagecompose.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Seed** (Number)
- **Min R** (Number)

- **Max R** (Number)
- **Min G** (Number)
- **Max G** (Number)
- **Min B** (Number)
- **Max B** (Number)
- **Min A** (Number)
- **Max A** (Number)
- **Multiply** (Object:Texture)

**< Output**

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/j\\_I1TG](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.RandomNumberTexture](#)

## 64.60 RectangleTexture\_v5



**Full Name:** Ops.Gl.ImageCompose.RectangleTexture\_v5

draws a 2d rectangle into a texture.

**> Inputs**

- **Render** (Trigger)
- **Amount** (Number)
- **Blend Mode Index** (Number: Integer)
- **Center** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Inner** (Number)
- **Width** (Number)
- **Height** (Number)
- **Rotate** (Number)
- **Roundness** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Map Texture** (Object:Texture)
- **Start X** (Number)
- **Start Y** (Number)
- **Map Width** (Number)
- **Map Height** (Number)
- **Mask** (Object:Texture)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/IPPT7i](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.RectangleTexture\\_v5](#)

## 64.61 RemoveAlpha



**Full Name:** Ops.Gl.ImageCompose.RemoveAlpha

Remove alpha information from image.

**> Inputs**

- **Render** (Trigger)

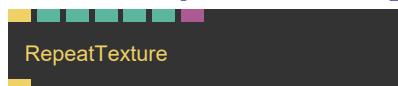
**< Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.ImageCompose.RemoveAlpha#example](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.RemoveAlpha](#)

## 64.62 RepeatTexture\_v2



**Full Name:** Ops.Gl.ImageCompose.RepeatTexture\_v2

Visit documentation for details.

**> Inputs**

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **X** (Number)
- **Y** (Number)
- **Clear** (Number: Boolean)
- **Multiply** (Object:Texture)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/S6JnT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.RepeatTexture\\_v2](#)

## 64.63 RgbMultiply



**Full Name:** Ops.Gl.ImageCompose.RgbMultiply  
multiply image colors by color channel.

**> Inputs**

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/3l\_8W6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.RgbMultiply

## 64.64 RGBOffset\_v2



**Full Name:** Ops.Gl.ImageCompose.RGBOffset\_v2  
Offsets the xy components of an RGB texture.

**> Inputs**

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Red Offset X** (Number)
- **Red Offset Y** (Number)
- **Red Amount** (Number)
- **amount of red** (fade, hide, show)
- **Green Offset X** (Number)
- **Green Offset Y** (Number)
- **Green Amount** (Number)
- **amount of green** (fade, hide, show)
- **Blue Offset X** (Number)
- **Blue Offset Y** (Number)
- **Blue Amount** (Number)
- **amount of blue** (fade, hide, show)

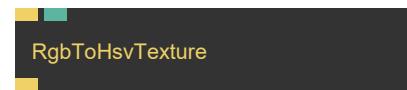
**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/pzC9rn

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.RGBOffset\_v2

## 64.65 RgbToHsvTexture



**Full Name:** Ops.Gl.ImageCompose.RgbToHsvTexture

Convert a RGB Texture to Hue/Saturation/Lightness values as RGB colors.

**> Inputs**

- **Render** (Trigger)
- **Output RGB Index** (Number: Integer)

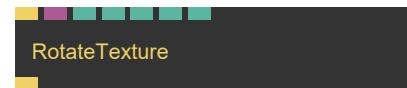
**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/V7z4v4

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.RgbToHsvTexture

## 64.66 RotateTexture\_v2



**Full Name:** Ops.Gl.ImageCompose.RotateTexture\_v2

Rotates a texture.

**> Inputs**

- **Render** (Trigger)
- **Multiplier** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Rotate** (Number)
- **Crop** (Number: Boolean)
- **Clear** (Number: Boolean)

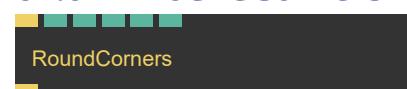
**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/fIURFr

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.RotateTexture\_v2

## 64.67 RoundCorners



**Full Name:** Ops.Gl.ImageCompose.RoundCorners

Draw round corners around image (border).

**> Inputs**

- **Render** (Trigger)

- **Radius** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

#### ◀ Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/iYLMj5](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.RoundCorners](#)

## 64.68 ScaleTexture\_v3



**Full Name:** Ops.Gl.ImageCompose.ScaleTexture\_v3

Scales a texture.

#### ▶ Inputs

- **Render** (Trigger)
- **Multiplier** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Center X** (Number)
- **Center Y** (Number)
- **Clear** (Number: Boolean)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/kj\\_Zbx](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ScaleTexture\\_v3](#)

## 64.69 ScrollTexture



**Full Name:** Ops.Gl.ImageCompose.ScrollTexture

Visit documentation for details.

#### ▶ Inputs

- **Render** (Trigger)

- **AmountX** (Number)
- **AmountY** (Number)
- **Mask** (Object:Texture)
- **Repeat** (Number: Boolean)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/DutaW6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.ScrollTexture](#)

## 64.70 Shapes2d\_v2



**Full Name:** Ops.Gl.ImageCompose.Shapes2d\_v2

Generates different 2d shapes to use as a texture.

#### ▶ Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Shape Index** (Number: Integer)
- **Mirror X** (Number: Boolean)
- **Mirror Y** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **FillShape** (Number: Boolean)
- **Line Thickness** (Number)
- **Invert Color** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Rotate** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/XBGbPO](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Shapes2d\\_v2](#)

## 64.71 Sharpen

Sharpen

**Full Name:** Ops.Gl.ImageCompose.Sharpen

Adjust image sharpness.

### > Inputs

- **Render** (Trigger)
- **Amount** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/Q6uJjr

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Sharpen

## 64.72 SkewStretchImage\_v2

SkewStretchImage

**Full Name:** Ops.Gl.ImageCompose.SkewStretchImage\_v2

skew / stretch an image by rendering scaled sides.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Clamp** (Number: Boolean)
- **Stretch Top** (Number)
- **Stretch Bottom** (Number)
- **Stretch Left** (Number)
- **Stretch Right** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/M2UA7k

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.SkewStretchImage\_v2

## 64.73 Stripes\_v4

Stripes

**Full Name:** Ops.Gl.ImageCompose.Stripes\_v4

Create a texture of stripes /lines.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Num** (Number)
- **Width** (Number)
- **Rotate** (Number)
- **Offset** (Number)
- **Gradients** (Number: Boolean)
- **Circular** (Number: Boolean)
- **Invert** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/dYhlT6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Stripes\_v4

## 64.74 TexMathModulo

TexMathModulo

**Full Name:** Ops.Gl.ImageCompose.TexMathModulo

modulo pixel color values.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Mask Invert** (Number: Boolean)
- **Mask** (Object:Texture)
- **Amount** (Number)
- **Modulo** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/FOpoxm

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.TexMathModulo

## 64.75 TextureDifference

TextureDifference

**Full Name:** Ops.Gl.ImageCompose.TextureDifference  
render the difference of two textures.

### > Inputs

- **Render** (Trigger)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/zCDlTi

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.TextureDifference

## 64.76 ToNormalMap\_v2

ToNormalMap

**Full Name:** Ops.Gl.ImageCompose.ToNormalMap\_v2

Convert a black and white map to a normal map.

### > Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Step Multiplier** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/L62oT6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.ToNormalMap\_v2

## 64.77 Twirl\_v4

Twirl

**Full Name:** Ops.Gl.ImageCompose.Twirl\_v4

Creates a twirl/swirl/spiral effect in a texture.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Twist Amount** (Number)

- **Radius** (Number)
- **Center X** (Number)
- **Center Y** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/2\_pmJ5

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Twirl\_v4

## 64.78 Vibrance

Vibrance

**Full Name:** Ops.Gl.ImageCompose.Vibrance

adjust vibrance/saturation.

### > Inputs

- **Render** (Trigger)
- **Amount** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/52iaW6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Vibrance

## 64.79 Vignette\_v3

Vignette

**Full Name:** Ops.Gl.ImageCompose.Vignette\_v3

Simulating an old camera effect of fading away the edges of the image.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Strength** (Number)
- **Radius** (Number)
- **Sharp** (Number)
- **Aspect** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Alpha** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/WDPlT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Vignette\\_v3](#)

## 64.80 Waveform\_v3



**Full Name:** Ops.Gl.ImageCompose.Waveform\_v3

Generates 4 different waveform textures. Sine, sawtooth, Triangle, Square.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Waveform Index** (Number: Integer)
- **Amplitude** (Number)
- **Frequency** (Number)
- **Line Width** (Number)
- **Line Glow** (Number)
- **Invert Color** (Number: Boolean)
- **Solid Fill** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Rotate** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)

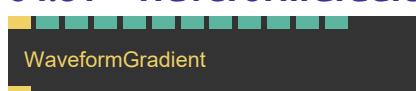
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/9aF\\_26](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Waveform\\_v3](#)

## 64.81 WaveformGradient\_v4



**Full Name:** Ops.Gl.ImageCompose.WaveformGradient\_v4

Generate different texture waveforms. Sine, sawtooth and triangle.

#### > Inputs

- **Render** (Trigger)

- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Mode Index** (Number: Integer)
- **Frequency** (Number)
- **Pow Factor** (Number)
- **Offset** (Number)
- **Rotate** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/Hfw7yu](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.WaveformGradient\\_v4](#)

## 64.82 Wobble\_v2



**Full Name:** Ops.Gl.ImageCompose.Wobble\_v2

waving wobble motion effect.

#### > Inputs

- **Render** (Trigger)
- **Time** (Number)
- **SpeedX** (Number)
- **SpeedY** (Number)
- **RepeatX** (Number)
- **RepeatY** (Number)
- **Multiply** (Number)
- **Amount Map** (Object:Texture)
- **Source Amount Map Index** (Number: Integer)
- **Invert Amount Map** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/wpgXXG](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Wobble\\_v2](#)

## 64.83 ZoomBlur\_v2

ZoomBlur

**Full Name:** Ops.Gl.ImageCompose.ZoomBlur\_v2

Directional blur effect.

### > Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Samples** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Strength Map** (Object:Texture)
- **Source Strength Map Index** (Number: Integer)
- **Invert Strength Map** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/qjtoT6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.ZoomBlur\_v2

## 65 Ops.Gl.ImageCompose.Math

### 65.1 ColorMapRange

ColorMapRange

**Full Name:** Ops.Gl.ImageCompose.Math.ColorMapRange

Map the range of color number values to another.

### > Inputs

- **Render** (Trigger)
- **Old Min** (Number)
- **Old Max** (Number)
- **New Min** (Number)
- **New Max** (Number)
- **Clamp** (Number: Boolean)
- **R** (Number: Boolean)
- **G** (Number: Boolean)
- **B** (Number: Boolean)
- **A** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/TgoiV6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Math.ColorMapRange

### 65.2 Normalize

Normalize

**Full Name:** Ops.Gl.ImageCompose.Math.Normalize

normalize texture rgb values.

### > Inputs

- **Render** (Trigger)
- **Fade** (Number)
- **Size** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/7c4jW2

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Math.Normalize

## 65.3 RgbeToFloat32Texture

RgbeToFloat32Texture

**Full Name:** Ops.Gl.ImageCompose.Math.RgbeToFloat32Texture

Convert a RGBE texture to HDR/floating point texture.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Mode Index** (Number: Integer)
- **Min** (Number)
- **Max** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/adsLpX

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Math.RgbeToFloat32Texture

## 65.4 RgbMath

RgbMath

**Full Name:** Ops.Gl.ImageCompose.Math.RgbMath

This OP enables you to use precise values to modify the pixels in your texture.

For example adjusting texture values that are modifying your geometry or array values, or even your post processing compositions.

### > Inputs

- **Render** (Trigger)
- **Operation Index** (Number: Integer)
- **R Active** (Number: Boolean)
- **G Active** (Number: Boolean)
- **B Active** (Number: Boolean)
- **A Active** (Number: Boolean)
- **Texture** (Object:Texture)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Multiply Texture** (Number)
- **Mask** (Object:Texture)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/H3cEpX

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Math.RgbMath

## 65.5 RgbMathExpression

RgbMathExpression

**Full Name:** Ops.Gl.ImageCompose.Math.RgbMathExpression

Execute a glsl code math expression in a image compose.

### > Inputs

- **Render** (Trigger)
- **Update Shader** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)
- **TexA** (Object:Texture)
- **TexB** (Object:Texture)
- **TexC** (Object:Texture)

### < Output

- **Trigger** (Trigger)
- **Code** (String)

**Example Patch:** cables.gl/edit/tG4xFs

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Math.RgbMathExpression

## 65.6 RgbTransform

RgbTransform

**Full Name:** Ops.Gl.ImageCompose.Math.RgbTransform

transform RGB values interpreted as XYZ coordinates.

### > Inputs

- **Render** (Trigger)
- **Translate** (Number: Boolean)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Pos Z** (Number)
- **Scale** (Number: Boolean)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotate** (Number: Boolean)

- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)
- **Mask** (Object:Texture)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/UJvMbk](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Math.RgbTransform](#)

## 65.7 Round



**Full Name:** Ops.Gl.ImageCompose.Math.Round

Round number values of texture color channels.

#### > Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Multiplier** (Number)

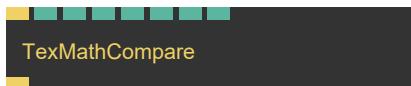
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.ImageCompose.Math.Round#example](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Math.Round](#)

## 65.8 TexMathCompare



**Full Name:** Ops.Gl.ImageCompose.Math.TexMathCompare

compare and pass through of color channel values.

#### > Inputs

- **Render** (Trigger)
- **Comparison Index** (Number: Integer)
- **Result Index** (Number: Integer)
- **Number** (Number)
- **R Active** (Number: Boolean)
- **G Active** (Number: Boolean)
- **B Active** (Number: Boolean)
- **A Active** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/RjKQWp](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Math.TexMathCompare](#)

# 66 Ops.Gl.ImageCompose.Noise

## 66.1 CellularNoise\_v2



**Full Name:** Ops.Gl.ImageCompose.Noise.CellularNoise\_v2

*Visit documentation for details.*

### > Inputs

- **Render** (Trigger)
- **Mask** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scale** (Number)
- **Harmonics Index** (Number: Integer)
- **Tileable** (Number: Boolean)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/9DZmT6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.CellularNoise\_v2

## 66.2 FBMNoise\_v2



**Full Name:** Ops.Gl.ImageCompose.Noise.FBMNoise\_v2

fractional brownian motion noise.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Scale** (Number)
- **Anim** (Number)
- **ScrollX** (Number)
- **ScrollY** (Number)
- **Repeat** (Number)
- **Aspect** (Number)
- **Layer 1** (Number: Boolean)
- **Layer 2** (Number: Boolean)
- **Layer 3** (Number: Boolean)
- **Layer 4** (Number: Boolean)
- **Tileable** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/DmWmT6

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.FBMNoise\_v2

## 66.3 GaborNoise



**Full Name:** Ops.Gl.ImageCompose.Noise.GaborNoise

Render "gabor noise" into a texture.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Phase** (Number)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/PWDdQm

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.GaborNoise

## 66.4 GlitchNoise\_v2



GlitchNoise

**Full Name:** Ops.Gl.ImageCompose.Noise.GlitchNoise\_v2

Creates a black and white glitched texture to use for displacement.

### > Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Seed** (Number)
- **Frequency** (Number)
- **Strength** (Number)
- **Block Size Small X** (Number)
- **Block Size Small Y** (Number)
- **Block Size Large X** (Number)
- **Block Size Large Y** (Number)
- **Scroll X** (Number)
- **Scroll Y** (Number)

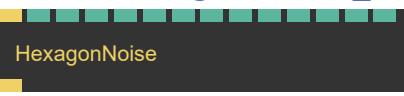
### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/cknm0r

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.GlitchNoise\_v2

## 66.5 HexagonNoise\_v2



HexagonNoise

**Full Name:** Ops.Gl.ImageCompose.Noise.HexagonNoise\_v2

Creates a hexagonal noise.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Loop** (Number: Boolean)
- **RGB** (Number: Boolean)
- **Minimum Value** (Number)
- **Maximum Value** (Number)
- **Scale** (Number)
- **Orientation** (Number: Boolean)

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Seed** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/plbB53

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.HexagonNoise\_v2

## 66.6 LayerNoise\_v3



LayerNoise

**Full Name:** Ops.Gl.ImageCompose.Noise.LayerNoise\_v3

Multilayer perlin noise variation.

### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Mode Index** (Number: Integer)
- **RGBA** (Number: Boolean)
- **Scale** (Number)
- **Layers** (Number: Integer)
- **Factor** (Number)
- **Exponent** (Number)
- **ScrollX** (Number)
- **ScrollY** (Number)
- **ScrollZ** (Number)
- **Tileable** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/NSYy0t

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.LayerNoise\_v3

## 66.7 Noise\_v2



Noise

**Full Name:** Ops.Gl.ImageCompose.Noise.Noise\_v2

White noise pixel effect.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Threshold** (Number)
- **Animated** (Number: Boolean)
- **RGB** (Number: Boolean)
- **Normalize** (Number: Boolean)
- **Multiply** (Object:Texture)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/PdHmT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Noise.Noise\\_v2](#)

## 66.8 PerlinNoise\_v2



**Full Name:** Ops.Gl.ImageCompose.Noise.PerlinNoise\_v2

Draw perlin noise into an image.

#### > Inputs

- **Render** (Trigger)
- **Mask** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Color Index** (Number: Integer)
- **Scale** (Number)
- **Multiply** (Number)
- **Harmonics Index** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/zfzmT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Noise.PerlinNoise\\_v2](#)

## 66.9 PixelNoise\_v3



**Full Name:** Ops.Gl.ImageCompose.Noise.PixelNoise\_v3

Amount of blend mode to apply.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **Loop** (Number: Boolean)
- **RGB** (Number: Boolean)
- **Minimum Value** (Number)
- **Maximum Value** (Number)
- **Num X** (Number)
- **Num Y** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Seed** (Number)
- **Centered** (Number: Boolean)

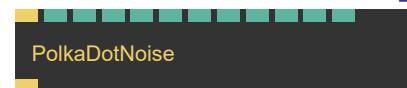
#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/pdjoOb](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Noise.PixelNoise\\_v3](#)

## 66.10 PolkaDotNoise\_v2



**Full Name:** Ops.Gl.ImageCompose.Noise.PolkaDotNoise\_v2

Visit documentation for details.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Square Look** (Number: Boolean)
- **Threshold** (Number)
- **Radius Low** (Number)
- **Radius High** (Number)

- **Scale** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/pKNTub

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.PolkaDotNoise\_v2

## 66.11 Shardnoise



**Full Name:** Ops.Gl.ImageCompose.Noise.Shardnoise

Render “shard noise” into a texture.

**> Inputs**

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Sharpness** (Number)
- **Scale** (Number)
- **Round** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/GSZtvs

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.Shardnoise

## 66.12 SimplexNoise\_v2



**Full Name:** Ops.Gl.ImageCompose.Noise.SimplexNoise\_v2

simplex noise generator.

**> Inputs**

- **Render** (Trigger)
- **Mask** (Object:Texture)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)

- **Alpha Mask Index** (Number: Integer)
- **Smoothness** (Number)
- **Harmonics Index** (Number: Integer)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)
- **Time** (Number)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

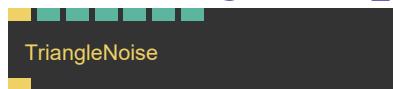
**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/c3vmUF

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.SimplexNoise\_v2

## 66.13 TriangleNoise\_v2



**Full Name:** Ops.Gl.ImageCompose.Noise.TriangleNoise\_v2

noise made from triangles.

**> Inputs**

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Scale** (Number)
- **Angle** (Number)
- **Add** (Number)

**< Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/wvkJyC

**Doc:** cables.gl/op/Ops.Gl.ImageCompose.Noise.TriangleNoise\_v2

## 66.14 ValueNoise\_v2



**Full Name:** Ops.Gl.ImageCompose.Noise.ValueNoise\_v2

*Visit documentation for details.*

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/SgTmT6](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Noise.ValueNoise\\_v2](#)

## 66.15 Voronoise\_v2



Voronoise

**Full Name:** Ops.Gl.ImageCompose.Noise.Voronoise\_v2

Voronoi Noise function.

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Amount** (Number)
- **Alpha Mask Index** (Number: Integer)
- **Time** (Number)
- **Movement** (Number)
- **Num** (Number)
- **Seed** (Number)
- **Fill Index** (Number: Integer)
- **Draw Isolines** (Number: Boolean)
- **Draw Distance** (Number: Boolean)
- **Draw Center** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/3zb6Us](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Noise.Voronoise\\_v2](#)

## 66.16 WorleyNoise\_v2



WorleyNoise

**Full Name:** Ops.Gl.ImageCompose.Noise.WorleyNoise\_v2

*Visit documentation for details.*

#### > Inputs

- **Render** (Trigger)
- **Blend Mode Index** (Number: Integer)
- **Alpha Mask Index** (Number: Integer)
- **Amount** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scale** (Number)
- **Harmonics Index** (Number: Integer)
- **Invert** (Number: Boolean)
- **RangeA** (Number)
- **RangeB** (Number)
- **Tileable** (Number: Boolean)
- **Amount Map** (Object:Texture)
- **Source Strength Map Index** (Number: Integer)
- **Invert Strength Map** (Number: Boolean)
- **Offset** (Object:Texture)
- **Offset Multiply** (Number)
- **Offset X Index** (Number: Integer)
- **Offset Y Index** (Number: Integer)
- **Offset Z Index** (Number: Integer)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/sivDjd](#)

**Doc:** [cables.gl/op/Ops.Gl.ImageCompose.Noise.WorleyNoise\\_v2](#)

# 67 Ops.Gl.Matrix

## 67.1 AnimMatrix



**Full Name:** Ops.Gl.Matrix.AnimMatrix  
animate values in a matrix to a new matrix.

### > Inputs

- **Update** (Trigger)
- **Next Matrix** (Array)
- **Duration** (Number)
- **Easing Index** (Number: Integer)

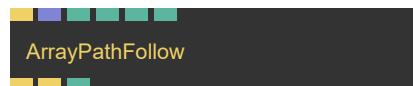
### < Output

- **Next** (Trigger)
- **Matrix** (Array)

**Example Patch:** cables.gl/edit/99cg1x

**Doc:** cables.gl/op/Ops.Gl.Matrix.AnimMatrix

## 67.2 ArrayPathFollow



**Full Name:** Ops.Gl.Matrix.ArrayPathFollow  
interpolate position on a spline/array3x.

### > Inputs

- **Exe** (Trigger)
- **Array** (Array)
- **Time** (Number)
- **Duration** (Number)
- **Offset** (Number)
- **Look Ahead** (Number)

### < Output

- **Trigger** (Trigger)
- **Transform Lookat** (Trigger)
- **Index** (Number)

**Example Patch:** cables.gl/edit/IL9\_EF

**Doc:** cables.gl/op/Ops.Gl.Matrix.ArrayPathFollow

## 67.3 ArrayPathFollowParticles\_v2



**Full Name:** Ops.Gl.Matrix.ArrayPathFollowParticles\_v2  
render lots of particles following a path/spline/array3x.

### > Inputs

- **Exec** (Trigger)
- **Points** (Array)
- **Num Particles** (Number)
- **Length** (Number)
- **Spread** (Number)
- **Offset** (Number)
- **Max Distance** (Number)
- **RandomSpeed** (Number: Boolean)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/4wT0J6

**Doc:** cables.gl/op/Ops.Gl.Matrix.ArrayPathFollowParticles\_v2

## 67.4 Billboard



**Full Name:** Ops.Gl.Matrix.Billboard  
rotate an object to always face the camera.

### > Inputs

- **Exec** (Trigger)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/GVpkrq

**Doc:** cables.gl/op/Ops.Gl.Matrix.Billboard

## 67.5 Camera\_v2



**Full Name:** Ops.Gl.Matrix.Camera\_v2

Transforms and projects the scene from the point of view of the camera.

### > Inputs

- **Render** (Trigger)

- **Identity** (Number: Boolean)
- **Projection Mode Index** (Number: Integer)
- **Frustum Near** (Number)
- **Frustum Far** (Number)
- **Fov** (Number)
- **Auto Aspect Ratio** (Number: Boolean)
- **Aspect Ratio** (Number)
- **Eye X** (Number)
- **Eye Y** (Number)
- **Eye Z** (Number)
- **Center X** (Number)
- **Center Y** (Number)
- **Center Z** (Number)
- **Truck** (Number)
- **Move sideways** (in local x axis)
- **Boom** (Number)
- **Dolly** (Number)
- **Tilt** (Number)
- **Pan** (Number)
- **Roll** (Number)

#### < Output

- **Trigger** (Trigger)
- **Aspect** (Number)
- **Look At Array** (Array)

**Example Patch:** [cables.gl/edit/PSw73e](https://cables.gl/edit/PSw73e)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.Camera\\_v2](https://cables.gl/op/Ops.Gl.Matrix.Camera_v2)

## 67.6 CameraInfo



**Full Name:** Ops.Gl.Matrix.CameraInfo

get camera attributes from current camera/orbit controls.

#### > Inputs

- **Render** (Trigger)
- **Camera Type Index** (Number: Integer)

#### < Output

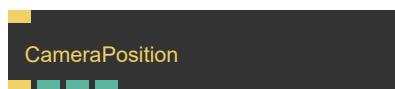
- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Right X** (Number)

- **Right Y** (Number)
- **Right Z** (Number)
- **Up X** (Number)
- **Up Y** (Number)
- **Up Z** (Number)
- **Forward X** (Number)
- **Forward Y** (Number)
- **Forward Z** (Number)
- **Near Frustum** (Number)
- **Far Frustum** (Number)
- **Bottom Frustum** (Number)
- **Top Frustum** (Number)
- **Left Frustum** (Number)
- **Right Frustum** (Number)
- **FOV** (Number)
- **Aspect Ratio** (Number)

**Example Patch:** [cables.gl/edit/YfJ4S](https://cables.gl/edit/YfJ4S)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.CameraInfo](https://cables.gl/op/Ops.Gl.Matrix.CameraInfo)

## 67.7 CameraPosition



**Full Name:** Ops.Gl.Matrix.CameraPosition

get the current position of viewmatrix/camera eye.

#### > Inputs

- **Render** (Trigger)

#### < Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** [cables.gl/edit/JwL86R](https://cables.gl/edit/JwL86R)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.CameraPosition](https://cables.gl/op/Ops.Gl.Matrix.CameraPosition)

## 67.8 Coordinates



**Full Name:** Ops.Gl.Matrix.Coordinates

current xyz coordinates (modelmatrix).

#### > Inputs

- **Render** (Trigger)

**< Output**

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** [cables.gl/edit/2AtI98](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.Coordinates](#)

## 67.9 DeviceOrientationCamera

DeviceOrientationCamera

**Full Name:** Ops.Gl.Matrix.DeviceOrientationCamera

gyroscope motionsensor camera.

**> Inputs**

- **Render** (Trigger)

**< Output**

- **Next** (Trigger)
- **Window Orientation** (Number)

**Example Patch:** [cables.gl/edit/dZ8wQ0](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.DeviceOrientationCamera](#)

## 67.10 GetMatrixScaling

GetMatrixScaling

**Full Name:** Ops.Gl.Matrix.GetMatrixScaling

Get the scalar scaling of a matrix.

**> Inputs**

- **Render** (Trigger)
- **Matrix** (Array)

**< Output**

- **Trigger** (Trigger)
- **Scaling** (Number)

**Example Patch:** [cables.gl/op/Ops.Gl.Matrix.GetMatrixScaling#example](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.GetMatrixScaling](#)

## 67.11 GetModelMatrix

GetModelMatrix

**Full Name:** Ops.Gl.Matrix.GetModelMatrix

Get current modelmatrix.

**> Inputs**

- **Render** (Trigger)

**< Output**

- **Trigger** (Trigger)
- **Matrix** (Array)

**Example Patch:** [cables.gl/edit/HkYpci](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.GetModelMatrix](#)

## 67.12 GetProjectionMatrix

GetProjectionMatrix

**Full Name:** Ops.Gl.Matrix.GetProjectionMatrix

get current projectionmatrix.

**> Inputs**

- **Render** (Trigger)

**< Output**

- **Trigger** (Trigger)
- **Matrix** (Array)

**Example Patch:** [cables.gl/edit/573\\_4S](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.GetProjectionMatrix](#)

## 67.13 GetViewMatrix

GetViewMatrix

**Full Name:** Ops.Gl.Matrix.GetViewMatrix

get current viewmatrix.

**> Inputs**

- **Render** (Trigger)

**< Output**

- **Trigger** (Trigger)
- **Matrix** (Array)

**Example Patch:** [cables.gl/edit/hDWuci](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.GetViewMatrix](#)

## 67.14 InterpolateMatrix

InterpolateMatrix

**Full Name:** Ops.Gl.Matrix.InterpolateMatrix  
interpolate between two matrices.

### > Inputs

- **Exe** (Trigger)
- **Array 1** (Array)
- **Array 2** (Array)
- **Perc** (Number)

### < Output

- **Next** (Trigger)
- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Gl.Matrix.InterpolateMatrix#example

**Doc:** cables.gl/op/Ops.Gl.Matrix.InterpolateMatrix

## 67.15 InvertMatrix

InvertMatrix

**Full Name:** Ops.Gl.Matrix.InvertMatrix  
outputs an inverted matrix.

### > Inputs

- **Matrix** (Array)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/G51Fhl

**Doc:** cables.gl/op/Ops.Gl.Matrix.InvertMatrix

## 67.16 LookatCamera

LookatCamera

**Full Name:** Ops.Gl.Matrix.LookatCamera  
transforms view to look from eye to center.

### > Inputs

- **Render** (Trigger)
- **EyeX** (Number)
- **EyeY** (Number)
- **EyeZ** (Number)

- **CenterX** (Number)
- **CenterY** (Number)
- **CenterZ** (Number)
- **UpX** (Number)
- **UpY** (Number)
- **UpZ** (Number)

### < Output

- **Trigger** (Trigger)
- **Array** (Array)

**Example Patch:** cables.gl/edit/\_JlGz6

**Doc:** cables.gl/op/Ops.Gl.Matrix.LookatCamera

## 67.17 MatrixTranslation

MatrixTranslation

**Full Name:** Ops.Gl.Matrix.MatrixTranslation  
get translation of a matrix.

### > Inputs

- **Render** (Trigger)
- **Matrix** (Array)

### < Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** cables.gl/edit/Zz52On

**Doc:** cables.gl/op/Ops.Gl.Matrix.MatrixTranslation

## 67.18 MultiplyModelMatrix

MultiplyModelMatrix

**Full Name:** Ops.Gl.Matrix.MultiplyModelMatrix  
multiply model matrix.

### > Inputs

- **Render** (Trigger)
- **Identity** (Number: Boolean)
- **Matrix** (Array)

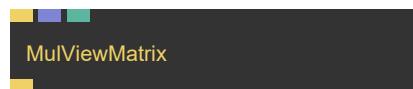
### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/HkYpci

**Doc:** cables.gl/op/Ops.Gl.Matrix.MultiplyModelMatrix

## 67.19 MulViewMatrix



**Full Name:** Ops.Gl.Matrix.MulViewMatrix

multiply view matrix.

### > Inputs

- **Render** (Trigger)
- **Matrix** (Array)
- **Identity** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/hDWuci

**Doc:** cables.gl/op/Ops.Gl.Matrix.MulViewMatrix

## 67.20 Quaternion



**Full Name:** Ops.Gl.Matrix.Quaternion

multiplies current modelmatrix with a quaternion.

### > Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

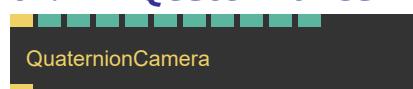
### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.Matrix.Quaternion#example

**Doc:** cables.gl/op/Ops.Gl.Matrix.Quaternion

## 67.21 QuaternionCamera



**Full Name:** Ops.Gl.Matrix.QuaternionCamera

Set up a camera, rotated by a quaternion.

### > Inputs

- **Render** (Trigger)
- **EyeX** (Number)
- **EyeY** (Number)
- **EyeZ** (Number)
- **QuatX** (Number)
- **QuatY** (Number)
- **QuatZ** (Number)
- **QuatW** (Number)
- **UpX** (Number)
- **UpY** (Number)
- **UpZ** (Number)

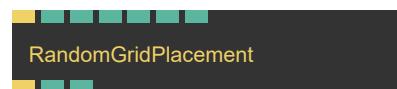
### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.Matrix.QuaternionCamera#example

**Doc:** cables.gl/op/Ops.Gl.Matrix.QuaternionCamera

## 67.22 RandomGridPlacement



**Full Name:** Ops.Gl.Matrix.RandomGridPlacement

place random objects on a grid.

### > Inputs

- **Exe** (Trigger)
- **Max Depth** (Number)
- **Possibility** (Number)
- **Seed** (Number)
- **Scale** (Number)
- **Width** (Number)
- **Height** (Number)

### < Output

- **Next** (Trigger)
- **Index** (Number)
- **Depth** (Number)

**Example Patch:** cables.gl/edit/FsZFVB

**Doc:** cables.gl/op/Ops.Gl.Matrix.RandomGridPlacement

## 67.23 RandomGridPlacementArrays

RandomGridPlacementArrays

**Full Name:** Ops.Gl.Matrix.RandomGridPlacementArrays

Place random objects on a grid.

### > Inputs

- **Exe** (Trigger)
- **Max Depth** (Number)
- **Possibility** (Number)
- **Seed** (Number)
- **Scale** (Number)
- **Width** (Number)
- **Height** (Number)

### < Output

- **Positions** (Array)
- **Scalings** (Array)
- **Array Length** (Number)
- **Total Points** (Number)

**Example Patch:** cables.gl/edit/PYUHNP

**Doc:** cables.gl/op/Ops.Gl.Matrix.RandomGridPlacementArrays

## 67.24 Scale

Scale

**Full Name:** Ops.Gl.Matrix.Scale

Scale all child objects (scaleXYZ).

### > Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/au9U7i

**Doc:** cables.gl/op/Ops.Gl.Matrix.Scale

## 67.25 ScaleXYZViewMatrix

ScaleXYZViewMatrix

**Full Name:** Ops.Gl.Matrix.ScaleXYZViewMatrix

scale xyz of viewmatrix.

### > Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/aSB6On

**Doc:** cables.gl/op/Ops.Gl.Matrix.ScaleXYZViewMatrix

## 67.26 ScreenCoordinates\_v2

ScreenCoordinates

**Full Name:** Ops.Gl.Matrix.ScreenCoordinates\_v2

screen/pixel coordinates of the current transform.

### > Inputs

- **Execute** (Trigger)
- **Pixel Unit Index** (Number: Integer)

### < Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Visible** (Number)

**Example Patch:** cables.gl/edit/-GNBD-

**Doc:** cables.gl/op/Ops.Gl.Matrix.ScreenCoordinates\_v2

## 67.27 ScreenPosTo3d\_v3

ScreenPosTo3d

**Full Name:** Ops.Gl.Matrix.ScreenPosTo3d\_v3

convert screen coordinates to a 3d position.

### > Inputs

- **Exec** (Trigger)

- **X** (Number)
- **Y** (Number)
- **Input Type Index** (Number: Integer)

#### < Output

- **Trigger Out** (Trigger)
- **Result X** (Number)
- **Result Y** (Number)

**Example Patch:** [cables.gl/edit/mDiCq6](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.ScreenPosTo3d\\_v3](#)

## 67.28 SetProjectionMatrix



SetProjectionMatrix

**Full Name:** Ops.Gl.Matrix.SetProjectionMatrix

set a projection matrix.

#### > Inputs

- **Exe** (Trigger)
- **Matrix** (Array)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/573\\_4S](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.SetProjectionMatrix](#)

## 67.29 Shear



Shear

**Full Name:** Ops.Gl.Matrix.Shear

displaces each point of a mesh in fixed direction.

#### > Inputs

- **Render** (Trigger)
- **ShearX** (Number)
- **ShearY** (Number)

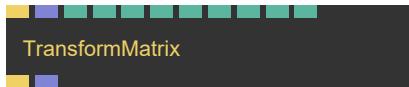
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/PmTYnO](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.Shear](#)

## 67.30 TransformMatrix



TransformMatrix

**Full Name:** Ops.Gl.Matrix.TransformMatrix

transform a matrix (mat4).

#### > Inputs

- **Transform** (Trigger)
- **Matrix** (Array)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)

#### < Output

- **Next** (Trigger)
- **Result** (Array)

**Example Patch:** [cables.gl/edit/A0W1Jx](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.TransformMatrix](#)

## 67.31 TransformMul



TransformMul

**Full Name:** Ops.Gl.Matrix.TransformMul

multiply current modelmatrix.

#### > Inputs

- **Render** (Trigger)
- **Mul** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Gl.Matrix.TransformMul#example](#)

**Doc:** [cables.gl/op/Ops.Gl.Matrix.TransformMul](#)

## 67.32 Translate

Translate

**Full Name:** Ops.Gl.Matrix.Translate

Translate objects (move / position in 3D space).

### > Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.Matrix.Translate#example

**Doc:** cables.gl/op/Ops.Gl.Matrix.Translate

## 67.33 TranslateView

TranslateView

**Full Name:** Ops.Gl.Matrix.TranslateView

translate the view/camera matrix.

### > Inputs

- **Render** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.Matrix.TranslateView#example

**Doc:** cables.gl/op/Ops.Gl.Matrix.TranslateView

## 67.34 VectorTranslate

VectorTranslate

**Full Name:** Ops.Gl.Matrix.VectorTranslate

Translate any geometry underneath it using vectors and speed.

### > Inputs

- **Exec** (Trigger)
- **Speed** (Number)

- **Vector X** (Number)

- **Vector Y** (Number)

- **Vector Z** (Number)

- **Reset Position X** (Number)

- **Reset Position Y** (Number)

- **Reset Position Z** (Number)

- **Reset** (Trigger)

- **Max** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.Matrix.VectorTranslate#example

**Doc:** cables.gl/op/Ops.Gl.Matrix.VectorTranslate

## 67.35 WASDCamera\_v2

WASDCamera

**Full Name:** Ops.Gl.Matrix.WASDCamera\_v2

simple camera you control with W,A,S,D keys like in a FPS game.

### > Inputs

- **Render** (Trigger)
- **Enable Pointer Lock** (Number: Boolean)
- **Speed** (Number)
- **Mouse Speed** (Number)
- **Allow Flying** (Number: Boolean)
- **Active** (Number: Boolean)
- **Move X-** (Number: Boolean)
- **Move Y-** (Number: Boolean)
- **Reset** (Trigger)

### < Output

- **Trigger** (Trigger)
- **IsLocked** (booleanNumber)
- **PosX** (Number)
- **PosY** (Number)
- **PosZ** (Number)
- **Mouse Left** (Trigger)
- **Mouse Right** (Trigger)
- **Dir X** (Number)
- **Dir Y** (Number)
- **Dir Z** (Number)

**Example Patch:** cables.gl/edit/oLCao

**Doc:** cables.gl/op/Ops.Gl.Matrix.WASDCamera\_v2

# 68 Ops.Gl.Meshes

## 68.1 ComposingGridOverlay

ComposingGridOverlay

**Full Name:** Ops.Gl.Meshes.ComposingGridOverlay

Rule of thirds image composition helper.

### > Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Show Center** (Number: Boolean)

### < Output

- Visit *Ops.Gl.Meshes.ComposingGridOverlay documentation for output port details*

**Example Patch:** cables.gl/edit/G8mQQ2

**Doc:** cables.gl/op/Ops.Gl.Meshes.ComposingGridOverlay

## 68.2 Cone

Cone

**Full Name:** Ops.Gl.Meshes.Cone

number of horizontal segments.

### > Inputs

- **Render** (Trigger)
- **Slices** (Number)
- **Stacks** (Number)
- **Radius** (Number)
- **Height** (Number)
- **Active** (Number: Boolean)

### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/fGA7W6

**Doc:** cables.gl/op/Ops.Gl.Meshes.Cone

## 68.3 Corner



Corner

**Full Name:** Ops.Gl.Meshes.Corner

render a rectangular corner.

### > Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Thickness** (Number)
- **Draw** (Number: Boolean)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)

### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/KWolQ6

**Doc:** cables.gl/op/Ops.Gl.Meshes.Corner

## 68.4 Cylinder\_v2



Cylinder

**Full Name:** Ops.Gl.Meshes.Cylinder\_v2

draw parameterizable cylinder (aka tube,pipe,round,circle).

### > Inputs

- **Render** (Trigger)
- **Render Mesh** (Number: Boolean)
- **Segments** (Number: Integer)
- **Stacks** (Number: Integer)
- **Length** (Number)
- **Outer Radius** (Number)
- **Inner Radius** (Number)
- **Flip Mapping** (Number: Boolean)
- **Caps** (Number: Boolean)
- **Flat Normals** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/GxagQ6

**Doc:** [cables.gl/op/Ops.Gl.Meshes.Cylinder\\_v2](#)

## 68.5 FloorGrid



**Full Name:** Ops.Gl.Meshes.FloorGrid

draw a grid on the floor.

### > Inputs

- **Render** (Trigger)
- **Active** (Number: Boolean)

### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/LiwB16](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.FloorGrid](#)

## 68.6 FreeFormPlane



**Full Name:** Ops.Gl.Meshes.FreeFormPlane

A freely deformable plane, rectangle, polygon.

### > Inputs

- **Render** (Trigger)
- **X 1** (Number)
- **Y 1** (Number)
- **Z 1** (Number)
- **X 2** (Number)
- **Y 2** (Number)
- **Z 2** (Number)
- **X 3** (Number)
- **Y 3** (Number)
- **Z 3** (Number)
- **X 4** (Number)
- **Y 4** (Number)
- **Z 4** (Number)
- **Tc X 1** (Number)
- **Tc Y 1** (Number)
- **Tc X 2** (Number)
- **Tc Y 2** (Number)
- **Tc X 3** (Number)
- **Tc Y 3** (Number)

- **Tc X 4** (Number)
- **Tc Y 4** (Number)

### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** [cables.gl/edit/Q92nQ6](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.FreeFormPlane](#)

## 68.7 FullscreenRectangle\_v2



**Full Name:** Ops.Gl.Meshes.FullscreenRectangle\_v2

Draws a rectangle using the full WebGL canvas size.

### > Inputs

- **Render** (Trigger)
- **Flip Y** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Texture** (Object:Texture)

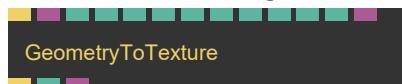
### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/uKkleG](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.FullscreenRectangle\\_v2](#)

## 68.8 GeometryToTexture\_v3



**Full Name:** Ops.Gl.Meshes.GeometryToTexture\_v3

Convert vertices of a geometry to a data texture.

### > Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)
- **Continuously Update** (Number: Boolean)
- **Order Index** (Number: Integer)
- **Content Index** (Number: Integer)
- **New Size** (Number)
- **Tex Width** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)

- **Color Texture** (Object:Texture)

#### < Output

- **Next** (Trigger)
- **Total Vertices** (Number)
- **Texture** (Object)

**Example Patch:** cables.gl/edit/bhWkpX

**Doc:** cables.gl/op/Ops.Gl.Meshes.GeometryToTexture\_v3

## 68.9 Grid



**Full Name:** Ops.Gl.Meshes.Grid

Draw a simple grid of lines.

#### > Inputs

- **Render** (Trigger)
- **Num** (Number: Integer)
- **Spacing** (Number)
- **Center** (Number: Boolean)
- **Axis Index** (Number: Integer)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/VxPlQ6

**Doc:** cables.gl/op/Ops.Gl.Meshes.Grid

## 68.10 HeightMap



**Full Name:** Ops.Gl.Meshes.HeightMap

generate a rectangular mesh where the height is defined by the luminance of an image.

#### > Inputs

- **Render** (Trigger)
- **File** (String)
- **Extrude** (Number)
- **Width** (Number)
- **Height** (Number)
- **Rows** (Number: Integer)
- **Columns** (Number: Integer)
- **TexCoords Slice** (Number: Boolean)

- **Flat** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/bRLsDe

**Doc:** cables.gl/op/Ops.Gl.Meshes.HeightMap

## 68.11 Helix



**Full Name:** Ops.Gl.Meshes.Helix

generates a helix, spiral spline.

#### > Inputs

- **Render** (Trigger)
- **Draw** (Number: Boolean)
- **Segments** (Number)
- **Frequency** (Number)
- **Radius** (Number)
- **Radius End** (Number)
- **Height** (Number)

#### < Output

- **Next** (Trigger)
- **Points** (Array)

**Example Patch:** cables.gl/edit/CW8-I6

**Doc:** cables.gl/op/Ops.Gl.Meshes.Helix

## 68.12 Icosahedron\_v2



**Full Name:** Ops.Gl.Meshes.Icosahedron\_v2

Renders a icosahedron (polyhedron with 20 faces).

#### > Inputs

- **Render** (Trigger)
- **Smooth** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/le6iQ6

**Doc:** [cables.gl/op/Ops.Gl.Meshes.Icosahedron\\_v2](#)

## 68.13 Line



**Full Name:** Ops.Gl.Meshes.Line

Draw a line between two points.

### > Inputs

- **Render** (Trigger)
- **X 1** (Number)
- **Y 1** (Number)
- **Z 1** (Number)
- **X 2** (Number)
- **Y 2** (Number)
- **Z 2** (Number)

### < Output

- **Next** (Trigger)
- **Array** (Array)

**Example Patch:** [cables.gl/edit/D\\_eE98](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.Line](#)

## 68.14 LinesArray



**Full Name:** Ops.Gl.Meshes.LinesArray

an array of lines.

### > Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Logarithmic** (Number: Boolean)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)
- **Num Columns** (Number: Integer)
- **Num Rows** (Number: Integer)
- **Axis Index** (Number: Integer)

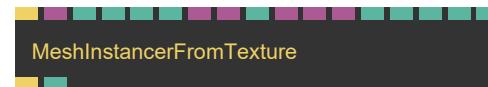
### < Output

- **Trigger** (Trigger)
- **Point Arrays** (Array)

**Example Patch:** [cables.gl/edit/oXke6r](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.LinesArray](#)

## 68.15 MeshInstancerFromTexture\_v3



**Full Name:** Ops.Gl.Meshes.MeshInstancerFromTexture\_v3

Draw the same mesh multiple times on the GPU.

