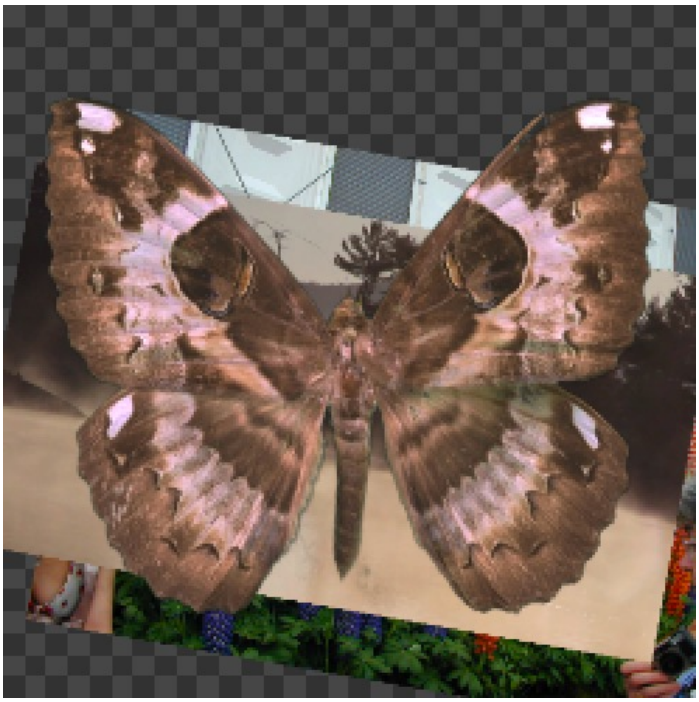


Texture Operators (TOPs) Part 2

David Meredith
dave@create.aau.dk

Sweet Sixteen TOPs

https://docs.derivative.ca/TOP#Sweet_16_TOPs

TOP	Purpose	Related TOP
Movie File In	Read movies, still images, or a sequence of still images.	Video Device In, Movie File Out
Ramp	Create vertical, horizontal, radial, and circular ramps.	Constant, Noise
Level	Adjust contrast, brightness, gamma, black level, color range, opacity.	Luma Level
Transform	Translate, scale, rotate, multi-repeat tile, background fill.	Flip
Over	Place and shift one image over another based on the alpha of one image.	Cross, Multiply
Text	Text generation with variety of fonts.	
Blur	Blur.	Luma Blur
Composite	Combine multiple images with variety of operations like under, difference.	
Render	Render 3D objects, lights and camera into an image.	
CHOP to	Convert CHOP channels into scanlines of an image.	
Resolution	Change the resolution of an image and smooth-filter down.	all TOPs alter resolution
Crop	Crop image to smaller resolution.	Corner Pin, Fit
Select	Selects an image from the same network or a different network.	Switch
Reorder	Re-order the channels of an image.	Channel Mix
Cache	Hold a static or dynamic sequence of images and output one of them.	Feedback
Displace	Use red-blue of one image to warp another image.	Time Machine

- The Sweet Sixteen TOPs are a set of 16 TOPs that are commonly used
- In this lecture, we'll cover the TOPs in the shaded region above