### > Inputs

- **Exe** (Trigger)
- **Geometry** (Object:Geometry)
- **Scale** (Number)
- **Limit Instances** (Number: Boolean)
- **Num Instances** (Number: Integer)
- **Position Texture** (Object:Texture)
- **Rotation Texture** (Object:Texture)
- **Scale Texture** (Object:Texture)
- **Color Texture** (Object:Texture)
- **TexCoord Texture** (Object:Texture)
- **Ignore Alpha Less Than** (Number)
- **Multiply Pos X** (Number)
- **Multiply Pos Y** (Number)
- **Multiply Pos Z** (Number)

### < Output

- **Trigger Out** (Trigger)
- **Num** (Number)

**Example Patch:** [cables.gl/edit/H3cEpX](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.MeshInstancerFromTexture\\_v3](#)

## 68.16 ParametricSurface



**Full Name:** Ops.Gl.Meshes.ParametricSurface

Creates a 3d mesh from a 2d area expressions.

### > Inputs

- **Shapes Index** (Number: Integer)
- **Render** (Trigger)
- **U Segments** (Number: Integer)
- **V Segments** (Number: Integer)
- **Multiple Of PI - U** (Number: Boolean)

- **UMin** (Number)
- **UMax** (Number)
- **Displace U** (Number)
- **Multiple Of PI - V** (Number: Boolean)
- **VMin** (Number)
- **VMax** (Number)
- **Displace V** (Number)
- **X Function** (String)
- **Y Function** (String)
- **Z Function** (String)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Draw** (Number: Boolean)

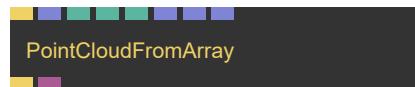
#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)
- **Position** (Array)
- **outputs the vertices of the surface** (as an xyz-Array)
- **Position Amount** (Number)

**Example Patch:** [cables.gl/edit/TnUBsL](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.ParametricSurface](#)

## 68.17 PointCloudFromArray\_v2



**Full Name:** Ops.Gl.Meshes.PointCloudFromArray\_v2

visualize an array of coordinates as points.

#### > Inputs

- **Exe** (Trigger)
- **Positions** (Array)
- **Num Points** (Number: Integer)
- **Scramble Texcoords** (Number: Boolean)
- **Seed** (Number)
- **Texture Coordinates** (Array)
- **Point Sizes** (Array)
- **Vertex Colors** (Array)

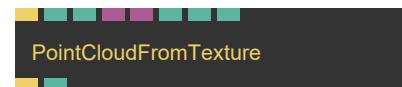
#### < Output

- **Trigger Out** (Trigger)
- **Geometry** (Object)

**Example Patch:** [cables.gl/edit/v8G4Wz](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.PointCloudFromArray\\_v2](#)

## 68.18 PointCloudFromTexture



**Full Name:** Ops.Gl.Meshes.PointCloudFromTexture

Visualize a RGB texture as XYZ coordinates as points.

#### > Inputs

- **Render** (Trigger)
- **Num Points** (Number: Integer)
- **Texture** (Object:Texture)
- **Point Size** (Object:Texture)
- **Normalize** (Number: Boolean)
- **Remove Point At 0** (Number: Boolean)
- **Ignore Alpha 0** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Total Points** (Number)

**Example Patch:** [cables.gl/edit/bhWkpX](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.PointCloudFromTexture](#)

## 68.19 Polyhedron\_v2



**Full Name:** Ops.Gl.Meshes.Polyhedron\_v2

Generate polyhedron meshes.

#### > Inputs

- **Receipt** (String)

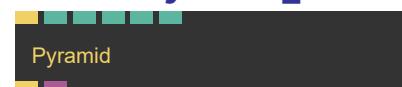
#### < Output

- **Geometry** (Object)

**Example Patch:** [cables.gl/edit/VRG6Q6](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.Polyhedron\\_v2](#)

## 68.20 Pyramid\_v2



**Full Name:** Ops.Gl.Meshes.Pyramid\_v2

render a pyramid mesh.

#### > Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Length** (Number)
- **Height** (Number)
- **Smooth** (Number: Boolean)
- **Draw** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/Y09mQ6

**Doc:** cables.gl/op/Ops.Gl.Meshes.Pyramid\_v2

## 68.21 QuadWarpTexture



**Full Name:** Ops.Gl.Meshes.QuadWarpTexture

Warp a texture mapped quad (projection mapping).

#### > Inputs

- **Render** (Trigger)
- **A X** (Number)
- **A Y** (Number)
- **B X** (Number)
- **B Y** (Number)
- **C X** (Number)
- **C Y** (Number)
- **D X** (Number)
- **D Y** (Number)
- **Flip Y** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Texture** (Object)

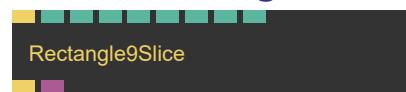
#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/T2A7zp

**Doc:** cables.gl/op/Ops.Gl.Meshes.QuadWarpTexture

## 68.22 Rectangle9Slice



**Full Name:** Ops.Gl.Meshes.Rectangle9Slice

nine slice image format texture mapped rectangle.

#### > Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Border Width** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Draw** (Number: Boolean)
- **Pivot X Index** (Number: Integer)
- **Pivot Y Index** (Number: Integer)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/WkQpIG

**Doc:** cables.gl/op/Ops.Gl.Meshes.Rectangle9Slice

## 68.23 RectangleFrame\_v2



**Full Name:** Ops.Gl.Meshes.RectangleFrame\_v2

Draws a rectangle frame.

#### > Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Thickness** (Number)
- **Draw Top** (Number: Boolean)
- **Draw Bottom** (Number: Boolean)
- **Draw Left** (Number: Boolean)
- **Draw Right** (Number: Boolean)
- **Active** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/HLViQ6

**Doc:** [cables.gl/op/Ops.Gl.Meshes.RectangleFrame\\_v2](#)

## 68.24 RectangleRounded\_v2



**Full Name:** Ops.Gl.Meshes.RectangleRounded\_v2

Draws a rectangle with rounded corners.

### ► Inputs

- **Render** (Trigger)
- **Segments** (Number: Integer)
- **Width** (Number)
- **Height** (Number)
- **Border Radius** (Number)
- **Top Left** (Number: Boolean)
- **Top Right** (Number: Boolean)
- **Bottom Left** (Number: Boolean)
- **Bottom Right** (Number: Boolean)
- **Draw** (Number: Boolean)

### ◀ Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** [cables.gl/edit/1la6mJ](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.RectangleRounded\\_v2](#)

## 68.25 SimpleSpline\_v2



**Full Name:** Ops.Gl.Meshes.SimpleSpline\_v2

Draws a simple spline only one pixel wide.

### ► Inputs

- **Render** (Trigger)
- **Points** (Array)
- **Num Points** (Number: Integer)
- **Line Strip** (Number: Boolean)
- **TexCoords Array** (Array)
- **Vertex Colors** (Array)

### ◀ Output

- **Geometry** (Object)
- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/qRD7W6](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.SimpleSpline\\_v2](#)

## 68.26 SimpleWireframe



**Full Name:** Ops.Gl.Meshes.SimpleWireframe

Simple Wireframe Line Renderer.

### ► Inputs

- **Render** (Trigger)
- **Geometry** (Object:Geometry)

### ◀ Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/gt0cay](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.SimpleWireframe](#)

## 68.27 SplineMesh\_v2



**Full Name:** Ops.Gl.Meshes.SplineMesh\_v2

draw splines/lines.

### ► Inputs

- **Render** (Trigger)
- **Points** (Array)
- **Tesselate Edges** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

### ◀ Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/3l5Uu-](#)

**Doc:** [cables.gl/op/Ops.Gl.Meshes.SplineMesh\\_v2](#)

## 68.28 SplineMeshMaterial\_v2



**Full Name:** Ops.Gl.Meshes.SplineMeshMaterial\_v2

material for splinemesh.

### ► Inputs

- **Render** (Trigger)

- **Width** (Number)
- **Width Perspective** (Number: Boolean)
- **Texture** (Object:Texture)
- **Texture Mask** (Object:Texture)
- **Mapping Index** (Number: Integer)
- **Mapping** (String)
- **Colorize Texture** (Number: Boolean)
- **Offset** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

#### < Output

- **Trigger** (Trigger)
- **Shader** (Object)

**Example Patch:** cables.gl/edit/tnUJta

**Doc:** cables.gl/op/Ops.Gl.Meshes.SplineMeshMaterial\_v2

## 68.29 TextMesh\_v2



**Full Name:** Ops.Gl.Meshes.TextMesh\_v2

Draws text in 3d space using one of the font ops.

#### > Inputs

- **Render** (Trigger)
- **Text** (String)
- **Scale Text** (Number)
- **Line Scale** (Number)
- **Font** (String)
- **Align Index** (Number: Integer)
- **Vertical Align Index** (Number: Integer)
- **Line Height** (Number)
- **Letter Spacing** (Number)
- **Texture Color** (Object:Texture)
- **Texture Mask** (Object:Texture)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

#### < Output

- **Next** (Trigger)

- **Total Lines** (Number)
- **Width** (Number)
- **Font Available** (booleanNumber)

**Example Patch:** cables.gl/edit/LzDnH-

**Doc:** cables.gl/op/Ops.Gl.Meshes.TextMesh\_v2

## 68.30 Torus\_v3



**Full Name:** Ops.Gl.Meshes.Torus\_v3

Draw a torus (doughnut, donut, ring mesh).

#### > Inputs

- **Render** (Trigger)
- **Sides** (Number)
- **Rings** (Number)
- **InnerRadius** (Number)
- **OuterRadius** (Number)
- **Render Mesh** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/ECMhQ6

**Doc:** cables.gl/op/Ops.Gl.Meshes.Torus\_v3

## 68.31 TriangleSphere



**Full Name:** Ops.Gl.Meshes.TriangleSphere

A sphere mesh with uniform distributed vertices.

#### > Inputs

- **Render** (Trigger)
- **Iterations** (Number)
- **Flat** (Number: Boolean)
- **Draw** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/T43V0D

**Doc:** cables.gl/op/Ops.Gl.Meshes.TriangleSphere

# 69 Ops.Gl.Pbr

## 69.1 PbrEnvironmentLight

PbrEnvironmentLight

**Full Name:** Ops.Gl.Pbr.PbrEnvironmentLight

PBR image based lighting setup.

### > Inputs

- **Render** (Trigger)
- **Intensity** (Number)
- **RGBE Environment Map** (Object:Texture)
- **Size Irradiance Map Index** (Number: Integer)
- **Size Pre-Filtered Environment Index** (Number: Integer)
- **Size IBL LUT Index** (Number: Integer)
- **Force 8bit IBL** (Number: Boolean)
- **Rotation** (Number)
- **Use Parallax Correction** (Number: Boolean)
- **Center X** (Number)
- **Center Y** (Number)
- **Center Z** (Number)
- **Box Min X** (Number)
- **Box Min Y** (Number)
- **Box Min Z** (Number)
- **Box Max X** (Number)
- **Box Max Y** (Number)
- **Box Max Z** (Number)

### < Output

- **Render** (Trigger)
- **Intensity** (Number)
- **RGBE Environment Map** (Object:Texture)
- **Size Irradiance Map Index** (Number: Integer)
- **Size Pre-Filtered Environment Index** (Number: Integer)
- **Size IBL LUT Index** (Number: Integer)
- **Force 8bit IBL** (Number: Boolean)
- **Rotation** (Number)
- **Use Parallax Correction** (Number: Boolean)
- **Center X** (Number)
- **Center Y** (Number)
- **Center Z** (Number)
- **Box Min X** (Number)
- **Box Min Y** (Number)

- **Box Min Z** (Number)
- **Box Max X** (Number)
- **Box Max Y** (Number)
- **Box Max Z** (Number)
- **Next** (Trigger)
- **IBL LUT** (Object)
- **for PBR Material** (not required)
- **Number Of Pre-Filtered Mip Levels** (Number)

**Example Patch:** cables.gl/edit/9z9kFK

**Doc:** cables.gl/op/Ops.Gl.Pbr.PbrEnvironmentLight

## 69.2 PbrMaterial

PbrMaterial

**Full Name:** Ops.Gl.Pbr.PbrMaterial

PBR/Physical Based Rendering Material for realistic materials.

### > Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Roughness** (Number)
- **Metalness** (Number)
- **Use Clear Coat** (Number: Boolean)
- **Clear Coat Intensity** (Number)
- **Clear Coat Roughness** (Number)
- **Use Normal Map For Clear Coat** (Number: Boolean)
- **Clear Coat Normal Map** (Object:Texture)
- **Use Thin Film** (Number: Boolean)
- **Thin Film Intensity** (Number)
- **Thin Film IOR** (Number)
- **Thickness Tex Min** (Number)
- **Thickness Tex Max** (Number)
- **Exposure** (Number)
- **Emission Intensity** (Number)
- **Disable Geometric Roughness** (Number: Boolean)
- **Use Roughness From Normal Map** (Number: Boolean)
- **Use Vertex Colours** (Number: Boolean)
- **Height Intensity** (Number)
- **Faster Heightmapping** (Number: Boolean)
- **Double Sided** (Number: Boolean)

- **IBL LUT** (Object:Texture)
- **Diffuse Irradiance** (Object:Texture)
- **Pre-Filtered Envmap** (Object:Texture)
- **Num Mip Levels** (Number: Integer)
- **Albedo** (Object:Texture)
- **AORM** (Object:Texture)
- **Normal Map** (Object:Texture)
- **Emission** (Object:Texture)
- **Height** (Object:Texture)
- **Lightmap** (Object:Texture)
- **Thin Film** (Object:Texture)
- **Diffuse Intensity** (Number)
- **Specular Intensity** (Number)
- **Lightmap Is RGBE** (Number: Boolean)
- **Lightmap Intensity** (Number)

#### < Output

- **Next** (Trigger)
- **Shader** (Object)

**Example Patch:** [cables.gl/edit/9z9kFK](https://cables.gl/edit/9z9kFK)

**Doc:** [cables.gl/op/Ops.Gl.Pbr.PbrMaterial](https://cables.gl/op/Ops.Gl.Pbr.PbrMaterial)

## 70 Ops.Gl.Phong

### 70.1 AmbientLight\_v4



**Full Name:** Ops.Gl.Phong.AmbientLight\_v4  
ambient light for phong material shading.

#### > Inputs

- **Trigger In** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Intensity** (Number)

#### < Output

- **Trigger Out** (Trigger)

**Example Patch:** [cables.gl/edit/g3ioXU](https://cables.gl/edit/g3ioXU)

**Doc:** [cables.gl/op/Ops.Gl.Phong.AmbientLight\\_v4](https://cables.gl/op/Ops.Gl.Phong.AmbientLight_v4)

### 70.2 DirectionalLight\_v5



**Full Name:** Ops.Gl.Phong.DirectionLight\_v5  
Directional light for phong shading.

#### > Inputs

- **Trigger In** (Trigger)
- **Cast Light** (Number: Boolean)
- **Intensity** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Specular R** (Number)
- **Specular G** (Number)
- **Specular B** (Number)
- **Cast Shadow** (Number: Boolean)
- **Rendering Active** (Number: Boolean)
- **Map Size Index** (Number: Integer)

- **Map Size** (String)
- **Shadow Strength** (Number)
- **LR-BottomTop** (Number)
- **Near** (Number)
- **Far** (Number)
- **Bias** (Number)
- **Polygon Offset** (Number: Integer)
- **Normal Offset** (Number)
- **Blur Amount** (Number)
- **Enable Advanced** (Number: Boolean)
- **MSAA Index** (Number: Integer)
- **MSAA** (String)
- **Texture Filter Index** (Number: Integer)
- **Texture Filter** (String)
- **Anisotropic Index** (Number: Integer)
- **Anisotropic** (String)

#### < Output

- **Trigger Out** (Trigger)
- **Shadow Map** (Object)

**Example Patch:** cables.gl/edit/nEWpXU

**Doc:** cables.gl/op/Ops.Gl.Phong.DirectionLight\_v5

## 70.3 LambertMaterial\_v2



LambertMaterial

**Full Name:** Ops.Gl.Phong.LambertMaterial\_v2

a simple shaded material.

#### > Inputs

- **Execute** (Trigger)
- **Diffuse R** (Number)
- **Diffuse G** (Number)
- **Diffuse B** (Number)
- **Diffuse A** (Number)
- **Diffuse Texture** (Object:Texture)
- **Colorize Texture** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Shader** (Object)

**Example Patch:** cables.gl/edit/PAvm26

**Doc:** cables.gl/op/Ops.Gl.Phong.LambertMaterial\_v2

## 70.4 PhongMaterial\_v6



PhongMaterial

**Full Name:** Ops.Gl.Phong.PhongMaterial\_v6

A shaded material for lighting objects.

#### > Inputs

- **Trigger In** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Albedo** (Number)
- **Roughness** (Number)
- **Fresnel Intensity** (Number)
- **Fresnel Width** (Number)
- **Fresnel Exponent** (Number)
- **Fresnel R** (Number)
- **Fresnel G** (Number)
- **Fresnel B** (Number)
- **Emissive Active** (Number: Boolean)
- **Color Intensity** (Number)
- **Emissive R** (Number)
- **Emissive G** (Number)
- **Emissive B** (Number)
- **Shininess** (Number)
- **Specular Amount** (Number)
- **Diffuse Texture** (Object:Texture)
- **Specular Texture** (Object:Texture)
- **Normal Map** (Object:Texture)
- **AO Texture** (Object:Texture)
- **Emissive Texture** (Object:Texture)
- **Emissive Mask** (Object:Texture)
- **Opacity Texture** (Object:Texture)
- **Environment Map** (Object:Texture)
- **Env Map Mask** (Object:Texture)
- **Diffuse Repeat X** (Number)
- **Diffuse Repeat Y** (Number)
- **Texture Offset X** (Number)
- **texture pixel offset on the C axis** (applied to all textures)
- **Texture Offset Y** (Number)
- **texture pixel offset on the Y axis** (applied to all textures)
- **Specular Intensity** (Number)

- **Normal Map Intensity** (Number)
- **AO Intensity** (Number)
- **Emissive Intensity** (Number)
- **Emissive Mask Intensity** (Number)
- **Env Map Intensity** (Number)
- **Env Mask Intensity** (Number)

#### < Output

- **Trigger Out** (Trigger)
- **Shader** (Object)

**Example Patch:** [cables.gl/edit/L3HqYa](#)

**Doc:** [cables.gl/op/Ops.Gl.Phong.PhongMaterial\\_v6](#)

## 70.5 PointLight\_v5



**Full Name:** Ops.Gl.Phong.PointLight\_v5

Point light for phong shading.

#### > Inputs

- **Trigger In** (Trigger)
- **Cast Light** (Number: Boolean)
- **Intensity** (Number)
- **Radius** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Specular R** (Number)
- **Specular G** (Number)
- **Specular B** (Number)
- **Falloff** (Number)
- **Cast Shadow** (Number: Boolean)
- **Rendering Active** (Number: Boolean)
- **Shadow Strength** (Number)
- **Near** (Number)
- **Far** (Number)
- **Bias** (Number)
- **Polygon Offset** (Number: Integer)

#### < Output

- **Trigger Out** (Trigger)

- **Cubemap** (Object)
- **World Position X** (Number)
- **World Position Y** (Number)
- **World Position Z** (Number)

**Example Patch:** [cables.gl/edit/MybtXU](#)

**Doc:** [cables.gl/op/Ops.Gl.Phong.PointLight\\_v5](#)

## 70.6 ResetLights



**Full Name:** Ops.Gl.Phong.ResetLights

reset lights for everything triggered after.

#### > Inputs

- **Trigger In** (Trigger)
- **Reset Lights** (Number: Boolean)

#### < Output

- **Trigger Out** (Trigger)

**Example Patch:** [cables.gl/edit/eU7obl](#)

**Doc:** [cables.gl/op/Ops.Gl.Phong.ResetLights](#)

## 70.7 SpotLight\_v5



**Full Name:** Ops.Gl.Phong.SpotLight\_v5

spot light that emits a cone of light.

#### > Inputs

- **Trigger In** (Trigger)
- **Cast Light** (Number: Boolean)
- **Intensity** (Number)
- **Radius** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Point At X** (Number)
- **Point At Y** (Number)
- **Point At Z** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Specular R** (Number)

- **Specular G** (Number)
- **Specular B** (Number)
- **Cone Angle** (Number)
- **Inner Cone Angle** (Number)
- **Spot Exponent** (Number)
- **Falloff** (Number)
- **Cast Shadow** (Number: Boolean)
- **Rendering Active** (Number: Boolean)
- **Shadow Strength** (Number)

#### ◀ Output

- **Trigger Out** (Trigger)
- **Shadow Map** (Object)
- **World Position X** (Number)
- **World Position Y** (Number)
- **World Position Z** (Number)

**Example Patch:** cables.gl/edit/D5evXU

**Doc:** cables.gl/op/Ops.Gl.Phong.SpotLight\_v5

# 71 Ops.Gl.Shader

## 71.1 AttributeAsColorMaterial



**Full Name:** Ops.Gl.Shader.AttributeAsColorMaterial  
render mesh normals as colors.

#### ▶ Inputs

- **Render** (Trigger)
- **Absolute** (Number: Boolean)
- **World Space** (Number: Boolean)

#### ◀ Output

- **Trigger** (Trigger)
- **Shader** (Object)

**Example Patch:** cables.gl/edit/bZEZGc

**Doc:** cables.gl/op/Ops.Gl.Shader.AttributeAsColorMaterial

## 71.2 BasicMaterial\_v3



**Full Name:** Ops.Gl.Shader.BasicMaterial\_v3  
A material without shading.

#### ▶ Inputs

- **Render** (Trigger)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Texture** (Object:Texture)
- **ColorizeTexture** (Number: Boolean)
- **Vertex Colors** (Number: Boolean)
- **TextureOpacity** (Object:Texture)
- **Opacity TexCoords Transform** (Number: Boolean)
- **Discard Transparent Pixels** (Number: Boolean)
- **DiffuseRepeatX** (Number)
- **DiffuseRepeatY** (Number)
- **Tex Offset X** (Number)
- **Tex Offset Y** (Number)
- **Crop TexCoords** (Number: Boolean)

- **Billboard** (Number: Boolean)

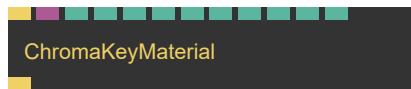
#### < Output

- **Trigger** (Trigger)
- **Shader** (Object)

**Example Patch:** cables.gl/edit/SKCL88

**Doc:** cables.gl/op/Ops.Gl.Shader.BasicMaterial\_v3

## 71.3 ChromaKeyMaterial



ChromaKeyMaterial

**Full Name:** Ops.Gl.Shader.ChromaKeyMaterial

display texture and replace a color with transparency.

#### > Inputs

- **Render** (Trigger)
- **Texture** (Object)
- **Mode Index** (Number: Integer)
- **WeightMul** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **White** (Number)
- **DiffuseRepeatX** (Number)
- **DiffuseRepeatY** (Number)
- **Tex Offset X** (Number)
- **Tex Offset Y** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/aDqoTq

**Doc:** cables.gl/op/Ops.Gl.Shader.ChromaKeyMaterial

## 71.4 CustomShader\_v2



CustomShader

**Full Name:** Ops.Gl.Shader.CustomShader\_v2

Write your own custom shader.

#### > Inputs

- **Render** (Trigger)
- **Fragment Code** (String)
- **Vertex Code** (String)

- **Use As Material** (Number: Boolean)

- **W** (Number)
- **H** (Number)
- **GPosition** (Object)
- **GNormal** (Object)
- **TexNoise** (Object)
- **Samples** (Array)
- **Projection** (Array)

#### < Output

- **Trigger** (Trigger)
- **Shader** (Object)
- **Has Errors** (booleanNumber)

**Example Patch:** cables.gl/edit/vWyGud

**Doc:** cables.gl/op/Ops.Gl.Shader.CustomShader\_v2

## 71.5 ErrorMaterial



**Full Name:** Ops.Gl.Shader.ErrorMaterial

draw meshes using the cables error material shader.

#### > Inputs

- **Render** (Trigger)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.Shader.ErrorMaterial#example

**Doc:** cables.gl/op/Ops.Gl.Shader.ErrorMaterial

## 71.6 FrontBacksideMaterial



**Full Name:** Ops.Gl.Shader.FrontBacksideMaterial

visualize which faces are facing the camera.

#### > Inputs

- **Render** (Trigger)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/Lm6p9r

**Doc:** cables.gl/op/Ops.Gl.Shader.FrontBacksideMaterial

## 71.7 GetShader

GetShader

**Full Name:** Ops.Gl.Shader.GetShader  
get current set shader.

### > Inputs

- **Update** (Trigger)

### < Output

- **Next** (Trigger)
- **Shader** (Object)

**Example Patch:** cables.gl/edit/BweOVL

**Doc:** cables.gl/op/Ops.Gl.Shader.GetShader

## 71.8 MatCapMaterial\_v3

MatCapMaterial

**Full Name:** Ops.Gl.Shader.MatCapMaterial\_v3

Easy to use image based lighting Material.

### > Inputs

- **Render** (Trigger)
- **MatCap** (Object:Texture)
- **Diffuse** (Object:Texture)
- **Normal** (Object:Texture)
- **Specular Mask** (Object:Texture)
- **Specular MatCap** (Object:Texture)
- **AO Texture** (Object:Texture)
- **Opacity Texture** (Object:Texture)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Opacity** (Number)
- **AO Intensity** (Number)
- **Normal Map Intensity** (Number)
- **Repeat X** (Number)
- **Repeat Y** (Number)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Double Sided** (Number: Boolean)
- **Screen Space Normals** (Number: Boolean)
- **check to use screen space normals** (flat shading)

- **Calc Normal Tangents** (Number: Boolean)
- **Opacity TexCoords Transform** (Number: Boolean)
- **Discard Transparent Pixels** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Shader** (Object)

**Example Patch:** cables.gl/edit/gWkgih

**Doc:** cables.gl/op/Ops.Gl.Shader.MatCapMaterial\_v3

## 71.9 MinifyGlsl

MinifyGlsl

**Full Name:** Ops.Gl.Shader.MinifyGlsl

Minify GLSL shader source code.

### > Inputs

- **Shader Source** (String)

### < Output

- **Minified Shader Source** (String)

**Example Patch:** cables.gl/edit/t5H1Qc

**Doc:** cables.gl/op/Ops.Gl.Shader.MinifyGlsl

## 71.10 PointMaterial\_v6

PointMaterial

**Full Name:** Ops.Gl.Shader.PointMaterial\_v6

Draw all vertices as points / circles.

### > Inputs

- **Render** (Trigger)
- **PointSize** (Number)
- **Size In Pixels** (Number: Boolean)
- **Random Size** (Number)
- **Round** (Number: Boolean)
- **Round Antialias** (Number: Boolean)
- **Scale By Distance** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)
- **Vertex Colors** (Number: Boolean)

- **Texture** (Object:Texture)
- **Colorize Texture** (Number: Boolean)
- **Texture Mask** (Object:Texture)
- **Texture Colorize** (Object:Texture)
- **Colorize Randomize** (Number: Boolean)
- **Texture Opacity** (Object:Texture)
- **Texture Point Size** (Object:Texture)
- **Texture Point Size Mul** (Number)
- **Flip Texture** (Number: Boolean)
- **Atlas Cross Fade** (Number: Boolean)
- **Atlas Repeat X** (Number)
- **Atlas Lookup** (Object:Texture)
- **Rotate Texture** (Object:Texture)
- **Min Point Size** (Number)

#### < Output

- **Trigger** (Trigger)
- **Shader** (Object)

**Example Patch:** cables.gl/edit/O9yR06

**Doc:** cables.gl/op/Ops.Gl.Shader.PointMaterial\_v6

## 71.11 PositionAsColorMaterial



**Full Name:** Ops.Gl.Shader.PositionAsColorMaterial

draw meshes using XYZ position coordinates as RGB color.

#### > Inputs

- **Render** (Trigger)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/qbilbk

**Doc:** cables.gl/op/Ops.Gl.Shader.PositionAsColorMaterial

## 71.12 SetShader



**Full Name:** Ops.Gl.Shader.SetShader

Reuse another shader at different points in the patch.

#### > Inputs

- **Render** (Trigger)

- **Shader** (Object)

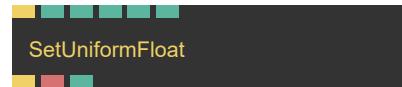
#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/BweOVL

**Doc:** cables.gl/op/Ops.Gl.Shader.SetShader

## 71.13 SetUniformFloat\_v2



**Full Name:** Ops.Gl.Shader.SetUniformFloat\_v2

set a uniform value of the current shader.

#### > Inputs

- **Render** (Trigger)
- **Uniform Index** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

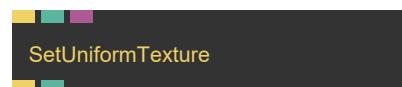
#### < Output

- **Next** (Trigger)
- **Type** (String)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/5W7X2F

**Doc:** cables.gl/op/Ops.Gl.Shader.SetUniformFloat\_v2

## 71.14 SetUniformTexture\_v2



**Full Name:** Ops.Gl.Shader.SetUniformTexture\_v2

set a uniform value of the current shader.

#### > Inputs

- **Render** (Trigger)
- **Uniform Index** (Number: Integer)
- **Texture** (Object:Texture)

#### < Output

- **Next** (Trigger)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/5W7X2F

**Doc:** cables.gl/op/Ops.Gl.Shader.SetUniformTexture\_v2

## 71.15 ShaderDefine

ShaderDefine

**Full Name:** Ops.Gl.Shader.ShaderDefine

Set shader defines.

### > Inputs

- **Shader** (Object)
- **Name** (String)
- **Value** (String)
- **Active** (Number: Boolean)
- **Public** (4): 1

### < Output

- Visit *Ops.Gl.Shader.ShaderDefine documentation* for output port details

**Example Patch:** cables.gl/op/Ops.Gl.Shader.ShaderDefine#example

**Doc:** cables.gl/op/Ops.Gl.Shader.ShaderDefine

## 71.16 ShaderInfo

ShaderInfo

**Full Name:** Ops.Gl.Shader.ShaderInfo

view current shader source code.

### > Inputs

- **Exec** (Trigger)
- **Show Fragment** (Trigger)
- **Show Vertex** (Trigger)
- **Show Modules** (Trigger)
- **Show Uniforms** (Trigger)
- **State Info** (Trigger)

### < Output

- **Next** (Trigger)
- **Source Frag** (String)
- **Source Vert** (String)
- **Name** (String)
- **Id** (String)
- **NeedsBarycentric** (booleanNumber)
- **Num Uniforms** (Number)
- **Num Attributes** (Number)
- **Attributes Names** (Array)
- **Num Defines** (Array)

**Example Patch:** cables.gl/op/Ops.Gl.Shader.ShaderInfo#example

**Doc:** cables.gl/op/Ops.Gl.Shader.ShaderInfo

## 71.17 ShaderInfoUniforms\_v2

ShaderInfoUniforms

**Full Name:** Ops.Gl.Shader.ShaderInfoUniforms\_v2

read back all uniforms values of the current bound shader.

### > Inputs

- **Exec** (Trigger)

### < Output

- **Next** (Trigger)
- **Uniforms** (Array)

**Example Patch:** cables.gl/op/Ops.Gl.Shader.ShaderInfoUniforms\_v2#example

**Doc:** cables.gl/op/Ops.Gl.Shader.ShaderInfoUniforms\_v2

## 71.18 ShaderToTexture\_v2

ShaderToTexture

**Full Name:** Ops.Gl.Shader.ShaderToTexture\_v2

render a shader into a texture.

### > Inputs

- **Render** (Trigger)
- **Shader** (Object:Shader)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Texture** (Object)
- **Texture 2** (Object)
- **Texture 3** (Object)
- **Texture 4** (Object)

**Example Patch:** cables.gl/edit/vWyGud

**Doc:** cables.gl/op/Ops.Gl.Shader.ShaderToTexture\_v2

## 71.19 VertexColorMaterial

VertexColorMaterial

**Full Name:** Ops.Gl.Shader.VertexColorMaterial

Draw a mesh, showing only its vertex colors.

### > Inputs

- **Render** (Trigger)
- **Opacity** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/6MsLhR

**Doc:** cables.gl/op/Ops.Gl.Shader.VertexColorMaterial

- **Diffuse A** (Number)
- **Fill** (Number: Boolean)
- **Fill R** (Number)
- **Fill G** (Number)
- **Fill B** (Number)
- **Fill A** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/bRISDe

**Doc:** cables.gl/op/Ops.Gl.Shader.WireframeMaterial\_v2

## 71.20 VertexNumberMaterial

VertexNumberMaterial

**Full Name:** Ops.Gl.Shader.VertexNumberMaterial

visually debug vertices of your 3D geometry.

### > Inputs

- **Render** (Trigger)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/x2PmHf

**Doc:** cables.gl/op/Ops.Gl.Shader.VertexNumberMaterial

## 71.21 WireframeMaterial\_v2

WireframeMaterial

**Full Name:** Ops.Gl.Shader.WireframeMaterial\_v2

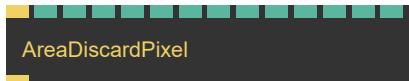
Renders following meshes as wireframes.

### > Inputs

- **Render** (Trigger)
- **Enable Depth Testing** (Number: Boolean)
- **Width** (Number)
- **AntiAlias** (Number)
- **Diffuse R** (Number)
- **Diffuse G** (Number)
- **Diffuse B** (Number)

# 72 Ops.Gl.ShaderEffects

## 72.1 AreaDiscardPixel\_v2



**Full Name:** Ops.Gl.ShaderEffects.AreaDiscardPixel\_v2

do not draw pixels inside a defined 3d area.

### > Inputs

- **Render** (Trigger)
- **Invert** (Number: Boolean)
- **Area Index** (Number: Integer)
- **Area** (Number: String)
- **Size** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Repeat** (Number: Boolean)
- **Repeat Distance** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **WorldSpace** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/GQiw18

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.AreaDiscardPixel\_v2

## 72.2 AreaRotate\_v2



**Full Name:** Ops.Gl.ShaderEffects.AreaRotate\_v2

rotate vertices in an area around a center point.

### > Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Strength** (Number)
- **Smooth** (Number: Boolean)
- **X** (Number)
- **Y** (Number)

- **Z** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/7mss1Q

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.AreaRotate\_v2

## 72.3 AreaScaler\_v3



**Full Name:** Ops.Gl.ShaderEffects.AreaScaler\_v3

Scales the size of meshes within the area of influence.

### > Inputs

- **Render** (Trigger)
- **Area Size** (Number)
- **Source Index** (Number: Integer)
- **Strength** (Number)
- **Smoothstep** (Number: Boolean)
- **Min Size Original** (Number: Boolean)
- **Clamp Size** (Number: Boolean)
- **Clamp Min** (Number)
- **Clamp Max** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Pos Z** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/LXN7D-

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.AreaScaler\_v3

## 72.4 AreaTranslateFBMNoise



**Full Name:** Ops.Gl.ShaderEffects.AreaTranslateFBMNoise

Area size of noise.

### > Inputs

- **Render** (Trigger)
- **Mode Index** (Number: Integer)
- **Size** (Number)
- **Strength** (Number)

- **Smooth** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Noise Scale** (Number)
- **Noise X** (Number)
- **Noise Y** (Number)
- **Noise Z** (Number)

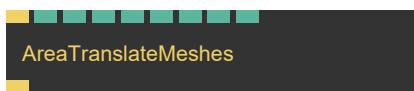
#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/hDcUC-](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.AreaTranslateFBMNoise](#)

## 72.5 AreaTranslateMeshes\_v3



AreaTranslateMeshes

**Full Name:** Ops.Gl.ShaderEffects.AreaTranslateMeshes\_v3

Change the position of all meshes inside of the area of influence.

#### ▶ Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Strength** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Multiply X** (Number)
- **Multiply Y** (Number)
- **Multiply Z** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/yWVQC-](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.AreaTranslateMeshes\\_v3](#)

## 72.6 Bend\_v2



Bend

**Full Name:** Ops.Gl.ShaderEffects.Bend\_v2

bend objects along an axis.

#### ▶ Inputs

- **Render** (Trigger)
- **Amount** (Number)
- **RotX** (Number)
- **RotY** (Number)
- **RotZ** (Number)
- **Scale** (Number)
- **Offset** (Number)
- **Limited** (Number: Boolean)

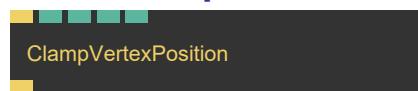
#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/HtcN9Z](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.Bend\\_v2](#)

## 72.7 ClampVertexPosition\_v2



ClampVertexPosition

**Full Name:** Ops.Gl.ShaderEffects.ClampVertexPosition\_v2

clamp/restrict the vertex position to min/max values per axis.

#### ▶ Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Min** (Number)
- **Max** (Number)
- **Update Normals** (Number: Boolean)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/RP4O73](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.ClampVertexPosition\\_v2](#)

## 72.8 ColorArea\_v5



ColorArea

**Full Name:** Ops.Gl.ShaderEffects.ColorArea\_v5

Colorize all meshes around current position.

#### ▶ Inputs

- **Render** (Trigger)
- **Area Index** (Number: Integer)
- **Size** (Number)
- **Roundness** (Number)

- **Amount** (Number)
- **Falloff** (Number)
- **Invert** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Change Size** (Number: Boolean)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Texture** (Object:Texture)
- **Priority** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/0Ti2gT](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.ColorArea\\_v5](#)

## 72.9 DeformArea



**Full Name:** Ops.Gl.ShaderEffects.DeformArea

deform a spherical area of a mesh.

#### > Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Strength** (Number)
- **Smooth** (Number: Boolean)
- **WorldSpace** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/CQ0wmo](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.DeformArea](#)

## 72.10 DiscardMaterialAlpha



**Full Name:** Ops.Gl.ShaderEffects.DiscardMaterialAlpha  
discard transparent pixels in material textures.

#### > Inputs

- **Render** (Trigger)
- **Method Index** (Number: Integer)
- **Threshold** (Number)

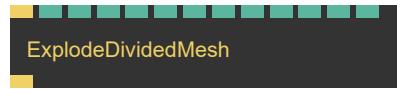
#### < Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/3r\\_lf6](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.DiscardMaterialAlpha](#)

## 72.11 ExplodeDividedMesh\_v2



**Full Name:** Ops.Gl.ShaderEffects.ExplodeDividedMesh\_v2  
explode a (divided) mesh in the direction of faces normals.

#### > Inputs

- **Render** (Trigger)
- **Distance** (Number)
- **Size** (Number)
- **Absolute** (Number: Boolean)
- **Add X** (Number)
- **Add Y** (Number)
- **Add Z** (Number)
- **Mul X** (Number)
- **Mul Y** (Number)
- **Mul Z** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

#### < Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/sYlxm1](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.ExplodeDividedMesh\\_v2](#)

## 72.12 FogEffect

FogEffect

**Full Name:** Ops.Gl.ShaderEffects.FogEffect

Fog as a shadereffect applied to a material.

### > Inputs

- **Render** (Trigger)
- **Mode Index** (Number: Integer)
- **Start** (Number)
- **End** (Number)
- **Amount** (Number)
- **R** (Number)
- **G** (Number)
- **B** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/3L3of6

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.FogEffect

## 72.13 FresnelGlow

FresnelGlow

**Full Name:** Ops.Gl.ShaderEffects.FresnelGlow

add fresnel glow to any material.

### > Inputs

- **Trigger In** (Trigger)
- **Active** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Fresnel Intensity** (Number)
- **Fresnel Exponent** (Number)

### < Output

- **Trigger Out** (Trigger)

**Example Patch:** cables.gl/edit/e02kYa

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.FresnelGlow

## 72.14 InstancedDisplacementMap\_v2

InstancedDisplacementMap

**Full Name:** Ops.Gl.ShaderEffects.InstancedDisplacementMap\_v2

displace positions of instanced meshes using a texture.

### > Inputs

- **Trigger** (Trigger)
- **Texture** (Object:Texture)
- **Source Index** (Number: Integer)
- **Mode Index** (Number: Integer)
- **Strength** (Number)
- **Min** (Number)
- **Scale** (Number)
- **Clamp** (Number: Boolean)
- **Colorize** (Number: Boolean)
- **Debug Bounds** (Number: Boolean)
- **Normalize** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Abs** (Number: Boolean)
- **Channel Index** (Number: Integer)
- **X** (Number: Boolean)
- **Y** (Number: Boolean)
- **Z** (Number: Boolean)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/yQJfFj

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.InstancedDisplacementMap\_v2

## 72.15 InstancedPerlinPosition\_v2

InstancedPerlinPosition

**Full Name:** Ops.Gl.ShaderEffects.InstancedPerlinPosition\_v2

displace position of instanced object by perlin noise value.

### > Inputs

- **Render** (Trigger)
- **Strength** (Number)
- **Scroll X** (Number)
- **Scroll Y** (Number)
- **Scroll Z** (Number)

- **Scale** (Number)
- **Method Index** (Number: Integer)
- **Method** (String)
- **Mul X** (Number)
- **Mul Y** (Number)
- **Mul Z** (Number)
- **Min Scale** (Number)
- **WorldSpace** (Number: Boolean)

#### ◀ Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/33bSY7](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.InstancedPerlinPosition\\_v2](#)

## 72.16 InstancedTextureColorize



**Full Name:** Ops.Gl.ShaderEffects.InstancedTextureColorize  
colorize instanced meshes using a texture.

#### ▶ Inputs

- **Trigger** (Trigger)
- **Texture** (Object:Texture)
- **Strength** (Number)
- **Scale** (Number)
- **Clamp** (Number: Boolean)
- **Debug Bounds** (Number: Boolean)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Method Index** (Number: Integer)

#### ◀ Output

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/yQJfFj](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.InstancedTextureColorize](#)

## 72.17 LimitMeshByTexCoord



**Full Name:** Ops.Gl.ShaderEffects.LimitMeshByTexCoord  
discard pixel if texture coordinate is below threshold.

#### ▶ Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Threshold** (Number)
- **Sine Animation** (Number: Boolean)
- **Time** (Number)
- **Sine Source Index** (Number: Integer)
- **Frequency** (Number)
- **Amplitude** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/pHfgJ5](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.LimitMeshByTexCoord](#)

## 72.18 MeshPixelNoise\_v2



**Full Name:** Ops.Gl.ShaderEffects.MeshPixelNoise\_v2  
3d space noise for mesh materials.

#### ▶ Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Amount** (Number)
- **Blendmode Index** (Number: Integer)
- **Blendmode** (String)
- **WorldSpace** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

#### ◀ Output

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/V7rjQ6](#)

**Doc:** [cables.gl/op/Ops.Gl.ShaderEffects.MeshPixelNoise\\_v2](#)

## 72.19 ModuloVertexPosition

ModuloVertexPosition

**Full Name:** Ops.Gl.ShaderEffects.ModuloVertexPosition  
vertex shader modulo operation on vertex position.

### > Inputs

- **Render** (Trigger)
- **Axis Index** (Number: Integer)
- **Modulo** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/IMCl\_8

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.ModuloVertexPosition

## 72.20 PerlinAreaDeform\_v4

PerlinAreaDeform

**Full Name:** Ops.Gl.ShaderEffects.PerlinAreaDeform\_v4

Displace vertices using perlin noise animation.

### > Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Size** (Number)
- **Strength** (Number)
- **Calc Normals** (Number: Boolean)
- **Flip Normals** (Number: Boolean)
- **Falloff** (Number)
- **Output Index** (Number: Integer)
- **Source Index** (Number: Integer)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scroll X** (Number)
- **Scroll Y** (Number)
- **Scroll Z** (Number)
- **WorldSpace** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/8RexP8

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.PerlinAreaDeform\_v4

## 72.21 ScaleByNormal\_v2

ScaleByNormal

**Full Name:** Ops.Gl.ShaderEffects.ScaleByNormal\_v2

Scale vertices of an object in the direction of face normals.

### > Inputs

- **Render** (Trigger)
- **Strength** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/Ft2xm1

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.ScaleByNormal\_v2

## 72.22 Shadow\_v3

Shadow

**Full Name:** Ops.Gl.ShaderEffects.Shadow\_v3

add shadow capabilities to any material.

### > Inputs

- **Trigger In** (Trigger)
- **Cast Shadow** (Number: Boolean)
- **Receive Shadow** (Number: Boolean)
- **Sample Distribution** (Number: Integer)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Discard Transparent** (Number: Boolean)
- **Opacity Threshold** (Number)
- **Opacity Texture** (Object:Texture)
- **Cull Backfacing** (Number: Boolean)

### < Output

- **Trigger Out** (Trigger)

**Example Patch:** cables.gl/edit/auVl18

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.Shadow\_v3

## 72.23 SplineDeform\_v2

SplineDeform

**Full Name:** Ops.Gl.ShaderEffects.SplineDeform\_v2

Deform a mesh along a spline.

### > Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Offset** (Number)
- **Points** (Array)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/F-UNZ4

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.SplineDeform\_v2

## 72.24 TextureProjection\_v2

TextureProjection

**Full Name:** Ops.Gl.ShaderEffects.TextureProjection\_v2

texture projection on meshes.

### > Inputs

- **Render** (Trigger)
- **Texture** (Object:Texture)
- **BlendMode Index** (Number: Integer)
- **Amount** (Number)
- **Scale** (Number)
- **Use Texture Alpha** (Number: Boolean)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Rot X** (Number)
- **Rot Y** (Number)
- **Rot Z** (Number)
- **Mapping Index** (Number: Integer)
- **Discard** (Number: Boolean)
- **WorldSpace** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/fJHt0e

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.TextureProjection\_v2

## 72.25 TransformTextureCoordinates

TransformTextureCoordinates

**Full Name:** Ops.Gl.ShaderEffects.TransformTextureCoordinates

Transform and repeat texture coordinates of a mesh via vertex shader.

### > Inputs

- **Render** (Trigger)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Repeat X** (Number)
- **Repeat Y** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Rotation** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/YzNrx8

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.TransformTextureCoordinates

## 72.26 TransformVertex

TransformVertex

**Full Name:** Ops.Gl.ShaderEffects.TransformVertex

transform vertices of a mesh via vertex shader.

### > Inputs

- **Render** (Trigger)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)
- **Transform Normals** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/u1iOhI

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.TransformVertex

## 72.27 Twist\_v3



**Full Name:** Ops.Gl.ShaderEffects.Twist\_v3

twist a mesh around an axis.

### > Inputs

- **Render** (Trigger)
- **Degree** (Number)
- **Height** (Number)
- **Axis Index** (Number: Integer)
- **Axis** (Number: String)

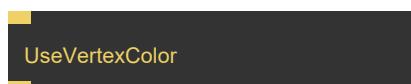
### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/VYPLJ5

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.Twist\_v3

## 72.28 UseVertexColor



**Full Name:** Ops.Gl.ShaderEffects.UseVertexColor

Use vertex color as basecolor/diffuse color.

### > Inputs

- **Render** (Trigger)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/ep1Umu

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.UseVertexColor

## 72.29 VertexArea



**Full Name:** Ops.Gl.ShaderEffects.VertexArea

transform an area of a mesh.

### > Inputs

- **Render** (Trigger)
- **Area Index** (Number: Integer)

- **Visualize Area** (Number: Boolean)
- **WorldSpace** (Number: Boolean)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Radius** (Number)
- **Area Size X** (Number)
- **Area Size Y** (Number)
- **Area Size Z** (Number)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)

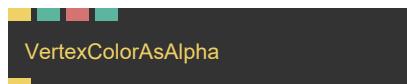
### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.Gl.ShaderEffects.VertexArea#example

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.VertexArea

## 72.30 VertexColorAsAlpha



**Full Name:** Ops.Gl.ShaderEffects.VertexColorAsAlpha

Use mesh vertexcolor as Alpha/Opacity.

### > Inputs

- **Render** (Trigger)
- **Input Index** (Number: Integer)
- **Invert** (Number: Boolean)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/ChcFXk

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.VertexColorAsAlpha

## 72.31 VertexDisplacementMap\_v5



**Full Name:** Ops.Gl.ShaderEffects.VertexDisplacementMap\_v5

Displace the vertices of a mesh with the pixels brightness values from a texture.

#### > Inputs

- **Render** (Trigger)
- **Extrude** (Number)
- **Texture** (Object:Texture)
- **Offset X** (Number)
- **Offset Y** (Number)
- **Scale** (Number)
- **Calc Normals** (Number: Boolean)
- **Discard Zero Values** (Number: Boolean)
- **Colorize** (Number: Boolean)
- **Colorize Min** (Number)
- **Colorize Max** (Number)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/aSWlLu

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.VertexDisplacementMap\_v5

## 72.32 VertexNumberLimit\_v2



**Full Name:** Ops.Gl.ShaderEffects.VertexNumberLimit\_v2

only draw the first X vertices of a mesh.

#### > Inputs

- **Render** (Trigger)
- **Min** (Number: Integer)
- **Max** (Number: Integer)
- **Invert** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/gLrrJV

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.VertexNumberLimit\_v2

## 72.33 VertexPositionFromTexture\_v2



**Full Name:** Ops.Gl.ShaderEffects.VertexPositionFromTexture\_v2

set vertex positions of a mesh from a texture.

#### > Inputs

- **Render** (Trigger)

#### > Inputs

- **Texture** (Object:Texture)

- **Mode Index** (Number: Integer)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/LDFZgL

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.VertexPositionFromTexture\_v2

## 72.34 VertexWobble\_v2



**Full Name:** Ops.Gl.ShaderEffects.VertexWobble\_v2

sine wave vertex displacement.

#### > Inputs

- **Render** (Trigger)
- **Source Index** (Number: Integer)
- **Amount** (Number)
- **Time** (Number)
- **Scale** (Number)
- **AxisX** (Number: Boolean)
- **AxisY** (Number: Boolean)
- **AxisZ** (Number: Boolean)
- **Area Index** (Number: Integer)
- **Size** (Number)
- **Falloff** (Number)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **WorldSpace** (Number: Boolean)
- **Invert** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/0PxhuO

**Doc:** cables.gl/op/Ops.Gl.ShaderEffects.VertexWobble\_v2

# 73 Ops.Gl.Textures

## 73.1 Base64ToTexture



Base64ToTexture

**Full Name:** Ops.Gl.Textures.Base64ToTexture

Converts a base-64 image string into a texture.

### > Inputs

- **Wrap Index** (Number: Integer)
- **Pre Multiplied Alpha** (Number: Boolean)

### < Output

- **Texture** (Object)
- **Has Error** (booleanNumber)
- **Loading** (booleanNumber)

**Example Patch:** cables.gl/edit/dNuMWr

**Doc:** cables.gl/op/Ops.Gl.Textures.Base64ToTexture

## 73.2 ColorTexture



ColorTexture

**Full Name:** Ops.Gl.Textures.ColorTexture

Simple texture filled with one color.

### > Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

### < Output

- **Texture\_out** (Object)

**Example Patch:** cables.gl/edit/QuT1X2

**Doc:** cables.gl/op/Ops.Gl.Textures.ColorTexture

## 73.3 CombineTextures



CombineTextures

**Full Name:** Ops.Gl.Textures.CombineTextures

combine multiple textures into one by copying colorchannels.

### > Inputs

- **Execute** (Trigger)
- **Filter Index** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Pixel Format Index** (Number: Integer)
- **Size Index** (Number: Integer)
- **R** (Object:Texture)
- **R Source Index** (Number: Integer)
- **R Value Index** (Number: Integer)
- **R Default** (Number)
- **G** (Object:Texture)
- **G Source Index** (Number: Integer)
- **G Value Index** (Number: Integer)
- **G Default** (Number)
- **B** (Object:Texture)
- **B Source Index** (Number: Integer)
- **B Value Index** (Number: Integer)
- **B Default** (Number)
- **A** (Object:Texture)
- **A Source Index** (Number: Integer)
- **A Value Index** (Number: Integer)
- **A Default** (Number)

### < Output

- **Next** (Trigger)
- **Texture** (Object)

**Example Patch:** cables.gl/edit/yZJ2WW

**Doc:** cables.gl/op/Ops.Gl.Textures.CombineTextures

## 73.4 CopyTexture\_v3



CopyTexture

**Full Name:** Ops.Gl.Textures.CopyTexture\_v3

copy a texture and optionally resize it.

### > Inputs

- **Render** (Trigger)
- **Texture** (Object:Texture)
- **Alpha Mask** (Object:Texture)
- **Use Original Size** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Pixel Format Index** (Number: Integer)
- **Wrap Index** (Number: Integer)

- **Invert A** (Number: Boolean)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)

**< Output**

- **Trigger** (Trigger)
- **Texture\_out** (Object)
- **Aspect Ratio** (Number)

**Example Patch:** cables.gl/edit/G2\_my7

**Doc:** cables.gl/op/Ops.Gl.Textures.CopyTexture\_v3

## 73.5 EmptyTexture



**Full Name:** Ops.Gl.Textures.EmptyTexture

A very simple empty transparent texture with an opacity of 0.

**> Inputs**

- **Width** (Number)
- **Height** (Number)

**< Output**

- **Texture** (Object)

**Example Patch:** cables.gl/edit/QuT1X2

**Doc:** cables.gl/op/Ops.Gl.Textures.EmptyTexture

## 73.6 ExrTexture



**Full Name:** Ops.Gl.Textures.ExrTexture

load .exr floating point texture files.

**> Inputs**

- **EXR File** (String)
- **Remove Alpha** (Number: Boolean)
- **Flip** (Number: Boolean)

**< Output**

- **Texture** (Object)
- **Width** (Number)
- **Height** (Number)
- **Channels** (String)
- **Loading** (booleanNumber)

**Example Patch:** cables.gl/edit/zHxXMW

**Doc:** cables.gl/op/Ops.Gl.Textures.ExrTexture

## 73.7 GraphTexture



**Full Name:** Ops.Gl.Textures.GraphTexture

draw a graph of a value into a texture.

**> Inputs**

- **Trigger** (Trigger)
- **Value** (Number)
- **Index** (Number: Integer)
- **Reset** (Trigger)
- **Color Random Seed** (Number)
- **Texture Width** (Number: Integer)
- **Texture Height** (Number: Integer)

**< Output**

- **Texture** (Object)

**Example Patch:** cables.gl/edit/eqfKTx

**Doc:** cables.gl/op/Ops.Gl.Textures.GraphTexture

## 73.8 Histogram



**Full Name:** Ops.Gl.Textures.Histogram

graphical representation of distribution of color in a texture.

**> Inputs**

- **Trigger** (Trigger)
- **Texture** (Object:Texture)

**< Output**

- **Histogram Texture** (Object)
- **Histogram Data** (Object)

**Example Patch:** cables.gl/edit/Z315nc

**Doc:** cables.gl/op/Ops.Gl.Textures.Histogram

## 73.9 MontageTextures\_v2



**Full Name:** Ops.Gl.Textures.MontageTextures\_v2

combine multiple textures into one by copying colorchannels.

#### > Inputs

- **Execute** (Trigger)
- **Flip Order** (Number: Boolean)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **PixelFormat Index** (Number: Integer)
- **Texture 0** (Object:Texture)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)
- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)
- **Texture 9** (Object:Texture)
- **Texture 10** (Object:Texture)
- **Texture 11** (Object:Texture)
- **Texture 12** (Object:Texture)
- **Texture 13** (Object:Texture)
- **Texture 14** (Object:Texture)
- **Texture 15** (Object:Texture)

#### < Output

- **Next** (Trigger)
- **Texture** (Object)
- **Columns** (Number)
- **Rows** (Number)

**Example Patch:** cables.gl/edit/pM45O8

**Doc:** cables.gl/op/Ops.Gl.Textures.MontageTextures\_v2

## 73.10 NoiseTexture



**Full Name:** Ops.Gl.Textures.NoiseTexture

Simple noisetexture.

#### > Inputs

- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Wrap Index** (Number: Integer)

- **Color** (Number: Boolean)
- **PixelFormat Index** (Number: Integer)
- **Integer** (Number: Boolean)
- **Seed** (Number)
- **Channel R** (Number: Boolean)
- **Min R** (Number)
- **Max R** (Number)
- **Channel G** (Number: Boolean)
- **Min G** (Number)
- **Max G** (Number)
- **Channel B** (Number: Boolean)
- **Min B** (Number)
- **Max B** (Number)
- **Channel A** (Number: Boolean)
- **Min A** (Number)
- **Max A** (Number)

#### < Output

- **Texture** (Object)
- **Total Pixel** (Number)

**Example Patch:** cables.gl/edit/Lv4hay

**Doc:** cables.gl/op/Ops.Gl.Textures.NoiseTexture

## 73.11 PaletteTexture



**Full Name:** Ops.Gl.Textures.PaletteTexture

Create a RGB color palette using an array.

#### > Inputs

- **Palette Array** (Array)
- **Smooth** (Number: Boolean)

#### < Output

- **Color Array** (Array)
- **Texture** (Object)

**Example Patch:** cables.gl/edit/tdRoSP

**Doc:** cables.gl/op/Ops.Gl.Textures.PaletteTexture

## 73.12 SequenceTextures

SequenceTextures

**Full Name:** Ops.Gl.Textures.SequenceTextures  
control order and flow of objects.

### > Inputs

- **Texture 0** (Object:Texture)
- **Texture 1** (Object:Texture)
- **Texture 2** (Object:Texture)
- **Texture 3** (Object:Texture)
- **Texture 4** (Object:Texture)
- **Texture 5** (Object:Texture)
- **Texture 6** (Object:Texture)
- **Texture 7** (Object:Texture)
- **Texture 8** (Object:Texture)
- **Texture 9** (Object:Texture)
- **Texture 10** (Object:Texture)
- **Texture 11** (Object:Texture)
- **Texture 12** (Object:Texture)
- **Texture 13** (Object:Texture)
- **Texture 14** (Object:Texture)
- **Texture 15** (Object:Texture)

### < Output

- **Output 0** (Object)
- **Output 1** (Object)
- **Output 2** (Object)
- **Output 3** (Object)
- **Output 4** (Object)
- **Output 5** (Object)
- **Output 6** (Object)
- **Output 7** (Object)
- **Output 8** (Object)
- **Output 9** (Object)
- **Output 10** (Object)
- **Output 11** (Object)
- **Output 12** (Object)
- **Output 13** (Object)
- **Output 14** (Object)
- **Output 15** (Object)

**Example Patch:** cables.gl/op/Ops.Gl.Textures.SequenceTextures#example

**Doc:** cables.gl/op/Ops.Gl.Textures.SequenceTextures

## 73.13 SSAO

SSAO

**Full Name:** Ops.Gl.Textures.SSAO  
screen space ambient occlusion from depth texture.

### > Inputs

- **Execute** (Trigger)
- **Depth Texture** (Object:Texture)
- **Radius** (Number)
- **Max Dist** (Number)
- **Begin** (Number)
- **End** (Number)
- **Strength** (Number)
- **Base** (Number)
- **Filter Index** (Number: Integer)

### < Output

- **Next** (Trigger)
- **SSAO** (Object)

**Example Patch:** cables.gl/edit/qt0JiG

**Doc:** cables.gl/op/Ops.Gl.Textures.SSAO

## 73.14 SwitchTextureMultiPort\_v2

SwitchTextureMultiPort

**Full Name:** Ops.Gl.Textures.SwitchTextureMultiPort\_v2  
Switch between multiple textures.

### > Inputs

- **Index** (Number: Integer)
- **Textures\_0** (Object)
- **Add Port** (Object)

### < Output

- **Texture** (Object)
- **Num Textures** (Number)

**Example Patch:** cables.gl/edit/pDGOrh

**Doc:** cables.gl/op/Ops.Gl.Textures.SwitchTextureMultiPort\_v2

## 73.15 SwitchTextures\_v2

SwitchTextures

**Full Name:** Ops.Gl.Textures.SwitchTextures\_v2

Switch between different textures.

### > Inputs

- **Exec** (Trigger)
- **Num** (Number: Integer)
- **Default Texture Transparent** (Number: Boolean)
- **Texture0** (Object:Texture)
- **Texture1** (Object:Texture)
- **Texture2** (Object:Texture)
- **Texture3** (Object:Texture)
- **Texture4** (Object:Texture)
- **Texture5** (Object:Texture)
- **Texture6** (Object:Texture)
- **Texture7** (Object:Texture)
- **Texture8** (Object:Texture)
- **Texture9** (Object:Texture)
- **Texture10** (Object:Texture)
- **Texture11** (Object:Texture)
- **Texture12** (Object:Texture)
- **Texture13** (Object:Texture)
- **Texture14** (Object:Texture)
- **Texture15** (Object:Texture)

### < Output

- **Next** (Trigger)
- **Texture** (Object)

**Example Patch:** cables.gl/edit/gsXwVJ

**Doc:** cables.gl/op/Ops.Gl.Textures.SwitchTextures\_v2

## 73.16 TextTexture\_v6

TextTexture

**Full Name:** Ops.Gl.Textures.TextTexture\_v6

Generates a texture of Text using one of the font ops.

### > Inputs

- **Render** (Trigger)
- **Text** (String)
- **Draw Mesh** (Number: Boolean)

- **Scale Mesh** (Number)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Auto Height** (Number: Boolean)
- **Auto Line Breaks** (Number: Boolean)
- **Font** (String)
- **Weight** (String)
- **FontSize** (Number)
- **Letter Spacing** (Number)
- **Line Height Add** (Number)
- **Padding Y Top** (Number: Integer)
- **Padding Y Bottom** (Number: Integer)
- **Padding X** (Number: Integer)
- **Wrap Index** (Number: Integer)
- **Reuse Texture** (Number: Boolean)
- **Show Debug** (Number: Boolean)
- **Redraw On Font Load** (Number: Boolean)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Opacity** (Number)
- **Background R** (Number)
- **Background G** (Number)
- **Background B** (Number)
- **Background A** (Number)
- **Force Redraw** (Trigger)

### < Output

- **Next** (Trigger)
- **Ratio** (Number)
- **Texture** (Object)
- **Canvas** (Object)
- **Aspect** (Number)
- **Num Lines** (Number)

**Example Patch:** cables.gl/edit/RZsPWU

**Doc:** cables.gl/op/Ops.Gl.Textures.TextTexture\_v6

## 73.17 TextureArrayInfo

TextureArrayInfo

**Full Name:** Ops.Gl.Textures.TextureArrayInfo

Information about Textures in an array.

#### > Inputs

- **Texture Array** (Array)

#### < Output

- **Names** (Array)
- **Widths** (Array)
- **Heights** (Array)

**Example Patch:** cables.gl/edit/vS5fjz

**Doc:** cables.gl/op/Ops.Gl.Textures.TextureArrayInfo

## 73.18 TextureInfo\_v2



**Full Name:** Ops.Gl.Textures.TextureInfo\_v2

Outputs information about the connected texture.

#### > Inputs

- **Texture** (Object:Texture)

#### < Output

- **Name** (String)
- **PixelFormat** (String)
- **Width** (Number)
- **Height** (Number)
- **Ratio** (Number)
- **Filter** (Number)
- **Wrap** (Number)
- **Flipped** (booleanNumber)
- **HDR** (booleanNumber)
- **IsEmpty Default Texture** (booleanNumber)
- **Is Default Texture** (booleanNumber)
- **Is Cubemap** (booleanNumber)
- **Id** (Number)

**Example Patch:** cables.gl/edit/y0A18i

**Doc:** cables.gl/op/Ops.Gl.Textures.TextureInfo\_v2

## 73.19 TextureSVG\_v2



**Full Name:** Ops.Gl.Textures.TextureSVG\_v2

Load a SVG image and convert to a texture of pixels.

#### > Inputs

- **File** (String)

- **Texture Width** (Number: Integer)

- **Texture Height** (Number: Integer)

- **Wrap Index** (Number: Integer)

- **Filter Index** (Number: Integer)

#### < Output

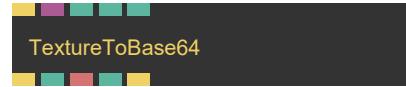
- **Texture** (Object)

- **Loaded** (booleanNumber)

**Example Patch:** cables.gl/edit/oqCKY6

**Doc:** cables.gl/op/Ops.Gl.Textures.TextureSVG\_v2

## 73.20 TextureToBase64\_v5



**Full Name:** Ops.Gl.Textures.TextureToBase64\_v5

Converts a texture into a base-64 image string.

#### > Inputs

- **Trigger** (Trigger)
- **Texture** (Object:Texture)
- **Quality** (Number)
- **Output DataUrl** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Binary Size** (Number)
- **Base64 String** (String)
- **Loading** (booleanNumber)
- **Finished** (Trigger)

**Example Patch:** cables.gl/edit/dNuMWr

**Doc:** cables.gl/op/Ops.Gl.Textures.TextureToBase64\_v5

## 73.21 TextureToCoordinateGrid



**Full Name:** Ops.Gl.Textures.TextureToCoordinateGrid

convert a texture to a 3d coordinate grid storing coordinates in texture RGB channels.

#### > Inputs

- **Execute** (Trigger)

- **Texture** (Object:Texture)

- **Aspect** (Number)
- **Threshold** (Number)
- **Repeats** (Number: Integer)
- **Repeats Spacing** (Number)

**< Output**

- **Next** (Trigger)
- **HDR Texture** (Object)

**Example Patch:** cables.gl/edit/nMBUVW

**Doc:** cables.gl/op/Ops.Gl.Textures.TextureToCoordinateGrid

## 73.22 VideoTexture\_v3



**Full Name:** Ops.Gl.Textures.VideoTexture\_v3

Play a video file and use it as a texture.

**> Inputs**

- **Update** (Trigger)
- **File** (String)
- **Play** (Number: Boolean)
- **Loop** (Number: Boolean)
- **Volume** (Number)
- **Mute** (Number: Boolean)
- **Update FPS** (Number)
- **Wrap Index** (Number: Integer)
- **Flip** (Number: Boolean)
- **Speed** (Number)
- **Set Time** (Number)
- **Rewind** (Trigger)
- **Preload** (Number: Boolean)
- **Show Interaction Needed Button** (Number: Boolean)

**< Output**

- **Next** (Trigger)
- **Texture** (Object)
- **Duration** (Number)
- **Progress** (Number)
- **Interaction Needed** (booleanNumber)
- **CurrentTime** (Number)
- **Loading** (booleanNumber)
- **Playing** (booleanNumber)
- **Can Play Through** (booleanNumber)
- **Width** (Number)

- **Height** (Number)
- **Aspect Ratio** (Number)
- **Has Error** (booleanNumber)
- **Auto FPS** (booleanNumber)
- **Error Message** (String)

**Example Patch:** cables.gl/edit/RQCm0m

**Doc:** cables.gl/op/Ops.Gl.Textures.VideoTexture\_v3

## 73.23 WebcamTexture\_v3



**Full Name:** Ops.Gl.Textures.WebcamTexture\_v3

Use your webcam camera as a texture.

**> Inputs**

- **Render** (Trigger)
- **Active** (Number: Boolean)
- **Generate Texture** (Number: Boolean)
- **Webcam Input Index** (Number: Integer)
- **Requested Width** (Number: Integer)
- **Requested Height** (Number: Integer)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Show HTML Element** (Number: Boolean)
- **CSS** (String)
- **Element Flip X** (Number: Boolean)
- **Element Flip Y** (Number: Boolean)

**< Output**

- **Next** (Trigger)
- **Texture** (Object)
- **Ratio** (Number)
- **Available** (booleanNumber)
- **Size Width** (Number)
- **Size Height** (Number)
- **Error** (String)
- **HTML Element** (Object)
- **Available Devices** (Array)
- **Active Device** (String)
- **Texture Updated** (Trigger)

**Example Patch:** cables.gl/edit/iwaEwm

**Doc:** cables.gl/op/Ops.Gl.Textures.WebcamTexture\_v3

# 74 Ops.Graphics

## 74.1 ArrayToExr



ArrayToExr

**Full Name:** Ops.Graphics.ArrayToExr

convert and download an array of numbers as an .exr image file.

### > Inputs

- **Array** (Array)
- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **ZIP Compression** (Number: Boolean)
- **Filename** (String)
- **Download** (Trigger)

### < Output

- Visit *Ops.Graphics.ArrayToExr documentation* for output port details

**Example Patch:** cables.gl/edit/PoAXNA

**Doc:** cables.gl/op/Ops.Graphics.ArrayToExr

## 74.2 DepthTest



DepthTest

**Full Name:** Ops.Graphics.DepthTest

change depth testing method (depthMask,depthWrite,depthFunc).

### > Inputs

- **Render** (Trigger)
- **Enable Depth Testing** (Number: Boolean)
- **Depth Test Method Index** (Number: Integer)
- **Write To Depth Buffer** (Number: Boolean)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/A9PD8i

**Doc:** cables.gl/op/Ops.Graphics.DepthTest

## 74.3 GeometryMergeSimple



GeometryMergeSimple

**Full Name:** Ops.Graphics.GeometryMergeSimple

merge two geometries into one.

### > Inputs

- **Geometry** (Object)
- **Geometry 2** (Object)

### < Output

- **Geometry Result** (Object)

**Example Patch:** cables.gl/edit/4gsNve

**Doc:** cables.gl/op/Ops.Graphics.GeometryMergeSimple

## 74.4 GetMaterialId



GetMaterialId

**Full Name:** Ops.Graphics.GetMaterialId

get the id/index of the current set material.

### > Inputs

- **Update** (Trigger)

### < Output

- **Next** (Trigger)
- **Material Id** (Number)

**Example Patch:** cables.gl/edit/PYpQit

**Doc:** cables.gl/op/Ops.Graphics.GetMaterialId

## 74.5 GetObjectId



GetObjectId

**Full Name:** Ops.Graphics.GetObjectId

get the id/index of the current object/mesh.

### > Inputs

- **Update** (Trigger)

### < Output

- **Next** (Trigger)
- **Material Id** (Number)

**Example Patch:** cables.gl/op/Ops.Graphics.GetObjectId#example

**Doc:** cables.gl/op/Ops.Graphics.GetObjectId

## 74.6 OrbitControls\_v3

OrbitControls

**Full Name:** Ops.Graphics.OrbitControls\_v3

rotate your object by clicking and dragging the mouse.

### > Inputs

- **Render** (Trigger)
- **Min Distance** (Number)
- **Max Distance** (Number)
- **Min Rot Y** (Number)
- **Max Rot Y** (Number)
- **Initial Radius** (Number)
- **Initial Axis Y** (Number)
- **Initial Axis X** (Number)
- **Smoothness** (Number)
- **Speed X** (Number)
- **Speed Y** (Number)
- **Active** (Number: Boolean)
- **Allow Panning** (Number: Boolean)
- **Allow Zooming** (Number: Boolean)
- **Allow Rotation** (Number: Boolean)
- **Restricted** (Number: Boolean)
- **Identity** (Number: Boolean)
- **Reset** (Trigger)

### < Output

- **Trigger** (Trigger)
- **Radius** (Number)
- **Rot X** (Number)
- **Rot Y** (Number)

**Example Patch:** cables.gl/edit/Krorsh

**Doc:** cables.gl/op/Ops.Graphics.OrbitControls\_v3

## 74.7 Transform

Transform

**Full Name:** Ops.Graphics.Transform

Transform objects in 3d space (rotate, translate, scale).

### > Inputs

- **Render** (Trigger)
- **PosX** (Number)

- **PosY** (Number)
- **PosZ** (Number)
- **Scale** (Number)
- **RotX** (Number)
- **RotY** (Number)
- **RotZ** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/o741ft

**Doc:** cables.gl/op/Ops.Graphics.Transform

## 74.8 TransformView

TransformView

**Full Name:** Ops.Graphics.TransformView

the most simple camera op / transform the viewmatrix.

### > Inputs

- **Render** (Trigger)
- **PosX** (Number)
- **PosY** (Number)
- **PosZ** (Number)
- **Scale** (Number)
- **RotX** (Number)
- **RotY** (Number)
- **RotZ** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/0GAv8i

**Doc:** cables.gl/op/Ops.Graphics.TransformView

# 75 Ops.Graphics.Geometry

## 75.1 AlignGeometry

AlignGeometry

**Full Name:** Ops.Graphics.Geometry.AlignGeometry  
align a geometry / change its pivot / center / origin point.

### > Inputs

- **Geometry** (Object)
- **X Index** (Number: Integer)
- **Y Index** (Number: Integer)
- **Z Index** (Number: Integer)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/FbXQ-G

**Doc:** cables.gl/op/Ops.Graphics.Geometry.AlignGeometry

## 75.2 BoundingBox

BoundingBox

**Full Name:** Ops.Graphics.Geometry.BoundingBox  
create a simple bounding box from width,height,depth.

### > Inputs

- **Width** (Number)
- **Height** (Number)
- **Depth** (Number)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Graphics.Geometry.BoundingBox#example

**Doc:** cables.gl/op/Ops.Graphics.Geometry.BoundingBox

## 75.3 CalculateNormals

CalculateNormals

**Full Name:** Ops.Graphics.Geometry.CalculateNormals  
calculate normals of a geometry.

### > Inputs

- **Geometry** (Object)

- **Smooth** (Number: Boolean)
- **Force Z Up** (Number: Boolean)

### < Output

- **Geometry Out** (Object)

**Example Patch:** cables.gl/op/Ops.Graphics.Geometry.CalculateNormals#example

**Doc:** cables.gl/op/Ops.Graphics.Geometry.CalculateNormals

## 75.4 DivideGeometry

DivideGeometry

**Full Name:** Ops.Graphics.Geometry.DivideGeometry  
disconnect faces/polylines of a mesh.

### > Inputs

- **Geometry** (Object)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/sYlxm1

**Doc:** cables.gl/op/Ops.Graphics.Geometry.DivideGeometry

## 75.5 FlipNormals

FlipNormals

**Full Name:** Ops.Graphics.Geometry.FlipNormals  
flip all normals of a geometry.

### > Inputs

- **Geometry** (Object)
- **Flip** (Number: Boolean)
- **Normalize** (Number: Boolean)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/cTfoii

**Doc:** cables.gl/op/Ops.Graphics.Geometry.FlipNormals

## 75.6 FreezeMeshes

FreezeMeshes

**Full Name:** Ops.Graphics.Geometry.FreezeMeshes  
capture all following meshes into one geometry.

#### > Inputs

- **Capture** (Trigger)

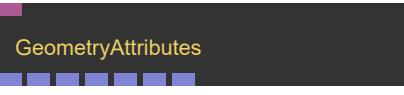
#### < Output

- **Geometry** (Object)
- **Next** (Trigger)

**Example Patch:** cables.gl/edit/BwxY2f

**Doc:** cables.gl/op/Ops.Graphics.Geometry.FreezeMeshes

## 75.7 GeometryAttributes



GeometryAttributes

**Full Name:** Ops.Graphics.Geometry.GeometryAttributes

Get vertices of a geometry as array3x (vertex vertices).

#### > Inputs

- **Geometry** (Object)

#### < Output

- **Faces** (Array)
- **Vertices** (Array)
- **Normals** (Array)
- **TexCoords** (Array)
- **Vertex Colors** (Array)
- **Tangents** (Array)
- **BiTangents** (Array)

**Example Patch:** cables.gl/edit/4VpJz6

**Doc:** cables.gl/op/Ops.Graphics.GeometryAttributes

## 75.8 GeometryExtrude



GeometryExtrude

**Full Name:** Ops.Graphics.Geometry.GeometryExtrude

basic extrusion of flat geometry.

#### > Inputs

- **Geometry** (Object:Geometry)
- **Height** (Number)
- **Smooth** (Number: Boolean)
- **Walls** (Number: Boolean)
- **Top** (Number: Boolean)
- **Bottom** (Number: Boolean)

#### < Output

- **Result Geometry** (Object)

**Example Patch:** cables.gl/edit/Cp5VS3

**Doc:** cables.gl/op/Ops.Graphics.Geometry.GeometryExtrude

## 75.9 GeometryFromArrays



GeometryFromArrays

**Full Name:** Ops.Graphics.Geometry.GeometryFromArrays

Create a geometry from array data.

#### > Inputs

- **Render** (Trigger)
- **Vertices** (Array)
- **Faces** (Array)
- **Texture Coords** (Array)
- **Normals** (Array)

#### < Output

- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/isWvii

**Doc:** cables.gl/op/Ops.Graphics.GeometryFromArrays

## 75.10 GeometryInfo



GeometryInfo

**Full Name:** Ops.Graphics.Geometry.GeometryInfo

information about a geometry.

#### > Inputs

- **Geometry** (Object:Geometry)

#### < Output

- **Indexed** (Number)
- **Faces** (Number)
- **Indices** (Number)
- **Vertices** (Number)
- **Normals** (Number)
- **TexCoords** (Number)
- **Tangents** (Number)
- **BiTangents** (Number)
- **VertexColors** (Number)
- **Other Attributes** (Number)

**Example Patch:** cables.gl/op/Ops.Graphics.Geometry.GeometryInfo#example

**Doc:** cables.gl/op/Ops.Graphics.Geometry.GeometryInfo

## 75.11 GeometryMerge

GeometryMerge

**Full Name:** Ops.Graphics.Geometry.GeometryMerge

merge two geometries to one.

### > Inputs

- **Geometry** (Object)
- **Geometry 2** (Object)
- **Merge** (Trigger)
- **Reset** (Trigger)

### < Output

- **Geometry Result** (Object)

**Example Patch:** cables.gl/edit/3rCDz6

**Doc:** cables.gl/op/Ops.Graphics.GeometryMerge

## 75.12 GeometryToObj

GeometryToObj

**Full Name:** Ops.Graphics.Geometry.GeometryToObj

Generate an .obj file as string from a geometry.

### > Inputs

- **Geometry** (Object:Geometry)

### < Output

- **Obj** (String)

**Example Patch:** cables.gl/edit/BwxY2f

**Doc:** cables.gl/op/Ops.Graphics.Geometry.GeometryToObj

## 75.13 GeometryToWireframeArray3

GeometryToWireframeArray3

**Full Name:** Ops.Graphics.Geometry.GeometryToWireframeArray3

generate an array of lines from a mesh to render a wireframe.

### > Inputs

- **Geometry** (Object)

### < Output

- **Array** (Array)

**Example Patch:** cables.gl/edit/r-xve

**Doc:** cables.gl/op/Ops.Graphics.Geometry.GeometryToWireframeArray3

## 75.14 GeometryUnIndex

GeometryUnIndex

**Full Name:** Ops.Graphics.Geometry.UnIndex

convert geometry to only flat triangles without reusing vertices positions.

### > Inputs

- **Geometry** (Object:Geometry)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Graphics.Geometry.UnIndex#example

**Doc:** cables.gl/op/Ops.Graphics.Geometry.UnIndex

## 75.15 ObjGeometry

ObjGeometry

**Full Name:** Ops.Graphics.Geometry.ObjGeometry

parse an obj string to a geometry object.

### > Inputs

- **Obj** (String)

### < Output

- **Geometry** (Object)
- **Status** (String)

**Example Patch:** cables.gl/edit/JeA8ck

**Doc:** cables.gl/op/Ops.Graphics.Geometry.ObjGeometry

## 75.16 RandomizeTriangles

RandomizeTriangles

**Full Name:** Ops.Graphics.Geometry.RandomizeTriangles

randomize order of triangles in a geometry.

### > Inputs

- **Geometry** (Object)
- **Seed** (Number)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/gLrrJV

**Doc:** cables.gl/op/Ops.Graphics.Geometry.RandomizeTriangles

## 75.17 ReverseVertices

ReverseVertices

**Full Name:** Ops.Graphics.Geometry.ReverseVertices

Reverses the order of vertices in a geometry, back facing triangles become front facing ones.

### > Inputs

- **Geometry** (Object)
- **Flip** (Number: Boolean)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/u9N6v4

**Doc:** cables.gl/op/Ops.Graphics.Geometry.ReverseVertices

## 75.18 ScaleGeometry

ScaleGeometry

**Full Name:** Ops.Graphics.Geometry.ScaleGeometry

uniform scaling of geometry vertices.

### > Inputs

- **Geometry** (Object)
- **Scale** (Number)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Graphics.Geometry.ScaleGeometry#example

**Doc:** cables.gl/op/Ops.Graphics.Geometry.ScaleGeometry

## 75.19 SortGeometryAxis

SortGeometryAxis

**Full Name:** Ops.Graphics.Geometry.SortGeometryAxis

sort geometry triangles by position.

### > Inputs

- **Geometry** (Object)

- **Sort Index** (Number: Integer)

- **Reverse** (Number: Boolean)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Graphics.Geometry.SortGeometryAxis#example

**Doc:** cables.gl/op/Ops.Graphics.Geometry.SortGeometryAxis

## 75.20 SvgPathToGeometry\_v2

SvgPathToGeometry

**Full Name:** Ops.Graphics.Geometry.SvgPathToGeometry\_v2

Generate a SVG path string of a string using an opentype font.

### > Inputs

- **SVG Path** (String)
- **Bezier Stepsize** (Number)
- **Rescale** (Number)

### < Output

- **Geometry** (Object)

**Example Patch:** cables.gl/edit/Cp5VS3

**Doc:** cables.gl/op/Ops.Graphics.Geometry.SvgPathToGeometry\_v2

## 75.21 TesselateGeometry

TesselateGeometry

**Full Name:** Ops.Graphics.Geometry.TesselateGeometry

create new triangles in a mesh (subdivide).

### > Inputs

- **Geometry** (Object)
- **Iterations** (Number: Integer)

### < Output

- **Result** (Object)
- **Num Vertices** (Number)

**Example Patch:** cables.gl/edit/gLrrJV

**Doc:** cables.gl/op/Ops.Graphics.Geometry.TesselateGeometry

## 75.22 TransformGeometry

TransformGeometry

**Full Name:** Ops.Graphics.Geometry.TransformGeometry  
transform vertices of geometry.

### > Inputs

- **Geometry** (Object)
- **Translate X** (Number)
- **Translate Y** (Number)
- **Translate Z** (Number)
- **Scale X** (Number)
- **Scale Y** (Number)
- **Scale Z** (Number)
- **Rotation X** (Number)
- **Rotation Y** (Number)
- **Rotation Z** (Number)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/aoBFz6

**Doc:** cables.gl/op/Ops.Graphics.Geometry.TransformGeometry

## 75.23 TriangleArrayToGeometry\_v2

TriangleArrayToGeometry

**Full Name:** Ops.Graphics.Geometry.TriangleArrayToGeometry\_v2

Draws multiple triangles using coordinates from an array.

### > Inputs

- **Render** (Trigger)
- **Points** (Array)
- **Vertex Colors** (Array)
- **TexCoords** (Array)
- **Flat** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/0fnxrc

**Doc:** cables.gl/op/Ops.Graphics.Geometry.TriangleArrayToGeometry\_v2

## 75.24 Triangulate2dPath

Triangulate2dPath

**Full Name:** Ops.Graphics.Geometry.Triangulate2dPath  
Triangulate a 2d path to a flat and filled 3d geometry.

### > Inputs

- **Update** (Trigger)
- **Combine Index** (Number: Integer)
- **Path 2** (Array)
- **Path 3** (Array)

### < Output

- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/LzTAeT

**Doc:** cables.gl/op/Ops.Graphics.Geometry.Triangulate2dPath

# 76 Ops.Graphics.Intersection

## 76.1 FilterIntersections



**Full Name:** Ops.Graphics.Intersection.FilterIntersections

Define filters to get colliding and intersecting bodies.

### > Inputs

- **Collisions** (Array)
- **Name 1** (String)
- **Match Name 1 Index** (Number: Integer)
- **Name 2** (String)
- **Match Name 2 Index** (Number: Integer)

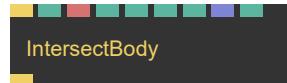
### < Output

- **Colliding** (booleanNumber)
- **Num Collisions** (Number)
- **Result Collisions** (Array)

**Example Patch:** cables.gl/op/Ops.Graphics.Intersection.FilterIntersections#example

**Doc:** cables.gl/op/Ops.Graphics.Intersection.FilterIntersections

## 76.2 IntersectBody



**Full Name:** Ops.Graphics.Intersection.IntersectBody

Add Bodies and check if they intersect/collide with each other.

### > Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Radius** (Number)
- **Size X** (Number)
- **Size Y** (Number)
- **Size Z** (Number)
- **Positions** (Array)
- **Append Index To Name** (Number: Boolean)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/ffRjjz

**Doc:** cables.gl/op/Ops.Graphics.Intersection.IntersectBody

## 76.3 IntersectTestBody



**Full Name:** Ops.Graphics.Intersection.IntersectTestBody

test one body against all bodies in the world.

### > Inputs

- **Trigger** (Trigger)
- **Name** (String)
- **Active** (Number: Boolean)

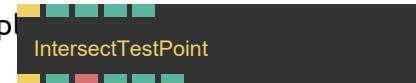
### < Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)

**Example Patch:** cables.gl/edit/bg73Qc

**Doc:** cables.gl/op/Ops.Graphics.Intersection.IntersectTestBody

## 76.4 IntersectTestPoint



**Full Name:** Ops.Graphics.Intersection.IntersectTestPoint

test intersect bodies collision against a point/coordinate.

### > Inputs

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Active** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)
- **Hit X** (Number)
- **Hit Y** (Number)
- **Hit Z** (Number)

**Example Patch:** cables.gl/edit/c2DAO8

**Doc:** cables.gl/op/Ops.Graphics.Intersection.IntersectTestPoint

## 76.5 IntersectTestRaycast

IntersectTestRaycast

**Full Name:** Ops.Graphics.Intersection.IntersectTestRaycast

Cast a ray and check if it intersect/collide with bodies.

### > Inputs

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **To X** (Number)
- **To Y** (Number)
- **To Z** (Number)
- **Active** (Number: Boolean)
- **Change Cursor** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Has Hit** (booleanNumber)
- **Hit Body Name** (String)
- **Hit X** (Number)
- **Hit Y** (Number)
- **Hit Z** (Number)

**Example Patch:** cables.gl/edit/ffRjjz

**Doc:** cables.gl/op/Ops.Graphics.Intersection.IntersectTestRaycast

## 76.6 IntersectWorld

IntersectWorld

**Full Name:** Ops.Graphics.Intersection.IntersectWorld

Define a world to check for intersections and collisions.

### > Inputs

- **Trigger** (Trigger)
- **Check Body Collisions** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Total Bodies** (Number)
- **Collisions** (Array)

**Example Patch:** cables.gl/edit/ffRjjz

**Doc:** cables.gl/op/Ops.Graphics.Intersection.IntersectWorld

## 77 Ops.Graphics.Meshes

### 77.1 CablesLogo

CablesLogo

**Full Name:** Ops.Graphics.Meshes.CablesLogo

cables logo mesh/geometry.

### > Inputs

- **Render** (Trigger)
- **Scale** (Number)
- **Draw** (Number: Boolean)

### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/xUMq3j

**Doc:** cables.gl/op/Ops.Graphics.Meshes.CablesLogo

### 77.2 Circle\_v3

Circle

**Full Name:** Ops.Graphics.Meshes.Circle\_v3

Draws a circle to the canvas.

### > Inputs

- **Render** (Trigger)
- **Radius** (Number)
- **InnerRadius** (Number)
- **Segments** (Number: Integer)
- **Percent** (Number)
- **Steps** (Number)
- **InvertSteps** (Number: Boolean)
- **Spline** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/DAAkQ6

**Doc:** cables.gl/op/Ops.Graphics.Meshes.Circle\_v3

## 77.3 Cross

Cross

**Full Name:** Ops.Graphics.Meshes.Cross

Draws a cross with controllable thickness and length.

### > Inputs

- **Render** (Trigger)
- **Size** (Number)
- **Thickness** (Number)
- **Crosshair** (Number: Boolean)
- **Left** (Number: Boolean)
- **Right** (Number: Boolean)
- **Top** (Number: Boolean)
- **Bottom** (Number: Boolean)
- **Active** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/ojTS\_o

**Doc:** cables.gl/op/Ops.Graphics.Meshes.Cross

## 77.4 Cube\_v2

Cube

**Full Name:** Ops.Graphics.Meshes.Cube\_v2

Draws a cube to the canvas. Please note that without doing a rotation you will only see a rectangle.

### > Inputs

- **Render** (Trigger)
- **Render Mesh** (Number: Boolean)
- **Width** (Number)
- **Length** (Number)
- **Height** (Number)
- **Center** (Number: Boolean)
- **Bias** (Number)
- **Flip X** (Number: Boolean)
- **Top** (Number: Boolean)
- **Bottom** (Number: Boolean)
- **Left** (Number: Boolean)
- **Right** (Number: Boolean)

- **Front** (Number: Boolean)
- **Back** (Number: Boolean)

### < Output

- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/0ghhQ6

**Doc:** cables.gl/op/Ops.Graphics.Meshes.Cube\_v2

## 77.5 Rectangle\_v4

Rectangle

**Full Name:** Ops.Graphics.Meshes.Rectangle\_v4

draw a rectangle (plane, square).

### > Inputs

- **Trigger** (Trigger)
- **Render** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Flip TexCoord X** (Number: Boolean)
- **Flip TexCoord Y** (Number: Boolean)
- **Num Columns** (Number: Integer)
- **Num Rows** (Number: Integer)

### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/M3QiQ6

**Doc:** cables.gl/op/Ops.Graphics.Meshes.Rectangle\_v4

## 77.6 Sphere\_v3

Sphere

**Full Name:** Ops.Graphics.Meshes.Sphere\_v3

Draw parameterizable sphere.

### > Inputs

- **Render** (Trigger)
- **Radius** (Number)
- **Stacks** (Number)
- **Slices** (Number)
- **Filloffset** (Number)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** [cables.gl/edit/HvxfQ6](#)

**Doc:** [cables.gl/op/Ops.Graphics.Meshes.Sphere\\_v3](#)

- **Geometry** (Object)

**Example Patch:** [cables.gl/edit/RnNiQ6](#)

**Doc:** [cables.gl/op/Ops.Graphics.Meshes.Triangle\\_v2](#)

## 77.7 Star\_v2



**Full Name:** Ops.Graphics.Meshes.Star\_v2

draw a star mesh (saw,gear).

#### > Inputs

- **Render** (Trigger)
- **Segments** (Number)
- **Radius** (Number)
- **Shape Index** (Number: Integer)
- **Length** (Number)
- **Peak Z Pos** (Number)
- **Percent** (Number)
- **Fill** (Number: Boolean)
- **Render Mesh** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)
- **Geometry** (Object)

**Example Patch:** [cables.gl/edit/eXhAY4](#)

**Doc:** [cables.gl/op/Ops.Graphics.Meshes.Star\\_v2](#)

## 77.8 Triangle\_v2



**Full Name:** Ops.Graphics.Meshes.Triangle\_v2

Renders a triangle to the canvas.

#### > Inputs

- **Render** (Trigger)
- **Width** (Number)
- **Height** (Number)
- **Draw** (Number: Boolean)

#### < Output

- **Trigger** (Trigger)

# 78 Ops.Html

## 78.1 ActiveElement



**Full Name:** Ops.Html.ActiveElement

Outputs the currently active/focused element.

### > Inputs

- **Trigger** (Trigger)

### < Output

- **Active Element** (Object)

**Example Patch:** cables.gl/edit/0iRDu1

**Doc:** cables.gl/op/Ops.Html.ActiveElement

## 78.2 AlignElement



**Full Name:** Ops.Html.AlignElement

Align a HTML element to another, keep positioning.

### > Inputs

- **Element** (Object:Element)
- **Align Element** (Object:Element)
- **Force Update** (Trigger)
- **Offset X** (Number)
- **Offset Y** (Number)

### < Output

- **Element Passthrough** (Object)
- **Aligned Element** (Object)

**Example Patch:** cables.gl/edit/jKcTdv

**Doc:** cables.gl/op/Ops.Html.AlignElement

## 78.3 AppendChild\_v2



**Full Name:** Ops.Html.AppendChild\_v2

Appends a HTML DOM Element to another.

### > Inputs

- **Parent** (Object:Element)

- **Child** (Object:Element)

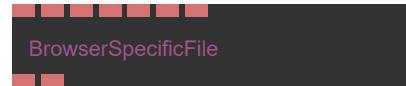
### < Output

- **Parent Out** (Object)
- **Child Out** (Object)

**Example Patch:** cables.gl/edit/PakK8i

**Doc:** cables.gl/op/Ops.Html.AppendChild\_v2

## 78.4 BrowserSpecificFile\_v2



**Full Name:** Ops.Html.BrowserSpecificFile\_v2

set file dependant on browser.

### > Inputs

- **Chrome File** (String)
- **Firefox File** (String)
- **Safari File** (String)
- **Edge File** (String)
- **Opera File** (String)
- **Default File** (String)

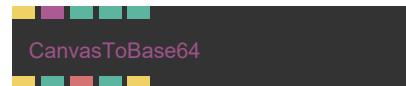
### < Output

- **Browser Specific File** (String)
- **Detected Browser** (String)

**Example Patch:** cables.gl/edit/CfJkIk

**Doc:** cables.gl/op/Ops.Html.BrowserSpecificFile\_v2

## 78.5 CanvasToBase64



**Full Name:** Ops.Html.CanvasToBase64

Create an image file from a canvas.