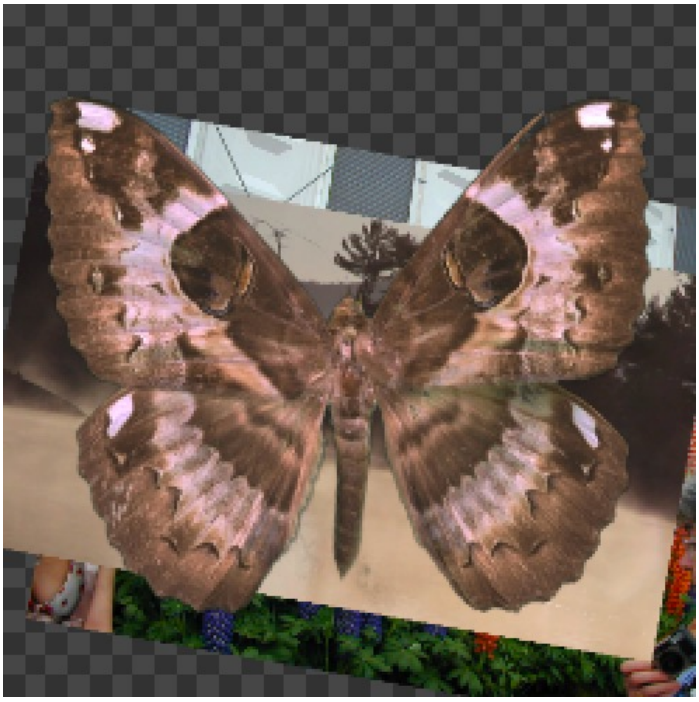
Composite TOP

https://docs.derivative.ca/Composite_TOP

- Multi-input TOP that performs a composite operation for each input
- You select the composite operation using the Operation parameter on the Composite parameter page
- Composite page:
  - TOP: In addition to all inputs attached, you can specify more using the TOPs listed in this field
    - e.g., ramp* composites all TOPs whose names start with “ramp”
  - Preview Grid: Shows effect of all operation types in a grid, with inputs swapped on the right side of each tile
  - Select Input: bypasses composites and lets just one input through
  - Input Index: Specifies the index of the input to let through when using Select Input
  - Operation: Menu for choosing which composite operation to perform
  - Swap Operation Order: Reverses order of operands
    - if operation is commutative (e.g., add), then order doesn’t matter, otherwise it does (e.g., Over, Hard Light)

Composite TOP – Transform Page

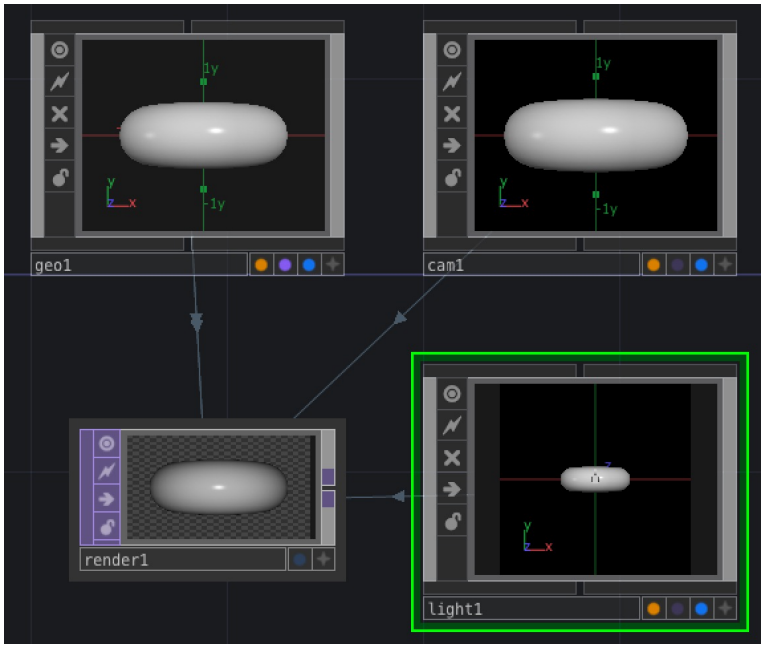
https://docs.derivative.ca/Composite_TOP



- Transform page (see effects with Over and Butterfly as Fixed Layer)
  - Fixed Layer: Selects which input to use as the fixed layer
    - Other layers are overlays – overlays are adjustable by the parameters on the Transform page
    - Order of composite is not changed
    - Resolution and aspect ratio of Fixed Layer is used in final result
  - Pre-Fit Overlay: Determines how overlay fills composite
  - Justify Horizontal/Vertical: Specify alignment of overlay
  - Extend Overlay: Sets extend/repeat conditions of overlay
  - Rotate: Rotates overlay (+ve is clockwise)
  - Translate: Translates overlay, Translate Units determines how numbers are interpreted
  - Scale: Scales overlay layer
  - Pivot: Defines center of enlargement and rotation, works with Pivot Units
  - Translate Step: Each overlay is translated relative to the previously applied one by the specified amount, works with Translate Step Units