### > Inputs

- **Trigger** (Trigger)
- **Texture** (Object)
- **Quality** (Number)
- **Output DataUrl** (Number: Boolean)

### < Output

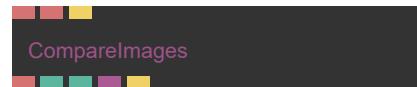
- **Next** (Trigger)
- **Binary Size** (Number)
- **Base64 String** (String)

- **Loading** (booleanNumber)
- **Finished** (Trigger)

**Example Patch:** [cables.gl/op/Ops.Html.CanvasToBase64#example](#)

**Doc:** [cables.gl/op/Ops.Html.CanvasToBase64](#)

## 78.6 CompareImages\_v2



**Full Name:** Ops.Html.CompareImages\_v2

compares two images and shows the difference as a pink color.

### > Inputs

- **Image 1** (String)
- **Image 2** (String)
- **Start** (Trigger)

### < Output

- **Difference Image** (String)
- **Mismatch Percentage** (Number)
- **Same Dimensions** (booleanNumber)
- **Resemble Data** (Object)
- **Finished** (Trigger)

**Example Patch:** [cables.gl/edit/1xkRN8](#)

**Doc:** [cables.gl/op/Ops.Html.CompareImages\\_v2](#)

## 78.7 DocumentBody



**Full Name:** Ops.Html.DocumentBody

Outputs the current document body element.

### > Inputs

- Visit *Ops.Html.DocumentBody documentation for input port details*

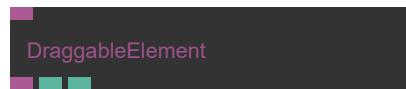
### < Output

- **Body** (Object)

**Example Patch:** [cables.gl/op/Ops.Html.DocumentBody#example](#)

**Doc:** [cables.gl/op/Ops.Html.DocumentBody](#)

## 78.8 DraggableElement



**Full Name:** Ops.Html.DraggableElement

Make a HTML element draggable to move it around with the mouse.

### > Inputs

- **Element** (Object:Element)

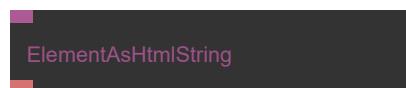
### < Output

- **Element Out** (Object)
- **X** (Number)
- **Y** (Number)

**Example Patch:** [cables.gl/edit/WSi9iO](#)

**Doc:** [cables.gl/op/Ops.Html.DraggableElement](#)

## 78.9 ElementAsHtmlString



**Full Name:** Ops.Html.ElementAsHtmlString

Serialize HTML/SVG elements to a string.

### > Inputs

- **Parent** (Object:Element)

### < Output

- **HTML String** (String)

**Example Patch:** [cables.gl/edit/3kGgr5](#)

**Doc:** [cables.gl/op/Ops.Html.ElementAsHtmlString](#)

## 78.10 ElementChilds\_v2



**Full Name:** Ops.Html.ElementChilds\_v2

Set childs of a HTML Element.

### > Inputs

- **Parent** (Object:Element)
- **Child 1** (Object:Element)
- **Child 2** (Object:Element)
- **Child 3** (Object:Element)
- **Child 4** (Object:Element)
- **Child 5** (Object:Element)

- **Child 6** (Object:Element)
- **Child 7** (Object:Element)
- **Child 8** (Object:Element)
- **Child 9** (Object:Element)
- **Child 10** (Object:Element)

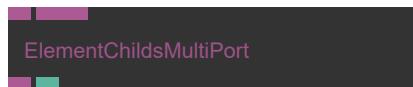
#### < Output

- **Parent Out** (Object)

**Example Patch:** cables.gl/edit/S4VD0H

**Doc:** cables.gl/op/Ops.Html.ElementChilds\_v2

## 78.11 ElementChildsMultiPort\_v2



**Full Name:** Ops.Html.ElementChildsMultiPort\_v2

add child elements to another HTML Element.

#### > Inputs

- **Parent** (Object:Element)
- **Childs\_0** (Object)
- **Add Port** (Object)

#### < Output

- **Parent Out** (Object)
- **Num Values** (Number)

**Example Patch:** cables.gl/edit/zC9iWh

**Doc:** cables.gl/op/Ops.Html.ElementChildsMultiPort\_v2

## 78.12 ElementClientRect



**Full Name:** Ops.Html.ElementClientRect

get html element absolute position and size in pixels on screen.

#### > Inputs

- **Update** (Trigger)
- **Element** (Object:Element)

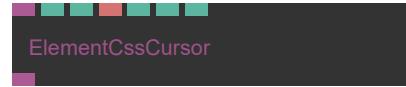
#### < Output

- **X** (Number)
- **Y** (Number)
- **Width** (Number)
- **Height** (Number)

**Example Patch:** cables.gl/edit/1Z8oLu

**Doc:** cables.gl/op/Ops.Html.ElementClientRect

## 78.13 ElementCssCursor\_v3



**Full Name:** Ops.Html.ElementCssCursor\_v3

Set the mouse cursor.

#### > Inputs

- **Element** (Object:Element)
- **CSS Cursors Index** (Number: Integer)
- **File** (String)
- **Offset X** (Number: Integer)
- **Offset Y** (Number: Integer)

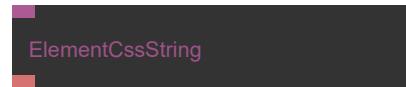
#### < Output

- **HTML Element** (Object)

**Example Patch:** cables.gl/edit/\_f5W8s

**Doc:** cables.gl/op/Ops.Html.ElementCssCursor\_v3

## 78.14 ElementCssString



**Full Name:** Ops.Html.ElementCssString

Output css attributes of an element as a string.

#### > Inputs

- **Element** (Object:Element)

#### < Output

- **CSS** (String)

**Example Patch:** cables.gl/edit/8JmrBZ

**Doc:** cables.gl/op/Ops.Html.ElementCssString

## 78.15 ElementDataSet



**Full Name:** Ops.Html.ElementDataSet

Get the data-attributes and values of an HTML element.

#### > Inputs

- **HTML Element** (Object:Element)

#### < Output

- **Dataset** (Object)

**Example Patch:** cables.gl/edit/MgdKjH

**Doc:** cables.gl/op/Ops.Html.ElementDataSet

## 78.16 ElementEquals

ElementEquals

**Full Name:** Ops.Html.ElementEquals

Check if two HTML element objects are equal.

### > Inputs

- **HTML Element** (Object:Element)
- **HTML Element 2** (Object:Element)

### < Output

- **Equal** (booleanNumber)

**Example Patch:** cables.gl/edit/LZSRjH

**Doc:** cables.gl/op/Ops.Html.ElementEquals

## 78.17 ElementFadeInOut\_v2

ElementFadeInOut

**Full Name:** Ops.Html.ElementFadeInOut\_v2

fade html elements in or out.

### > Inputs

- **HTML Element** (Object)
- **Visible** (Number: Boolean)
- **Duration** (Number)
- **Opacity** (Number)

### < Output

- **PassThrough** (Object)
- **Is Showing** (booleanNumber)

**Example Patch:** cables.gl/edit/Whj018

**Doc:** cables.gl/op/Ops.Html.ElementFadeInOut\_v2

## 78.18 ElementGetClosest

ElementGetClosest

**Full Name:** Ops.Html.ElementGetClosest

get the closest parent element matching the query selector.

### > Inputs

- **HTML Element** (Object:Element)
- **Query** (String)

### < Output

- **Element** (Object)

**Example Patch:** cables.gl/edit/ojHGjH

**Doc:** cables.gl/op/Ops.Html.ElementGetClosest

## 78.19 ElementGradientBg

ElementGradientBg

**Full Name:** Ops.Html.ElementGradientBg

Use a cables gradient as HTML element background.

### > Inputs

- **Element** (Object:Element)
- **Rect Color Space Index** (Number: Integer)
- **Angle** (Number)
- **Gradient Object** (Object:Gradient)

### < Output

- **HTML Element** (Object)
- **CSS String** (String)

**Example Patch:** cables.gl/edit/QB7br5

**Doc:** cables.gl/op/Ops.Html.ElementGradientBg

## 78.20 ElementHasClass

ElementHasClass

**Full Name:** Ops.Html.ElementHasClass

Does the element currently have a specific class set.

### > Inputs

- **Element** (Object:Element)
- **Classname** (String)
- **Update** (Trigger)

### < Output

- **Has Class** (booleanNumber)

**Example Patch:** cables.gl/op/Ops.Html.ElementHasClass#example

**Doc:** cables.gl/op/Ops.Html.ElementHasClass

## 78.21 ElementInfo

ElementInfo

**Full Name:** Ops.Html.ElementInfo

Get information about an element.

### > Inputs

- **Element** (Object)

### < Output

- **Tagname** (String)
- **Id** (String)

**Example Patch:** cables.gl/edit/0iRDu1

**Doc:** cables.gl/op/Ops.Html.ElementInfo

## 78.22 ElementIsFocused

ElementIsFocused

**Full Name:** Ops.Html.ElementIsFocused

Is the connected element currently focused.

### > Inputs

- **Element** (Object:Element)
- **Update** (Trigger)

### < Output

- **Has Focus** (booleanNumber)

**Example Patch:** cables.gl/edit/9jTwz1

**Doc:** cables.gl/op/Ops.Html.ElementIsFocused

## 78.23 ElementsPositionsByClass

ElementsPositionsByClass

**Full Name:** Ops.Html.ElementsPositionsByClass

get html element absolute positions and sizes by classname.

### > Inputs

- **Update** (Trigger)
- **Classname** (String)

### < Output

- **Position** (Array)
- **Size** (Array)
- **Total Elements** (Number)

**Example Patch:** cables.gl/op/Ops.Html.ElementsPositionsByClass#example

**Doc:** cables.gl/op/Ops.Html.ElementsPositionsByClass

## 78.24 FontFile\_v2

FontFile

**Full Name:** Ops.Html.FontFile\_v2

Load a font file like .otf, .ttf, .woff via css.

### > Inputs

- **File** (String)
- **Family** (String)
- **Active** (Number: Boolean)

### < Output

- **Loaded** (booleanNumber)
- **Loaded Trigger** (Trigger)

**Example Patch:** cables.gl/edit/xR9zIR

**Doc:** cables.gl/op/Ops.Html.FontFile\_v2

## 78.25 FontsLoaded

FontsLoaded

**Full Name:** Ops.Html.FontsLoaded

triggers when asynchronous requests finised loading.

### > Inputs

- Visit *Ops.Html.FontsLoaded documentation* for input port details

### < Output

- **Font Loaded** (Trigger)

**Example Patch:** cables.gl/edit/xP04r1

**Doc:** cables.gl/op/Ops.Html.FontsLoaded

## 78.26 FullscreenMode

FullscreenMode

**Full Name:** Ops.Html.FullscreenMode

Switch webgl to fullscreen.

### > Inputs

- **Request Fullscreen** (Trigger)
- **Exit Fullscreen** (Trigger)

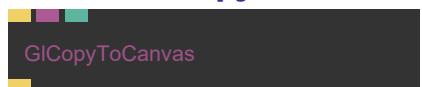
#### < Output

- **Is Fullscreen** (booleanNumber)
- **Supported** (booleanNumber)

**Example Patch:** cables.gl/edit/CCoJji

**Doc:** cables.gl/op/Ops.Html.FullscreenMode

## 78.27 GlCopyToCanvas



**Full Name:** Ops.Html.GlCopyToCanvas

Copy GL canvas content to another canvas.

#### > Inputs

- **Render** (Trigger)
- **Canvas** (Object:Element)
- **Smooth** (Number: Boolean)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/u2vAu1

**Doc:** cables.gl/op/Ops.Html.GlCopyToCanvas

## 78.28 HyperLink\_v3



**Full Name:** Ops.Html.HyperLink\_v3

Open another website.

#### > Inputs

- **Open** (Trigger)
- **URL** (String)
- **Frame Name** (String)
- **Win Specs** (String)
- **Rel Attribute** (String)

#### < Output

- Visit *Ops.Html.HyperLink\_v3 documentation for output port details*

**Example Patch:** cables.gl/edit/ilt57O

**Doc:** cables.gl/op/Ops.Html.HyperLink\_v3

## 78.29 InnerHTML



**Full Name:** Ops.Html.InnerHTML

Set innerHTML or innerTEXT of an HTML element.

#### > Inputs

- **Element** (Object)
- **Value** (String)
- **Active** (Number: Boolean)
- **Clear** (Trigger)

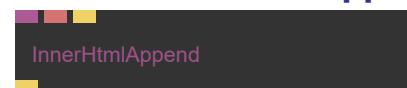
#### < Output

- **HTML Element** (Object)

**Example Patch:** cables.gl/edit/jgArsw

**Doc:** cables.gl/op/Ops.Html.InnerHTML

## 78.30 InnerHtmlAppend



**Full Name:** Ops.Html.InnerHtmlAppend

Append string to the inner html or an element.

#### > Inputs

- **Element** (Object:Element)
- **Html** (String)
- **Trigger** (Trigger)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/hmTiu1

**Doc:** cables.gl/op/Ops.Html.InnerHtmlAppend

## 78.31 MailtoLink



**Full Name:** Ops.Html.MailtoLink

creates a mailto: link to open the default email app.

#### > Inputs

- **Email** (String)
- **Subject** (String)
- **Execute** (Trigger)

## < Output

- Visit `Ops.Html.MailtoLink` documentation for output port details

**Example Patch:** [cables.gl/edit/iltS7O](#)

**Doc:** [cables.gl/op/Ops.Html.MailtoLink](#)

## 78.32 MarkdownToHtml



**Full Name:** `Ops.Html.MarkdownToHtml`

markdown markup language to html parser.

### > Inputs

- **Markdown** (String)
- **Active** (Number: Boolean)

### < Output

- **Html** (String)

**Example Patch:** [cables.gl/edit/52Zlij](#)

**Doc:** [cables.gl/op/Ops.Html.MarkdownToHtml](#)

## 78.33 ModalOverlay



**Full Name:** `Ops.Html.ModalOverlay`

create a modal HTML overlay with a darkened background.

### > Inputs

- **Content Element** (Object)
- **Show** (Trigger)
- **Close** (Trigger)
- **Show Closebutton** (Number: Boolean)
- **Opacity** (Number)

### < Output

- **Visible** (booleanNumber)
- **Closed** (Trigger)
- **Element** (Object)

**Example Patch:** [cables.gl/edit/RXU-K2](#)

**Doc:** [cables.gl/op/Ops.Html.ModalOverlay](#)

## 78.34 QuerySelector\_v3



**Full Name:** `Ops.Html.QuerySelector_v3`

Selects an element in the DOM.

### > Inputs

- **Update** (Trigger)
- **Query** (String)
- **Type Index** (Number: Integer)
- **Document** (String)
- **Input Element** (Object:Element)

### < Output

- **Element** (Object)

**Example Patch:** [cables.gl/edit/C6z3GH](#)

**Doc:** [cables.gl/op/Ops.Html.QuerySelector\\_v3](#)

## 78.35 QuerySelectorAll\_v2



**Full Name:** `Ops.Html.QuerySelectorAll_v2`

Selects all matching elements in the DOM.

### > Inputs

- **Query** (String)
- **Mode Index** (Number: Integer)
- **Type Index** (Number: Integer)
- **Document** (String)
- **Element** (Object:Element)
- **Update** (Trigger)

### < Output

- **Elements** (Array)

**Example Patch:** [cables.gl/edit/QTs5GH](#)

**Doc:** [cables.gl/op/Ops.Html.QuerySelectorAll\\_v2](#)

## 78.36 ReloadPage



**Full Name:** `Ops.Html.ReloadPage`

reload the website.

#### > Inputs

- **Exec** (Trigger)

#### < Output

- Visit [Ops.Html.ReloadPage documentation for output port details](#)

**Example Patch:** [cables.gl/edit/BPeCci](#)

**Doc:** [cables.gl/op/Ops.Html.ReloadPage](#)

## 78.37 ScrollIntoView



**Full Name:** Ops.Html.ScrollIntoView

Scroll an area, so the html element is visible/in view.

#### > Inputs

- **Element** (Object:Element)
- **Scroll Into View** (Trigger)

#### < Output

- **HTML Element** (Object)

**Example Patch:** [cables.gl/edit/KmnVEm](#)

**Doc:** [cables.gl/op/Ops.Html.ScrollIntoView](#)

## 78.38 ScrollPosition\_v2



**Full Name:** Ops.Html.ScrollPosition\_v2

the current x y top left scrolling position of html page or element.

#### > Inputs

- **Update** (Trigger)
- **Element** (Object:Element)
- **Scroll To Top** (Trigger)

#### < Output

- **Next** (Trigger)
- **Left** (Number)
- **Top** (Number)
- **Percentage X** (Number)
- **Percentage Y** (Number)

**Example Patch:** [cables.gl/op/Ops.Html.ScrollPosition\\_v2#example](#)

**Doc:** [cables.gl/op/Ops.Html.ScrollPosition\\_v2](#)

## 78.39 ScrollTo



**Full Name:** Ops.Html.ScrollTo

Trigger the browser to scroll to top or bottom of an element.

#### > Inputs

- **Element** (Object:Element)
- **Scroll To Top** (Trigger)
- **Scroll To Bottom** (Trigger)

#### < Output

- Visit [Ops.Html.ScrollTo documentation for output port details](#)

**Example Patch:** [cables.gl/edit/JEThu1](#)

**Doc:** [cables.gl/op/Ops.Html.ScrollTo](#)

## 78.40 WindowClose



**Full Name:** Ops.Html.WindowClose

close current window.

#### > Inputs

- **Close** (Trigger)

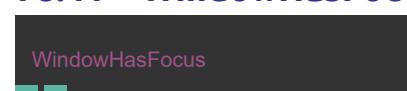
#### < Output

- Visit [Ops.Html.WindowClose documentation for output port details](#)

**Example Patch:** [cables.gl/edit/WGBCci](#)

**Doc:** [cables.gl/op/Ops.Html.WindowClose](#)

## 78.41 WindowHasFocus



**Full Name:** Ops.Html.WindowHasFocus

detect if the browser window/tab has focus.

#### > Inputs

- Visit [Ops.Html.WindowHasFocus documentation for input port details](#)

#### < Output

- **Has Focus** (booleanNumber)
- **Tab Visible** (booleanNumber)

**Example Patch:** [cables.gl/edit/uI9yOg](#)

**Doc:** [cables.gl/op/Ops.Html.WindowHasFocus](#)

## 78.42 WindowInfo

WindowInfo

**Full Name:** Ops.Html.WindowInfo  
size of browser window in pixels.

### > Inputs

- Visit *Ops.Html.WindowInfo* documentation for input port details

### < Output

- ClientWidth (Number)
- ClientHeight (Number)
- Body Scroll Height (Number)
- Device Pixel Ratio (Number)
- Iframe Parent (booleanNumber)
- Orientation Angle (Number)
- Orientation Type (String)

**Example Patch:** [cables.gl/edit/DyHxSP](#)

**Doc:** [cables.gl/op/Ops.Html.WindowInfo](#)

## 78.43 WindowScroll

WindowScroll

**Full Name:** Ops.Html.WindowScroll

Get the current scroll position of the window.

### > Inputs

- Update (Trigger)

### < Output

- Scoll X (Number)
- Scoll Y (Number)

**Example Patch:** [cables.gl/op/Ops.Html.WindowScroll#example](#)

**Doc:** [cables.gl/op/Ops.Html.WindowScroll](#)

## 79 Ops.Html.Attributes

### 79.1 ElementAccessibility

ElementAccessibility

**Full Name:** Ops.Html.Attributes.ElementAccessibility

Element Accessibility properties for screen reader.

### > Inputs

- Element (Object)
- Aria Label (String)
- Aria Labeled By (String)
- Aria Hidden (Number: Boolean)

### < Output

- HTML Element (Object)

**Example Patch:** [cables.gl/edit/R5XS8x](#)

**Doc:** [cables.gl/op/Ops.Html.Attributes.ElementAccessibility](#)

### 79.2 ElementAttributes

ElementAttributes

**Full Name:** Ops.Html.Attributes.ElementAttributes

Get all attributes from an element an object.

### > Inputs

- Element (Object)

### < Output

- Attrbs (Object)

**Example Patch:** [cables.gl/edit/Gflosw](#)

**Doc:** [cables.gl/op/Ops.Html.Attributes.ElementAttributes](#)

### 79.3 ElementGetAttribute

ElementGetAttribute

**Full Name:** Ops.Html.Attributes.ElementGetAttribute

Read or Get the value of an HTML element Attribute.

### > Inputs

- Element (Object)
- Attribute Name (String)

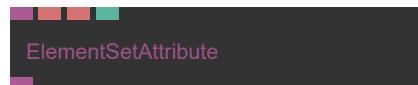
#### < Output

- **Value** (String)
- **Has Attribute** (booleanNumber)

**Example Patch:** cables.gl/edit/lfiS8x

**Doc:** cables.gl/op/Ops.Html.Attributes.ElementGetAttribute

## 79.4 ElementSetAttribute



**Full Name:** Ops.Html.Attributes.ElementSetAttribute

Write or Set the value of an HTML element Attribute.

#### > Inputs

- **Element** (Object)
- **Attribute** (String)
- **Value** (String)
- **Active** (Number: Boolean)

#### < Output

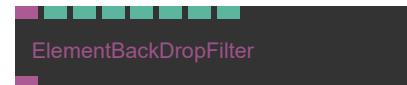
- **HTML Element** (Object)

**Example Patch:** cables.gl/edit/lfiS8x

**Doc:** cables.gl/op/Ops.Html.Attributes.ElementSetAttribute

# 80 Ops.Html.Css

## 80.1 ElementBackDropFilter



**Full Name:** Ops.Html.Css.ElementBackDropFilter

Set CSS backdrop filter like blur, contrast, brightness, saturation.

#### > Inputs

- **Element** (Object)
- **Blur** (Number)
- **Contrast** (Number)
- **Brightness** (Number)
- **Hue** (Number)
- **Invert** (Number)
- **Saturate** (Number)
- **Sepia** (Number)

#### < Output

- **HTML Element** (Object)

**Example Patch:** cables.gl/edit/Tem67C

**Doc:** cables.gl/op/Ops.Html.Css.ElementBackDropFilter

## 80.2 ElementMargin



**Full Name:** Ops.Html.Css.ElementMargin

Set CSS margins of a html element.

#### > Inputs

- **Element** (Object:Element)
- **Margin** (Number)
- **Margin Top** (Number)
- **Margin Bottom** (Number)
- **Margin Left** (Number)
- **Margin Right** (Number)

#### < Output

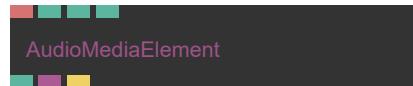
- **HTML Element** (Object)

**Example Patch:** cables.gl/op/Ops.Html.Css.ElementMargin#example

**Doc:** cables.gl/op/Ops.Html.Css.ElementMargin

# 81 Ops.Html.Elements

## 81.1 AudioMediaElement



**Full Name:** Ops.Html.Elements.AudioMediaElement

Simple Audio Player, using HTML5 Audio, does not need WebAudio.

### > Inputs

- **File** (String)
- **Play** (Number: Boolean)
- **Volume** (Number)
- **Loop** (Number: Boolean)

### < Output

- **Playing** (Number)
- **Element** (Object)
- **Has Ended** (Trigger)

**Example Patch:** cables.gl/edit/ftHtx3

**Doc:** cables.gl/op/Ops.Html.Elements.AudioMediaElement

## 81.2 Element\_v2



**Full Name:** Ops.Html.Elements.Element\_v2

A more convenient version of div element op, that can be used for creating html without writing much css code.

### > Inputs

- **Text** (String)
- **Set Size** (Number: Boolean)
- **Width** (Number)
- **Height** (Number)
- **Inline Style** (String)
- **CSS Class** (String)
- **Disable CSS Props** (String)
- **Display Index** (Number: Integer)
- **Tag Name** (String)
- **Opacity** (Number)
- **Propagate Click-Events** (Number: Boolean)
- **Add To DOM** (Number: Boolean)

### < Output

- **DOM Element** (Object)
- **Hovering** (booleanNumber)
- **Clicked** (Trigger)

**Example Patch:** cables.gl/edit/KmnVEm

**Doc:** cables.gl/op/Ops.Html.Elements.Element\_v2

## 81.3 IFrame\_v3



**Full Name:** Ops.Html.Elements.IFrame\_v3

Show another website in an iframe element.

### > Inputs

- **URL** (String)
- **ID** (String)
- **Active** (Number: Boolean)
- **Style** (String)

### < Output

- **Element** (Object)

**Example Patch:** cables.gl/edit/SLesr2

**Doc:** cables.gl/op/Ops.Html.Elements.IFrame\_v3

## 81.4 ImageElement\_v3



**Full Name:** Ops.Html.Elements.ImageElement\_v3

Create an image(img) html element.

### > Inputs

- **File** (String)
- **Class** (String)
- **Style** (String)
- **Alt Text** (String)

### < Output

- **Image Element** (Object)
- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)
- **Error** (booleanNumber)
- **Loaded** (Trigger)

**Example Patch:** cables.gl/edit/OZaVN8

## 81.5 InputElement



**Full Name:** Ops.Html.Elements.InputElement

HTML input/textarea element to allow the user to enter text.

### > Inputs

- **Default Value** (String)
- **Placeholder** (String)
- **Id** (String)
- **Class** (String)
- **Style** (String)
- **Autocomplete** (Number: Boolean)
- **Max Length** (Number: Integer)
- **Enter Key Prevent Default** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Focus** (Trigger)
- **Blur** (Trigger)
- **Clear** (Trigger)
- **Select** (Trigger)

### < Output

- **DOM Element** (Object)
- **Value** (String)
- **Hover** (booleanNumber)
- **Enter Pressed** (Trigger)
- **Escape Pressed** (Trigger)

**Example Patch:** cables.gl/edit/L83aeG

**Doc:** cables.gl/op/Ops.Html.Elements.InputElement

- **Controls** (Number: Boolean)
- **Active** (Number: Boolean)
- **Loop** (Number: Boolean)
- **Muted** (Number: Boolean)
- **Style** (String)
- **Rewind** (Trigger)

### < Output

- **Element** (Object)
- **Playing** (booleanNumber)
- **Can Play Through** (booleanNumber)
- **Time** (Number)
- **Ended** (Trigger)
- **Has Error** (booleanNumber)
- **Error Message** (String)
- **Video Width** (Number)
- **Video Height** (Number)

**Example Patch:** cables.gl/edit/1QTBve

**Doc:** cables.gl/op/Ops.Html.Elements.VideoElement

## 81.6 VideoElement



**Full Name:** Ops.Html.Elements.VideoElement

html video player element.

### > Inputs

- **File** (String)
- **ID** (String)
- **Play** (Number: Boolean)
- **Autoplay** (Number: Boolean)

# 82 Ops.Html.Event

## 82.1 ElementEventListener\_v2

ElementEventListener

**Full Name:** Ops.Html.Event.ElementEventListener\_v2

Add a custom event listener.

### > Inputs

- **Element** (Object)
- **Event Name** (String)
- **Use Capture** (Number: Boolean)
- **Prevent Default** (Number: Boolean)
- **Stop Propagation** (Number: Boolean)

### < Output

- **Element Passthrough** (Object)
- **Event Trigger** (Trigger)
- **Event Object** (Object)

**Example Patch:** cables.gl/edit/9ixt13

**Doc:** cables.gl/op/Ops.Html.Event.ElementEventListener\_v2

## 82.2 ElementPointerEvents

ElementPointerEvents

**Full Name:** Ops.Html.Event.ElementPointerEvents

Listen to events of an element.

### > Inputs

- **Dom Element** (Object)
- **Mouse Down Active** (Number: Boolean)
- **Mouse Up Active** (Number: Boolean)
- **Click Active** (Number: Boolean)
- **Mouse Move Active** (Number: Boolean)
- **Touch Start Active** (Number: Boolean)
- **Touch Move Active** (Number: Boolean)
- **Touch End Active** (Number: Boolean)
- **Touch Cancel Active** (Number: Boolean)

### < Output

- **Event Object** (Object)
- **Mouse Down** (Trigger)
- **Mouse Up** (Trigger)

- **Click** (Trigger)
- **Mouse Move** (Trigger)
- **Touch Start** (Trigger)
- **Touch Move** (Trigger)
- **Touch End** (Trigger)
- **Touch Cancel** (Trigger)
- **Event Name** (Number)

**Example Patch:** cables.gl/op/Ops.Html.Event.ElementPointerEvents#example

**Doc:** cables.gl/op/Ops.Html.Event.ElementPointerEvents

## 82.3 ElementsArrayEventListener

ElementsArrayEventListener

**Full Name:** Ops.Html.Event.ElementsArrayEventListener  
listen to events on multiple html elements.

### > Inputs

- **Elements** (Array)
- **Event Name** (String)
- **Use Capture** (Number: Boolean)
- **Prevent Default** (Number: Boolean)
- **Stop Propagation** (Number: Boolean)

### < Output

- **Event Trigger** (Trigger)
- **Index** (Number)
- **Event Object** (Object)
- **Event Element** (Object)

**Example Patch:** cables.gl/edit/4rKHP0

**Doc:** cables.gl/op/Ops.Html.Event.ElementsArrayEventListener

## 82.4 PreventDefault

PreventDefault

**Full Name:** Ops.Html.Event.PreventDefault  
Prevents the default on a JavaScript event.

### > Inputs

- **Execute** (Trigger)
- **Event In** (Object)

### < Output

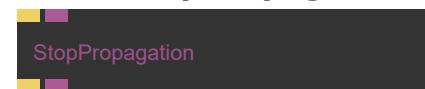
- **Next** (Trigger)

- **Event Out** (Object)

**Example Patch:** cables.gl/op/Ops.Html.Event.PreventDefault#example

**Doc:** cables.gl/op/Ops.Html.Event.PreventDefault

## 82.5 StopPropagation



**Full Name:** Ops.Html.Event.StopPropagation

Stop a JavaScript event (bubbling / capturing).

➢ **Inputs**

- **Execute** (Trigger)
- **Event In** (Object)

◀ **Output**

- **Next** (Trigger)
- **Event Out** (Object)

**Example Patch:** cables.gl/op/Ops.Html.Event.StopPropagation#example

**Doc:** cables.gl/op/Ops.Html.Event.StopPropagation

# 83 Ops.Html\_Utils

## 83.1 CablesLink



**Full Name:** Ops.Html\_Utils.CablesLink

create a cables logo which links to cables gl.

➢ **Inputs**

- **Size** (Number)
- **Opacity** (Number)

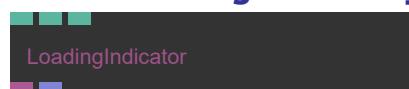
◀ **Output**

- Visit *Ops.Html\_Utils.CablesLink documentation for output port details*

**Example Patch:** cables.gl/edit/ilt570

**Doc:** cables.gl/op/Ops.Html\_Utils.CablesLink

## 83.2 LoadingIndicator\_v2



**Full Name:** Ops.Html\_Utils.LoadingIndicator\_v2

show a typical web loading/progress indicator animation.

➢ **Inputs**

- **Center Position** (Number: Boolean)

◀ **Output**

- **Elment** (Object)
- **Requests** (Array)

**Example Patch:** cables.gl/edit/EsV74q

**Doc:** cables.gl/op/Ops.Html\_Utils.LoadingIndicator\_v2

## 83.3 Notification



**Full Name:** Ops.Html\_Utils.Notification

Trigger a simple pop up notification on the screen.

➢ **Inputs**

- **Trigger Animation** (Trigger)
- **Text** (String)
- **Class** (String)
- **Style** (String)

- **Active** (Number: Boolean)
- **Convert Line Breaks** (Number: Boolean)
- **Fade In** (Number)
- **Hold** (Number)
- **Fade Out** (Number)
- **Mode Index** (Number: Integer)
- **Side Index** (Number: Integer)
- **Starting Position** (Number)
- **Ending Position** (Number)

#### < Output

- **Finished Trigger** (Trigger)
- **Finished** (booleanNumber)
- **DOM Element** (Object)

**Example Patch:** <cables.gl/edit/2Rue0j>

**Doc:** <cables.gl/op/Ops.Html.Utils.Notification>

## 83.4 PlayButton



**Full Name:** Ops.Html.Utils.PlayButton

shows a playbutton for forcing a simple user interaction.

#### > Inputs

- **Trigger** (Trigger)
- **Only If Audio Suspended** (Number: Boolean)
- **Reset** (Trigger)
- **Style Outer** (String)
- **Style Inner** (String)
- **Active** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Not Clicked** (Trigger)
- **Audiocontext State** (String)
- **Element** (Object)
- **Clicked** (booleanNumber)
- **Clicked Trigger** (Trigger)

**Example Patch:** <cables.gl/edit/WoGy8s>

**Doc:** <cables.gl/op/Ops.Html.Utils.PlayButton>

## 83.5 PlayerControlPanel\_v2



**Full Name:** Ops.Html.Utils.PlayerControlPanel\_v2

simple html ui for timeline/mediaplayers (was: TimelineUI).

#### > Inputs

- **Length** (Number)
- **Current** (Number)
- **Clamp** (Number: Boolean)
- **Is Playing** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Show Time** (Number: Boolean)
- **Show Skip Buttons** (Number: Boolean)

#### < Output

- **Play Clicked** (Trigger)
- **Pause Clicked** (Trigger)
- **Rewind Clicked** (Trigger)
- **Skip Back Clicked** (Trigger)
- **Skip Forward Clicked** (Trigger)
- **Dragged** (Trigger)
- **Current Value** (Number)
- **Dragging** (booleanNumber)
- **DOM Element** (Object)

**Example Patch:** <cables.gl/edit/3F6DOe>

**Doc:** [cables.gl/op/Ops.Html.Utils.PlayerControlPanel\\_v2](cables.gl/op/Ops.Html.Utils.PlayerControlPanel_v2)

## 83.6 QrCode



**Full Name:** Ops.Html.Utils.QrCode

Generate a qr code as a texture.

#### > Inputs

- **Text** (String)

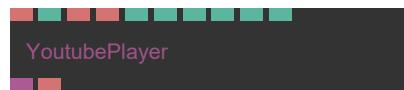
#### < Output

- **Image DataUrl** (String)
- **Element** (Object)

**Example Patch:** <cables.gl/edit/QjlEo->

**Doc:** <cables.gl/op/Ops.Html.Utils.QrCode>

## 83.7 YoutubePlayer



**Full Name:** Ops.Html.Utils.YoutubePlayer  
play a youtube video in a HTML element.

### > Inputs

- **Video Id** (String)
- **Active** (Number: Boolean)
- **Style** (String)
- **ElementID** (String)
- **Autoplay** (Number: Boolean)
- **Display Captions** (Number: Boolean)
- **Loop** (Number: Boolean)
- **Allow Fullscreen** (Number: Boolean)
- **Hide Controls** (Number: Boolean)
- **Start At Second** (Number: Integer)

### < Output

- **Element** (Object)
- **Direct Link** (String)

**Example Patch:** cables.gl/edit/aMkD16

**Doc:** cables.gl/op/Ops.Html.Utils.YoutubePlayer

## 84 Ops.Json

### 84.1 ArrayOfObjectsMultiPort\_v2



**Full Name:** Ops.Json.ArrayOfObjectsMultiPort\_v2  
create an array with multiple objects.

### > Inputs

- **Objects\_0** (Object)
- **Add Port** (Object)

### < Output

- **Array** (Array)
- **Num Values** (Number)

**Example Patch:** cables.gl/op/Ops.Json.ArrayOfObjectsMultiPort\_v2#example

**Doc:** cables.gl/op/Ops.Json.ArrayOfObjectsMultiPort\_v2

### 84.2 CopyObject



**Full Name:** Ops.Json.CopyObject  
Creates a copy of a JSON object.

### > Inputs

- Visit *Ops.Json.CopyObject documentation for input port details*

### < Output

- **Valid** (booleanNumber)

**Example Patch:** cables.gl/edit/xJCXJK

**Doc:** cables.gl/op/Ops.Json.CopyObject

### 84.3 CsvArray



**Full Name:** Ops.Json.CsvArray  
parse CSV files as array.

### > Inputs

- **File** (String)

### < Output

- **Result** (Array)
- **Num Items** (Number)

**Example Patch:** cables.gl/edit/Ull2G1

**Doc:** cables.gl/op/Ops.Json.CsvArray

## 84.4 CsvColumnArray\_v2

CsvColumnArray

**Full Name:** Ops.Json.CsvColumnArray\_v2

get all values of a CSV column as array of strings.

### > Inputs

- **Column Name** (String)
- **CSV Array** (Array)
- **Numbers** (Number: Boolean)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Json.CsvColumnArray\_v2#example

**Doc:** cables.gl/op/Ops.Json.CsvColumnArray\_v2

## 84.5 EmptyObject

EmptyObject

**Full Name:** Ops.Json.EmptyObject

Visit documentation for details.

### > Inputs

- Visit *Ops.Json.EmptyObject* documentation for input port details

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/edit/piMxeG

**Doc:** cables.gl/op/Ops.Json.EmptyObject

## 84.6 FilterValidObject

FilterValidObject

**Full Name:** Ops.Json.FilterValidObject

Filter valid objects.

### > Inputs

- **Object** (Object)

### < Output

- **Last Valid Object** (Object)

- **Is Valid** (booleanNumber)

**Example Patch:** cables.gl/op/Ops.Json.FilterValidObject#example

**Doc:** cables.gl/op/Ops.Json.FilterValidObject

## 84.7 GateObject

GateObject

**Full Name:** Ops.Json.GateObject

Will only allow an Object to be output if the pass through parameter evaluates to true.

### > Inputs

- **Object In** (Object)
- **Pass Through** (Number: Boolean)
- **Only Valid Objects** (Number: Boolean)

### < Output

- **Object Out** (Object)

**Example Patch:** cables.gl/op/Ops.Json.GateObject#example

**Doc:** cables.gl/op/Ops.Json.GateObject

## 84.8 HttpFetchStream

HttpFetchStream

**Full Name:** Ops.Json.HttpFetchStream

HttpRequest/Fetch Streaming.

### > Inputs

- **Fetch Response** (Object)

### < Output

- **Result** (Object)
- **Received Result** (Trigger)
- **Started** (Trigger)

**Example Patch:** cables.gl/op/Ops.Json.HttpFetchStream#example

**Doc:** cables.gl/op/Ops.Json.HttpFetchStream

## 84.9 HttpRequest\_v4

HttpRequest

**Full Name:** Ops.Json.HttpRequest\_v4

Request a json file and output an object (ajax, url, json,fetch).

#### > Inputs

- **URL** (String)
- **HTTP Method Index** (Number: Integer)
- **Request Body** (String)
- **Content-Type** (String)
- **the content type of the body sent** (if any)
- **Send Credentials** (Number: Boolean)
- **Headers** (Object)
- **Auto Request** (Number: Boolean)
- **trigger the request on any value change** (or on pagereload)
- **Empty Output On Change** (Number: Boolean)
- **Retry On Error** (Number: Boolean)
- **Reload** (Trigger)

#### < Output

- **Response Json Object** (Object)
- **Response String** (String)
- **Response Data Url** (String)
- **Status Code** (Number)
- **Is Loading** (booleanNumber)
- **Has Error** (booleanNumber)
- **Error** (String)
- **Duration MS** (Number)
- **Fetch Response** (Object)
- **Loaded** (Trigger)

**Example Patch:** <https://dev.cables.gl/edit/gSRYVQ>

**Doc:** [cables.gl/op/Ops.Json.HttpRequest\\_v4](cables.gl/op/Ops.Json.HttpRequest_v4)

## 84.10 Object

Object

**Full Name:** Ops.Json.Object

*Visit documentation for details.*

#### > Inputs

- **Object** (Object)

#### < Output

- **Result** (Object)

**Example Patch:** <cables.gl/op/Ops.Json.Object#example>

**Doc:** <cables.gl/op/Ops.Json.Object>

## 84.11 ObjectDeleteKey

ObjectDeleteKey

**Full Name:** Ops.Json.ObjectDeleteKey

Remove a Property from an Object by Key.

#### > Inputs

- **Object** (Object)
- **Key** (String)

#### < Output

- **Object Result** (Object)

**Example Patch:** <cables.gl/edit/piMxeG>

**Doc:** <cables.gl/op/Ops.Json.ObjectDeleteKey>

## 84.12 ObjectFilterContentByKey

ObjectFilterContentByKey

**Full Name:** Ops.Json.ObjectFilterContentByKey

filter values from an object if key starts with input string.

#### > Inputs

- **Object** (Object)
- **Name** (String)
- **Remove Null** (Number: Boolean)

#### < Output

- **Result** (Object)

**Example Patch:** <cables.gl/edit/KEDALu>

**Doc:** <cables.gl/op/Ops.Json.ObjectFilterContentByKey>

## 84.13 ObjectFunnel

ObjectFunnel

**Full Name:** Ops.Json.ObjectFunnel

outputs the last changed object.

#### > Inputs

- **Object1** (Object)
- **Object2** (Object)
- **Object3** (Object)
- **Object4** (Object)
- **Object5** (Object)

#### < Output

- **Out Object** (Object)

**Example Patch:** cables.gl/op/Ops.Json.ObjectFunnel#example

**Doc:** cables.gl/op/Ops.Json.ObjectFunnel

## 84.14 ObjectGetArray\_v2



**Full Name:** Ops.Json.ObjectGetArray\_v2

Returns an array from a JSON-object.

#### > Inputs

- **Data** (Object)
- **Key** (String)

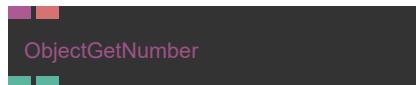
#### < Output

- **Result** (Array)
- **Length** (Number)

**Example Patch:** cables.gl/edit/yU2Pet

**Doc:** cables.gl/op/Ops.Json.ObjectGetArray\_v2

## 84.15 ObjectGetNumber\_v2



**Full Name:** Ops.Json.ObjectGetNumber\_v2

Get a number from an object.

#### > Inputs

- **Data** (Object)
- **Key** (String)

#### < Output

- **Result** (Number)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/op/Ops.Json.ObjectGetNumber\_v2#example

**Doc:** cables.gl/op/Ops.Json.ObjectGetNumber\_v2

## 84.16 ObjectGetObject\_v2



**Full Name:** Ops.Json.ObjectGetObject\_v2

Get an object from an object.

#### > Inputs

- **Object** (Object)
- **Key** (String)

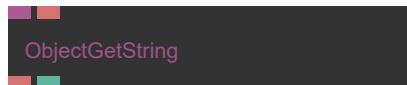
#### < Output

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Json.ObjectGetObject\_v2#example

**Doc:** cables.gl/op/Ops.Json.ObjectGetObject\_v2

## 84.17 ObjectGetString\_v2



**Full Name:** Ops.Json.ObjectGetString\_v2

Get string from object by key.

#### > Inputs

- **Data** (Object)
- **Key** (String)

#### < Output

- **Result** (String)
- **Found** (booleanNumber)

**Example Patch:** cables.gl/edit/Sn0k9Q

**Doc:** cables.gl/op/Ops.Json.ObjectGetString\_v2

## 84.18 ObjectIsNull



**Full Name:** Ops.Json.ObjectIsNull

check if object is null or a valid object.

#### > Inputs

- **Object** (Object)

#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Json.ObjectIsNull#example

**Doc:** cables.gl/op/Ops.Json.ObjectIsNull

## 84.19 ObjectKeys



### **Full Name:** Ops.Json.ObjectKeys

returns an array of strings, which contain the keys of the object.

#### > Inputs

- **Object** (Object)

#### < Output

- **Keys** (Array)
- **Num Keys** (Number)

**Example Patch:** cables.gl/edit/3pkLji

**Doc:** cables.gl/op/Ops.Json.ObjectKeys

## 84.20 ObjectMerge



### **Full Name:** Ops.Json.ObjectMerge

merge key+values of two objects.

#### > Inputs

- **Object 1** (Object)
- **Object 2** (Object)

#### < Output

- **Object Result** (Object)

**Example Patch:** cables.gl/edit/LNJHeG

**Doc:** cables.gl/op/Ops.Json.ObjectMerge

## 84.21 ObjectOr



### **Full Name:** Ops.Json.ObjectOr

result is first connected valid object.

#### > Inputs

- **Object 1** (Object)
- **Object 2** (Object)
- **Object 3** (Object)
- **Object 4** (Object)
- **Object 5** (Object)
- **Object 6** (Object)
- **Object 7** (Object)
- **Object 8** (Object)

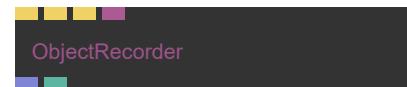
#### < Output

- **Result** (Object)

### **Example Patch:** cables.gl/op/Ops.Json.ObjectOr#example

**Doc:** cables.gl/op/Ops.Json.ObjectOr

## 84.22 ObjectRecorder



### **Full Name:** Ops.Json.ObjectRecorder

record objects and download as json file.

#### > Inputs

- **Exec** (Trigger)
- **Reset** (Trigger)
- **Download** (Trigger)
- **Object** (Object)

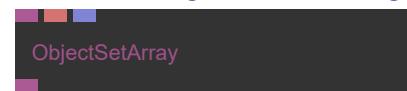
#### < Output

- **Result** (Array)
- **Num Objects** (Number)

**Example Patch:** cables.gl/op/Ops.Json.ObjectRecorder#example

**Doc:** cables.gl/op/Ops.Json.ObjectRecorder

## 84.23 ObjectSetArray\_v2



### **Full Name:** Ops.Json.ObjectSetArray\_v2

Set array by key in an object.

#### > Inputs

- **Object** (Object)
- **Key** (String)
- **Value** (Array)

#### < Output

- **Result Object** (Object)

**Example Patch:** cables.gl/op/Ops.Json.ObjectSetArray\_v2#example

**Doc:** cables.gl/op/Ops.Json.ObjectSetArray\_v2

## 84.24 ObjectSetBool



### **Full Name:** Ops.Json.ObjectSetBool

set number at key in an object.

#### > Inputs

- **Object** (Object)
- **Key** (String)
- **Boolean** (Number: Boolean)

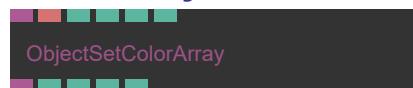
#### < Output

- **Result Object** (Object)

**Example Patch:** cables.gl/edit/w63Au1

**Doc:** cables.gl/op/Ops.Json.ObjectSetBool

## 84.25 ObjectSetColorArray



**Full Name:** Ops.Json.ObjectSetColorArray

Set rgba array by key in an object.

#### > Inputs

- **Object** (Object)
- **Key** (String)
- **R** (Number)
- **G** (Number)
- **B** (Number)
- **A** (Number)

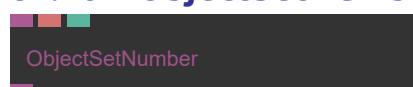
#### < Output

- **Result Object** (Object)
- **Out R** (Number)
- **Out G** (Number)
- **Out B** (Number)
- **Out A** (Number)

**Example Patch:** cables.gl/edit/joA-JK

**Doc:** cables.gl/op/Ops.Json.ObjectSetColorArray

## 84.26 ObjectSetNumber\_v2



**Full Name:** Ops.Json.ObjectSetNumber\_v2

set number at key in an object.