Render TOP

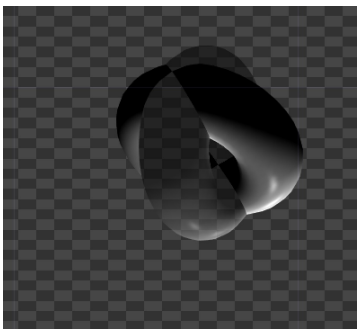
https://docs.derivative.ca/Render_TOP



- Used to render all 3D scenes
- Needs to be given a Camera node and a Geometry node as a minimum
  - Typically also use Light nodes
- Geometry object needs to have a Material assigned to it
  - Material can be either a pre-packaged MAT or an OpenGL GLSL shader
  - All textures and bump maps in TD are TOPs that have to be read in using Movie File In TOPs
- Render TOP renders in many RGBA and single-channel formats – 8-bit fixed-point up to 32-bit floating point per pixel component
- Renders transparent surfaces correctly using Multi-Pass Depth Peeling
  - See “Order Independent Transparency”
- Render TOP can render multiple cameras in a single node
  - Multiple cameras are specified in one Camera parameter
  - Render Select TOP can be used to pull out camera results
  - Supports GPU acceleration

Render TOP – Render Page

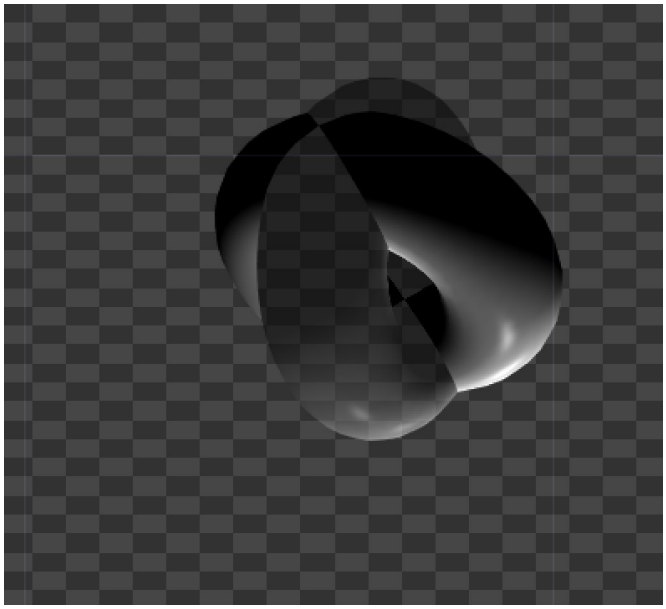
https://docs.derivative.ca/Render_TOP



- Camera(s): Specifies which Cameras to look through when rendering the scene
  - Can specify multiple cameras and retrieve each one using the Render Select TOP
- Multi-Camera Hint: Helps Render TOP optimize rendering when using multiple cameras – controls Multi-Camera Rendering behaviour for this node
  - Nvidia calls Multi-Camera Rendering "Simultaneous Multi-Projection"
- Geometry: Specifies which Geometry will be used – can have multiple Geometry objects and you can specify them using regular expressions (e.g., "geo* ^geo7" = all objects whose name starts with "geo" except geo7)
- Lights: Specifies which Lights to use - can also use regex to specify a pattern to select the Lights to use
- Anti-Alias: Sets level of anti-aliasing (higher values use more graphics memory)
- Render Mode: For rendering various projections – normal 2D, Cube Map, Fish Eye (180), Dual Paraboloid
  - Cube Map renders 6 views as required for an environment map in the Phong MAT and Environment Light COMP
  - Dual paraboloid mapping is a technique for generating an environment map that only requires 2 passes, compared with the 6 passes required for a Cube Map
- Positive/Negative Sides: Specifies which sides of the cube are rendered +/-X, +/-Y and +/-Z when using Cube Map
- UV Unwrap Coord: Select which Texture Layer the coordinates are rendered to when Render Mode is UVUnwap Coord
  - Used when producing a UV map