#### > Inputs

- **Object** (Object)
- **Key** (String)
- **Number** (Number)

#### < Output

- **Result Object** (Object)

**Example Patch:** cables.gl/op/Ops.Json.ObjectSetNumber\_v2#example

**Doc:** cables.gl/op/Ops.Json.ObjectSetNumber\_v2

## 84.27 ObjectSetObject\_v2



**Full Name:** Ops.Json.ObjectSetObject\_v2

set object as value in an object.

#### > Inputs

- **Object** (Object)
- **Key** (String)
- **Object Value** (Object)

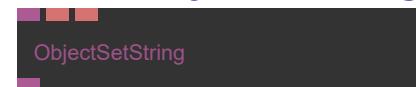
#### < Output

- **Result Object** (Object)

**Example Patch:** cables.gl/edit/7X58nR

**Doc:** cables.gl/op/Ops.Json.ObjectSetObject\_v2

## 84.28 ObjectSetString\_v2



**Full Name:** Ops.Json.ObjectSetString\_v2

set a string value by key in an object.

#### > Inputs

- **Object** (Object)
- **Key** (String)
- **Value** (String)

#### < Output

- **Result Object** (Object)

**Example Patch:** cables.gl/op/Ops.Json.ObjectSetString\_v2#example

**Doc:** cables.gl/op/Ops.Json.ObjectSetString\_v2

## 84.29 ObjectStringify\_v2



**Full Name:** Ops.Json.ObjectStringify\_v2

Convert object to string.

#### > Inputs

- **Object** (Object)
- **Beautify** (Number: Boolean)

#### < Output

- **Result** (String)
- **Error** (booleanNumber)

**Example Patch:** cables.gl/edit/7X58nR

**Doc:** cables.gl/op/Ops.Json.ObjectStringify\_v2

## 84.30 ObjectToArray

ObjectToArray

**Full Name:** Ops.Json.ObjectToArray

cast an object port to an array port.

#### > Inputs

- **Object** (Object)

#### < Output

- **Array** (Array)

**Example Patch:** cables.gl/op/Ops.Json.ObjectToArray#example

**Doc:** cables.gl/op/Ops.Json.ObjectToArray

## 84.31 ObjectValuesAsArray

ObjectValuesAsArray

**Full Name:** Ops.Json.ObjectValuesAsArray

extract all object values as an array.

#### > Inputs

- **Object** (Object)

#### < Output

- **Values** (Array)
- **Num Values** (Number)

**Example Patch:** cables.gl/edit/bIQ8cl

**Doc:** cables.gl/op/Ops.Json.ObjectValuesAsArray

## 84.32 ParseObject\_v2

ParseObject

**Full Name:** Ops.Json.ParseObject\_v2

Parses a string to a JSON object.

#### > Inputs

- **JSON String** (String)

#### < Output

- **Result** (Object)
- **Valid** (booleanNumber)

**Example Patch:** cables.gl/edit/Z17vG8

**Doc:** cables.gl/op/Ops.Json.ParseObject\_v2

## 84.33 RemoveDataUrlPrefix

RemoveDataUrlPrefix

**Full Name:** Ops.Json.RemoveDataUrlPrefix

Removes data URL prefix from a string.

#### > Inputs

- **String Input** (String)

#### < Output

- **String Output** (String)

**Example Patch:** cables.gl/op/Ops.Json.RemoveDataUrlPrefix#example

**Doc:** cables.gl/op/Ops.Json.RemoveDataUrlPrefix

## 84.34 RouteObject

RouteObject

**Full Name:** Ops.Json.RouteObject

Route an object to an output port.

#### > Inputs

- **Index** (Number: Integer)
- **Object In** (Object)
- **Default Object** (Object)

#### < Output

- **Index 0 Object** (Object)
- **Index 1 Object** (Object)
- **Index 2 Object** (Object)
- **Index 3 Object** (Object)
- **Index 4 Object** (Object)
- **Index 5 Object** (Object)
- **Index 6 Object** (Object)

- **Index 7 Object** (Object)
- **Index 8 Object** (Object)
- **Index 9 Object** (Object)

**Example Patch:** cables.gl/edit/-xrxX8

**Doc:** cables.gl/op/Ops.Json.RouteObject

## 84.35 SaveJsonFile



SaveJsonFile

**Full Name:** Ops.Json.SaveJsonFile

save/download an object as json file.

► **Inputs**

- **Download** (Trigger)
- **Filename** (String)
- **Object** (Object)

◀ **Output**

- Visit *Ops.Json.SaveJsonFile* documentation for output port details

**Example Patch:** cables.gl/edit/J0c008

**Doc:** cables.gl/op/Ops.Json.SaveJsonFile

## 84.36 SequenceObjects\_v2



SequenceObjects

**Full Name:** Ops.Json.SequenceObjects\_v2

control order and flow of objects.

► **Inputs**

- **Number 0** (Object)
- **Number 1** (Object)
- **Number 2** (Object)
- **Number 3** (Object)
- **Number 4** (Object)
- **Number 5** (Object)
- **Number 6** (Object)
- **Number 7** (Object)
- **Number 8** (Object)
- **Number 9** (Object)
- **Number 10** (Object)
- **Number 11** (Object)
- **Number 12** (Object)
- **Number 13** (Object)

- **Number 14** (Object)
- **Number 15** (Object)

◀ **Output**

- **Output 0** (Object)
- **Output 1** (Object)
- **Output 2** (Object)
- **Output 3** (Object)
- **Output 4** (Object)
- **Output 5** (Object)
- **Output 6** (Object)
- **Output 7** (Object)
- **Output 8** (Object)
- **Output 9** (Object)
- **Output 10** (Object)
- **Output 11** (Object)
- **Output 12** (Object)
- **Output 13** (Object)
- **Output 14** (Object)
- **Output 15** (Object)

**Example Patch:** cables.gl/op/Ops.Json.SequenceObjects\_v2#example

**Doc:** cables.gl/op/Ops.Json.SequenceObjects\_v2

## 84.37 SwitchObject



SwitchObject

**Full Name:** Ops.Json.SwitchObject

Allows switching between objects.

► **Inputs**

- **Object Index** (Number: Integer)
- **Object Port 0** (Object)
- **Object Port 1** (Object)
- **Object Port 2** (Object)
- **Object Port 3** (Object)
- **Object Port 4** (Object)
- **Object Port 5** (Object)
- **Object Port 6** (Object)
- **Object Port 7** (Object)

◀ **Output**

- **Object Out** (Object)

**Example Patch:** cables.gl/edit/X55cRo

**Doc:** cables.gl/op/Ops.Json.SwitchObject

## 84.38 SwitchObjectMultiPort\_v2

SwitchObjectMultiPort

**Full Name:** Ops.Json.SwitchObjectMultiPort\_v2

Switch between multiple object inputs.

### > Inputs

- **Index** (Number: Integer)
- **Objects\_0** (Object)
- **Add Port** (Object)

### < Output

- **Object** (Object)
- **Num Values** (Number)

**Example Patch:** cables.gl/edit/PI2xsh

**Doc:** cables.gl/op/Ops.Json.SwitchObjectMultiPort\_v2

## 84.39 TriggerObject

TriggerObject

**Full Name:** Ops.Json.TriggerObject

set output object when triggered.

### > Inputs

- **Trigger** (Trigger)
- **Object** (Object)

### < Output

- **Next** (Trigger)
- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Json.TriggerObject#example

**Doc:** cables.gl/op/Ops.Json.TriggerObject

## 84.40 TriggerObjectSetNumber

TriggerObjectSetNumber

**Full Name:** Ops.Json.TriggerObjectSetNumber

set a number value of an object using trigger.

### > Inputs

- **Trigger** (Trigger)
- **Object** (Object)
- **Key** (String)

- **Number** (Number)

### < Output

- **Next** (Trigger)
- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Json.TriggerObjectSetNumber#example

**Doc:** cables.gl/op/Ops.Json.TriggerObjectSetNumber

## 84.41 TriggerObjectSetString

TriggerObjectSetString

**Full Name:** Ops.Json.TriggerObjectSetString

set a string value of an object using trigger.

### > Inputs

- **Trigger** (Trigger)
- **Object** (Object)
- **Key** (String)
- **String** (String)

### < Output

- **Next** (Trigger)
- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Json.TriggerObjectSetString#example

**Doc:** cables.gl/op/Ops.Json.TriggerObjectSetString

# 85 Ops.Math

## 85.1 Abs



**Full Name:** Ops.Math.Abs

Returns the absolute, positive value.

### > Inputs

- **Number** (Number)

### < Output

- **Result** (Number)
- **The absolute value of Number** (always positive)

**Example Patch:** cables.gl/edit/vtPZ7i

**Doc:** cables.gl/op/Ops.Math.Abs

## 85.2 Accumulator



**Full Name:** Ops.Math.Accumulator

Add to and multiply a number, set to current value.

### > Inputs

- **Trigger In** (Trigger)
- **Add To Number** (Number)
- **Multiplier To Add Number** (Number)
- **Default Value** (Number)
- **Set Default Value** (Trigger)

### < Output

- **Current Value** (Number)

**Example Patch:** cables.gl/edit/Ejzvsx

**Doc:** cables.gl/op/Ops.Math.Accumulator

## 85.3 AddUp



**Full Name:** Ops.Math.AddUp

Visit documentation for details.

### > Inputs

- **Number** (Number)

- **Add** (Trigger)
- **Reset** (Trigger)

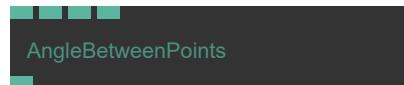
### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/cWh78i

**Doc:** cables.gl/op/Ops.Math.AddUp

## 85.4 AngleBetweenPoints



**Full Name:** Ops.Math.AngleBetweenPoints

outputs the angle between two points (degree).

### > Inputs

- **Point 1 X** (Number)
- **Point 1 Y** (Number)
- **Point 2 X** (Number)
- **Point 2 Y** (Number)

### < Output

- **Angle** (Number)

**Example Patch:** cables.gl/edit/aMsTGc

**Doc:** cables.gl/op/Ops.Math.AngleBetweenPoints

## 85.5 Array3MultiplyMatrix



**Full Name:** Ops.Math.Array3MultiplyMatrix

multiply every XYZ coordinate with a matrix.

### > Inputs

- **Update** (Trigger)
- **Array** (Array)
- **Matrix** (Array)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Math.Array3MultiplyMatrix#example

**Doc:** cables.gl/op/Ops.Math.Array3MultiplyMatrix

## 85.6 Array3To2dProjection

Array3To2dProjection

**Full Name:** Ops.Math.Array3To2dProjection  
calculate 2d positions of an array3x.

### > Inputs

- **Exec** (Trigger)
- **Array3x** (Array)
- **Fov** (Number)
- **W** (Number)
- **H** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)
- **Mul** (Number)

### < Output

- **Next** (Trigger)
- **Array2x** (Array)

**Example Patch:** cables.gl/op/Ops.Math.Array3To2dProjection#example  
**Doc:** cables.gl/op/Ops.Math.Array3To2dProjection

## 85.7 Atan2

Atan2

**Full Name:** Ops.Math.Atan2

Calculates the angle from a specified point to the coordinate origin.

### > Inputs

- **X** (Number)
- **Y** (Number)
- **Phase** (Number)
- **Frequency** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Atan2#example  
**Doc:** cables.gl/op/Ops.Math.Atan2

## 85.8 Average

Average

**Full Name:** Ops.Math.Average  
average of last two values.

### > Inputs

- **Number** (Number)
- **Influence** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Average#example  
**Doc:** cables.gl/op/Ops.Math.Average

## 85.9 ButterflyCurve

ButterflyCurve

**Full Name:** Ops.Math.ButterflyCurve  
generate coordinates of a butterfly curve.

### > Inputs

- **Value** (Number)

### < Output

- **X** (Number)
- **Y** (Number)

**Example Patch:** cables.gl/op/Ops.Math.ButterflyCurve#example  
**Doc:** cables.gl/op/Ops.Math.ButterflyCurve

## 85.10 Ceil

Ceil

**Full Name:** Ops.Math.Ceil

Returns the smallest integer greater than or equal to a given number.

### > Inputs

- **Number** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/nPvVW2  
**Doc:** cables.gl/op/Ops.Math.Ceil

## 85.11 CircleCoordinates

CircleCoordinates

**Full Name:** Ops.Math.CircleCoordinates  
x and y coordinates of a circle.

### > Inputs

- **Position** (Number)
- **Radius** (Number)

### < Output

- **X** (Number)
- **Y** (Number)

**Example Patch:** cables.gl/edit/uAkdl5

**Doc:** cables.gl/op/Ops.Math.CircleCoordinates

## 85.12 Clamp

Clamp

**Full Name:** Ops.Math.Clamp

Makes sure a value is within range cuts off the rest.

### > Inputs

- **Val** (Number)
- **Min** (Number)
- **Max** (Number)
- **Ignore Outside Values** (Number: Boolean)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Clamp#example

**Doc:** cables.gl/op/Ops.Math.Clamp

## 85.13 Cosine

Cosine

**Full Name:** Ops.Math.Cosine

Calculates the cosine of an angle.

### > Inputs

- **Value** (Number)
- **Phase** (Number)
- **Frequency** (Number)

- **Amplitude** (Number)
- **Asine** (Number: Boolean)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/RhfUW2

**Doc:** cables.gl/op/Ops.Math.Cosine

## 85.14 Cross

Cross

**Full Name:** Ops.Math.Cross

Computes the cross product of two vec3's.

### > Inputs

- **Exec** (Trigger)
- **X1** (Number)
- **Y1** (Number)
- **Z1** (Number)
- **X2** (Number)
- **Y2** (Number)
- **Z2** (Number)

### < Output

- **Next** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Cross#example

**Doc:** cables.gl/op/Ops.Math.Cross

## 85.15 Degrees

Degrees

**Full Name:** Ops.Math.Degrees

Converts a radian measurement to its corresponding value in degrees.

### > Inputs

- **Radians** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Degrees#example

**Doc:** cables.gl/op/Ops.Math.Degrees

## 85.16 DegreeToVector

DegreeToVector

**Full Name:** Ops.Math.DegreeToVector

Calculates a vector (x and y) based on an angle in degrees.

### > Inputs

- **Degree** (Number)
- **The angle you want to convert** (in degrees)

### < Output

- **X** (Number)
- **Y** (Number)

**Example Patch:** cables.gl/edit/k76YnO

**Doc:** cables.gl/op/Ops.Math.DegreeToVector

## 85.17 Delta

Delta

**Full Name:** Ops.Math.Delta

difference to the last value (previous, store).

### > Inputs

- **Value** (Number)
- **Change Always** (Number: Boolean)
- **Reset** (Trigger)

### < Output

- **Delta** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Delta#example

**Doc:** cables.gl/op/Ops.Math.Delta

## 85.18 DeltaSum

DeltaSum

**Full Name:** Ops.Math.DeltaSum

add delta values to an clamped absolute value.

### > Inputs

- **Delta Value** (Number)
- **Default Value** (Number)
- **Multiply** (Number)
- **Reset** (Trigger)

- **Limit** (Number: Boolean)
- **Min** (Number)
- **Max** (Number)
- **Rubberband** (Number)

### < Output

- **Absolute Value** (Number)

**Example Patch:** cables.gl/edit/hH8f\_6

**Doc:** cables.gl/op/Ops.Math.DeltaSum

## 85.19 Difference

Difference

**Full Name:** Ops.Math.Difference

Difference between two numbers.

### > Inputs

- **Number A** (Number)
- **Number B** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Difference#example

**Doc:** cables.gl/op/Ops.Math.Difference

## 85.20 Distance2d

Distance2d

**Full Name:** Ops.Math.Distance2d

Calculates the Distance between two 2d points.

### > Inputs

- **X1** (Number)
- **Y1** (Number)
- **X2** (Number)
- **Y2** (Number)

### < Output

- **Distance** (Number)

**Example Patch:** cables.gl/edit/7mTKgg

**Doc:** cables.gl/op/Ops.Math.Distance2d

## 85.21 Distance3d\_v2



**Full Name:** Ops.Math.Distance3d\_v2

distance between two 3d points, calculated when triggered.

### > Inputs

- **Calc** (Trigger)
- **X1** (Number)
- **Y1** (Number)
- **Z1** (Number)
- **X2** (Number)
- **Y2** (Number)
- **Z2** (Number)

### < Output

- **Next** (Trigger)
- **Distance** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Distance3d\_v2#example

**Doc:** cables.gl/op/Ops.Math.Distance3d\_v2

## 85.22 Divide



**Full Name:** Ops.Math.Divide

Divides a number by another.

### > Inputs

- **Number1** (Number)
- **Number2** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Divide#example

**Doc:** cables.gl/op/Ops.Math.Divide

## 85.23 Ease



**Full Name:** Ops.Math.Ease

map a value to an easing curve.

### > Inputs

- **Value** (Number)
- **Min** (Number)
- **Max** (Number)
- **Easing Index** (Number: Integer)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/rLxYY6

**Doc:** cables.gl/op/Ops.Math.Ease

## 85.24 Exp



**Full Name:** Ops.Math.Exp

Calculates the power of Euler's number.

### > Inputs

- **Number** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Exp#example

**Doc:** cables.gl/op/Ops.Math.Exp

## 85.25 FlipSign



**Full Name:** Ops.Math.FlipSign

positive numbers become negative and vice versa (negate).

### > Inputs

- **Value** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.FlipSign#example

**Doc:** cables.gl/op/Ops.Math.FlipSign

## 85.26 Floor



**Full Name:** Ops.Math.Floor

returns the largest integer less than or equal to a given number.

### > Inputs

- **Number** (Number)

### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/nPvVW2](#)

**Doc:** [cables.gl/op/Ops.Math.Floor](#)

## 85.27 Fract



**Full Name:** Ops.Math.Fract

returns the fractional part of a number.

### > Inputs

- **Value** (Number)

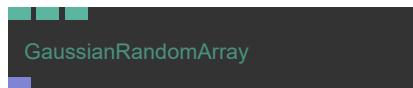
### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/VWb2t7](#)

**Doc:** [cables.gl/op/Ops.Math.Fract](#)

## 85.28 GaussianRandomArray



**Full Name:** Ops.Math.GaussianRandomArray

random numbers fitting a Gaussian, or normal, distribution.

### > Inputs

- **Num** (Number: Integer)
- **Deviation** (Number)
- **Random Seed** (Number)

### < Output

- **Array** (Array)

**Example Patch:** [cables.gl/edit/i14QNS](#)

**Doc:** [cables.gl/op/Ops.Math.GaussianRandomArray](#)

## 85.29 Incrementor



**Full Name:** Ops.Math.Incrementor

increment a number by triggering.

### > Inputs

- **Increment** (Trigger)
- **Decrement** (Trigger)
- **Limit** (Number: Boolean)
- **Length** (Number: Integer)
- **Default** (Number: Integer)
- **Reset** (Trigger)

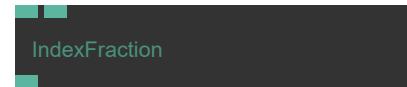
### < Output

- **Changed** (Trigger)
- **Value** (Number)
- **Restarted** (Trigger)

**Example Patch:** [cables.gl/edit/OdcvGu](#)

**Doc:** [cables.gl/op/Ops.Math.Incrementor](#)

## 85.30 IndexFraction



**Full Name:** Ops.Math.IndexFraction

return fraction of value by index.

### > Inputs

- **Number** (Number)
- **Index** (Number: Integer)

### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/SV3NPO](#)

**Doc:** [cables.gl/op/Ops.Math.IndexFraction](#)

## 85.31 Interpolate



**Full Name:** Ops.Math.Interpolate

Interpolate between values, lerp, linear interpolate.

### > Inputs

- **Value 1** (Number)
- **Value 2** (Number)
- **Percentage** (Number)

### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/op/Ops.Math.Interpolate#example](#)

**Doc:** cables.gl/op/Ops.Math.Interpolate

## 85.32 IsNumberRising

IsNumberRising

**Full Name:** Ops.Math.IsNumberRising

detect if a number rising or falling.

### > Inputs

- **Number** (Number)

### < Output

- **Rising** (Number)

**Example Patch:** cables.gl/edit/UN11cl

**Doc:** cables.gl/op/Ops.Math.IsNumberRising

## 85.33 Log

Log

**Full Name:** Ops.Math.Log

Calculates the logarithm of Number.

### > Inputs

- **Number** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Log#example

**Doc:** cables.gl/op/Ops.Math.Log

## 85.34 MapGeoCoordsSpherical

MapGeoCoordsSpherical

**Full Name:** Ops.Math.MapGeoCoordsSpherical

map geo locations (latitude - longitude) to spherical coordinates.

### > Inputs

- **Coordinates** (Array)
- **Radius** (Number)

### < Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/BvXW5Q

**Doc:** cables.gl/op/Ops.Math.MapGeoCoordsSpherical

## 85.35 MapRange

MapRange

**Full Name:** Ops.Math.MapRange

Maps a value from one range into another.

### > Inputs

- **Value** (Number)
- **Old Min** (Number)
- **Old Max** (Number)
- **New Min** (Number)
- **New Max** (Number)
- **Easing Index** (Number: Integer)
- **Clamp** (Number: Boolean)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/YFIVGc

**Doc:** cables.gl/op/Ops.Math.MapRange

## 85.36 Math

Math

**Full Name:** Ops.Math.Math

Allows different mathematical operations to be applied to two numbers.

### > Inputs

- **Number 0** (Number)
- **Number 1** (Number)
- **Math Mode Index** (Number: Integer)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/mTqdVJ

**Doc:** cables.gl/op/Ops.Math.Math

## 85.37 MathExpression

MathExpression

**Full Name:** Ops.Math.MathExpression

calculates a user defined mathematical expression.

### > Inputs

- **A** (Number)
- **B** (Number)
- **C** (Number)
- **D** (Number)
- **Expression** (String)

#### ◀ Output

- **Result** (Number)
- **Expression Valid** (booleanNumber)

**Example Patch:** cables.gl/edit/s5-tve

**Doc:** cables.gl/op/Ops.Math.MathExpression

## 85.38 Max



**Full Name:** Ops.Math.Max

Sets the output to the input value which is higher.

#### ▶ Inputs

- **Value** (Number)
- **Maximum** (Number)

#### ◀ Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/hV3X7i

**Doc:** cables.gl/op/Ops.Math.Max

## 85.39 MaxSinceReset



**Full Name:** Ops.Math.MaxSinceReset

Outputs the maximum value since reset has been triggered.

#### ▶ Inputs

- **Value** (Number)
- **Reset** (Trigger)

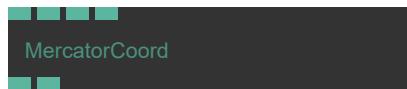
#### ◀ Output

- **Maximum** (Number)

**Example Patch:** cables.gl/op/Ops.Math.MaxSinceReset#example

**Doc:** cables.gl/op/Ops.Math.MaxSinceReset

## 85.40 MercatorCoord



**Full Name:** Ops.Math.MercatorCoord

project mercator coordinates.

#### ▶ Inputs

- **Latitude** (Number)
- **Longitude** (Number)
- **MapWidth** (Number)
- **MapHeight** (Number)

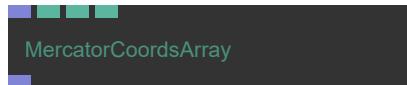
#### ◀ Output

- **X** (Number)
- **Y** (Number)

**Example Patch:** cables.gl/edit/oi9AI4

**Doc:** cables.gl/op/Ops.Math.MercatorCoord

## 85.41 MercatorCoordsArray



**Full Name:** Ops.Math.MercatorCoordsArray

Mercator map and center an array of latitudes and longitudes to a local coordinate system.

#### ▶ Inputs

- **LatLon Array** (Array)
- **MapWidth** (Number)
- **Center Lat** (Number)
- **Center Lon** (Number)

#### ◀ Output

- **Result** (Array)

**Example Patch:** cables.gl/edit/vgRDeT

**Doc:** cables.gl/op/Ops.Math.MercatorCoordsArray

## 85.42 Min\_v3



**Full Name:** Ops.Math.Min\_v3

Result will be the smaller number of the inputs.

#### ▶ Inputs

- **Value 1** (Number)
- **Value 2** (Number)

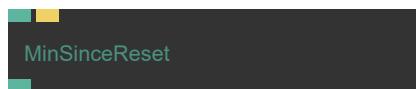
#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/rvAW7i

**Doc:** cables.gl/op/Ops.Math.Min\_v3

## 85.43 MinSinceReset



**Full Name:** Ops.Math.MinSinceReset

Outputs the minimum value since reset has been triggered.

#### > Inputs

- **Value** (Number)
- **Reset** (Trigger)

#### < Output

- **Minimum** (Number)

**Example Patch:** cables.gl/op/Ops.Math.MinSinceReset#example

**Doc:** cables.gl/op/Ops.Math.MinSinceReset

## 85.44 Modulo



**Full Name:** Ops.Math.Modulo

outputs the remainder after division of one number by another.

#### > Inputs

- **Number1** (Number)
- **Number2** (Number)
- **Pingpong** (Number: Boolean)

#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Modulo#example

**Doc:** cables.gl/op/Ops.Math.Modulo

## 85.45 MulMatrixXyz



**Full Name:** Ops.Math.MulMatrixXyz

multiply XYZ values with a gl matrix vec3 x mat4.

#### > Inputs

- **Update** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Matrix** (Array)

#### < Output

- **Next** (Trigger)
- **Result X** (Number)
- **Result Y** (Number)
- **Result Z** (Number)

**Example Patch:** cables.gl/edit/QlOcck

**Doc:** cables.gl/op/Ops.Math.MulMatrixXyz

## 85.46 Multiply



**Full Name:** Ops.Math.Multiply

Multiplies two numbers.

#### > Inputs

- **Number1** (Number)
- **Number2** (Number)

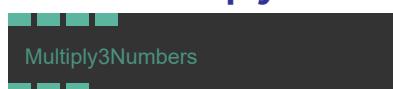
#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/0010r1

**Doc:** cables.gl/op/Ops.Math.Multiply

## 85.47 Multiply3Numbers



**Full Name:** Ops.Math.Multiply3Numbers

multiply three numbers.

#### > Inputs

- **R** (Number)
- **G** (Number)
- **B** (Number)
- **Multiply** (Number)

## < Output

- **ResultR** (Number)
- **ResultG** (Number)
- **ResultB** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Multiply3Numbers#example

**Doc:** cables.gl/op/Ops.Math.Multiply3Numbers

## 85.48 Normalize



**Full Name:** Ops.Math.Normalize

normalize a vector.

### > Inputs

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

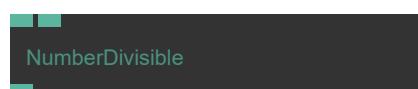
### < Output

- **Result X** (Number)
- **Result Y** (Number)
- **Result Z** (Number)

**Example Patch:** cables.gl/edit/O8S5O8

**Doc:** cables.gl/op/Ops.Math.Normalize

## 85.49 NumberDivisible



**Full Name:** Ops.Math.NumberDivisible

is a number capable of being divided.

### > Inputs

- **Number** (Number)
- **Divisor** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/-lqoJ5

**Doc:** cables.gl/op/Ops.Math.NumberDivisible

## 85.50 OneMinus



**Full Name:** Ops.Math.OneMinus

subtract a number from one.

### > Inputs

- **Value** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/8-XQ5d

**Doc:** cables.gl/op/Ops.Math.OneMinus

## 85.51 PerlinNoise\_v2



**Full Name:** Ops.Math.PerlinNoise\_v2

outputs a perlin noise value like random.

### > Inputs

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **Scale** (Number)
- **Seed** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/gOCdhL

**Doc:** cables.gl/op/Ops.Math.PerlinNoise\_v2

## 85.52 Pi



**Full Name:** Ops.Math.Pi

returns PI (3.141592653589793) \* multiply amount.

### > Inputs

- **Multiply Amount** (Number)

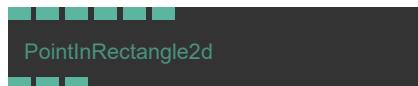
### < Output

- **Pi** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Pi#example

**Doc:** cables.gl/op/Ops.Math.Pi

## 85.53 PointInRectangle2d



**Full Name:** Ops.Math.PointInRectangle2d  
test if a point is in or outside of a rectangle.

### > Inputs

- **X** (Number)
- **Y** (Number)
- **Rect Top** (Number)
- **Rect Left** (Number)
- **Rect Right** (Number)
- **Rect Bottom** (Number)

### < Output

- **Result** (Number)
- **Pos X** (Number)
- **Pos Y** (Number)

**Example Patch:** cables.gl/edit/dG4B98

**Doc:** cables.gl/op/Ops.Math.PointInRectangle2d

## 85.54 Pow



**Full Name:** Ops.Math.Pow

value of x to the power of y.

### > Inputs

- **Base** (Number)
- **Exponent** (Number)

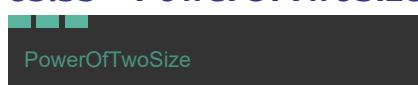
### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Pow#example

**Doc:** cables.gl/op/Ops.Math.Pow

## 85.55 PowerOfTwoSize



**Full Name:** Ops.Math.PowerOfTwoSize

Return the next values as power of two.

### > Inputs

- **Width** (Number: Integer)
- **Height** (Number: Integer)
- **Strategy Index** (Number: Integer)

### < Output

- **Width Result** (Number)
- **Height Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.PowerOfTwoSize#example

**Doc:** cables.gl/op/Ops.Math.PowerOfTwoSize

## 85.56 Radians



**Full Name:** Ops.Math.Radians

Converts a degree measurement to its corresponding value in radians.

### > Inputs

- **Degrees** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Radians#example

**Doc:** cables.gl/op/Ops.Math.Radians

## 85.57 RandomCounter



**Full Name:** Ops.Math.RandomCounter

add up random numbers by triggering.

### > Inputs

- **Count** (Trigger)
- **Step Min** (Number)
- **Step Max** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/l8AxE

**Doc:** cables.gl/op/Ops.Math.RandomCounter

## 85.58 RandomNumbers\_v3

RandomNumbers

**Full Name:** Ops.Math.RandomNumbers\_v3

Simple way to get random numbers without using arrays.

### > Inputs

- **Seed** (Number)
- **Min** (Number)
- **Max** (Number)

### < Output

- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)

**Example Patch:** cables.gl/edit/W\_z9bl

**Doc:** cables.gl/op/Ops.Math.RandomNumbers\_v3

## 85.59 RandomNumbersFromString

RandomNumbersFromString

**Full Name:** Ops.Math.RandomNumbersFromString

Random number generator from a string seed.

### > Inputs

- **Input String** (String)
- **Random Number Count** (Number: Integer)

### < Output

- **Random Value** (Number)
- **Random Numbers** (Array)

**Example Patch:** cables.gl/edit/aAaJgt

**Doc:** cables.gl/op/Ops.Math.RandomNumbersFromString

## 85.60 RotationFromNormal

RotationFromNormal

**Full Name:** Ops.Math.RotationFromNormal

Create rotation matrix from normal.

### > Inputs

- **Normal X** (Number)

- **Normal Y** (Number)
- **Normal Z** (Number)
- **Recalculate** (Trigger)

### < Output

- **RotationMatrix** (Array)

**Example Patch:** cables.gl/op/Ops.Math.RotationFromNormal#example

**Doc:** cables.gl/op/Ops.Math.RotationFromNormal

## 85.61 Round

Round

**Full Name:** Ops.Math.Round

Outputs number rounded to the nearest integer.

### > Inputs

- **Number** (Number)
- **Decimal Places** (Number: Integer)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/nPvVW2

**Doc:** cables.gl/op/Ops.Math.Round

## 85.62 RoundEven

RoundEven

**Full Name:** Ops.Math.RoundEven

round to the next even number.

### > Inputs

- **Number** (Number)
- **Mode Index** (Number: Integer)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/a0z7hL

**Doc:** cables.gl/op/Ops.Math.RoundEven

## 85.63 SchlickBias

SchlickBias

**Full Name:** Ops.Math.SchlickBias

Custom easing curve via schlick bias and gain.

#### > Inputs

- **Value** (Number)
- **Gain** (Number)
- **Bias** (Number)

#### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/FO9IG3](#)

**Doc:** [cables.gl/op/Ops.Math.SchlickBias](#)

## 85.64 Sign



**Full Name:** Ops.Math.Sign

get sign of value.

#### > Inputs

- **Value** (Number)
- **Remove Zero** (Number: Boolean)

#### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/pixllg](#)

**Doc:** [cables.gl/op/Ops.Math.Sign](#)

## 85.65 SimpleMovingAverage



**Full Name:** Ops.Math.SimpleMovingAverage

Calculate the Average of the last X values.

#### > Inputs

- **Value** (Number)
- **Number Of Values** (Number: Integer)

#### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/op/Ops.Math.SimpleMovingAverage#example](#)

**Doc:** [cables.gl/op/Ops.Math.SimpleMovingAverage](#)

## 85.66 Sine



**Full Name:** Ops.Math.Sine

Calculates the sine of an angle.

#### > Inputs

- **Value** (Number)
- **Phase** (Number)
- **Frequency** (Number)
- **Amplitude** (Number)
- **Asine** (Number: Boolean)

#### < Output

- **Result** (Number)

**Example Patch:** [cables.gl/edit/RhfUW2](#)

**Doc:** [cables.gl/op/Ops.Math.Sine](#)

## 85.67 Speed



**Full Name:** Ops.Math.Speed

measure speed of how much a value changes.

#### > Inputs

- **Update** (Trigger)
- **Value** (Number)

#### < Output

- **Speed** (Number)

**Example Patch:** [cables.gl/edit/Sgmd39](#)

**Doc:** [cables.gl/op/Ops.Math.Speed](#)

## 85.68 Sqrt



**Full Name:** Ops.Math.Sqrt

square root of a number.

#### > Inputs

- **Number** (Number)

#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Sqrt#example

**Doc:** cables.gl/op/Ops.Math.Sqrt

## 85.69 Subtract



**Full Name:** Ops.Math.Subtract

Subtracts Number2 from Number1 (minus, -).

### > Inputs

- **Number1** (Number)
- **Number2** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Subtract#example

**Doc:** cables.gl/op/Ops.Math.Subtract

## 85.70 Sum



**Full Name:** Ops.Math.Sum

Result of the addition.

### > Inputs

- **Number1** (Number)
- **Number2** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/P7d1r1

**Doc:** cables.gl/op/Ops.Math.Sum

## 85.71 Tangent



**Full Name:** Ops.Math.Tangent

Calculates the ratio of the sine and cosine of an angle.

### > Inputs

- **Value** (Number)
- **Phase** (Number)
- **Frequency** (Number)

- **Amplitude** (Number)

- **Asine** (Number: Boolean)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Math.Tangent#example

**Doc:** cables.gl/op/Ops.Math.Tangent

## 85.72 TriggerMathExpression



**Full Name:** Ops.Math.TriggerMathExpression

calculates a user defined mathematical expression.

### > Inputs

- **Calculate** (Trigger)
- **Expression** (String)
- **X** (Number)
- **Y** (Number)
- **Z** (Number)
- **W** (Number)
- **A** (Number)
- **B** (Number)
- **C** (Number)
- **D** (Number)
- **I** (Number)

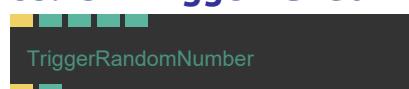
### < Output

- **Next** (Trigger)
- **Result** (Number)
- **Expression Valid** (booleanNumber)

**Example Patch:** cables.gl/edit/6K7A5f

**Doc:** cables.gl/op/Ops.Math.TriggerMathExpression

## 85.73 TriggerRandomNumber\_v3



**Full Name:** Ops.Math.TriggerRandomNumber\_v3

Generate random number between min and max.

### > Inputs

- **Generate** (Trigger)
- **Min** (Number)

- **Max** (Number)
- **Integer** (Number: Boolean)
- **No Consecutive Duplicates** (Number: Boolean)

#### ◀ Output

- **Next** (Trigger)
- **Result** (Number)

**Example Patch:** cables.gl/edit/s3FP7f

**Doc:** cables.gl/op/Ops.Math.TriggerRandomNumber\_v3

## 85.74 VectorLength



**Full Name:** Ops.Math.VectorLength

length of a vector.

#### ▶ Inputs

- **X** (Number)
- **Y** (Number)
- **Z** (Number)

#### ◀ Output

- **Length** (Number)

**Example Patch:** cables.gl/op/Ops.Math.VectorLength#example

**Doc:** cables.gl/op/Ops.Math.VectorLength

# 86 Ops.Math.Compare

## 86.1 Between



**Full Name:** Ops.Math.Compare.Between

result is true if value is between number1 and number2.

#### ▶ Inputs

- **Value** (Number)
- **Number1** (Number)
- **Number2** (Number)

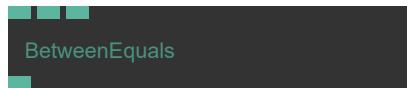
#### ◀ Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/pixllg

**Doc:** cables.gl/op/Ops.Math.Compare.Between

## 86.2 BetweenEquals



**Full Name:** Ops.Math.Compare.BetweenEquals

result is true if value is between or equal number1 and number2.

#### ▶ Inputs

- **Value** (Number)
- **Range 1** (Number)
- **Range 2** (Number)

#### ◀ Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/pixllg

**Doc:** cables.gl/op/Ops.Math.Compare.BetweenEquals

## 86.3 CompareNumbers



**Full Name:** Ops.Math.Compare.CompareNumbers

Performs logical comparisons on numbers (compare, operators).

#### ▶ Inputs

- **Value In** (Number)
- **Comparison Mode Index** (Number: Integer)

- Condition Value (Number)
- Max (Number)

#### < Output

- Result (Number)

**Example Patch:** [cables.gl/edit/54YpN](https://cables.gl/edit/54YpN)

**Doc:** [cables.gl/op/Ops.Math.Compare.CompareNumbers](https://cables.gl/op/Ops.Math.Compare.CompareNumbers)

## 86.4 Equals



**Full Name:** Ops.Math.Compare.Equals

result is true if number1 and number2 are equal.

#### > Inputs

- Number1 (Number)
- Number2 (Number)

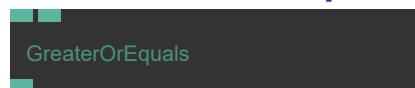
#### < Output

- Result (Number)

**Example Patch:** [cables.gl/op/Ops.Math.Compare.Equals#example](https://cables.gl/op/Ops.Math.Compare.Equals#example)

**Doc:** [cables.gl/op/Ops.Math.Compare.Equals](https://cables.gl/op/Ops.Math.Compare.Equals)

## 86.5 GreaterOrEquals



**Full Name:** Ops.Math.Compare.GreaterOrEquals

result is true if number 1 is greater or equals number 2.

#### > Inputs

- Number1 (Number)
- Number2 (Number)

#### < Output

- Result (Number)

**Example Patch:** [cables.gl/op/Ops.Math.Compare.GreaterOrEquals#example](https://cables.gl/op/Ops.Math.Compare.GreaterOrEquals#example)

**Doc:** [cables.gl/op/Ops.Math.Compare.GreaterOrEquals](https://cables.gl/op/Ops.Math.Compare.GreaterOrEquals)

## 86.6 GreaterThan



**Full Name:** Ops.Math.Compare.GreaterThan

result is true if number1 is greater than number2.

#### > Inputs

- Number1 (Number)
- Number2 (Number)

#### < Output

- Result (booleanNumber)

**Example Patch:** [cables.gl/edit/pixllg](https://cables.gl/edit/pixllg)

**Doc:** [cables.gl/op/Ops.Math.Compare.GreaterThan](https://cables.gl/op/Ops.Math.Compare.GreaterThan)

## 86.7 IfBetweenThen



**Full Name:** Ops.Math.Compare.IfBetweenThen

triggers when value is between min and max.

#### > Inputs

- Exe (Trigger)
- Number (Number)
- Min (Number)
- Max (Number)

#### < Output

- Then (Trigger)
- Else (Trigger)
- Bs Between (Number)

**Example Patch:** [cables.gl/op/Ops.Math.Compare.IfBetweenThen#example](https://cables.gl/op/Ops.Math.Compare.IfBetweenThen#example)

**Doc:** [cables.gl/op/Ops.Math.Compare.IfBetweenThen](https://cables.gl/op/Ops.Math.Compare.IfBetweenThen)

## 86.8 IsEven



**Full Name:** Ops.Math.Compare.IsEven

Checks if Value is even or not.

#### > Inputs

- Number1 (Number)

#### < Output

- Result (Number)

**Example Patch:** [cables.gl/op/Ops.Math.Compare.IsEven#example](https://cables.gl/op/Ops.Math.Compare.IsEven#example)

**Doc:** [cables.gl/op/Ops.Math.Compare.IsEven](https://cables.gl/op/Ops.Math.Compare.IsEven)

## 86.9 LessThan

LessThan

**Full Name:** Ops.Math.Compare.LessThan

Is n1 smaller than n2? (lesser, less).

### > Inputs

- **Number1** (Number)
- **Number2** (Number)

### < Output

- **Result** (booleanNumber)

**Example Patch:** cables.gl/edit/pixllg

**Doc:** cables.gl/op/Ops.Math.Compare.LessThan

## 87 Ops.Net

### 87.1 CorsProxy\_v3

CorsProxy

**Full Name:** Ops.Net.CorsProxy\_v3

create a cables.gl CORS proxy URL.

### > Inputs

- **URL** (String)
- **Use In Export** (Number: Boolean)
- **Active** (Number: Boolean)

### < Output

- **CORS URL** (String)

**Example Patch:** cables.gl/edit/PAedBi

**Doc:** cables.gl/op/Ops.Net.CorsProxy\_v3

# 88 Ops.Net.WebSocket

## 88.1 WebSocket\_v2



**Full Name:** Ops.Net.WebSocket.WebSocket\_v2

Create a websocket connection and receive data from it.

### > Inputs

- **URL** (String)

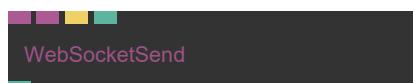
### < Output

- **Result** (Object)
- **Valid JSON** (booleanNumber)
- **Connection** (Object)
- **Connected** (booleanNumber)
- **Received Data** (Trigger)
- **Raw Data** (String)

**Example Patch:** cables.gl/edit/gu7DBo

**Doc:** cables.gl/op/Ops.Net.WebSocket.WebSocket\_v2

## 88.2 WebSocketSend



**Full Name:** Ops.Net.WebSocket.WebSocketSend

send an object to a websocket connection.

### > Inputs

- **Connection** (Object:Websocket)
- **Object** (Object)
- **Send** (Trigger)
- **Send String** (Number: Boolean)

### < Output

- **Sent** (Number)

**Example Patch:** cables.gl/edit/gu7DBo

**Doc:** cables.gl/op/Ops.Net.WebSocket.WebSocketSend

# 89 Ops.Number

## 89.1 DelayedNumber



**Full Name:** Ops.Number.DelayedNumber

delay a value by seconds.

### > Inputs

- **Update** (Trigger)
- **Value** (Number)
- **Delay** (Number)
- **Clear On Change** (Number: Boolean)
- **Easing Index** (Number: Integer)

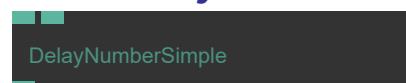
### < Output

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Number.DelayedNumber#example

**Doc:** cables.gl/op/Ops.Number.DelayedNumber

## 89.2 DelayNumberSimple



**Full Name:** Ops.Number.DelayNumberSimple

delay the value data flow by x seconds.

### > Inputs

- **Value** (Number)
- **Delay** (Number)

### < Output

- **Out Value** (Number)

**Example Patch:** cables.gl/op/Ops.Number.DelayNumberSimple#example

**Doc:** cables.gl/op/Ops.Number.DelayNumberSimple

## 89.3 FilterValidNumber



**Full Name:** Ops.Number.FilterValidNumber

Filter valid numbers.

### > Inputs

- **Number** (Number)

- **Invalid When 0** (Number: Boolean)

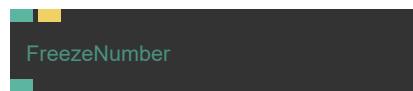
#### < Output

- **Last Valid Number** (Number)
- **Is Valid** (booleanNumber)

**Example Patch:** cables.gl/op/Ops.Number.FilterValidNumber#example

**Doc:** cables.gl/op/Ops.Number.FilterValidNumber

## 89.4 FreezeNumber



**Full Name:** Ops.Number.FreezeNumber

capture the current input and copy it to the output, even after a reload.

#### > Inputs

- **Number** (Number)
- **Button** (Trigger)

#### < Output

- **Frozen Number** (Number)

**Example Patch:** cables.gl/edit/MuPepX

**Doc:** cables.gl/op/Ops.Number.FreezeNumber

## 89.5 GateNumber



**Full Name:** Ops.Number.GateNumber

Let's a number through only if control bool is true, like a gate.

#### > Inputs

- **Value In** (Number)
- **Pass Through** (Number: Boolean)
- **Custom Value** (Number)

#### < Output

- **Value Out** (Number)

**Example Patch:** cables.gl/edit/JJSfIJ

**Doc:** cables.gl/op/Ops.Number.GateNumber

## 89.6 Integer



**Full Name:** Ops.Number.Integer

Number op which only outputs integers.

#### > Inputs

- **Integer** (Number: Integer)

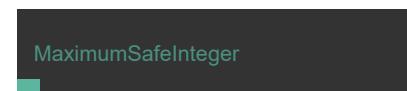
#### < Output

- **Number Out** (Number)

**Example Patch:** cables.gl/op/Ops.Number.Integer#example

**Doc:** cables.gl/op/Ops.Number.Integer

## 89.7 MaximumSafeInteger



**Full Name:** Ops.Number.MaximumSafeInteger

Returns the maximum safe integer (number, constant).

#### > Inputs

- Visit *Ops.Number.MaximumSafeInteger documentation* for input port details

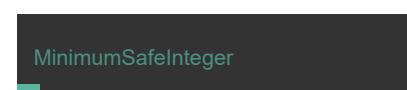
#### < Output

- **Max Int** (Number)

**Example Patch:** cables.gl/op/Ops.Number.MaximumSafeInteger#example

**Doc:** cables.gl/op/Ops.Number.MaximumSafeInteger

## 89.8 MinimumSafeInteger



**Full Name:** Ops.Number.MinimumSafeInteger

Returns the minimum safe integer (number, constant).

#### > Inputs

- Visit *Ops.Number.MinimumSafeInteger documentation* for input port details

#### < Output

- **Min Int** (Number)

**Example Patch:** cables.gl/op/Ops.Number.MinimumSafeInteger#example

**Doc:** cables.gl/op/Ops.Number.MinimumSafeInteger

## 89.9 Number

Number

**Full Name:** Ops.Number.Number

Stores a value, use the same value in different places (was: value.value).

### > Inputs

- **Value** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/0010r1

**Doc:** cables.gl/op/Ops.Number.Number

## 89.10 NumberSequence

NumberSequence

**Full Name:** Ops.Number.NumberSequence

Copies the input value to the (value sequence).

### > Inputs

- **In Value** (Number)

### < Output

- **In Value** (Number)
- **Value Changed** (Trigger)
- **Out Value 0** (Number)
- **Out Value 1** (Number)
- **Out Value 2** (Number)
- **Out Value 3** (Number)

**Example Patch:** cables.gl/edit/GfgpOb

**Doc:** cables.gl/op/Ops.Number.NumberSequence

## 89.11 Preset

Preset

**Full Name:** Ops.Number.Preset

State management of all parameters connected to it - Create presets of multiple ops.

### > Inputs

- **Data** (String)
- **Sets** (String)

- **Presetid** (String)
- **Interpolation Index** (Number: Integer)
- **Interpolation** (String)
- **Preset A** (Number)
- **Preset B** (Number)
- **Fade** (Number)
- **Preset Index** (Number: Integer)
- **Preset** (Number: String)
- **Create New** (Trigger)
- **Update** (Trigger)
- **Move** (Trigger)
- **Delete** (Trigger)
- **Rename** (Trigger)

### < Output

- **Create Variable** (Dynamic)
- **Num Presets** (Number)
- **Current Preset** (Number)
- **Dbg\_data** (Array)
- **Dbg\_sets** (Array)

**Example Patch:** cables.gl/edit/KI3veT

**Doc:** cables.gl/op/Ops.Number.Preset

## 89.12 PreviousNumberStore

PreviousNumberStore

**Full Name:** Ops.Number.PreviousNumberStore

remember/store last set number.

### > Inputs

- **Value** (Number)

### < Output

- **Current Value** (Number)
- **Previous Value** (Number)

**Example Patch:** cables.gl/edit/XhZWfo

**Doc:** cables.gl/op/Ops.Number.PreviousNumberStore

## 89.13 RouteNumber

RouteNumber

**Full Name:** Ops.Number.RouteNumber

Routes the value to one of the (based on index, relay).

#### > Inputs

- **Index** (Number: Integer)
- **Value** (Number)

#### < Output

- **Index** (Number: Integer)
- **Value** (Number)
- **Default VaonlyOnePortlue** (Number)
- **Set Inactive To Default** (Number: Boolean)
- **Index 0 Value** (Number)
- **Index 1 Value** (Number)
- **Index 2 Value** (Number)
- **Index 3 Value** (Number)
- **Index 4 Value** (Number)
- **Index 5 Value** (Number)
- **Index 6 Value** (Number)
- **Index 7 Value** (Number)
- **Index 8 Value** (Number)
- **Index 9 Value** (Number)

**Example Patch:** [cables.gl/edit/qJcKT6](#)

**Doc:** [cables.gl/op/Ops.Number.RouteNumber](#)

## 89.14 SequenceNumbers



**Full Name:** Ops.Number.SequenceNumbers

control order and flow of numbers.

#### > Inputs

- **Number 0** (Number)
- **Number 1** (Number)
- **Number 2** (Number)
- **Number 3** (Number)
- **Number 4** (Number)
- **Number 5** (Number)
- **Number 6** (Number)
- **Number 7** (Number)
- **Number 8** (Number)
- **Number 9** (Number)
- **Number 10** (Number)
- **Number 11** (Number)
- **Number 12** (Number)
- **Number 13** (Number)

- **Number 14** (Number)
- **Number 15** (Number)

#### < Output

- **Output 0** (Number)
- **Output 1** (Number)
- **Output 2** (Number)
- **Output 3** (Number)
- **Output 4** (Number)
- **Output 5** (Number)
- **Output 6** (Number)
- **Output 7** (Number)
- **Output 8** (Number)
- **Output 9** (Number)
- **Output 10** (Number)
- **Output 11** (Number)
- **Output 12** (Number)
- **Output 13** (Number)
- **Output 14** (Number)
- **Output 15** (Number)

**Example Patch:** [cables.gl/op/Ops.Number.SequenceNumbers#example](#)

**Doc:** [cables.gl/op/Ops.Number.SequenceNumbers](#)

## 89.15 SumMultiPort\_v2



**Full Name:** Ops.Number.SumMultiPort\_v2

Switch between multiple number inputs.

#### > Inputs

- **Numbers\_0** (Number)
- **Add Port** (Number)

#### < Output

- **Number** (Number)
- **Num Values** (Number)

**Example Patch:** [cables.gl/edit/fUoCu1](#)

**Doc:** [cables.gl/op/Ops.Number.SumMultiPort\\_v2](#)

## 89.16 SwitchNumber



SwitchNumber

**Full Name:** Ops.Number.SwitchNumber  
switch between number values by index.

**> Inputs**

- **Index** (Number: Integer)
- **Value 0** (Number)
- **Value 1** (Number)
- **Value 2** (Number)
- **Value 3** (Number)
- **Value 4** (Number)
- **Value 5** (Number)
- **Value 6** (Number)
- **Value 7** (Number)
- **Value 8** (Number)
- **Value 9** (Number)
- **Value 10** (Number)
- **Value 11** (Number)
- **Value 12** (Number)
- **Value 13** (Number)
- **Value 14** (Number)
- **Value 15** (Number)

**< Output**

- **Result** (Number)

**Example Patch:** cables.gl/op/Ops.Number.SwitchNumber#example

**Doc:** cables.gl/op/Ops.Number.SwitchNumber

## 89.17 SwitchNumberMultiPort\_v2



SwitchNumberMultiPort

**Full Name:** Ops.Number.SwitchNumberMultiPort\_v2

Switch between multiple number inputs.

**> Inputs**

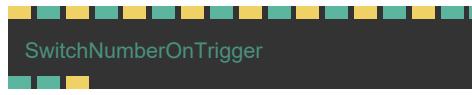
- **Index** (Number: Integer)
- **Numbers\_0** (Number)
- **Add Port** (Number)

**< Output**

- **Number** (Number)
- **Num Values** (Number)

**Example Patch:** cables.gl/op/Ops.Number.SwitchNumberMultiPort\_v2#example  
**Doc:** cables.gl/op/Ops.Number.SwitchNumberMultiPort\_v2

## 89.18 SwitchNumberOnTrigger



SwitchNumberOnTrigger

**Full Name:** Ops.Number.SwitchNumberOnTrigger

Sets a specific output value on trigger.

**> Inputs**

- **Trigger 0** (Trigger)
- **Value 0** (Number)
- **Trigger 1** (Trigger)
- **Value 1** (Number)
- **Trigger 2** (Trigger)
- **Value 2** (Number)
- **Trigger 3** (Trigger)
- **Value 3** (Number)
- **Trigger 4** (Trigger)
- **Value 4** (Number)
- **Trigger 5** (Trigger)
- **Value 5** (Number)
- **Trigger 6** (Trigger)
- **Value 6** (Number)
- **Trigger 7** (Trigger)
- **Value 7** (Number)
- **Default Value** (Number: String)

**< Output**

- **Value** (Number)
- **Last Value** (Number)
- **Triggered** (Trigger)

**Example Patch:** cables.gl/op/Ops.Number.SwitchNumberOnTrigger#example

**Doc:** cables.gl/op/Ops.Number.SwitchNumberOnTrigger

## 89.19 Trigger3Numbers



Trigger3Numbers

**Full Name:** Ops.Number.Trigger3Numbers

Stores a 3D coordinate (was Value3).

**> Inputs**

- **Exe** (Trigger)

- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)

#### < Output

- **Exe** (Trigger)
- **Value X** (Number)
- **Value Y** (Number)
- **Value Z** (Number)
- **Result X** (Number)
- **Result Y** (Number)
- **Result Z** (Number)

**Example Patch:** [cables.gl/op/Ops.Number.Trigger3Numbers#example](https://cables.gl/op/Ops.Number.Trigger3Numbers#example)

**Doc:** [cables.gl/op/Ops.Number.Trigger3Numbers](https://cables.gl/op/Ops.Number.Trigger3Numbers)

## 89.20 TriggerOnChangeNumber\_v2



**Full Name:** Ops.Number.TriggerOnChangeNumber\_v2

triggers every time the input value changed.

#### > Inputs

- **Value** (Number)

#### < Output

- **Next** (Trigger)
- **Number** (Number)

**Example Patch:** [cables.gl/edit/8y5hVJ](https://cables.gl/edit/8y5hVJ)

**Doc:** [cables.gl/op/Ops.Number.TriggerOnChangeNumber\\_v2](https://cables.gl/op/Ops.Number.TriggerOnChangeNumber_v2)

# 90 Ops Sidebar

## 90.1 Button\_v2



**Full Name:** Ops Sidebar.Button\_v2

sidebar push button/trigger element.

#### > Inputs

- **Link** (Object)
- **Text** (String)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)

#### < Output

- **Childs** (Object)
- **Pressed Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/aDgYX5](https://cables.gl/edit/aDgYX5)

**Doc:** [cables.gl/op/Ops Sidebar.Button\\_v2](https://cables.gl/op/Ops Sidebar.Button_v2)

## 90.2 ColorPicker\_v3



**Full Name:** Ops Sidebar.ColorPicker\_v3

Shows a color-picker in the sidebar.

#### > Inputs

- **Link** (Object)
- **Text** (String)
- **Input Red** (Number)
- **Input Green** (Number)
- **Input Blue** (Number)
- **Input Opacity** (Number)
- **Set Default** (Trigger)
- **Show Opacity** (Number: Boolean)

#### < Output

- **Children** (Object)
- **Red** (Number)
- **Green** (Number)
- **Blue** (Number)
- **Opacity** (Number)
- **Hex** (String)

**Example Patch:** cables.gl/edit/8-XQ5d

**Doc:** cables.gl/op/Ops Sidebar ColorPicker\_v3

## 90.3 DisplayValue\_v2



**Full Name:** Ops Sidebar.DisplayValue\_v2

display a value or string.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Value** (String)

### < Output

- **Childs** (Object)

**Example Patch:** cables.gl/edit/aDgYX5

**Doc:** cables.gl/op/Ops Sidebar.DisplayValue\_v2

## 90.4 DropDown\_v2



**Full Name:** Ops Sidebar.DropDown\_v2

Shows a drop-down (select) element in the sidebar.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Values** (Array)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Multiple Selection** (Number: Boolean)
- **Lines** (Number: Integer)
- **Set Default** (Trigger)

### < Output

- **Children** (Object)
- **Result** (String)
- **Index** (Number)
- **Selected Values** (Array)

**Example Patch:** cables.gl/edit/0wKJ5d

**Doc:** cables.gl/op/Ops Sidebar.DropDown\_v2

## 90.5 Group



**Full Name:** Ops Sidebar.Group

organize sidebar elements into groups.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Show Title** (Number: Boolean)
- **Default Minimized** (Number: Boolean)
- **Visible** (Number: Boolean)

### < Output

- **Next** (Object)
- **Childs** (Object)

**Example Patch:** cables.gl/op/Ops Sidebar.Group#example

**Doc:** cables.gl/op/Ops Sidebar.Group

## 90.6 Incrementor\_v3



**Full Name:** Ops Sidebar.Incrementor\_v3

steps through numerical or array values one by one.

### > Inputs

- **Link** (Object)
- **Label** (String)
- **Min** (Number)
- **Max** (Number)
- **Stepsize** (Number)
- **Default** (Number)
- **Grey Out** (Number: Boolean)
- **Increment** (Trigger)
- **Decrement** (Trigger)
- **Set Default** (Trigger)
- **Reset** (Trigger)

### < Output

- **Childs** (Object)
- **Value** (Number)
- **Changed** (Trigger)

**Example Patch:** cables.gl/edit/DLV0n6

**Doc:** cables.gl/op/Ops Sidebar.Incrementor\_v3

## 90.7 LocalFileToDataUrl



**Full Name:** Ops.Sidebar.LocalFileToDataUrl  
load a local file and output as data url.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Button Text** (String)
- **Accept Files** (String)
- **Allow Multiple Files** (Number: Boolean)
- **Id** (Number: String)
- **Visible** (Number: Boolean)
- **Grey Out** (Number: Boolean)
- **Show Dialog** (Trigger)
- **Reset** (Trigger)

### < Output

- **Childs** (Object)
- **Data URL** (String)
- **Filename** (String)
- **File Object** (Object)
- **Num Files** (Number)
- **Data URLs** (Array)
- **Filenames** (Array)
- **File Changed** (Trigger)

**Example Patch:** cables.gl/edit/a0V6xn

**Doc:** cables.gl/op/Ops Sidebar.LocalFileToDataUrl

## 90.8 NumberInput\_v2



**Full Name:** Ops.Sidebar.NumberInput\_v2

Enter a number in the sidebar.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Set Default** (Trigger)

### < Output

- **Children** (Object)
- **Result** (Number)

**Example Patch:** cables.gl/edit/aDgYX5

**Doc:** cables.gl/op/Ops Sidebar.NumberInput\_v2

## 90.9 Presets\_v2



**Full Name:** Ops.Sidebar.Presets\_v2  
manage sidebar presets.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Add Preset** (Trigger)
- **Update Current Preset** (Trigger)
- **Preset Title 0** (String)
- **Preset 0** (Object)
- **Preset Title 1** (String)
- **Preset 1** (Object)
- **Preset Title 2** (String)
- **Preset 2** (Object)
- **Preset Title 3** (String)
- **Preset 3** (Object)
- **Preset Title 4** (String)
- **Preset 4** (Object)
- **Preset Title 5** (String)
- **Preset 5** (Object)
- **Preset Title 6** (String)
- **Preset 6** (Object)
- **Preset Title 7** (String)
- **Preset 7** (Object)

### < Output

- **Children** (Object)
- **Index** (Number)

**Example Patch:** cables.gl/edit/KKabBN

**Doc:** cables.gl/op/Ops Sidebar.Presets\_v2

## 90.10 Sidebar



**Full Name:** Ops.Sidebar.Sidebar  
Sidebar overlay to control values.

#### > Inputs

- **Visible** (Number: Boolean)
- **Opacity** (Number)
- **Default Minimized** (Number: Boolean)
- **Minimized Opacity** (Number)
- **Show Undo Button** (Number: Boolean)
- **Show Minimize** (Number: Boolean)
- **Title** (String)
- **Side** (Number: Boolean)
- **Default CSS** (Number: Boolean)

#### < Output

- **Childs** (Object)
- **Opened** (booleanNumber)

**Example Patch:** [cables.gl/edit/aDgYX5](https://cables.gl/edit/aDgYX5)

**Doc:** [cables.gl/op/Ops Sidebar Sidebar](https://cables.gl/op/Ops Sidebar Sidebar)

## 90.11 SidebarDateTime



**Full Name:** Ops Sidebar SidebarDateTime  
date or datetime picker in the sidebar.

#### > Inputs

- **Link** (Object)
- **Text** (String)
- **Default** (String)
- **Min** (String)
- **Max** (String)
- **Type Index** (Number: Integer)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)

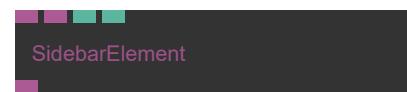
#### < Output

- **Children** (Object)
- **Result** (String)
- **Focus** (booleanNumber)

**Example Patch:** [cables.gl/edit/Bkzmci](https://cables.gl/edit/Bkzmci)

**Doc:** [cables.gl/op/Ops Sidebar SidebarDateTime](https://cables.gl/op/Ops Sidebar SidebarDateTime)

## 90.12 SidebarElement



**Full Name:** Ops Sidebar SidebarElement

Add custom HTML Elements into the sidebar.

#### > Inputs

- **Link** (Object)
- **Child Element** (Object)
- **Border** (Number: Boolean)
- **Visible** (Number: Boolean)

#### < Output

- **Childs** (Object)

**Example Patch:** [cables.gl/edit/CQrFox](https://cables.gl/edit/CQrFox)

**Doc:** [cables.gl/op/Ops Sidebar SidebarElement](https://cables.gl/op/Ops Sidebar SidebarElement)

## 90.13 SideBarImage



**Full Name:** Ops Sidebar SideBarImage

Display an image in the sidebar.

#### > Inputs

- **Link** (Object)
- **File** (String)

#### < Output

- **Childs** (Object)
- **Image Element** (Object)

**Example Patch:** [cables.gl/edit/nLvdby](https://cables.gl/edit/nLvdby)

**Doc:** [cables.gl/op/Ops Sidebar SideBarImage](https://cables.gl/op/Ops Sidebar SideBarImage)

## 90.14 SideBarStyle



**Full Name:** Ops Sidebar SideBarStyle

adjust appearance of sidebar.

#### > Inputs

- **Link** (Object)
- **Width** (Number: Integer)
- **Round Corners** (Number)

- **Special Color** (String)

#### < Output

- **Childs** (Object)

**Example Patch:** [cables.gl/edit/o1fXgI](https://cables.gl/edit/o1fXgI)

**Doc:** [cables.gl/op/Ops Sidebar SidebarStyle](https://cables.gl/op/Ops Sidebar SidebarStyle)

## 90.15 SideBarSwitch



**Full Name:** Ops Sidebar.SideBarSwitch

add tabs or switchbar to a sidebar.

#### > Inputs

- **Link** (Object)
- **Names** (Array)
- **Text** (String)
- **Set Default** (Trigger)
- **Grey Out** (Number: Boolean)
- **Default** (Number)

#### < Output

- **Childs** (Object)
- **Index** (Number)
- **String** (String)

**Example Patch:** [cables.gl/edit/7uuz6D](https://cables.gl/edit/7uuz6D)

**Doc:** [cables.gl/op/Ops Sidebar.SideBarSwitch](https://cables.gl/op/Ops Sidebar.SideBarSwitch)

## 90.16 SidebarText\_v3



**Full Name:** Ops Sidebar.SidebarText\_v3

Display text in the sidebar.

#### > Inputs

- **Link** (Object)
- **Text** (String)
- **Id** (String)
- **Visible** (Number: Boolean)

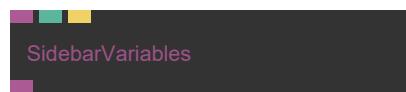
#### < Output

- **Childs** (Object)

**Example Patch:** [cables.gl/edit/Ut4y8i](https://cables.gl/edit/Ut4y8i)

**Doc:** [cables.gl/op/Ops Sidebar SidebarText\\_v3](https://cables.gl/op/Ops Sidebar SidebarText_v3)

## 90.17 SidebarVariables



**Full Name:** Ops Sidebar.SidebarVariables  
show values of all variables in a sidebar.

#### > Inputs

- **Link** (Object)
- **Id** (Number: String)
- **Update** (Trigger)

#### < Output

- **Childs** (Object)

**Example Patch:** [cables.gl/edit/H2kYgL](https://cables.gl/edit/H2kYgL)

**Doc:** [cables.gl/op/Ops Sidebar SidebarVariables](https://cables.gl/op/Ops Sidebar SidebarVariables)

## 90.18 Slider\_v3



**Full Name:** Ops Sidebar.Slider\_v3

Sidebar slider element (range).

#### > Inputs

- **Link** (Object)
- **Text** (String)
- **Min** (Number)
- **Max** (Number)
- **Step** (Number)
- **Suffix** (String)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Set Default** (Trigger)
- **Reset** (Trigger)

#### < Output

- **Childs** (Object)
- **Result** (Number)

**Example Patch:** [cables.gl/edit/aDgYX5](https://cables.gl/edit/aDgYX5)

**Doc:** [cables.gl/op/Ops Sidebar Slider\\_v3](https://cables.gl/op/Ops Sidebar Slider_v3)

## 90.19 TextInput\_v2



**Full Name:** Ops.Sidebar.TextInput\_v2

Get a string from an sidebar input field.

### > Inputs

- **Link** (Object)
- **Where to attach the sidebar item to** (Sidebar / Sidebar Group)
- **Text** (String)
- **Default** (String)
- **Placeholder** (String)
- **TextArea** (Number: Boolean)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)
- **Spellcheck** (Number: Boolean)
- **Enter Key Prevent Default** (Number: Boolean)
- **Clear** (Trigger)
- **Focus Input** (Trigger)

### < Output

- **Children** (Object)
- **Result** (String)
- **Focus** (booleanNumber)
- **Keypress Enter** (Trigger)
- **Keypress ESC** (Trigger)

**Example Patch:** cables.gl/edit/wa-KH-

**Doc:** cables.gl/op/Ops.Sidebar.TextInput\_v2

## 90.20 Toggle\_v4



**Full Name:** Ops.Sidebar.Toggle\_v4

sidebar boolean toggle/switch element.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Set Default** (Trigger)
- **Grey Out** (Number: Boolean)
- **Visible** (Number: Boolean)

### < Output

- **Childs** (Object)

- **Value** (booleanNumber)

- **Toggled** (Trigger)

**Example Patch:** cables.gl/edit/aDgYX5

**Doc:** cables.gl/op/Ops.Sidebar.Toggle\_v4

## 90.21 XYPad



**Full Name:** Ops.Sidebar.XYPad

2d coordinate input element.

### > Inputs

- **Link** (Object)
- **Text** (String)
- **Input X** (Number)
- **Input Y** (Number)
- **Flip X** (Number: Boolean)
- **Flip Y** (Number: Boolean)
- **Set Default** (Trigger)
- **Visible** (Number: Boolean)

### < Output

- **Children** (Object)
- **X** (Number)
- **Y** (Number)
- **HTML Element** (Object)

**Example Patch:** cables.gl/edit/0NF2FL

**Doc:** cables.gl/op/Ops.Sidebar.XYPad

# 91 Ops.String

## 91.1 AddLineBreaks\_v2



**Full Name:** Ops.String.AddLineBreaks\_v2

Insert a line break in a string of words.

### > Inputs

- **String** (String)
- **Max Characters Per Line** (Number: Integer)

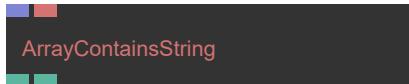
### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/4f-D16

**Doc:** cables.gl/op/Ops.String.AddLineBreaks\_v2

## 91.2 ArrayContainsString



**Full Name:** Ops.String.ArrayContainsString

Check if an array contains a string which can also be a number (find,search,indexOf).

### > Inputs

- **Array** (Array)
- **SearchValue** (String)

### < Output

- **Found** (booleanNumber)
- **Index** (Number)

**Example Patch:** cables.gl/edit/VuK4ve

**Doc:** cables.gl/op/Ops.String.ArrayContainsString

## 91.3 ArrayOfStrings



**Full Name:** Ops.String.ArrayOfStrings

Create an array of strings and optionally attach index-number.

### > Inputs

- **String** (String)
- **Length** (Number: Integer)
- **Attach Number** (Number: Boolean)

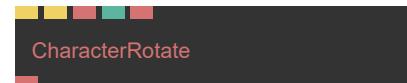
### < Output

- **Array** (Array)

**Example Patch:** cables.gl/edit/haeXx3

**Doc:** cables.gl/op/Ops.String.ArrayOfStrings

## 91.4 CharacterRotate



**Full Name:** Ops.String.CharacterRotate

String rotate characters like a split-flap display.

### > Inputs

- **Update** (Trigger)
- **Reset** (Trigger)
- **Text** (String)
- **Random Seed** (Number)
- **Characters** (String)

### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/-luM8S

**Doc:** cables.gl/op/Ops.String.CharacterRotate

## 91.5 Concat\_v2



**Full Name:** Ops.String.Concat\_v2

Joins two strings together.

### > Inputs

- **String1** (String)
- **String2** (String)
- **New Line** (Number: Boolean)
- **Active** (Number: Boolean)

### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/a8qVz6

**Doc:** cables.gl/op/Ops.String.Concat\_v2

## 91.6 ConcatMulti\_v2

ConcatMulti

**Full Name:** Ops.String.ConcatMulti\_v2

Joins multiple strings together.

### > Inputs

- **String 0** (String)
- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)
- **String 6** (String)
- **String 7** (String)

### < Output

- **Concat String** (String)

**Example Patch:** cables.gl/edit/DNW-QJ

**Doc:** cables.gl/op/Ops.String.ConcatMulti\_v2

## 91.7 ConcatMultiPort\_v2

ConcatMultiPort

**Full Name:** Ops.String.ConcatMultiPort\_v2

concatinate/join multiple string inputs.

### > Inputs

- **Strings\_0** (String)
- **Add Port** (String)

### < Output

- **String** (String)
- **Num Strings** (Number)

**Example Patch:** cables.gl/edit/PBHPRh

**Doc:** cables.gl/op/Ops.String.ConcatMultiPort\_v2

## 91.8 CopyToClipboard

CopyToClipboard

**Full Name:** Ops.String.CopyToClipboard

Copy string to clipboard on trigger.

### > Inputs

- **Copy** (Trigger)
- **String** (String)

### < Output

- **Success** (booleanNumber)

**Example Patch:** cables.gl/edit/Rquam4

**Doc:** cables.gl/op/Ops.String.CopyToClipboard

## 91.9 DelayStringSimple

DelayStringSimple

**Full Name:** Ops.String.DelayStringSimple

delay the output of a string by n seconds.

### > Inputs

- **Value** (String)
- **Delay** (Number)

### < Output

- **Out Value** (String)

**Example Patch:** cables.gl/edit/kqtJkE

**Doc:** cables.gl/op/Ops.String.DelayStringSimple

## 91.10 EndsWith

EndsWith

**Full Name:** Ops.String.EndsWith

does a string starts with another string?.

### > Inputs

- **String** (String)
- **Search** (String)

### < Output

- **Ends With** (booleanNumber)

**Example Patch:** cables.gl/edit/X0EBz1

**Doc:** cables.gl/op/Ops.String.EndsWith

## 91.11 FileUrlsToArrayMultiPort\_v2

FileUrlsToArrayMultiPort

## Full Name: Ops.String.FileUrlsToArrayMultiPort\_v2

create an array from multiple string.

### > Inputs

- **Strings\_0** (String)
- **Add Port** (String)

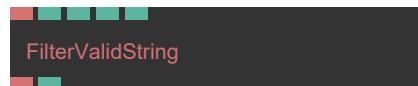
### < Output

- **Result** (Array)
- **Num Values** (Number)

**Example Patch:** [cables.gl/edit/u0Pbz1](#)

**Doc:** [cables.gl/op/Ops.String.FileUrlsToArrayMultiPort\\_v2](#)

## 91.12 FilterValidString



### Full Name: Ops.String.FilterValidString

filter valid strings (not null,undefined or empty).

### > Inputs

- **String** (String)
- **Invalid If Null** (Number: Boolean)
- **Invalid If Undefined** (Number: Boolean)
- **Invalid If Empty** (Number: Boolean)
- **Invalid If 0** (Number: Boolean)

### < Output

- **Last Valid String** (String)
- **Is Valid** (Number)

**Example Patch:** [cables.gl/op/Ops.String.FilterValidString#example](#)

**Doc:** [cables.gl/op/Ops.String.FilterValidString](#)

## 91.13 FreezeString



### Full Name: Ops.String.FreezeString

capture the current input and copy it to the output, even after a reload.

### > Inputs

- **String** (String)
- **Button** (Trigger)

### < Output

- **Frozen String** (String)

**Example Patch:** [cables.gl/edit/MuPepX](#)

**Doc:** [cables.gl/op/Ops.String.FreezeString](#)

## 91.14 GateString



### Full Name: Ops.String.GateString

Output string if pass through is true.

### > Inputs

- **String In** (String)
- **Pass Through** (Number: Boolean)
- **Custom Value** (String)

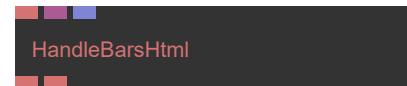
### < Output

- **String Out** (String)

**Example Patch:** [cables.gl/op/Ops.String.GateString#example](#)

**Doc:** [cables.gl/op/Ops.String.GateString](#)

## 91.15 HandleBarsHtml\_v2



### Full Name: Ops.String.HandleBarsHtml\_v2

string conversion using handlebars template engine.

### > Inputs

- **Template** (String)
- **Data** (Object)
- **Array** (Array)

### < Output

- **Result** (String)
- **Errors** (String)

**Example Patch:** [cables.gl/edit/TKQIs7](#)

**Doc:** [cables.gl/op/Ops.String.HandleBarsHtml\\_v2](#)

## 91.16 HtmlDecode



### Full Name: Ops.String.HtmlDecode

convert a html encoded string to a normal UTF8 string.

### > Inputs

- **String** (String)

## < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/jVwciO

**Doc:** cables.gl/op/Ops.String.HtmlDecode

## 91.17 HtmlEncode



HtmlEncode

**Full Name:** Ops.String.HtmlEncode

encode a string to html.

### > Inputs

- **String** (String)

### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/jVwciO

**Doc:** cables.gl/op/Ops.String.HtmlEncode

## 91.18 LeftPad\_v2



LeftPad

**Full Name:** Ops.String.LeftPad\_v2

create a fixed length string from a number 1 -> 0001.

### > Inputs

- **Value** (String)
- **Char** (String)
- **Num** (Number: Integer)

### < Output

- **String** (String)

**Example Patch:** cables.gl/edit/8LJxz7

**Doc:** cables.gl/op/Ops.String.LeftPad\_v2

## 91.19 LimitLineBreaks\_v2



LimitLineBreaks

**Full Name:** Ops.String.LimitLineBreaks\_v2

Limit number of lines in a string.

### > Inputs

- **String** (String)

## > Num Lines (Number: Integer)

## > Reverse (Number: Boolean)

## > Force Num Lines (Number: Boolean)

## < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/ZCUND-

**Doc:** cables.gl/op/Ops.String.LimitLineBreaks\_v2

## 91.20 LineBreak



LineBreak

**Full Name:** Ops.String.LineBreak

Outputs a linebreak, or adds a linebreak to a string.

### > Inputs

- **String** (String)

### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/U7PniO

**Doc:** cables.gl/op/Ops.String.LineBreak

## 91.21 LineBreaksHtml



LineBreaksHtml

**Full Name:** Ops.String.LineBreaksHtml

Convert linebreaks to html breaks.

### > Inputs

- **String** (String)
- **Add Num Breaks** (Number: Integer)

### < Output

- **HTML** (String)

**Example Patch:** cables.gl/edit/M0BG16

**Doc:** cables.gl/op/Ops.String.LineBreaksHtml

## 91.22 LoremIpsum



LoremIpsum

**Full Name:** Ops.String.LoremIpsum

Loem ipsum dolor sit amet.

#### > Inputs

- Visit [Ops.String.LoremIpsum](#) documentation for input port details

#### < Output

- **String** (String)
- **HTML String** (String)
- **Array** (Array)

**Example Patch:** [cables.gl/edit/4f-D16](#)

**Doc:** [cables.gl/op/Ops.String.LoremIpsum](#)

## 91.23 Lowercase\_v2



**Full Name:** Ops.String.Lowercase\_v2

convert all characters to small letters.

#### > Inputs

- **String** (String)

#### < Output

- **Result** (String)

**Example Patch:** [cables.gl/edit/a8qVz6](#)

**Doc:** [cables.gl/op/Ops.String.Lowercase\\_v2](#)

## 91.24 Md5



**Full Name:** Ops.String.Md5

Create a md5 hash of a string.

#### > Inputs

- **String** (String)

#### < Output

- **MD5 Hash** (String)

**Example Patch:** [cables.gl/edit/lyC0O8](#)

**Doc:** [cables.gl/op/Ops.String.Md5](#)

## 91.25 NumberFormatter



**Full Name:** Ops.String.NumberFormatter

Format a number to a string in the given locale and format.

#### > Inputs

- **Input Number** (Number)
- **Locale String** (String)
- **Minimum Integer Digits** (Number: Integer)
- **Minimum Fraction Digits** (Number: Integer)
- **Maximum Fraction Digits** (Number: Integer)
- **Minimum Significant Digits** (Number: Integer)
- **Maximum Significant Digits** (Number: Integer)
- **Use Grouping** (Number: Boolean)
- **Currency Name** (String)

#### < Output

- **Formatted Number** (String)
- **Has Error** (booleanNumber)

**Example Patch:** [cables.gl/edit/-h-Rx3](#)

**Doc:** [cables.gl/op/Ops.String.NumberFormatter](#)

## 91.26 NumberSwitchByString



**Full Name:** Ops.String.NumberSwitchByString

associate numbers by strings.

#### > Inputs

- **String** (String)
- **String 1** (String)
- **Number 1** (Number)
- **String 2** (String)
- **Number 2** (Number)
- **String 3** (String)
- **Number 3** (Number)
- **String 4** (String)
- **Number 4** (Number)
- **String 5** (String)
- **Number 5** (Number)
- **String 6** (String)
- **Number 6** (Number)
- **String 7** (String)
- **Number 7** (Number)
- **String 8** (String)
- **Number 8** (Number)
- **String 9** (String)
- **Number 9** (Number)

- **String 10** (String)
- **Number 10** (Number)

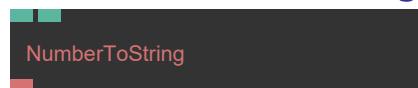
#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/CWSBeE

**Doc:** cables.gl/op/Ops.String.NumberSwitchByString

## 91.27 NumberToString\_v2



**Full Name:** Ops.String.NumberToString\_v2

Convert a number to a string.

#### > Inputs

- **Number** (Number)
- **Decimal Places** (Number: Integer)

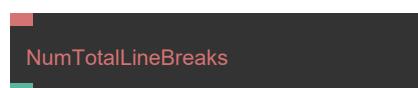
#### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/fo6nci

**Doc:** cables.gl/op/Ops.String.NumberToString\_v2

## 91.28 NumTotalLineBreaks



**Full Name:** Ops.String.NumTotalLineBreaks

Count number of line breaks in a string.

#### > Inputs

- **String** (String)

#### < Output

- **Total Lines** (Number)

**Example Patch:** cables.gl/edit/lkDCeT

**Doc:** cables.gl/op/Ops.String.NumTotalLineBreaks

## 91.29 OrString



**Full Name:** Ops.String.OrString

outputs the first valid string.

#### > Inputs

- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)
- **String 6** (String)
- **String 7** (String)
- **String 8** (String)

#### < Output

- **Result** (String)

**Example Patch:** cables.gl/op/Ops.String.OrString#example

**Doc:** cables.gl/op/Ops.String.OrString

## 91.30 ParseInt\_v2



**Full Name:** Ops.String.ParseInt\_v2

Parse a string to a integer number / string to number.

#### > Inputs

- **String** (String)

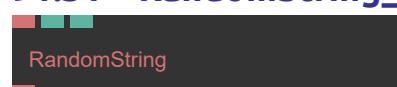
#### < Output

- **Number** (Number)

**Example Patch:** cables.gl/op/Ops.String.ParseInt\_v2#example

**Doc:** cables.gl/op/Ops.String.ParseInt\_v2

## 91.31 RandomString\_v3



**Full Name:** Ops.String.RandomString\_v3

Generate a random string of given characters.

#### > Inputs

- **Chars** (String)
- **Length** (Number: Integer)
- **Seed** (Number)

#### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/HqmXN8

**Doc:** cables.gl/op/Ops.String.RandomString\_v3

## 91.32 RightPad\_v2

RightPad

**Full Name:** Ops.String.RightPad\_v2

create a string with a fixed length filling the space with a character.

### > Inputs

- **Value** (String)
- **Char** (String)
- **Num** (Number: Integer)

### < Output

- **String** (String)

**Example Patch:** [cables.gl/edit/8LJxz7](https://cables.gl/edit/8LJxz7)

**Doc:** [cables.gl/op/Ops.String.RightPad\\_v2](https://cables.gl/op/Ops.String.RightPad_v2)

## 91.33 RightPadNumber\_v2

RightPadNumber

**Full Name:** Ops.String.RightPadNumber\_v2

Converts a number to a string with num decimal places, adds 0's.

### > Inputs

- **Value** (Number)
- **Num** (Number: Integer)

### < Output

- **String** (String)

**Example Patch:** [cables.gl/edit/ps8ZHq](https://cables.gl/edit/ps8ZHq)

**Doc:** [cables.gl/op/Ops.String.RightPadNumber\\_v2](https://cables.gl/op/Ops.String.RightPadNumber_v2)

## 91.34 RouteString

RouteString

**Full Name:** Ops.String.RouteString

Route a string to an output port.

### > Inputs

- **Index** (Number: Integer)
- **String In** (String)
- **Default String** (String)
- **Set Inactive To Default** (Number: Boolean)

### < Output

- **Index 0 String** (String)
- **Index 1 String** (String)
- **Index 2 String** (String)
- **Index 3 String** (String)
- **Index 4 String** (String)
- **Index 5 String** (String)
- **Index 6 String** (String)
- **Index 7 String** (String)
- **Index 8 String** (String)
- **Index 9 String** (String)

**Example Patch:** [cables.gl/edit/WDoBX8](https://cables.gl/edit/WDoBX8)

**Doc:** [cables.gl/op/Ops.String.RouteString](https://cables.gl/op/Ops.String.RouteString)

## 91.35 SaveTextFile

SaveTextFile

**Full Name:** Ops.String.SaveTextFile

download a textfile containing the input string.

### > Inputs

- **Download** (Trigger)
- **Filename** (String)
- **Content String** (String)

### < Output

• Visit [Ops.String.SaveTextFile documentation for output port details](#)

**Example Patch:** [cables.gl/edit/mxybpX](https://cables.gl/edit/mxybpX)

**Doc:** [cables.gl/op/Ops.String.SaveTextFile](https://cables.gl/op/Ops.String.SaveTextFile)

## 91.36 SequenceStrings

SequenceStrings

**Full Name:** Ops.String.SequenceStrings

control order and flow of strings.

### > Inputs

- **String 0** (String)
- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)
- **String 6** (String)

- **String 7** (String)
- **String 8** (String)
- **String 9** (String)
- **String 10** (String)
- **String 11** (String)
- **String 12** (String)
- **String 13** (String)
- **String 14** (String)
- **String 15** (String)

#### < Output

- **Output 0** (String)
- **Output 1** (String)
- **Output 2** (String)
- **Output 3** (String)
- **Output 4** (String)
- **Output 5** (String)
- **Output 6** (String)
- **Output 7** (String)
- **Output 8** (String)
- **Output 9** (String)
- **Output 10** (String)
- **Output 11** (String)
- **Output 12** (String)
- **Output 13** (String)
- **Output 14** (String)
- **Output 15** (String)

**Example Patch:** [cables.gl/op/Ops.String.SequenceStrings#example](https://cables.gl/edit/Ops.String.SequenceStrings#example)

**Doc:** [cables.gl/op/Ops.String.SequenceStrings](https://cables.gl/op/Ops.String.SequenceStrings)

## 91.37 StartsWith



**Full Name:** Ops.String.StartsWith

does a string starts with another string?.

#### > Inputs

- **String** (String)
- **Search** (String)

#### < Output

- **Starts With** (booleanNumber)

**Example Patch:** [cables.gl/edit/Hht1O8](https://cables.gl/edit/Hht1O8)

**Doc:** [cables.gl/op/Ops.String.StartsWith](https://cables.gl/op/Ops.String.StartsWith)

## 91.38 String\_v3



**Full Name:** Ops.String.String\_v3

String input/output.

#### > Inputs

- **Value** (String)

#### < Output

- **String** (String)

**Example Patch:** [cables.gl/edit/FXRsi](https://cables.gl/edit/FXRsi)

**Doc:** [cables.gl/op/Ops.String.String\\_v3](https://cables.gl/op/Ops.String.String_v3)

## 91.39 StringCompose\_v3



**Full Name:** Ops.String.StringCompose\_v3

Combine multiple Values to a new String.

#### > Inputs

- **Format** (String)
- **String A** (String)
- **String B** (String)
- **String C** (String)
- **String D** (String)
- **String E** (String)
- **String F** (String)

#### < Output

- **Result** (String)

**Example Patch:** [cables.gl/edit/U4M4J5](https://cables.gl/edit/U4M4J5)

**Doc:** [cables.gl/op/Ops.String.StringCompose\\_v3](https://cables.gl/op/Ops.String.StringCompose_v3)

## 91.40 StringContains\_v2



**Full Name:** Ops.String.StringContains\_v2

check if string contains another string (find,search,indexOf).

#### > Inputs

- **String** (String)
- **SearchValue** (String)

#### < Output

- **Found** (Number)
- **Index** (Number)

**Example Patch:** cables.gl/op/Ops.String.StringContains\_v2#example

**Doc:** cables.gl/op/Ops.String.StringContains\_v2

## 91.41 StringEditor



**Full Name:** Ops.String.StringEditor

string text editor.

#### > Inputs

- **Value** (String)
- **Syntax Index** (Number: Integer)

#### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/Jhvni8i

**Doc:** cables.gl/op/Ops.String.StringEditor

## 91.42 StringEquals\_v2



**Full Name:** Ops.String.StringEquals\_v2

check if content of two strings is the same.

#### > Inputs

- **String 1** (String)
- **String 2** (String)

#### < Output

- **Result** (booleanNumber)

**Example Patch:** cables.gl/edit/Nx2zci

**Doc:** cables.gl/op/Ops.String.StringEquals\_v2

## 91.43 StringGetLineNumAtIndex



**Full Name:** Ops.String.StringGetLineNumAtIndex

output the line number at the character index.

#### > Inputs

- **String** (String)

- **Index** (Number: Integer)

#### < Output

- **Line** (Number)
- **Found** (Number)

**Example Patch:** cables.gl/op/Ops.String.StringGetLineNumAtIndex#example

**Doc:** cables.gl/op/Ops.String.StringGetLineNumAtIndex

## 91.44 StringIterator\_v2



**Full Name:** Ops.String.StringIterator\_v2

iterate over every character of a string.

#### > Inputs

- **Exec** (Trigger)
- **String** (String)

#### < Output

- **Next** (Trigger)
- **Character** (String)
- **Index** (Number)
- **Length** (Number)

**Example Patch:** cables.gl/op/Ops.String.StringIterator\_v2#example

**Doc:** cables.gl/op/Ops.String.StringIterator\_v2

## 91.45 StringLength\_v2



**Full Name:** Ops.String.StringLength\_v2

number of characters in a string.

#### > Inputs

- **String** (String)

#### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/v9GLji

**Doc:** cables.gl/op/Ops.String.StringLength\_v2

## 91.46 StringRemoveCharacters

StringRemoveCharacters

**Full Name:** Ops.String.StringRemoveCharacters

Remove every occurrences of given characters from a string.

### > Inputs

- **String** (String)
- **Characters** (String)
- **Replace** (String)

### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/ls8ciO

**Doc:** cables.gl/op/Ops.String.StringRemoveCharacters

## 91.47 StringReplace

StringReplace

**Full Name:** Ops.String.StringReplace

replace occurrences of a string with another string.

### > Inputs

- **String** (String)
- **Search For** (String)
- **Replace** (String)
- **Replace What Index** (Number: Integer)

### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/q0iLkE

**Doc:** cables.gl/op/Ops.String.StringReplace

## 91.48 StringSortLines

StringSortLines

**Full Name:** Ops.String.StringSortLines

sort each line of a string alphabetically.

### > Inputs

- **String** (String)
- **Reverse** (Number: Boolean)

### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/MMS2O8

**Doc:** cables.gl/op/Ops.String.StringSortLines

## 91.49 StringsToArrayMultiPort\_v2

StringsToArrayMultiPort

**Full Name:** Ops.String.StringsToArrayMultiPort\_v2

create an array from multiple string.

### > Inputs

- **Strings\_0** (String)
- **Add Port** (String)

### < Output

- **Result** (Array)
- **Num Values** (Number)

**Example Patch:** cables.gl/edit/oBPhsh

**Doc:** cables.gl/op/Ops.String.StringsToArrayMultiPort\_v2

## 91.50 StringSwitchByString

StringSwitchByString

**Full Name:** Ops.String.StringSwitchByString

Switch between multiple strings by a string index.

### > Inputs

- **String** (String)
- **Default** (String)
- **String 1** (String)
- **Result String 1** (String)
- **String 2** (String)
- **Result String 2** (String)
- **String 3** (String)
- **Result String 3** (String)
- **String 4** (String)
- **Result String 4** (String)
- **String 5** (String)
- **Result String 5** (String)
- **String 6** (String)
- **Result String 6** (String)
- **String 7** (String)
- **Result String 7** (String)

- **String 8** (String)
- **Result String 8** (String)
- **String 9** (String)
- **Result String 9** (String)
- **String 10** (String)
- **Result String 10** (String)

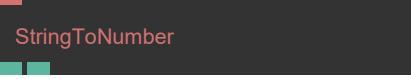
**< Output**

- **Result** (String)

**Example Patch:** cables.gl/op/Ops.String.StringSwitchByString#example

**Doc:** cables.gl/op/Ops.String.StringSwitchByString

## 91.51 StringToNumber



StringToNumber

**Full Name:** Ops.String.StringToNumber

Parses a string and returns a floating point number / string to number.

**> Inputs**

- **String** (String)

**< Output**

- **Number** (Number)
- **Not A Number** (booleanNumber)

**Example Patch:** cables.gl/edit/XMEwci

**Doc:** cables.gl/op/Ops.String.StringToNumber

## 91.52 StringTrim\_v2



StringTrim

**Full Name:** Ops.String.StringTrim\_v2

Remove whitespace from both ends of a string.

**> Inputs**

- **String** (String)

**< Output**

- **Result** (String)

**Example Patch:** cables.gl/edit/Ddmsii

**Doc:** cables.gl/op/Ops.String.StringTrim\_v2

## 91.53 StripHtml



StripHtml

**Full Name:** Ops.String.StripHtml

remove html tags from a string.

**> Inputs**

- **String** (String)

**< Output**

- **Result** (String)

**Example Patch:** cables.gl/edit/5NsMve

**Doc:** cables.gl/op/Ops.String.StripHtml

## 91.54 SubString\_v2



SubString

**Full Name:** Ops.String.SubString\_v2

Subset of a string between one index and another.

**> Inputs**

- **String** (String)
- **Start** (Number: Integer)
- **End** (Number: Integer)
- **End Of String** (Number: Boolean)

**< Output**

- **Result** (String)

**Example Patch:** cables.gl/edit/Fvlvci

**Doc:** cables.gl/op/Ops.String.SubString\_v2

## 91.55 SwitchString



SwitchString

**Full Name:** Ops.String.SwitchString

Switch between multiple strings with an index.