Render TOP – Render Page > Transparency

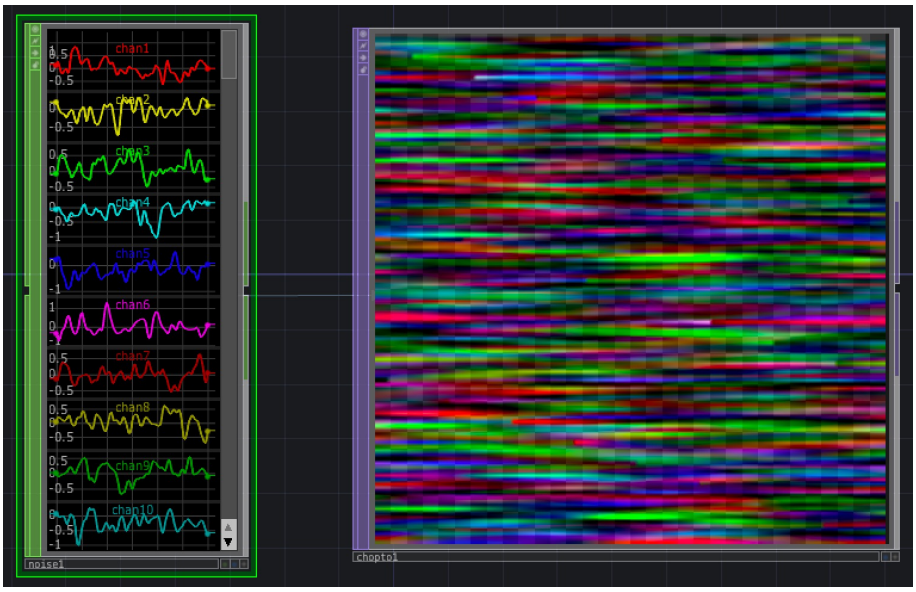
https://docs.derivative.ca/Render_TOP



- Helps with rendering transparent geometry in proper depth order
- No need to sort geometry based on distance from camera
- Multi-pass process where each pass processes surfaces that are progressively further and further away from the camera
- Turning on transparency disables some advanced features in the Render TOP, including anti-aliasing
- Pixel based approach, so not dependent on number of objects but rather on how they are layered
- Uses Depth Peeling: First render normal frame, then peel away all pixels seen in the first frame, revealing pixels underneath; then peel away pixels seen in second frame and so on. Finally composite layers Over each other, starting at the deepest layer
  - e.g., two passes for a hollow sphere: first pass does outer surface, second pass does inner surface
  - If you have 10 spheres in front of each other than may need up to 20 passes; if the spheres do not occlude each other, then only need 2 passes
- Typically don't need so many passes to get an acceptable rendering – note that each pass is a full rendering so can take significant time

CHOP To TOP

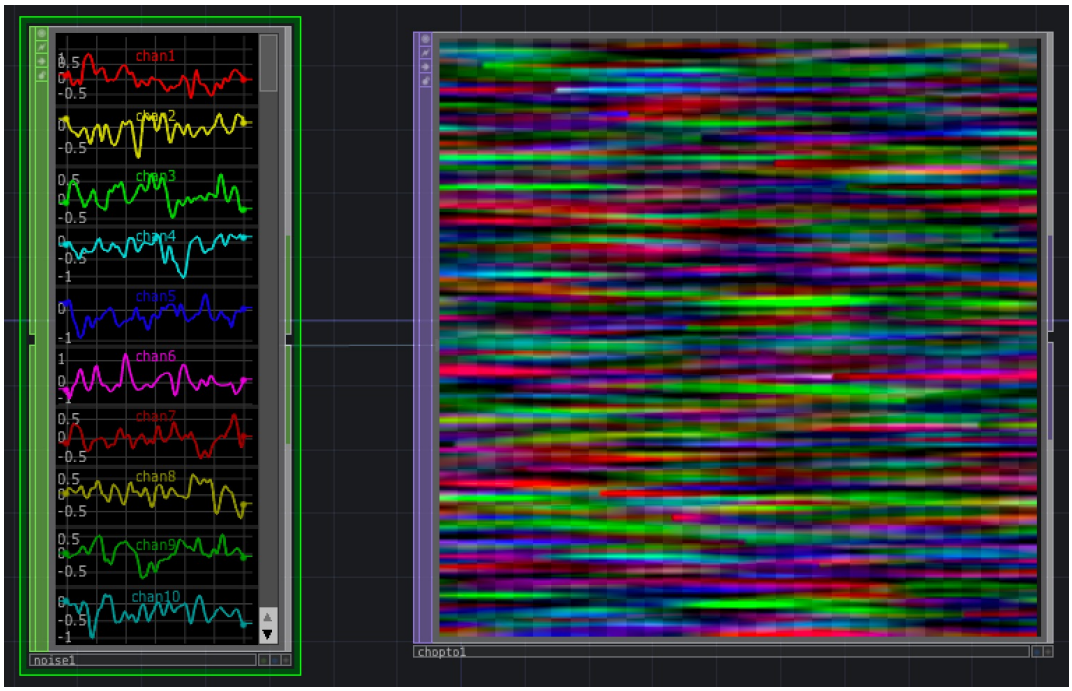
https://docs.derivative.ca/CHOP_to_TOP



- CHOP To TOP puts CHOP channels into a TOP image
  - 32-bit floating point
- Data Format parameter determines how input channels are converted to pixel colors
  - If Data Format is ‘R’ then each channel is interpreted as the R pixel values for a separate row in the image
  - If Data Format is ‘RGBA’, then each set of 4 consecutive channels are interpreted as the R, G, B and A channels of pixels for a single row
- Image Layout parameter controls how pixel rows are arrangd in the output
  - By default, image width = number of samples in CHOP; and height is number of channel sets
  - If channel length > image width, then wrapped layout option can be used to continue channel data onto additional pixel rows
  - Fit to Square determines a square image resolution that uses all the values in the channels

CHOP To TOP – CHOP to TOP Page

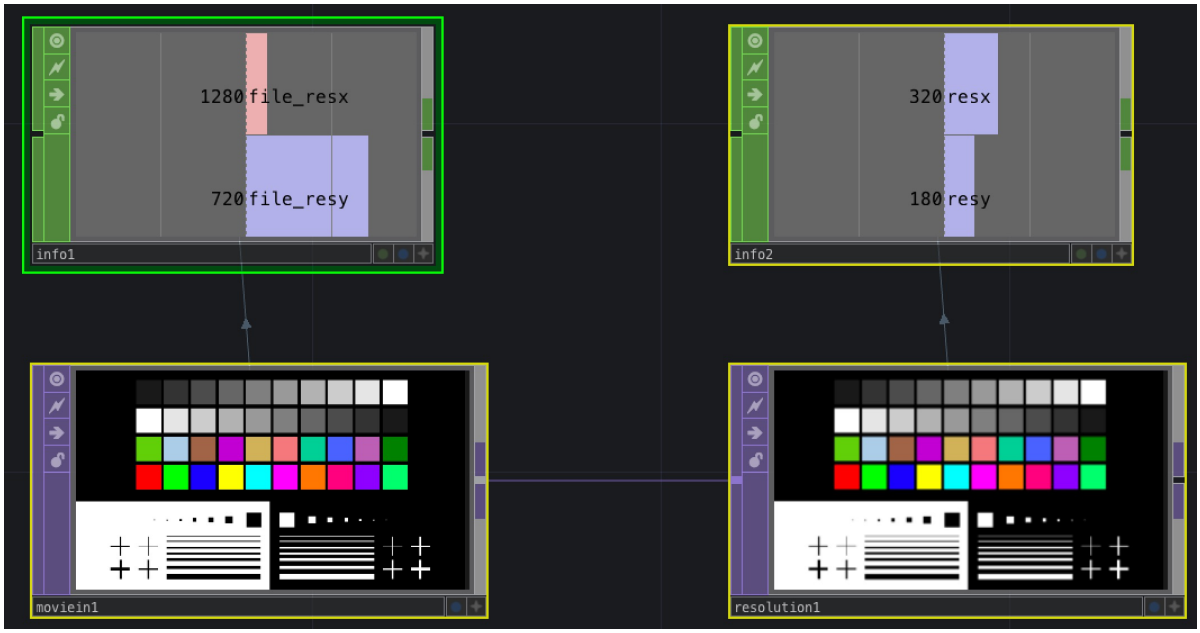
https://docs.derivative.ca/CHOP_to_TOP



- CHOP: The path of the CHOP being referenced
- Data Format: determines how input CHOP channels will be turned into an image
- Clamp CHOP Values: Clamps CHOP values to range 0-1
- Image Layout: Controls the dimensions of the output image and how CHOP samples are arranged as pixels
- Extra Pixel Values (RGBA): Values used to fill in pixel values in image when there are not enough values in the CHOP data