**> Inputs**

- **Index** (Number: Integer)
- **String 0** (String)
- **String 1** (String)
- **String 2** (String)
- **String 3** (String)

- **String 4** (String)
- **String 5** (String)
- **String 6** (String)
- **String 7** (String)
- **String 8** (String)
- **String 9** (String)

#### < Output

- **Result** (String)

**Example Patch:** [cables.gl/edit/2uRACi](#)

**Doc:** [cables.gl/op/Ops.String.SwitchString](#)

## 91.56 SwitchStringMultiPort\_v2



**Full Name:** Ops.String.SwitchStringMultiPort\_v2

switch between multiple string inputs.

#### > Inputs

- **Index** (Number: Integer)
- **Strings\_0** (String)
- **Add Port** (String)

#### < Output

- **String** (String)
- **Num Values** (Number)

**Example Patch:** [cables.gl/edit/TwZ1sh](#)

**Doc:** [cables.gl/op/Ops.String.SwitchStringMultiPort\\_v2](#)

## 91.57 Uppercase\_v2



**Full Name:** Ops.String.Uppercase\_v2

Convert all characters in a string to uppercase.

#### > Inputs

- **String** (String)

#### < Output

- **Result** (String)

**Example Patch:** [cables.gl/edit/a8qVz6](#)

**Doc:** [cables.gl/op/Ops.String.Uppercase\\_v2](#)

## 91.58 UUID



**Full Name:** Ops.String.UUID

outputs a unique identifier string.

#### > Inputs

- **Generate** (Trigger)

#### < Output

- **Id** (String)

**Example Patch:** [cables.gl/edit/ryYQwn](#)

**Doc:** [cables.gl/op/Ops.String.UUID](#)

## 92 Ops.String.Base64

### 92.1 Base64Decode\_v2



**Full Name:** Ops.String.Base64.Base64Decode\_v2

decode a string to base64.

#### > Inputs

- **String** (String)

#### < Output

- **Result** (String)

**Example Patch:** cables.gl/op/Ops.String.Base64.Base64Decode\_v2#example

**Doc:** cables.gl/op/Ops.String.Base64.Base64Decode\_v2

### 92.2 Base64Encode\_v3



**Full Name:** Ops.String.Base64.Base64Encode\_v3

encode a string to base64.

#### > Inputs

- **String** (String)
- **MimeType** (String)

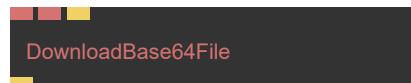
#### < Output

- **Result** (String)

**Example Patch:** cables.gl/op/Ops.String.Base64.Base64Encode\_v3#example

**Doc:** cables.gl/op/Ops.String.Base64.Base64Encode\_v3

### 92.3 DownloadBase64File



**Full Name:** Ops.String.Base64.DownloadBase64File

trigger a download of a base64 binary file.

#### > Inputs

- **Data URL** (String)
- **Filename** (String)
- **Download** (Trigger)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/jE9zO8

**Doc:** cables.gl/op/Ops.String.Base64.DownloadBase64File

## 93 Ops.String.File

**Example Patch:** [cables.gl/edit/unutii](#)  
**Doc:** [cables.gl/op/Ops.String.File.SwitchFile\\_v2](#)

### 93.1 FileInput\_v2



**Full Name:** Ops.String.File.FileInput\_v2

get URL of a file.

#### > Inputs

- **File** (String)

#### < Output

- **URL** (String)

**Example Patch:** [cables.gl/op/Ops.String.File.FileInput\\_v2#example](#)

**Doc:** [cables.gl/op/Ops.String.File.FileInput\\_v2](#)

### 93.2 SwitchFile\_v2



**Full Name:** Ops.String.File.SwitchFile\_v2

switch between filenames.

#### > Inputs

- **Index** (Number: Integer)
- **File 0** (String)
- **File 1** (String)
- **File 2** (String)
- **File 3** (String)
- **File 4** (String)
- **File 5** (String)
- **File 6** (String)
- **File 7** (String)
- **File 8** (String)
- **File 9** (String)
- **File 10** (String)
- **File 11** (String)
- **File 12** (String)
- **File 13** (String)
- **File 14** (String)
- **File 15** (String)

#### < Output

- **Result** (String)

# 94 Ops.Templates

## 94.1 ExampleVizOp

ExampleVizOp

**Full Name:** Ops.Templates.ExampleVizOp  
example how to code a viz layer op.

### > Inputs

- **Number** (Number)

### < Output

- Visit *Ops.Templates.ExampleVizOp documentation for output port details*

**Example Patch:** cables.gl/op/Ops.Templates.ExampleVizOp#example

**Doc:** cables.gl/op/Ops.Templates.ExampleVizOp

## 94.2 MinimalMaterial

MinimalMaterial

**Full Name:** Ops.Templates.MinimalMaterial

Material Example Template.

### > Inputs

- **Render** (Trigger)
- **Red** (Number)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/aySyci

**Doc:** cables.gl/op/Ops.Templates.MinimalMaterial

## 94.3 PortsArrayExample

PortsArrayExample

**Full Name:** Ops.Templates.PortsArrayExample

Is a template for creating Array ports.

### > Inputs

- **Array In** (Array)

### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/rWJICn

**Doc:** cables.gl/op/Ops.Templates.PortsArrayExample

## 94.4 PortsBooleanExample

PortsBooleanExample

**Full Name:** Ops.Templates.PortsBooleanExample

Is a template for creating Boolean ports.

### > Inputs

- **Boolean In** (Number: Boolean)

### < Output

- **Boolean Out** (Number)

**Example Patch:** cables.gl/edit/rWJICn

**Doc:** cables.gl/op/Ops.Templates.PortsBooleanExample

## 94.5 PortsObjectExample

PortsObjectExample

**Full Name:** Ops.Templates.PortsObjectExample

Is a template for creating Object ports.

### > Inputs

- **Object In** (Object)

### < Output

- **Object Out** (Object)

**Example Patch:** cables.gl/edit/rWJICn

**Doc:** cables.gl/op/Ops.Templates.PortsObjectExample

## 94.6 PortsStringExample

PortsStringExample

**Full Name:** Ops.Templates.PortsStringExample

Is a template for creating String ports.

### > Inputs

- **String In** (String)

### < Output

- **String Out** (String)

**Example Patch:** cables.gl/edit/rWJICn

**Doc:** cables.gl/op/Ops.Templates.PortsStringExample

## 94.7 PortsTriggerExample

PortsTriggerExample

**Full Name:** Ops.Templates.PortsTriggerExample  
Is a template for creating Trigger ports.

### > Inputs

- **Trigger In** (Trigger)
- **Press Me** (Trigger)

### < Output

- **Trigger Out** (Trigger)

**Example Patch:** cables.gl/edit/rWJICn

**Doc:** cables.gl/op/Ops.Templates.PortsTriggerExample

## 94.8 PortsValueExample

PortsValueExample

**Full Name:** Ops.Templates.PortsValueExample  
Is a template for creating Value ports.

### > Inputs

- **Number In** (Number)

### < Output

- **Value Out** (Number)

**Example Patch:** cables.gl/edit/rWJICn

**Doc:** cables.gl/op/Ops.Templates.PortsValueExample

## 94.9 ShaderEffectExample

ShaderEffectExample

**Full Name:** Ops.Templates.ShaderEffectExample  
shader effect example template.

### > Inputs

- **Render** (Trigger)
- **Width** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Templates.ShaderEffectExample#example

**Doc:** cables.gl/op/Ops.Templates.ShaderEffectExample

## 94.10 UiTestOp

UiTestOp

**Full Name:** Ops.Templates.UiTestOp  
UI indicators example op.

### > Inputs

- **Loading Task** (Number: Boolean)
- **Loading** (Number: Boolean)
- **Warning** (Number: Boolean)
- **Error** (Number: Boolean)
- **Hint** (Number: Boolean)
- **Not Working** (Number: Boolean)
- **Slider** (Number)
- **Gradient** (Number)
- **Resizable** (Number: Boolean)
- **Trigger** (Trigger)
- **Greyout** (Number: Boolean)
- **This Will Greyout** (Number)
- **Open Prompt** (Trigger)
- **Open Modal** (Trigger)
- **Open New Tab** (Trigger)

### < Output

- **Something** (Number)

**Example Patch:** cables.gl/edit/RUUacl

**Doc:** cables.gl/op/Ops.Templates.UiTestOp

# 95 Ops.TimeLine

## 95.1 Anim



**Full Name:** Ops.TimeLine.Anim  
timeline keyframable animation object.

### > Inputs

- **Value** (Number)
- **Clip** (Number: Boolean)
- **Clip Name** (String)

### < Output

- **Anim** (Object)
- **Loop Length** (Number)
- **Length** (Number)

**Example Patch:** cables.gl/edit/sKguKJ  
**Doc:** cables.gl/op/Ops.TimeLine.Anim

## 95.2 AnimGetKey



**Full Name:** Ops.TimeLine.AnimGetKey  
Get data from a single key in an animation.

### > Inputs

- **Anim** (Object)
- **Time** (Number)

### < Output

- **Index** (Number)
- **Key Value** (Number)
- **Key Time** (Number)

**Example Patch:** cables.gl/edit/gXgDz1  
**Doc:** cables.gl/op/Ops.TimeLine.AnimGetKey

## 95.3 AnimGetValue



**Full Name:** Ops.TimeLine.AnimGetValue  
get the animated value at time x of an animation object.

### > Inputs

- **Anim** (Object)
- **Time** (Number)

### < Output

- **Value** (Number)
- **Loop** (Number)

**Example Patch:** cables.gl/edit/yElpR1

**Doc:** cables.gl/op/Ops.TimeLine.AnimGetValue

## 95.4 AnimInfo



**Full Name:** Ops.TimeLine.AnimInfo  
Get information about an anim object.

### > Inputs

- **Anim** (Object)

### < Output

- **Total Keys** (Number)
- **Length Seconds** (Number)

**Example Patch:** cables.gl/op/Ops.TimeLine.AnimInfo#example  
**Doc:** cables.gl/op/Ops.TimeLine.AnimInfo

## 95.5 AutoPlay



**Full Name:** Ops.TimeLine.AutoPlay

Automatically starts the timeline playback when opening patch.

### > Inputs

- Visit *Ops.TimeLine.AutoPlay documentation* for input port details

### < Output

- Visit *Ops.TimeLine.AutoPlay documentation* for output port details

**Example Patch:** cables.gl/op/Ops.TimeLine.AutoPlay#example

**Doc:** cables.gl/op/Ops.TimeLine.AutoPlay

## 95.6 DemoPrerender



DemoPrerender

**Full Name:** Ops.TimeLine.DemoPrerender  
Prerenderer based on timeline progress.

#### > Inputs

- **Render** (Trigger)
- **Manual Timestamps** (Array)
- **Record Events** (Number: Boolean)
- **Reset** (Trigger)
- **Clear** (Trigger)
- **ReRender On Resize** (Number: Boolean)

#### < Output

- **Next** (Trigger)
- **Prerendered Frame** (Trigger)
- **Progress** (Number)
- **Num Events** (Number)

**Example Patch:** cables.gl/edit/sewM2h

**Doc:** cables.gl/op/Ops.TimeLine.DemoPrerender

## 95.7 GotoFrame



**Full Name:** Ops.TimeLine.GotoFrame

jump to a key in the timeline.

#### > Inputs

- **Frame** (Number)

#### < Output

- Visit *Ops.TimeLine.GotoFrame documentation* for output port details

**Example Patch:** cables.gl/op/Ops.TimeLine.GotoFrame#example

**Doc:** cables.gl/op/Ops.TimeLine.GotoFrame

## 95.8 PreRender



**Full Name:** Ops.TimeLine.PreRender

Render the patch at certain times.

#### > Inputs

- **Render** (Trigger)
- **Max Time** (Number: Integer)
- **Step** (Number: Integer)
- **Reset** (Trigger)

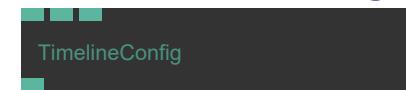
#### < Output

- **Next** (Trigger)
- **Render Progress** (Trigger)
- **Done** (Trigger)
- **Progress** (Number)

**Example Patch:** cables.gl/op/Ops.TimeLine.PreRender#example

**Doc:** cables.gl/op/Ops.TimeLine.PreRender

## 95.9 TimelineConfig



**Full Name:** Ops.TimeLine.TimelineConfig

configure the timeline for the current patch.

#### > Inputs

- **FPS** (Number: Integer)
- **Restrict To Frames** (Number: Boolean)
- **Fade In Frames** (Number: Boolean)

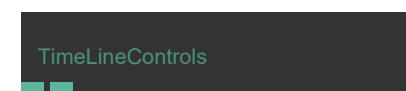
#### < Output

- **Duration Seconds** (Number)

**Example Patch:** cables.gl/op/Ops.TimeLine.TimelineConfig#example

**Doc:** cables.gl/op/Ops.TimeLine.TimelineConfig

## 95.10 TimeLineControls



**Full Name:** Ops.TimeLine.TimeLineControls

use position and play pause state of cables timeline.

#### > Inputs

- Visit *Ops.TimeLine.TimeLineControls documentation* for input port details

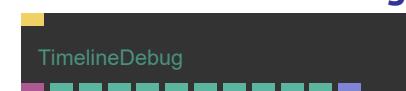
#### < Output

- **Time** (Number)

**Example Patch:** cables.gl/op/Ops.TimeLine.TimeLineControls#example

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineControls

## 95.11 TimelineDebug



**Full Name:** Ops.TimeLine.TimelineDebug

Visit documentation for details.

**> Inputs**

- **Update** (Trigger)

**< Output**

- **Data** (Object)
- **Time Cursor** (Number)
- **Visible Duration** (Number)
- **Visible Time Start** (Number)
- **Loop Start** (Number)
- **Loop End** (Number)
- **Num Selected Keys** (Number)
- **Selected Values Min** (Number)
- **Selected Values Max** (Number)
- **Selected Times Min** (Number)
- **Selected Times Max** (Number)
- **Selected Keys** (Array)

**Example Patch:** cables.gl/op/Ops.TimeLine.TimelineDebug#example

**Doc:** cables.gl/op/Ops.TimeLine.TimelineDebug

## 95.12 TimeLineFrame



**Full Name:** Ops.TimeLine.TimeLineFrame

Returns the current frame number of the timeline.

**> Inputs**

- Visit *Ops.TimeLine.TimeLineFrame documentation for input port details*

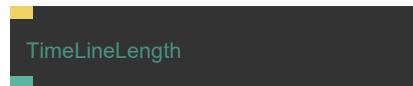
**< Output**

- **Time** (Number)

**Example Patch:** cables.gl/op/Ops.TimeLine.TimeLineFrame#example

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineFrame

## 95.13 TimeLineLength



**Full Name:** Ops.TimeLine.TimeLineLength

current set length of the timeline.

**> Inputs**

- **Update** (Trigger)

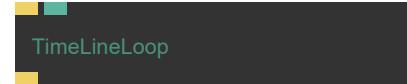
**< Output**

- **Length** (Number)

**Example Patch:** cables.gl/edit/qSMdck

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineLength

## 95.14 TimeLineLoop



**Full Name:** Ops.TimeLine.TimeLineLoop

Automatic rewind of timeline at a certain time.

**> Inputs**

- **Execute** (Trigger)
- **Duration** (Number)
- **How long the loop should be** (in seconds)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/GbEql-

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineLoop

## 95.15 TimeLineOverwrite



**Full Name:** Ops.TimeLine.TimeLineOverwrite

overwrite timeline time value.

**> Inputs**

- **Exe** (Trigger)
- **New Time** (Number)

**< Output**

- **Trigger** (Trigger)

**Example Patch:** cables.gl/op/Ops.TimeLine.TimeLineOverwrite#example

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineOverwrite

## 95.16 TimeLinePlay



**Full Name:** Ops.TimeLine.TimeLinePlay

Visit documentation for details.

**> Inputs**

- **Play** (Trigger)
- **Pause** (Trigger)

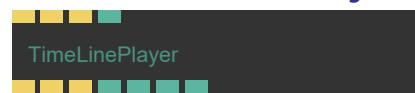
#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/3F6DOe

**Doc:** cables.gl/op/Ops.TimeLine.TimeLinePlay

## 95.17 TimeLinePlayer



**Full Name:** Ops.TimeLine.TimeLinePlayer

Player controls for the timeline.

#### > Inputs

- **Play** (Trigger)
- **Pause** (Trigger)
- **Rewind** (Trigger)
- **Set Current Time** (Number)

#### < Output

- **Play Trigger** (Trigger)
- **Pause Trigger** (Trigger)
- **Rewind Trigger** (Trigger)
- **Is Playing** (booleanNumber)
- **Current Time** (Number)
- **Current Frame** (Number)
- **Current time in frames** (30fps)

**Example Patch:** cables.gl/op/Ops.TimeLine.TimeLinePlayer#example

**Doc:** cables.gl/op/Ops.TimeLine.TimeLinePlayer

## 95.18 TimeLineRewind



**Full Name:** Ops.TimeLine.TimeLineRewind

set time of timeline to 0 (rewind, restart).

#### > Inputs

- **Exe** (Trigger)

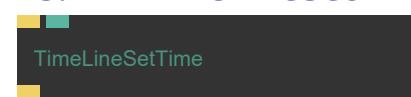
#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/3F6DOe

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineRewind

## 95.19 TimeLineSetTime



**Full Name:** Ops.TimeLine.TimeLineSetTime

set current time of timeline.

#### > Inputs

- **Update** (Trigger)
- **Time** (Number)

#### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/3F6DOe

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineSetTime

## 95.20 TimeLineTime



**Full Name:** Ops.TimeLine.TimeLineTime

Returns the current time of the timeline.

#### > Inputs

- Visit *Ops.TimeLine.TimeLineTime documentation for input port details*

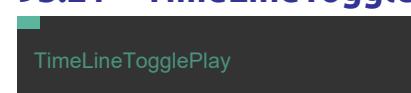
#### < Output

- **Time** (Number)
- **The current time of the timeline** (in seconds)

**Example Patch:** cables.gl/op/Ops.TimeLine.TimeLineTime#example

**Doc:** cables.gl/op/Ops.TimeLine.TimeLineTime

## 95.21 TimeLineTogglePlay



**Full Name:** Ops.TimeLine.TimeLineTogglePlay

toggle between timeline playing and being paused.

#### > Inputs

- **Play** (Number: Boolean)
- **Public** (20): MY IDENTITY PATTERN

#### < Output

- Visit *Ops.TimeLine.TimeLineTogglePlay documentation for output port details*

**Example Patch:** cables.gl/op/Ops.TimeLine.TimeLineTogglePlay#example

## 95.22 TimelineValue



**Full Name:** Ops.TimeLine.TimelineValue

Animate and get value at “time” of timeline.

### > Inputs

- **Time** (Number)
- **Value** (Number)
- **Unit Index** (Number: Integer)

### < Output

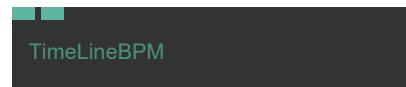
- **Result** (Number)
- **Anim Array** (Array)
- **Anim Finished** (booleanNumber)

**Example Patch:** [cables.gl/edit/xAg8P6](https://cables.gl/edit/xAg8P6)

**Doc:** [cables.gl/op/Ops.TimeLine.TimelineValue](https://cables.gl/op/Ops.TimeLine.TimelineValue)

# 96 Ops.TimeLine.Viz

## 96.1 TimeLineBPM



**Full Name:** Ops.TimeLine.Viz.TimeLineBPM

Display current Beat index and BPM timing information as beat rectangles on the timeline.

### > Inputs

- **BPM** (Number)
- **Offset** (Number)

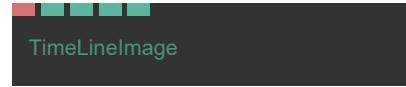
### < Output

- Visit *Ops.TimeLine.Viz.TimeLineBPM documentation* for output port details

**Example Patch:** [cables.gl/edit/gpr6A1](https://cables.gl/edit/gpr6A1)

**Doc:** [cables.gl/op/Ops.TimeLine.Viz.TimeLineBPM](https://cables.gl/op/Ops.TimeLine.Viz.TimeLineBPM)

## 96.2 TimeLineImage



**Full Name:** Ops.TimeLine.Viz.TimeLineImage

Display an image on the timeline.

### > Inputs

- **File** (String)
- **Slot** (Number: Integer)
- **Opacity** (Number)
- **Start** (Number)
- **End** (Number)

### < Output

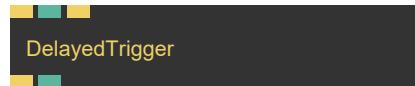
- Visit *Ops.TimeLine.Viz.TimeLineImage documentation* for output port details

**Example Patch:** [cables.gl/edit/1DD6A1](https://cables.gl/edit/1DD6A1)

**Doc:** [cables.gl/op/Ops.TimeLine.Viz.TimeLineImage](https://cables.gl/op/Ops.TimeLine.Viz.TimeLineImage)

# 97 Ops.Trigger

## 97.1 DelayedTrigger



**Full Name:** Ops.Trigger.DelayedTrigger  
delay triggering next port by x seconds.

### > Inputs

- **Exe** (Trigger)
- **Delay** (Number)
- **Cancel** (Trigger)

### < Output

- **Next** (Trigger)
- **Delaying** (booleanNumber)

**Example Patch:** cables.gl/edit/VgtMji

**Doc:** cables.gl/op/Ops.Trigger.DelayedTrigger

## 97.2 GateTrigger



**Full Name:** Ops.Trigger.GateTrigger  
Allows a trigger to pass only if the gate is open.

### > Inputs

- **Execute** (Trigger)
- **Pass Through** (Number: Boolean)

### < Output

- **Trigger Out** (Trigger)

**Example Patch:** cables.gl/edit/xotJAH

**Doc:** cables.gl/op/Ops.Trigger.GateTrigger

## 97.3 Interval



**Full Name:** Ops.Trigger.Interval  
Timed Trigger every x ms.

### > Inputs

- **Interval** (Number)
- **Active** (Number: Boolean)

### < Output

- **Trigger** (Trigger)

**Example Patch:** cables.gl/edit/ZdvX7i

**Doc:** cables.gl/op/Ops.Trigger.Interval

## 97.4 IsTriggered



**Full Name:** Ops.Trigger.IsTriggered  
outputs true if being triggered last frame.

### > Inputs

- **Trigger** (Trigger)

### < Output

- **Next** (Trigger)
- **Was Triggered** (Number)

**Example Patch:** cables.gl/edit/kmXCm6

**Doc:** cables.gl/op/Ops.Trigger.IsTriggered

## 97.5 NthTrigger\_v2



**Full Name:** Ops.Trigger.NthTrigger\_v2

Lets a trigger through every nth time (trigger limiter).

### > Inputs

- **Execute** (Trigger)
- **Nth** (Number)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/cnVqii

**Doc:** cables.gl/op/Ops.Trigger.NthTrigger\_v2

## 97.6 NumberByTrigger



**Full Name:** Ops.Trigger.NumberByTrigger

Outputs the last number of the input port which was triggered.

### > Inputs

- Visit *Ops.Trigger.NumberByTrigger documentation* for input port details

#### < Output

- **Number** (Number)
- **Triggered** (Trigger)

**Example Patch:** cables.gl/edit/kzTxsh

**Doc:** cables.gl/op/Ops.Trigger.NumberByTrigger

## 97.7 NumberByTriggerMultiPort\_v2



NumberByTriggerMultiPort

**Full Name:** Ops.Trigger.NumberByTriggerMultiPort\_v2

output a number by triggering an index port.

#### > Inputs

- **Trigger\_0** (Trigger)
- **Add Port** (Trigger)

#### < Output

- **Next** (Trigger)
- **Number Triggered** (Number)

**Example Patch:** cables.gl/edit/ubuysh

**Doc:** cables.gl/op/Ops.Trigger.NumberByTriggerMultiPort\_v2

## 97.8 ProbabilityTrigger



ProbabilityTrigger

**Full Name:** Ops.Trigger.ProbabilityTrigger

trigger by chance.

#### > Inputs

- **Trigger In** (Trigger)
- **Probability** (Number)

#### < Output

- **Trigger Output** (Trigger)
- **Inverse Trigger Output** (Trigger)

**Example Patch:** cables.gl/edit/l61CCu

**Doc:** cables.gl/op/Ops.Trigger.ProbabilityTrigger

## 97.9 RandomTrigger



RandomTrigger

**Full Name:** Ops.Trigger.RandomTrigger

randomly trigger.

#### > Inputs

- **Render** (Trigger)
- **Num Times** (Number)
- **Seed** (Number)
- **Only Once** (Number: Boolean)

#### < Output

- **Render** (Trigger)
- **Num Times** (Number)
- **Seed** (Number)
- **Only Once** (Number: Boolean)
- **Index** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)

**Example Patch:** cables.gl/edit/3P54t7

**Doc:** cables.gl/op/Ops.Trigger.RandomTrigger

## 97.10 Repeat2d



Repeat2d

**Full Name:** Ops.Trigger.Repeat2d

Triggers all ops underneath Num X \* Num Y times.

#### > Inputs

- **Exe** (Trigger)
- **Num X** (Number: Integer)
- **Num Y** (Number: Integer)
- **Mul** (Number)
- **Center** (Number: Boolean)
- **Centers X and Y around the origin (0/0)**

#### < Output

- **Trigger** (Trigger)
- **X** (Number)
- **Y** (Number)
- **Index** (Number)

- **Total Iterations** (Number)

**Example Patch:** [cables.gl/edit/lPZfgg](#)

**Doc:** [cables.gl/op/Ops.Trigger.Repeat2d](#)

## 97.11 Repeat\_v2



**Full Name:** Ops.Trigger.Repeat\_v2

Triggers all ops below x times (for loop / while).

### > Inputs

- **Execute** (Trigger)
- **Repeats** (Number: Integer)

### < Output

- **Next** (Trigger)
- **Index** (Number)

**Example Patch:** [cables.gl/edit/VFAfgg](#)

**Doc:** [cables.gl/op/Ops.Trigger.Repeat\\_v2](#)

## 97.12 RouteTrigger



**Full Name:** Ops.Trigger.RouteTrigger

Triggers one of the out ports - value index switch case (was SwitchTrigger).

### > Inputs

- **Execute** (Trigger)
- **Switch Value** (Number: Integer)

### < Output

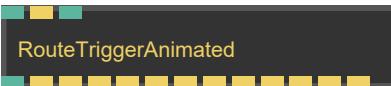
- **Next Trigger** (Trigger)
- **Switched Value** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)

- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)
- **Trigger 20** (Trigger)
- **Trigger 21** (Trigger)
- **Trigger 22** (Trigger)
- **Trigger 23** (Trigger)
- **Default Trigger** (Trigger)
- **Highest Index** (Number)

**Example Patch:** [cables.gl/edit/DzH9S5](#)

**Doc:** [cables.gl/op/Ops.Trigger.RouteTrigger](#)

## 97.13 RouteTriggerAnimated



**Full Name:** Ops.Trigger.RouteTriggerAnimated  
animated switching between things.

### > Inputs

- **Index** (Number: Integer)
- **Exe** (Trigger)
- **Duration** (Number)

### < Output

- **Qutsn94pc** (Trigger)
- **Hvyzlh9o8** (Trigger)
- **T8dvyjuoq** (Trigger)
- **A0w7orgi8** (Trigger)
- **R8h4qx4z8** (Trigger)
- **Cr80a86xi** (Trigger)

**Example Patch:** [cables.gl/edit/pUtH15](#)

**Doc:** [cables.gl/op/Ops.Trigger.RouteTriggerAnimated](#)

## 97.14 RouteTriggerMultiPort\_v2

RouteTriggerMultiPort

**Full Name:** Ops.Trigger.RouteTriggerMultiPort\_v2

Triggers one of the - value index switch case.

### > Inputs

- **Execute** (Trigger)
- **Switch Value** (Number: Integer)

### < Output

- **Execute** (Trigger)
- **Switch Value** (Number: Integer)
- **Total Connections** (Number)
- **Connected Op Names** (Array)
- **Trigger\_0** (Trigger)
- **Trigger\_1** (Trigger)
- **Trigger\_2** (Trigger)
- **Trigger\_3** (Trigger)
- **Trigger\_4** (Trigger)
- **Trigger\_5** (Trigger)
- **Trigger\_6** (Trigger)
- **Trigger\_7** (Trigger)
- **Trigger\_8** (Trigger)
- **Trigger\_9** (Trigger)
- **Trigger\_10** (Trigger)
- **Trigger\_11** (Trigger)
- **Trigger\_12** (Trigger)
- **Trigger\_13** (Trigger)
- **Trigger\_14** (Trigger)
- **Trigger\_15** (Trigger)
- **Trigger\_16** (Trigger)
- **Trigger\_17** (Trigger)

**Example Patch:** cables.gl/edit/NxGysh

**Doc:** cables.gl/op/Ops.Trigger.RouteTriggerMultiPort\_v2

## 97.15 RouteTriggerString\_v2

RouteTriggerString

**Full Name:** Ops.Trigger.RouteTriggerString\_v2

route trigger output by string.

### > Inputs

- **Execute** (Trigger)
- **Switch Value** (String)
- **String 0** (String)
- **String 1** (String)
- **String 2** (String)
- **String 3** (String)
- **String 4** (String)
- **String 5** (String)
- **String 6** (String)
- **String 7** (String)
- **String 8** (String)
- **String 9** (String)
- **String 10** (String)
- **String 11** (String)
- **String 12** (String)
- **String 13** (String)
- **String 14** (String)
- **String 15** (String)
- **String 16** (String)
- **String 17** (String)
- **String 18** (String)
- **String 19** (String)
- **String 20** (String)
- **String 21** (String)
- **String 22** (String)
- **String 23** (String)

### < Output

- **Next Trigger** (Trigger)
- **Switched Index** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)

- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)
- **Trigger 20** (Trigger)
- **Trigger 21** (Trigger)
- **Trigger 22** (Trigger)
- **Trigger 23** (Trigger)

**Example Patch:** [cables.gl/edit/8uTjhl](https://cables.gl/edit/8uTjhl)

**Doc:** [cables.gl/op/Ops.Trigger.RouteTriggerString\\_v2](https://cables.gl/op/Ops.Trigger.RouteTriggerString_v2)

## 97.16 Sequence



**Full Name:** Ops.Trigger.Sequence

control the order of execution/triggering.

### > Inputs

- **Exe** (Trigger)
- **Exe 0** (Trigger)
- **Exe 1** (Trigger)
- **Exe 2** (Trigger)
- **Exe 3** (Trigger)
- **Exe 4** (Trigger)
- **Exe 5** (Trigger)
- **Exe 6** (Trigger)
- **Exe 7** (Trigger)
- **Exe 8** (Trigger)
- **Exe 9** (Trigger)
- **Exe 10** (Trigger)
- **Exe 11** (Trigger)
- **Exe 12** (Trigger)
- **Exe 13** (Trigger)
- **Exe 14** (Trigger)

### < Output

- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)

- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)

**Example Patch:** [cables.gl/edit/0bQrii](https://cables.gl/edit/0bQrii)

**Doc:** [cables.gl/op/Ops.Trigger.Sequence](https://cables.gl/op/Ops.Trigger.Sequence)

## 97.17 SequenceMultiPort\_v2



**Full Name:** Ops.Trigger.SequenceMultiPort\_v2

sequence trigger.

### > Inputs

- **Input\_0** (Trigger)
- **Add Port** (Trigger)

### < Output

- **Output\_0** (Trigger)
- **Output\_1** (Trigger)

**Example Patch:** [cables.gl/edit/F5L0sh](https://cables.gl/edit/F5L0sh)

**Doc:** [cables.gl/op/Ops.Trigger.SequenceMultiPort\\_v2](https://cables.gl/op/Ops.Trigger.SequenceMultiPort_v2)

## 97.18 SwitchTrigger



**Full Name:** Ops.Trigger.SwitchTrigger

route input triggers by index to one output.

### > Inputs

- **Trigger Index** (Number: Integer)
- **Trigger In 0** (Trigger)
- **Trigger In 1** (Trigger)
- **Trigger In 2** (Trigger)
- **Trigger In 3** (Trigger)
- **Trigger In 4** (Trigger)

- **Trigger In 5** (Trigger)
- **Trigger In 6** (Trigger)
- **Trigger In 7** (Trigger)
- **Trigger In 8** (Trigger)
- **Trigger In 9** (Trigger)
- **Trigger In 10** (Trigger)
- **Trigger In 11** (Trigger)
- **Trigger In 12** (Trigger)
- **Trigger In 13** (Trigger)
- **Trigger In 14** (Trigger)
- **Trigger In 15** (Trigger)

**< Output**

- **Trigger Out** (Trigger)

**Example Patch:** [cables.gl/edit/upF4rn](#)

**Doc:** [cables.gl/op/Ops.Trigger.SwitchTrigger](#)

## 97.19 Threshold



**Full Name:** Ops.Trigger.Threshold

Triggers only once when threshold is crossed.

**> Inputs**

- **Threshold** (Number)

**< Output**

- Visit *Ops.Trigger.Threshold documentation for output port details*

**Example Patch:** [cables.gl/edit/pG-Mwq](#)

**Doc:** [cables.gl/op/Ops.Trigger.Threshold](#)

## 97.20 TimedSequence



**Full Name:** Ops.Trigger.TimedSequence

timed switching of trigger.

**> Inputs**

- **Exe** (Trigger)
- **Current** (Number: Integer)
- **OverwriteTime** (Number: Boolean)
- **IgnoreInSubPatch** (Number: Boolean)

**< Output**

- **TriggerAlways** (Trigger)
- **Names** (Array)
- **CurrentKeyTime** (Number)
- **Current** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)
- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)
- **Trigger 20** (Trigger)
- **Trigger 21** (Trigger)
- **Trigger 22** (Trigger)
- **Trigger 23** (Trigger)
- **Trigger 24** (Trigger)
- **Trigger 25** (Trigger)
- **Trigger 26** (Trigger)
- **Trigger 27** (Trigger)
- **Trigger 28** (Trigger)
- **Trigger 29** (Trigger)
- **Trigger 30** (Trigger)
- **Trigger 31** (Trigger)

**Example Patch:** [cables.gl/edit/GbEqL-](#)

**Doc:** [cables.gl/op/Ops.Trigger.TimedSequence](#)

## 97.21 TimeSinceTrigger

TimeSinceTrigger

**Full Name:** Ops.Trigger.TimeSinceTrigger

Get the time since last trigger.

### > Inputs

- **Exe** (Trigger)
- **Trigger** (Trigger)
- **Reset** (Trigger)

### < Output

- **Next** (Trigger)
- **Time** (Number)

**Example Patch:** cables.gl/edit/fCN\_98

**Doc:** cables.gl/op/Ops.Trigger.TimeSinceTrigger

## 97.22 TriggerButton

TriggerButton

**Full Name:** Ops.Trigger.TriggerButton

simple button to trigger manually.

### > Inputs

- **Trigger** (Trigger)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/05Arii

**Doc:** cables.gl/op/Ops.Trigger.TriggerButton

## 97.23 TriggerCounter

TriggerCounter

**Full Name:** Ops.Trigger.TriggerCounter

Counts how often the port was triggered.

### > Inputs

- **Exe** (Trigger)
- **Reset** (Trigger)

### < Output

- **Trigger** (Trigger)
- **TimesTriggered** (Number)

**Example Patch:** cables.gl/edit/WNh8pc

**Doc:** cables.gl/op/Ops.Trigger.TriggerCounter

## 97.24 TriggerCounterLoop

TriggerCounterLoop

**Full Name:** Ops.Trigger.TriggerCounterLoop

Increments with each trigger and loops depending on min and max loop values.

### > Inputs

- **Trigger In** (Trigger)
- **Reset** (Trigger)
- **Loop Min** (Number: Integer)
- **Loop Max** (Number: Integer)

### < Output

- **Trigger Out** (Trigger)
- **Current Count** (Number)

**Example Patch:** cables.gl/edit/V8TekF

**Doc:** cables.gl/op/Ops.Trigger.TriggerCounterLoop

## 97.25 TriggerDistributeByValue

TriggerDistributeByValue

**Full Name:** Ops.Trigger.TriggerDistributeByValue

triggers evenly distributed by value.

### > Inputs

- **Exe** (Trigger)
- **Number** (Number)
- **Max** (Number)
- **Num Outputs** (Number)

### < Output

- **Num** (Number)
- **Trigger 0** (Trigger)
- **Trigger 1** (Trigger)
- **Trigger 2** (Trigger)
- **Trigger 3** (Trigger)
- **Trigger 4** (Trigger)
- **Trigger 5** (Trigger)
- **Trigger 6** (Trigger)
- **Trigger 7** (Trigger)

- **Trigger 8** (Trigger)
- **Trigger 9** (Trigger)
- **Trigger 10** (Trigger)
- **Trigger 11** (Trigger)
- **Trigger 12** (Trigger)
- **Trigger 13** (Trigger)
- **Trigger 14** (Trigger)
- **Trigger 15** (Trigger)
- **Trigger 16** (Trigger)
- **Trigger 17** (Trigger)
- **Trigger 18** (Trigger)
- **Trigger 19** (Trigger)

**Example Patch:** [cables.gl/edit/FsZFVB](https://cables.gl/edit/FsZFVB)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerDistributeByValue](https://cables.gl/op/Ops.Trigger.TriggerDistributeByValue)

## 97.26 TriggerExtender

TriggerExtender

**Full Name:** Ops.Trigger.TriggerExtender

Extends a trigger (useful in big patches for better overview).

› **Inputs**

- **Execute** (Trigger)

‹ **Output**

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/mDiCq6](https://cables.gl/edit/mDiCq6)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerExtender](https://cables.gl/op/Ops.Trigger.TriggerExtender)

## 97.27 TriggerIfDecreased

TriggerIfDecreased

**Full Name:** Ops.Trigger.TriggerIfDecreased

trigger if a value decreases / gets smaller.

› **Inputs**

- **Value** (Number)

‹ **Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/AFiCfe](https://cables.gl/edit/AFiCfe)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerIfDecreased](https://cables.gl/op/Ops.Trigger.TriggerIfDecreased)

## 97.28 TriggerIfIncreased

TriggerIfIncreased

**Full Name:** Ops.Trigger.TriggerIfIncreased

Outputs a trigger if the value of a number increases.

› **Inputs**

- **Value** (Number)

‹ **Output**

- **Trigger** (Trigger)

**Example Patch:** [cables.gl/edit/AFiCfe](https://cables.gl/edit/AFiCfe)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerIfIncreased](https://cables.gl/op/Ops.Trigger.TriggerIfIncreased)

## 97.29 TriggerLimiter

TriggerLimiter

**Full Name:** Ops.Trigger.TriggerLimiter

Limits how often a trigger goes through to x ms.

› **Inputs**

- **In Trigger** (Trigger)
- **Milliseconds** (Number)

‹ **Output**

- **Out Trigger** (Trigger)
- **Progress** (Number)

**Example Patch:** [cables.gl/edit/dS8EQm](https://cables.gl/edit/dS8EQm)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerLimiter](https://cables.gl/op/Ops.Trigger.TriggerLimiter)

## 97.30 TriggerNumber

TriggerNumber

**Full Name:** Ops.Trigger.TriggerNumber

Outputs a number when triggered.

› **Inputs**

- **Set** (Trigger)
- **Number** (Number)

‹ **Output**

- **Next** (Trigger)
- **Out Value** (Number)

**Example Patch:** [cables.gl/edit/Qq3Y7i](https://cables.gl/edit/Qq3Y7i)

**Doc:** cables.gl/op/Ops.Trigger.TriggerNumber

## 97.31 TriggerOnce

TriggerOnce

**Full Name:** Ops.Trigger.TriggerOnce

Trigger the following children once.

### > Inputs

- **Exec** (Trigger)
- **Reset** (Trigger)

### < Output

- **Next** (Trigger)
- **Was Triggered** (Number)

**Example Patch:** cables.gl/edit/9EiyCi

**Doc:** cables.gl/op/Ops.Trigger.TriggerOnce

## 97.32 TriggerOnChangeArray\_v2

TriggerOnChangeArray

**Full Name:** Ops.Trigger.TriggerOnChangeArray\_v2

triggers when array has changed.

### > Inputs

- **Array** (Array)

### < Output

- **Changed** (Trigger)
- **Result** (Array)

**Example Patch:** cables.gl/op/Ops.Trigger.TriggerOnChangeArray\_v2#example

**Doc:** cables.gl/op/Ops.Trigger.TriggerOnChangeArray\_v2

## 97.33 TriggerOnChangeObject\_v2

TriggerOnChangeObject

**Full Name:** Ops.Trigger.TriggerOnChangeObject\_v2

triggers when Object has changed.

### > Inputs

- **Object** (Object)

### < Output

- **Changed** (Trigger)

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Trigger.TriggerOnChangeObject\_v2#example

**Doc:** cables.gl/op/Ops.Trigger.TriggerOnChangeObject\_v2

## 97.34 TriggerOnChangeString\_v2

TriggerOnChangeString

**Full Name:** Ops.Trigger.TriggerOnChangeString\_v2

triggers when string has changed.

### > Inputs

- **String** (String)

### < Output

- **Changed** (Trigger)
- **Result** (String)

**Example Patch:** cables.gl/edit/ohxBci

**Doc:** cables.gl/op/Ops.Trigger.TriggerOnChangeString\_v2

## 97.35 TriggerOnChangeTexture

TriggerOnChangeTexture

**Full Name:** Ops.Trigger.TriggerOnChangeTexture

triggers when texture has changed.

### > Inputs

- **Texture** (Object:Texture)

### < Output

- **Changed** (Trigger)
- **Result** (Object)

**Example Patch:** cables.gl/edit/QGqQ7f

**Doc:** cables.gl/op/Ops.Trigger.TriggerOnChangeTexture

## 97.36 TriggerReceive

TriggerReceive

**Full Name:** Ops.Trigger.TriggerReceive

Receives triggers from a TriggerSend op with the same variable name.

### > Inputs

- Visit *Ops.Trigger.TriggerReceive documentation* for input port details

### < Output

- **Triggered** (Trigger)

**Example Patch:** [cables.gl/edit/hrXVpH](#)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerReceive](#)

## 97.37 TriggerReceiveFilter



TriggerReceiveFilter

**Full Name:** Ops.Trigger.TriggerReceiveFilter

receives all named triggers and relays them, optionally using a filter-prefix on the name.

> **Inputs**

- **Prefix** (String)

< **Output**

- **Trigger Out** (Trigger)
- **Trigger Name** (String)

**Example Patch:** [cables.gl/edit/niHmJt](#)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerReceiveFilter](#)

## 97.38 TriggerSend



TriggerSend

**Full Name:** Ops.Trigger.TriggerSend

Allows triggers to be sent to a TriggerReceive op with the same variable name.

> **Inputs**

- **Trigger** (Trigger)

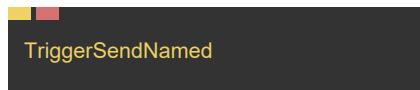
< **Output**

- **Next** (Trigger)

**Example Patch:** [cables.gl/edit/hrXVpH](#)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerSend](#)

## 97.39 TriggerSendNamed



TriggerSendNamed

**Full Name:** Ops.Trigger.TriggerSendNamed

Allows triggers to be sent to a TriggerReceive op with the same variable name.

> **Inputs**

- **Trigger** (Trigger)
- **Named Trigger** (String)

< **Output**

• Visit [Ops.Trigger.TriggerSendNamed documentation](#) for output port details

**Example Patch:** [cables.gl/edit/Tc3pcl](#)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerSendNamed](#)

## 97.40 TriggersPerSecond



TriggersPerSecond

**Full Name:** Ops.Trigger.TriggersPerSecond

Counts how often the port is triggered per second.

> **Inputs**

- **Exe** (Trigger)

< **Output**

- **Cps** (Number)

**Example Patch:** [cables.gl/edit/JCkpVJ](#)

**Doc:** [cables.gl/op/Ops.Trigger.TriggersPerSecond](#)

## 97.41 TriggerString



TriggerString

**Full Name:** Ops.Trigger.TriggerString

trigger a string.

> **Inputs**

- **Trigger** (Trigger)
- **String** (String)

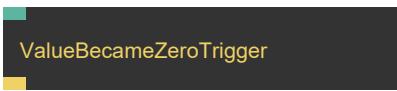
< **Output**

- **Next** (Trigger)
- **Result** (String)

**Example Patch:** [cables.gl/edit/VHsHue](#)

**Doc:** [cables.gl/op/Ops.Trigger.TriggerString](#)

## 97.42 ValueBecameZeroTrigger



ValueBecameZeroTrigger

**Full Name:** Ops.Trigger.ValueBecameZeroTrigger

Triggers when the input value became zero.

> **Inputs**

- **Value** (Number)

## < Output

- Became Zero Trigger (Trigger)

**Example Patch:** cables.gl/op/Ops.Trigger.ValueBecameZeroTrigger#example

**Doc:** cables.gl/op/Ops.Trigger.ValueBecameZeroTrigger

# 98 Ops.Ui

## 98.1 Area

Area

**Full Name:** Ops.Ui.Area

Organize and group your patch operators.

### > Inputs

- Delete (Trigger)

### < Output

- Visit *Ops.Ui.Area documentation for output port details*

**Example Patch:** cables.gl/edit/ozgnnR

**Doc:** cables.gl/op/Ops.Ui.Area

## 98.2 CablesEditorEvents

CablesEditorEvents

**Full Name:** Ops.Ui.CablesEditorEvents

Cables UI Event Triggers.

### > Inputs

- Set Changed Patch (Trigger)

### < Output

- Saving Patch (Trigger)
- PortValueEdited (Trigger)

**Example Patch:** cables.gl/edit/gdbdQc

**Doc:** cables.gl/op/Ops.Ui.CablesEditorEvents

## 98.3 Comment\_v2

Comment

**Full Name:** Ops.Ui.Comment\_v2

Displays a comment in the patch area.

### > Inputs

- Visit *Ops.Ui.Comment\_v2 documentation for input port details*

### < Output

- Visit *Ops.Ui.Comment\_v2 documentation for output port details*

**Example Patch:** cables.gl/edit/7Tyqii

**Doc:** [cables.gl/op/Ops.Ui.Comment\\_v2](https://cables.gl/op/Ops.Ui.Comment_v2)

## 98.4 GetCablesDefaultTheme

GetCablesDefaultTheme

**Full Name:** Ops.Ui.GetCablesDefaultTheme

Get the default theme colors of the cables editor.

### > Inputs

- Visit [Ops.Ui.GetCablesDefaultTheme documentation for input port details](#)

### < Output

- **Theme** (Object)

**Example Patch:** [cables.gl/edit/Kq8Pq1](https://cables.gl/edit/Kq8Pq1)

**Doc:** [cables.gl/op/Ops.Ui.GetCablesDefaultTheme](https://cables.gl/op/Ops.Ui.GetCablesDefaultTheme)

## 98.5 MaximizeRenderer

MaximizeRenderer

**Full Name:** Ops.Ui.MaximizeRenderer

maximize renderer to window size.

### > Inputs

- **Toggle Maximized** (Trigger)

### < Output

- **Maximized** (booleanNumber)

**Example Patch:** [cables.gl/edit/BaFBnO](https://cables.gl/edit/BaFBnO)

**Doc:** [cables.gl/op/Ops.Ui.MaximizeRenderer](https://cables.gl/op/Ops.Ui.MaximizeRenderer)

## 98.6 PatchInput

PatchInput

**Full Name:** Ops.Ui.PatchInput

Helper op for sub-patches.

### > Inputs

- Visit [Ops.Ui.PatchInput documentation for input port details](#)

### < Output

- **Create Port** (Dynamic)

**Example Patch:** [cables.gl/op/Ops.Ui.PatchInput#example](https://cables.gl/op/Ops.Ui.PatchInput#example)

**Doc:** [cables.gl/op/Ops.Ui.PatchInput](https://cables.gl/op/Ops.Ui.PatchInput)

## 98.7 PatchOutput

PatchOutput

**Full Name:** Ops.Ui.PatchOutput

Helper op for sub-patches.

### > Inputs

- **Create Port** (Dynamic)

### < Output

- Visit [Ops.Ui.PatchOutput documentation for output port details](#)

**Example Patch:** [cables.gl/op/Ops.Ui.PatchOutput#example](https://cables.gl/op/Ops.Ui.PatchOutput#example)

**Doc:** [cables.gl/op/Ops.Ui.PatchOutput](https://cables.gl/op/Ops.Ui.PatchOutput)

## 98.8 SetCablesTheme

SetCablesTheme

**Full Name:** Ops.Ui.SetCablesTheme

Set cables editor colors.

### > Inputs

- **Theme** (Object)

### < Output

- **Missing** (Object)

**Example Patch:** [cables.gl/edit/Kq8Pq1](https://cables.gl/edit/Kq8Pq1)

**Doc:** [cables.gl/op/Ops.Ui.SetCablesTheme](https://cables.gl/op/Ops.Ui.SetCablesTheme)

## 98.9 SubPatch

SubPatch

**Full Name:** Ops.Ui.SubPatch

Visit documentation for details.

### > Inputs

- **Create Port** (Dynamic)
- **DataStr** (Number)
- **PatchId** (Number)

### < Output

- **Create Port Out** (Dynamic)

**Example Patch:** [cables.gl/op/Ops.Ui.SubPatch#example](https://cables.gl/op/Ops.Ui.SubPatch#example)

**Doc:** [cables.gl/op/Ops.Ui.SubPatch](https://cables.gl/op/Ops.Ui.SubPatch)

## 98.10 Subpatch2Template

Subpatch2Template

**Full Name:** Ops.Ui.Subpatch2Template

*Visit documentation for details.*

### ► Inputs

- **PatchId** (String)
- **Public** (3): 1

### ◀ Output

- *Visit Ops.Ui.Subpatch2Template documentation for output port details*

**Example Patch:** cables.gl/op/Ops.Ui.Subpatch2Template#example

**Doc:** cables.gl/op/Ops.Ui.Subpatch2Template

## 98.11 SubPatchInput

SubPatchInput

**Full Name:** Ops.Ui.SubPatchInput

*Visit documentation for details.*

### ► Inputs

- *Visit Ops.Ui.SubPatchInput documentation for input port details*

### ◀ Output

- **A1jf8yr1w** (Number)

**Example Patch:** cables.gl/op/Ops.Ui.SubPatchInput#example

**Doc:** cables.gl/op/Ops.Ui.SubPatchInput

## 98.12 SubPatchOutput

SubPatchOutput

**Full Name:** Ops.Ui.SubPatchOutput

*Visit documentation for details.*

### ► Inputs

- *Visit Ops.Ui.SubPatchOutput documentation for input port details*

### ◀ Output

- *Visit Ops.Ui.SubPatchOutput documentation for output port details*

**Example Patch:** cables.gl/op/Ops.Ui.SubPatchOutput#example

**Doc:** cables.gl/op/Ops.Ui.SubPatchOutput

## 98.13 VizArrayChart

VizArrayChart

**Full Name:** Ops.Ui.VizArrayChart

Displays information of the distribution of numerical values in an array.

### ► Inputs

- **Array Numbers** (Array)
- **Titles** (Array)

### ◀ Output

- *Visit Ops.Ui.VizArrayChart documentation for output port details*

**Example Patch:** cables.gl/edit/bPWV2f

**Doc:** cables.gl/op/Ops.Ui.VizArrayChart

## 98.14 VizArrayGraph

VizArrayGraph

**Full Name:** Ops.Ui.VizArrayGraph

Visualize Array as line graph.

### ► Inputs

- **Array Numbers** (Array)
- **Curve** (Number: Boolean)

### ◀ Output

- **Passthrough Array** (Array)

**Example Patch:** cables.gl/edit/gCl1ws

**Doc:** cables.gl/op/Ops.Ui.VizArrayGraph

## 98.15 VizArrayTable\_v2

VizArrayTable

**Full Name:** Ops.Ui.VizArrayTable\_v2

Show the contents of the input array in a table in the patch, useful for debugging.

### ► Inputs

- **Array** (Array)
- **Stride** (Number: Integer)
- **Scroll** (Number)

### ◀ Output

- **Passthrough Array** (Array)

**Example Patch:** cables.gl/edit/g8Qfq4  
**Doc:** cables.gl/op/Ops.Ui.VizArrayTable\_v2

## 98.16 VizBool



VizBool

**Full Name:** Ops.Ui.VizBool

Visualize the state of a boolean input in the patch, useful for debugging.

**> Inputs**

- **Boolean** (Number: Boolean)

**< Output**

- **Bool** (booleanNumber)

**Example Patch:** cables.gl/edit/9SHiq4

**Doc:** cables.gl/op/Ops.Ui.VizBool

## 98.17 VizGraph



VizGraph

**Full Name:** Ops.Ui.VizGraph

Displays graphs for the numbers on the input port in the patchfield.

**> Inputs**

- **Number 1** (Number)
- **Number 2** (Number)
- **Number 3** (Number)
- **Number 4** (Number)
- **Number 5** (Number)
- **Number 6** (Number)
- **Number 7** (Number)
- **Number 8** (Number)
- **Fill Graph** (Number: Boolean)
- **Reset** (Trigger)

**< Output**

- Visit *Ops.Ui.VizGraph documentation* for output port details

**Example Patch:** cables.gl/edit/4D2DnR

**Doc:** cables.gl/op/Ops.Ui.VizGraph

## 98.18 VizImageUrl



VizImageUrl

**Full Name:** Ops.Ui.VizImageUrl

preview an image URL or a data/base64 URL.

**> Inputs**

- **File** (String)

**< Output**

- **Width** (Number)
- **Height** (Number)
- **Loading** (booleanNumber)

**Example Patch:** cables.gl/edit/gsP8hO

**Doc:** cables.gl/op/Ops.Ui.VizImageUrl

## 98.19 VizLogger



VizLogger

**Full Name:** Ops.Ui.VizLogger

Log changes of input values line by line, use like a logfile for debugging.

**> Inputs**

- **Number** (Number)
- **String** (String)
- **Object** (Object)
- **Clear** (Trigger)

**< Output**

- Visit *Ops.Ui.VizLogger documentation* for output port details

**Example Patch:** cables.gl/edit/-4pkq4

**Doc:** cables.gl/op/Ops.Ui.VizLogger

## 98.20 VizNumber



VizNumber

**Full Name:** Ops.Ui.VizNumber

Displays input string on the patchfield.

**> Inputs**

- **Number** (Number)

**< Output**

- **Result** (Number)

**Example Patch:** cables.gl/edit/gkySnR

**Doc:** cables.gl/op/Ops.Ui.VizNumber

## 98.21 VizNumberBar



**Full Name:** Ops.Ui.VizNumberBar

Visualize numbers as a bar in patch, useful for debugging.

### > Inputs

- **Number** (Number)

### < Output

- **Passthrough** (Number)

**Example Patch:** cables.gl/edit/-yFlq4

**Doc:** cables.gl/op/Ops.Ui.VizNumberBar

## 98.22 VizObject



**Full Name:** Ops.Ui.VizObject

Show information about any object for patch debugging.

### > Inputs

- **Object** (Object)
- **ZoomText** (Number: Boolean)
- **Line Numbers** (Number: Boolean)
- **Experimental Stringify** (Number: Boolean)
- **Sort Keys** (Number: Boolean)
- **Font Size** (Number)
- **Scroll** (Number)

### < Output

- Visit *Ops.Ui.VizObject documentation for output port details*

**Example Patch:** cables.gl/edit/PKAmq4

**Doc:** cables.gl/op/Ops.Ui.VizObject

## 98.23 VizString



**Full Name:** Ops.Ui.VizString

Displays long input string on the patchfield.

### > Inputs

- **String** (String)
- **ZoomText** (Number: Boolean)
- **Line Numbers** (Number: Boolean)
- **Whitespace** (Number: Boolean)
- **Wrap Lines** (Number: Boolean)
- **Syntax Index** (Number: Integer)
- **Font Size** (Number)
- **Scroll** (Number)

### < Output

- **Passthrough** (String)

**Example Patch:** cables.gl/edit/tRmy5f

**Doc:** cables.gl/op/Ops.Ui.VizString

## 98.24 VizTexture



**Full Name:** Ops.Ui.VizTexture

Displays texture at input port.

### > Inputs

- **Texture In** (Object:Texture)
- **Show Info** (Number: Boolean)
- **Show Color** (Number: Boolean)
- **X** (Number)
- **Y** (Number)

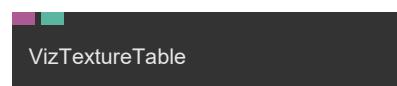
### < Output

- **Texture Out** (Object)
- **Info** (String)

**Example Patch:** cables.gl/edit/HOVjnR

**Doc:** cables.gl/op/Ops.Ui.VizTexture

## 98.25 VizTextureTable



**Full Name:** Ops.Ui.VizTextureTable

Show pixel colors of connected texture as a table, useful for debugging.

### > Inputs

- **Texture** (Object:Texture)
- **Row Start** (Number: Integer)

## < Output

- Visit *Ops.Ui.VizTextureTable* documentation for output port details

**Example Patch:** cables.gl/edit/kp6oq4

**Doc:** cables.gl/op/Ops.Ui.VizTextureTable

## 98.26 VizTrigger



**Full Name:** Ops.Ui.VizTrigger

Visualize triggering for debugging reasons.

### > Inputs

- **Trigger** (Trigger)
- **Reset** (Trigger)
- **Count Overlay** (Number: Boolean)

### < Output

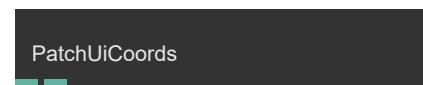
- **Count** (Number)
- **Next** (Trigger)

**Example Patch:** cables.gl/edit/ROKBEe

**Doc:** cables.gl/op/Ops.Ui.VizTrigger

# 99 Ops.Ui.Debug

## 99.1 PatchUiCoords



**Full Name:** Ops.Ui.Debug.PatchUiCoords

Output the current patch coordinates.

### > Inputs

- Visit *Ops.Ui.Debug.PatchUiCoords* documentation for input port details

### < Output

- **X** (Number)
- **Y** (Number)

**Example Patch:** cables.gl/op/Ops.Ui.Debug.PatchUiCoords#example

**Doc:** cables.gl/op/Ops.Ui.Debug.PatchUiCoords

# 100 Ops.Ui.Routing

## 100.1 RouteArray

RouteArray

**Full Name:** Ops.Ui.Routing.RouteArray

Patchfield cable routing helper for array cables.

### > Inputs

- **Array In** (Array)

### < Output

- **Array Out** (Array)

**Example Patch:** cables.gl/edit/CLMeDg

**Doc:** cables.gl/op/Ops.Ui.Routing.RouteArray

## 100.2 RouteNumber

RouteNumber

**Full Name:** Ops.Ui.Routing.RouteNumber

Patchfield cable routing helper for number cables.

### > Inputs

- **Value** (Number)

### < Output

- **Result** (Number)

**Example Patch:** cables.gl/edit/CLMeDg

**Doc:** cables.gl/op/Ops.Ui.Routing.RouteNumber

## 100.3 RouteObject

RouteObject

**Full Name:** Ops.Ui.Routing.RouteObject

Patchfield cable routing helper for object cables.

### > Inputs

- **Array In** (Object)

### < Output

- **Array Out** (Object)

**Example Patch:** cables.gl/edit/CLMeDg

**Doc:** cables.gl/op/Ops.Ui.Routing.RouteObject

## 100.4 RouteString

RouteString

**Full Name:** Ops.Ui.Routing.RouteString

Patchfield cable routing helper for string cables.

### > Inputs

- **Value** (String)

### < Output

- **String** (String)

**Example Patch:** cables.gl/edit/CLMeDg

**Doc:** cables.gl/op/Ops.Ui.Routing.RouteString

## 100.5 RouteTrigger

RouteTrigger

**Full Name:** Ops.Ui.Routing.RouteTrigger

Routing Helper for trigger cables.

### > Inputs

- **Trigger** (Trigger)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/CLMeDg

**Doc:** cables.gl/op/Ops.Ui.Routing.RouteTrigger

# 101 Ops.Vars

## 101.1 TriggerVarGetArray

TriggerVarGetArray

**Full Name:** Ops.Vars.TriggerVarGetArray

Get an array variable value at time of trigger.

**> Inputs**

- **Update** (Trigger)

**< Output**

- **Next** (Trigger)
- **Value** (Array)

**Example Patch:** cables.gl/op/Ops.Vars.TriggerVarGetArray#example

**Doc:** cables.gl/op/Ops.Vars.TriggerVarGetArray

## 101.2 TriggerVarGetNumber

TriggerVarGetNumber

**Full Name:** Ops.Vars.TriggerVarGetNumber

Get a number variable value at time of trigger.

**> Inputs**

- **Update** (Trigger)

**< Output**

- **Next** (Trigger)
- **Value** (Number)

**Example Patch:** cables.gl/edit/yNCGmy

**Doc:** cables.gl/op/Ops.Vars.TriggerVarGetNumber

## 101.3 TriggerVarGetObject

TriggerVarGetObject

**Full Name:** Ops.Vars.TriggerVarGetObject

Get an object variable value at time of trigger.

**> Inputs**

- **Update** (Trigger)

**< Output**

- **Next** (Trigger)

- **Value** (Object)

**Example Patch:** cables.gl/op/Ops.Vars.TriggerVarGetObject#example

**Doc:** cables.gl/op/Ops.Vars.TriggerVarGetObject

## 101.4 TriggerVarGetString

TriggerVarGetString

**Full Name:** Ops.Vars.TriggerVarGetString

Get a string variable value at time of trigger.

**> Inputs**

- **Update** (Trigger)

**< Output**

- **Next** (Trigger)
- **Value** (String)

**Example Patch:** cables.gl/edit/elyQeG

**Doc:** cables.gl/op/Ops.Vars.TriggerVarGetString

## 101.5 VarGetArray\_v2

VarGetArray

**Full Name:** Ops.Vars.VarGetArray\_v2

Get a variable array.

**> Inputs**

- Visit *Ops.Vars.VarGetArray\_v2 documentation for input port details*

**< Output**

- **Value** (Array)

**Example Patch:** cables.gl/edit/3LkNp6

**Doc:** cables.gl/op/Ops.Vars.VarGetArray\_v2

## 101.6 VarGetNumber\_v2

VarGetNumber

**Full Name:** Ops.Vars.VarGetNumber\_v2

read a variable number.

**> Inputs**

- Visit *Ops.Vars.VarGetNumber\_v2 documentation for input port details*

**< Output**

- **Value** (Number)

**Example Patch:** cables.gl/edit/1tfFT6

**Doc:** cables.gl/op/Ops.Vars.VarGetNumber\_v2

## 101.7 VarGetObject\_v2

VarGetObject

**Full Name:** Ops.Vars.VarGetObject\_v2

Get a variable object.

### > Inputs

- **Variable** (Number: String)

### < Output

- **Value** (Object)

**Example Patch:** cables.gl/edit/0pVTP6

**Doc:** cables.gl/op/Ops.Vars.VarGetObject\_v2

## 101.8 VarGetString

VarGetString

**Full Name:** Ops.Vars.VarGetString

String variable getter.

### > Inputs

- Visit *Ops.Vars.VarGetString documentation for input port details*

### < Output

- **Value** (String)

**Example Patch:** cables.gl/edit/W14cIJ

**Doc:** cables.gl/op/Ops.Vars.VarGetString

## 101.9 VarGetTexture\_v2

VarGetTexture

**Full Name:** Ops.Vars.VarGetTexture\_v2

get a texture from a variable.

### > Inputs

- Visit *Ops.Vars.VarGetTexture\_v2 documentation for input port details*

### < Output

- **Value** (Object)

**Example Patch:** cables.gl/edit/lkS998

**Doc:** cables.gl/op/Ops.Vars.VarGetTexture\_v2

## 101.10 VariablesAsObject

VariablesAsObject

**Full Name:** Ops.Vars.VariablesAsObject

outputs an object containing all variables.

### > Inputs

- **Execute** (Trigger)
- **Filter Prefix** (String)

### < Output

- **Result** (Object)

**Example Patch:** cables.gl/op/Ops.Vars.VariablesAsObject#example

**Doc:** cables.gl/op/Ops.Vars.VariablesAsObject

## 101.11 VarSetArray\_v2

VarSetArray

**Full Name:** Ops.Vars.VarSetArray\_v2

Set a variable array.

### > Inputs

- **Value** (Array)

### < Output

- Visit *Ops.Vars.VarSetArray\_v2 documentation for output port details*

**Example Patch:** cables.gl/edit/3LkNp6

**Doc:** cables.gl/op/Ops.Vars.VarSetArray\_v2

## 101.12 VarSetNumber\_v2

VarSetNumber

**Full Name:** Ops.Vars.VarSetNumber\_v2

set a variable number.

### > Inputs

- **Value** (Number)

### < Output

- Visit *Ops.Vars.VarSetNumber\_v2 documentation for output port details*

**Example Patch:** cables.gl/edit/1tfFT6

**Doc:** cables.gl/op/Ops.Vars.VarSetNumber\_v2

## 101.13 VarSetObject\_v2

VarSetObject

**Full Name:** Ops.Vars.VarSetObject\_v2

Set a variable object.

> **Inputs**

- **Value** (Object)

< **Output**

- Visit *Ops.Vars.VarSetObject\_v2 documentation for output port details*

**Example Patch:** cables.gl/edit/0pVTP6

**Doc:** cables.gl/op/Ops.Vars.VarSetObject\_v2

## 101.14 VarSetString\_v2

VarSetString

**Full Name:** Ops.Vars.VarSetString\_v2

Set string variable.

> **Inputs**

- **Value** (String)

< **Output**

- Visit *Ops.Vars.VarSetString\_v2 documentation for output port details*

**Example Patch:** cables.gl/edit/W14cLJ

**Doc:** cables.gl/op/Ops.Vars.VarSetString\_v2

## 101.15 VarSetTexture\_v2

VarSetTexture

**Full Name:** Ops.Vars.VarSetTexture\_v2

set a texture variable.

> **Inputs**

- **Value** (Object:Texture)

< **Output**

- Visit *Ops.Vars.VarSetTexture\_v2 documentation for output port details*

**Example Patch:** cables.gl/edit/lkS998

**Doc:** cables.gl/op/Ops.Vars.VarSetTexture\_v2

## 101.16 VarTriggerArray

VarTriggerArray

**Full Name:** Ops.Vars.VarTriggerArray

Set an array variable by a trigger.

> **Inputs**

- **Trigger** (Trigger)
- **Value** (Array)

< **Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/8WWthI

**Doc:** cables.gl/op/Ops.Vars.VarTriggerArray

## 101.17 VarTriggerNumber

VarTriggerNumber

**Full Name:** Ops.Vars.VarTriggerNumber

set number variable by trigger.

> **Inputs**

- **Trigger** (Trigger)
- **Value** (Number)

< **Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/JEYSfE

**Doc:** cables.gl/op/Ops.Vars.VarTriggerNumber

## 101.18 VarTriggerObject

VarTriggerObject

**Full Name:** Ops.Vars.VarTriggerObject

Set an object variable by trigger.

> **Inputs**

- **Trigger** (Trigger)
- **Value** (Object)

< **Output**

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Vars.VarTriggerObject#example

**Doc:** cables.gl/op/Ops.Vars.VarTriggerObject

## 101.19 VarTriggerString

VarTriggerString

**Full Name:** Ops.Vars.VarTriggerString  
set string variable by trigger.

### > Inputs

- **Trigger** (Trigger)
- **Value** (String)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/edit/PILFcl

**Doc:** cables.gl/op/Ops.Vars.VarTriggerString

## 101.20 VarTriggerTexture

VarTriggerTexture

**Full Name:** Ops.Vars.VarTriggerTexture  
Set an object variable by trigger.

### > Inputs

- **Trigger** (Trigger)
- **Value** (Object:Texture)

### < Output

- **Next** (Trigger)

**Example Patch:** cables.gl/op/Ops.Vars.VarTriggerTexture#example

**Doc:** cables.gl/op/Ops.Vars.VarTriggerTexture

## 102 Ops.WebAudio

### 102.1 AnalyzerTexture\_v2

AnalyzerTexture

**Full Name:** Ops.WebAudio.AnalyzerTexture\_v2

Creates a spectrogram texture from an audio FFT array.

### > Inputs

- **Refresh** (Trigger)
- **FFT Array** (Array)
- **Mirror Active** (Number: Boolean)
- **Mirror Width** (Number)
- **Texture Size Index** (Number: Integer)

### < Output

- **Texture Out** (Object)
- **Position** (Number)

**Example Patch:** cables.gl/edit/T\_-vCp

**Doc:** cables.gl/op/Ops.WebAudio.AnalyzerTexture\_v2

### 102.2 AudioAnalyzer\_v2

AudioAnalyzer

**Full Name:** Ops.WebAudio.AudioAnalyzer\_v2

Extracts FFT, RMS & Waveform data from an incoming audio signal.

### > Inputs

- **Trigger In** (Trigger)
- **Audio In** (Object:AudioNode)
- **FFT Size Index** (Number: Integer)
- **Smoothing** (Number)
- **Range** (in dBFS)
- **Min** (Number)
- **Max** (Number)

### < Output

- **Trigger Out** (Trigger)
- **Audio Out** (Object)
- **FFT Array** (Array)
- **Waveform Array** (Array)
- **Frequencies By Index Array** (Array)
- **Array Length** (Number)

- **Average Volume** (Number)
- **Average Volume Time-Domain** (Number)
- **RMS Volume** (Number)

**Example Patch:** [cables.gl/edit/h2eBh-](#)

**Doc:** [cables.gl/op/Ops.WebAudio.AudioAnalyzer\\_v2](#)

## 102.3 AudioBuffer\_v3



**Full Name:** Ops.WebAudio.AudioBuffer\_v3

Holds an audio file / sample in a buffer.

### ➤ Inputs

- **URL** (String)
- **Create Loading Task** (Number: Boolean)
- **Active** (Number: Boolean)

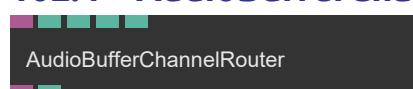
### ◀ Output

- **Audio Buffer** (Object)
- **Finished Loading** (booleanNumber)
- **Sample Rate** (Number)
- **Length** (Number)
- **Duration** (Number)
- **Number Of Channels** (Number)
- **IsLoading** (booleanNumber)

**Example Patch:** [cables.gl/edit/xEL0rn](#)

**Doc:** [cables.gl/op/Ops.WebAudio.AudioBuffer\\_v3](#)

## 102.4 AudioBufferChannelRouter



**Full Name:** Ops.WebAudio.AudioBufferChannelRouter

Route audio from one input channel to any output channel.

### ➤ Inputs

- **Audio Buffer** (Object:AudioBuffer)
- **Channel In** (Number: Integer)
- **Channel Out** (Number: Integer)
- **Clear Others** (Number: Boolean)
- **Channel Offset** (Number: Boolean)

### ◀ Output

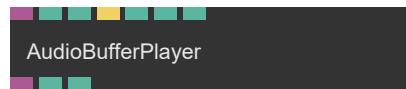
- **Audio Buffer Out** (Object)

- **Output Channels** (Number)

**Example Patch:** [cables.gl/edit/KICyYN](#)

**Doc:** [cables.gl/op/Ops.WebAudio.AudioBufferChannelRouter](#)

## 102.5 AudioBufferPlayer\_v2



**Full Name:** Ops.WebAudio.AudioBufferPlayer\_v2

Play back audio data stored in an AudioBuffer.

### ➤ Inputs

- **Audio Buffer** (Object:AudioBuffer)
- **Loop** (Number: Boolean)
- **Restart** (Trigger)
- **Offset** (Number)
- **Playback Rate** (Number)
- **Detune** (Number)

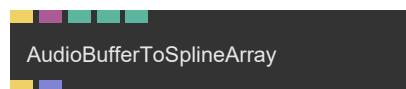
### ◀ Output

- **Audio Out** (Object)
- **Is Playing** (booleanNumber)
- **Loading** (booleanNumber)

**Example Patch:** [cables.gl/edit/5PFIfu](#)

**Doc:** [cables.gl/op/Ops.WebAudio.AudioBufferPlayer\\_v2](#)

## 102.6 AudioBufferToSplineArray



**Full Name:** Ops.WebAudio.AudioBufferToSplineArray

Outputs the waveform of an audio file as a spline array.

### ➤ Inputs

- **Render** (Trigger)
- **Audio Buffer** (Object:AudioBuffer)
- **Width** (Number)
- **Height** (Number)
- **Samples Per Pixel** (Number: Integer)

### ◀ Output

- **Next** (Trigger)
- **Array Out** (Array)

**Example Patch:** [cables.gl/edit/OcOVBp](#)

**Doc:** [cables.gl/op/Ops.WebAudio.AudioBufferToSplineArray](#)

## 102.7 AudioPanner

AudioPanner

**Full Name:** Ops.WebAudio.AudioPanner  
stereo pan an audio signal from left to right.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Pan** (Number)

### < Output

- **Audio Out** (Object)

**Example Patch:** cables.gl/edit/iNue\_j

**Doc:** cables.gl/op/Ops.WebAudio.AudioPanner

## 102.8 AudioRecorder

AudioRecorder

**Full Name:** Ops.WebAudio.AudioRecorder  
record, playback and download audio.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Start Recording** (Trigger)
- **Stop Recording** (Trigger)
- **Input Gain** (Number)
- **Start Playback** (Trigger)
- **Stop Playback** (Trigger)
- **Clear Buffer** (Trigger)
- **Playback Gain** (Number)
- **Loop Playback** (Number: Boolean)

### < Output

- **Audio Out** (Object)
- **Recorded Audio Out** (Object)
- **Is Recording** (booleanNumber)
- **Is Playing Back** (booleanNumber)
- **State** (String)
- **AudioBuffer Out** (Object)
- **Data URL** (String)

**Example Patch:** cables.gl/edit/nEKhbl

**Doc:** cables.gl/op/Ops.WebAudio.AudioRecorder

## 102.9 BiquadFilter\_v2

BiquadFilter

**Full Name:** Ops.WebAudio.BiquadFilter\_v2  
Different kinds of audio filters.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Type Index** (Number: Integer)
- **Frequency** (Number)
- **Q** (Number)
- **Gain** (Number)
- **Detune** (in cents)
- **Frequency Array** (Array)

### < Output

- **Audio Out** (Object)
- **Magnitude Response Array** (Array)
- **Phase Response Array** (Array)
- **Response Arrays Length** (Number)

**Example Patch:** cables.gl/edit/nhyACp

**Doc:** cables.gl/op/Ops.WebAudio.BiquadFilter\_v2

## 102.10 ClockSequencer

ClockSequencer

**Full Name:** Ops.WebAudio.ClockSequencer

send bpm based triggers like a clocked trigger sequencer / clock divider.

### > Inputs

- **BPM** (Number: Integer)
- **beats per minute** (tempo)
- **Start** (Trigger)
- **Stop** (Trigger)
- **Reset** (Trigger)

### < Output

- **Sequencer Running** (booleanNumber)
- **BPM Out** (Number)
- **Start Out** (Trigger)
- **Stop Out** (Trigger)
- **Reset Out** (Trigger)

**Example Patch:** cables.gl/edit/J8Uccu

**Doc:** [cables.gl/op/Ops.WebAudio.ClockSequencer](#)

## 102.11 ClockSequencerPattern

ClockSequencerPattern

**Full Name:** Ops.WebAudio.ClockSequencerPattern  
sequence triggers by defining a pattern (like a drum machine).

### > Inputs

- **Clock Trigger Input** (Trigger)
- **Sequence Array** (Array)
- **Steps Index** (Number: Integer)
- **Steps** (Number: String)
- **Reset** (Trigger)

### < Output

- **Sequence Trigger Output** (Trigger)
- **Sequenced Value** (Number)
- **Current Step** (Number)

**Example Patch:** [cables.gl/edit/KM0Dgu](#)

**Doc:** [cables.gl/op/Ops.WebAudio.ClockSequencerPattern](#)

## 102.12 Convolver\_v2

Convolver

**Full Name:** Ops.WebAudio.Convolver\_v2

Audio reverb using an impulse response (sample).

### > Inputs

- **Audio In** (Object:AudioNode)
- **Impulse Response** (String)
- **Normalize** (Number: Boolean)
- **IR Gain** (Number)
- **Output Gain** (Number)

### < Output

- **Audio Out** (Object)
- **Wet Out** (Object)

**Example Patch:** [cables.gl/edit/WlLDwp](#)

**Doc:** [cables.gl/op/Ops.WebAudio.Convolver\\_v2](#)

## 102.13 CutFilter

CutFilter

**Full Name:** Ops.WebAudio.CutFilter  
dj style filter (lowpass and highpass).

### > Inputs

- **Audio In** (Object:AudioNode)
- **Highpass Active** (Number: Boolean)
- **Low Frequency** (Number)
- **Low Q** (Number)
- **Lowpass Active** (Number: Boolean)
- **High Frequency** (Number)
- **High Q** (Number)

### < Output

- **Audio Out** (Object)

**Example Patch:** [cables.gl/edit/6SsZxp](#)

**Doc:** [cables.gl/op/Ops.WebAudio.CutFilter](#)

## 102.14 Delay

Delay

**Full Name:** Ops.WebAudio.Delay

add a delay effect to an audio stream.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Feedback** (Number)
- **BPM Based Delay Time** (Number: Boolean)
- **BPM** (Number)
- **Highpass Frequency** (Number)
- **Highpass Q** (Number)
- **Lowpass Frequency** (Number)
- **Lowpass Q** (Number)
- **LFO Intensity** (Number)
- **LFO Waveform Index** (Number: Integer)

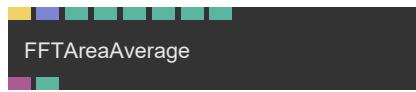
### < Output

- **Mix Out** (Object)
- **Wet Out** (Object)

**Example Patch:** [cables.gl/edit/IUjXgu](#)

**Doc:** [cables.gl/op/Ops.WebAudio.Delay](#)

## 102.15 FFTAreaAverage\_v3



FFTAreaAverage

**Full Name:** Ops.WebAudio.FFTAreaAverage\_v3

get average value in an area of a fft audio analysis buffer.

### > Inputs

- **Refresh** (Trigger)
- **FFT Array** (Array)
- **X Position** (Number)
- **Y Position** (Number)
- **Width** (Number)
- **Height** (Number)
- **Create Texture** (Number: Boolean)

### < Output

- **Texture Out** (Object)
- **Area Average Volume** (Number)

**Example Patch:** [cables.gl/edit/F6Fhyp](#)

**Doc:** [cables.gl/op/Ops.WebAudio.FFTAreaAverage\\_v3](#)

## 102.16 Gain



Gain

**Full Name:** Ops.WebAudio.Gain

Changes the gain / volume.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Gain** (Number)
- **Mute** (Number: Boolean)

### < Output

- **Audio Out** (Object)

**Example Patch:** [cables.gl/edit/JeKgDp](#)

**Doc:** [cables.gl/op/Ops.WebAudio.Gain](#)

## 102.17 KeyPiano



KeyPiano

**Full Name:** Ops.WebAudio.KeyPiano

Generates notes based on key presses.

### > Inputs

- **C Note On** (Trigger)
- **C Note Off** (Trigger)
- **Cis Note On** (Trigger)
- **Cis Note Off** (Trigger)
- **D Note On** (Trigger)
- **D Note Off** (Trigger)
- **Dis Note On** (Trigger)
- **Dis Note Off** (Trigger)
- **E Note On** (Trigger)
- **E Note Off** (Trigger)
- **F Note On** (Trigger)
- **F Note Off** (Trigger)
- **Fis Note On** (Trigger)
- **Fis Note Off** (Trigger)
- **G Note On** (Trigger)
- **G Note Off** (Trigger)
- **Gis Note Ons** (Trigger)
- **Gis Note Off** (Trigger)
- **A Note On** (Trigger)
- **A Note Off** (Trigger)
- **Ais Note On** (Trigger)
- **Ais Note Off** (Trigger)
- **B Note On** (Trigger)
- **B Note Off** (Trigger)
- **Octave** (Number)

### < Output

- **Frequency** (Number)
- **Is Pressed** (Number)

**Example Patch:** [cables.gl/op/Ops.WebAudio.KeyPiano#example](#)

**Doc:** [cables.gl/op/Ops.WebAudio.KeyPiano](#)

## 102.18 MicrophoneIn\_v2



MicrophoneIn

**Full Name:** Ops.WebAudio.MicrophoneIn\_v2

Access to the microphone and/or audio input devices.

### > Inputs

- **Audio Input Index** (Number: Integer)
- **Volume** (Number)
- **Mute** (Number: Boolean)

- **Start** (Trigger)

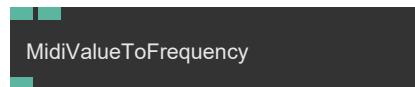
#### < Output

- **Audio Out** (Object)
- **Listening** (booleanNumber)
- **List Of Input Devices** (Array)

**Example Patch:** cables.gl/edit/xjHACp

**Doc:** cables.gl/op/Ops.WebAudio.Microphoneln\_v2

## 102.19 MidiValueToFrequency



MidiValueToFrequency

**Full Name:** Ops.WebAudio.MidiValueToFrequency

Converts a midi value to a frequency.

#### > Inputs

- **MIDI Value** (Number)
- **Tuning** (Number)

#### < Output

- **Frequency** (Number)

**Example Patch:** cables.gl/op/Ops.WebAudio.MidiValueToFrequency#example

**Doc:** cables.gl/op/Ops.WebAudio.MidiValueToFrequency

## 102.20 Mixer



Mixer

**Full Name:** Ops.WebAudio.Mixer

Mix audio signals together.

#### > Inputs

- **Audio In 0** (Object:AudioNode)
- **Audio In 1** (Object:AudioNode)
- **Audio In 2** (Object:AudioNode)
- **Audio In 3** (Object:AudioNode)
- **Audio In 4** (Object:AudioNode)
- **Audio In 5** (Object:AudioNode)
- **Audio In 6** (Object:AudioNode)
- **Audio In 7** (Object:AudioNode)
- **In 0 Gain** (Number)
- **In 1 Gain** (Number)
- **In 2 Gain** (Number)
- **In 3 Gain** (Number)

- **In 4 Gain** (Number)
- **In 5 Gain** (Number)
- **In 6 Gain** (Number)
- **In 7 Gain** (Number)
- **In 0 Pan** (Number)
- **In 1 Pan** (Number)
- **In 2 Pan** (Number)
- **In 3 Pan** (Number)
- **In 4 Pan** (Number)
- **In 5 Pan** (Number)
- **In 6 Pan** (Number)
- **In 7 Pan** (Number)
- **Output Gain** (Number)

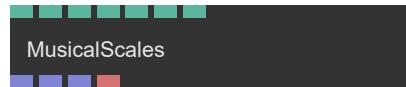
#### < Output

- **Audio Out** (Object)

**Example Patch:** cables.gl/edit/J7YdCp

**Doc:** cables.gl/op/Ops.WebAudio.Mixer

## 102.21 MusicalScales



MusicalScales

**Full Name:** Ops.WebAudio.MusicalScales

Outputs a musical scale array (major, minor, ...) as strings, steps and midi notes.

#### > Inputs

- **Root Note Index** (Number: Integer)
- **Root Note** (Number: String)
- **Scale Type Index** (Number: Integer)
- **Scale Type** (Number: String)
- **Include Upper Root Note** (Number: Boolean)
- **Octave** (Number: Integer)
- **the octave of the scale** (only for string & midi note outputs)
- **Append Octave To Names** (Number: Boolean)

#### < Output

- **Note Names Array** (Array)
- **Note Step Number Array** (Array)
- **Midi Note Array** (Array)
- **Current Scale** (String)

**Example Patch:** cables.gl/edit/8Ekchu

**Doc:** cables.gl/op/Ops.WebAudio.MusicalScales

## 102.22 Output\_v2



**Full Name:** Ops.WebAudio.Output\_v2

Sends an audio signal to your speakers.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Volume** (Number)
- **Mute** (Number: Boolean)
- **Show Audio Suspended Button** (Number: Boolean)

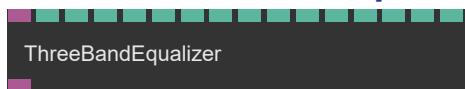
### < Output

- **Current Volume** (Number)
- **Number Of Channels** (Number)
- **Context State** (String)

**Example Patch:** cables.gl/edit/teZhCp

**Doc:** cables.gl/op/Ops.WebAudio.Output\_v2

## 102.23 ThreeBandEqualizer



**Full Name:** Ops.WebAudio.ThreeBandEqualizer

3 filters in one - an eq to quickly process an audio signal.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Low Filter Type Index** (Number: Integer)
- **Low Filter Type** (Number: String)
- **Low Frequency** (Number)
- **Low Q** (Number)
- **Low Gain** (Number)
- **Mid Filter Type Index** (Number: Integer)
- **Mid Filter Type** (Number: String)
- **Mid Frequency** (Number)
- **Mid Q** (Number)
- **Mid Gain** (Number)
- **High Filter Type Index** (Number: Integer)
- **High Filter Type** (Number: String)
- **High Frequency** (Number)
- **High Q** (Number)
- **High Gain** (Number)

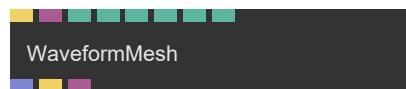
### < Output

- **Audio Out** (Object)

**Example Patch:** cables.gl/edit/tD2Vxp

**Doc:** cables.gl/op/Ops.WebAudio.ThreeBandEqualizer

## 102.24 WaveformMesh



**Full Name:** Ops.WebAudio.WaveformMesh

Outputs the waveform of an audio file as a geometry.

### > Inputs

- **Render** (Trigger)
- **Audio Buffer** (Object:AudioBuffer)
- **Render Active** (Number: Boolean)
- **Show Bottom Half** (Number: Boolean)
- **Center Origin** (Number: Boolean)
- **Width** (Number)
- **Samples Per Pixel** (Number: Integer)
- **Calculate Tex Coords** (Number: Boolean)

### < Output

- **Spline Points** (Array)
- **Next** (Trigger)
- **Geometry** (Object)

**Example Patch:** cables.gl/edit/VqDkCp

**Doc:** cables.gl/op/Ops.WebAudio.WaveformMesh

## 102.25 Waveshaper



**Full Name:** Ops.WebAudio.Waveshaper

add waveshaping (distortion, overdrive, fuzz) to an audio stream.

### > Inputs

- **Audio In** (Object:AudioNode)
- **Oversampling Index** (Number: Integer)
- **Distortion Amount** (Number: Integer)
- **Waveshape Array In** (Array)
- **array input for the waveshaper** (custom distortion transfer function)
- **Output Gain** (Number)

### < Output

- **Audio Out** (Object)

- **Curve Out** (Array)
- **distortion curve array output** (one-dimensional)
- **Curve Length** (Number)

**Example Patch:** [cables.gl/edit/6Vl87I](https://cables.gl/edit/6Vl87I)

**Doc:** [cables.gl/op/Ops.WebAudio.Waveshaper](https://cables.gl/op/Ops.WebAudio.Waveshaper)

## 103 Ops.Website

### 103.1 Cookie



**Full Name:** Ops.Website.Cookie  
cookie of the current website as object.

#### > Inputs

- Visit [Ops.Website.Cookie documentation](#) for input port details

#### < Output

- **Cookie** (Object)
- **Cookie String** (String)

**Example Patch:** [cables.gl/edit/oNMzci](https://cables.gl/edit/oNMzci)

**Doc:** [cables.gl/op/Ops.Website.Cookie](https://cables.gl/op/Ops.Website.Cookie)

### 103.2 FileInfo



**Full Name:** Ops.Website.FileInfo  
information about a filename, like url protocol, suffix etc.

#### > Inputs

- **URL** (String)

#### < Output

- **Protocol** (String)
- **Host** (String)
- **Full Path** (String)
- **Filename** (String)
- **Basename** (String)
- **Suffix** (String)
- **Is URL** (String)
- **queryParams** (String)

**Example Patch:** [cables.gl/edit/RyrLMg](https://cables.gl/edit/RyrLMg)

**Doc:** [cables.gl/op/Ops.Website.FileInfo](https://cables.gl/op/Ops.Website.FileInfo)

### 103.3 ForceHttps



**Full Name:** Ops.Website.ForceHttps

will redirect to same URL using https protocol.

#### > Inputs

- Visit [Ops.Website.ForceHttps documentation for input port details](#)

#### < Output

- Visit [Ops.Website.ForceHttps documentation for output port details](#)

**Example Patch:** [cables.gl/op/Ops.Website.ForceHttps#example](https://cables.gl/op/Ops.Website.ForceHttps#example)

**Doc:** [cables.gl/op/Ops.Website.ForceHttps](https://cables.gl/op/Ops.Website.ForceHttps)

## 103.4 InfoURL



**Full Name:** Ops.Website.InfoURL

Information about the current URL.

#### > Inputs

- Visit [Ops.Website.InfoURL documentation for input port details](#)

#### < Output

- **URL** (String)
- **Host** (String)
- **Hash** (String)
- **Pathname** (String)
- **Protocol** (String)
- **Port** (String)
- **Hash Changed** (Trigger)

**Example Patch:** [cables.gl/edit/9UM2YG](https://cables.gl/edit/9UM2YG)

**Doc:** [cables.gl/op/Ops.Website.InfoURL](https://cables.gl/op/Ops.Website.InfoURL)

## 103.5 InIframe



**Full Name:** Ops.Website.InIframe

Outputs true if the patch is inside of an iframe.

#### > Inputs

- Visit [Ops.Website.InIframe documentation for input port details](#)

#### < Output

- **In Iframe** (booleanNumber)

**Example Patch:** [cables.gl/edit/qWDDci](https://cables.gl/edit/qWDDci)

**Doc:** [cables.gl/op/Ops.Website.InIframe](https://cables.gl/op/Ops.Website.InIframe)

## 103.6 LocalStorageNumber



**Full Name:** Ops.Website.LocalStorageNumber

Store and retrieve a number in browser localstorage.

#### > Inputs

- **Key** (String)
- **Number** (Number)
- **Store** (Trigger)

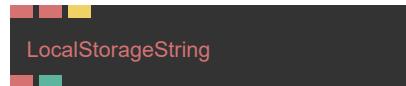
#### < Output

- **Stored Number** (Number)
- **Storage Support** (Number)

**Example Patch:** [cables.gl/edit/9di48i](https://cables.gl/edit/9di48i)

**Doc:** [cables.gl/op/Ops.Website.LocalStorageNumber](https://cables.gl/op/Ops.Website.LocalStorageNumber)

## 103.7 LocalStorageString



**Full Name:** Ops.Website.LocalStorageString

Store and retrieve a string in browser localstorage.

#### > Inputs

- **Key** (String)
- **String** (String)
- **Store** (Trigger)

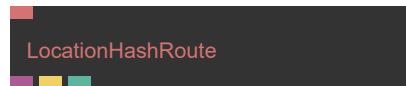
#### < Output

- **Stored String** (String)
- **Storage Support** (booleanNumber)

**Example Patch:** [cables.gl/edit/QKe58i](https://cables.gl/edit/QKe58i)

**Doc:** [cables.gl/op/Ops.Website.LocalStorageString](https://cables.gl/op/Ops.Website.LocalStorageString)

## 103.8 LocationHashRoute



**Full Name:** Ops.Website.LocationHashRoute

gives updated information about window.location.hash.

#### > Inputs

- **Route** (String)
- **pattern for url and variables** (i.e. /scene/:id)

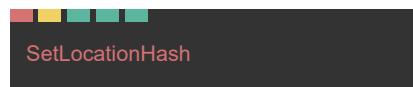
#### < Output

- **Values** (Object)
- **Changed** (Trigger)
- **Matching** (booleanNumber)

**Example Patch:** cables.gl/edit/EfiWpG

**Doc:** cables.gl/op/Ops.Website.LocationHashRoute

## 103.9 SetLocationHash



**Full Name:** Ops.Website.SetLocationHash

sets window.location.hash to the specified value(s).

#### > Inputs

- **Hash** (String)
- **Update** (Trigger)
- **Active** (Number: Boolean)
- **Silent** (Number: Boolean)
- **Allow Empty** (Number: Boolean)

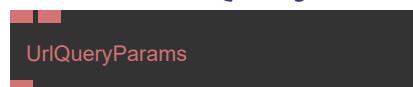
#### < Output

- Visit *Ops.Website.SetLocationHash documentation for output port details*

**Example Patch:** cables.gl/edit/EfiWpG

**Doc:** cables.gl/op/Ops.Website.SetLocationHash

## 103.10 UrlqueryParams\_v2



**Full Name:** Ops.Website.UrlqueryParams\_v2

Returns a URL query parameter.

#### > Inputs

- **Parameter** (String)
- **Default** (String)

#### < Output

- **Result** (String)

**Example Patch:** cables.gl/edit/2SE58i

**Doc:** cables.gl/op/Ops.Website.UrlqueryParams\_v2