Resolution TOP

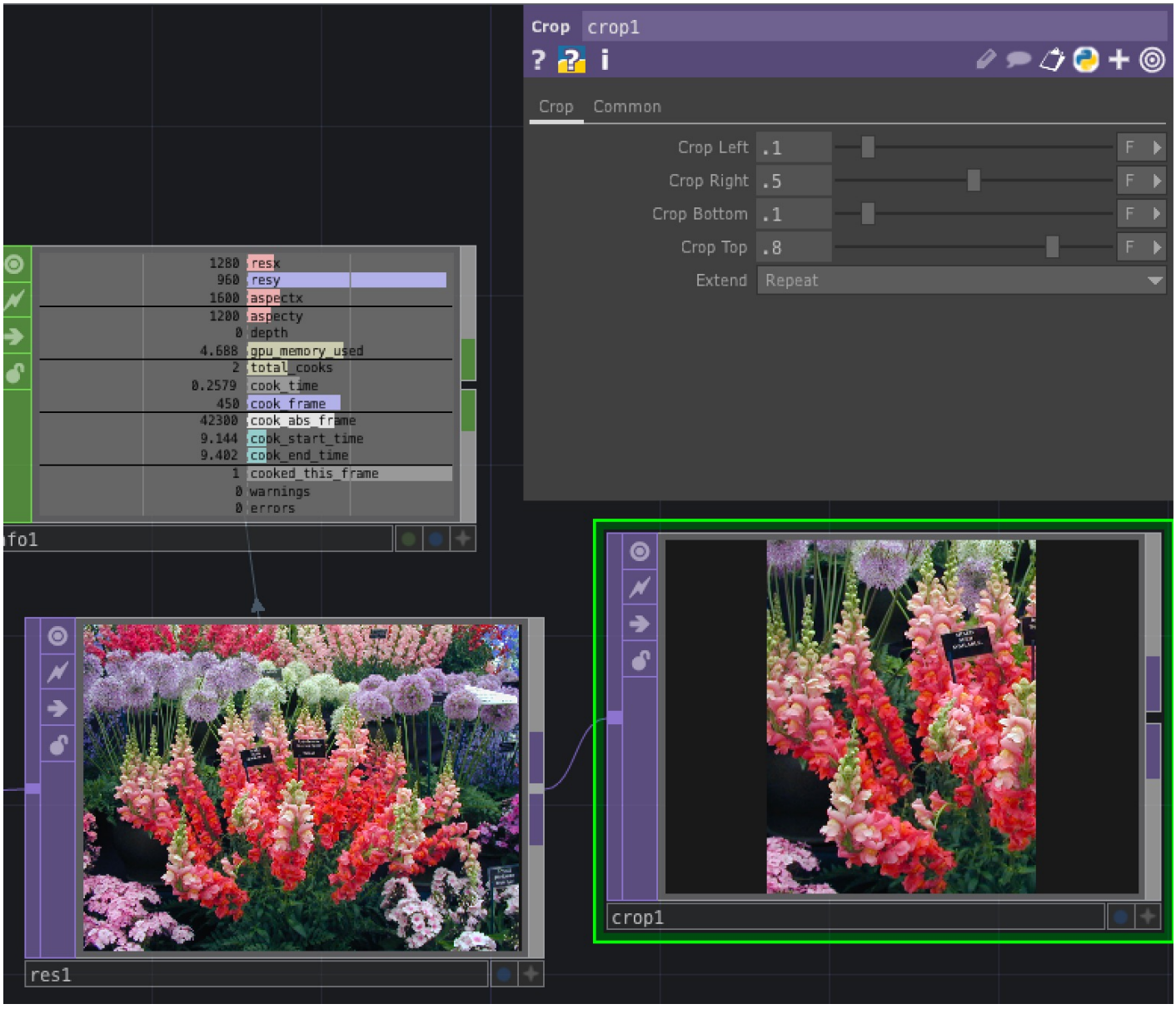
https://docs.derivative.ca/Resolution_TOP



- The Resolution TOP changes the resolution of a TOP image
- This can also be done on the Common Page of most other TOPs
- High Quality Resize Parameter uses weighted averages of multiple-pixels when scaling down the image

Crop TOP

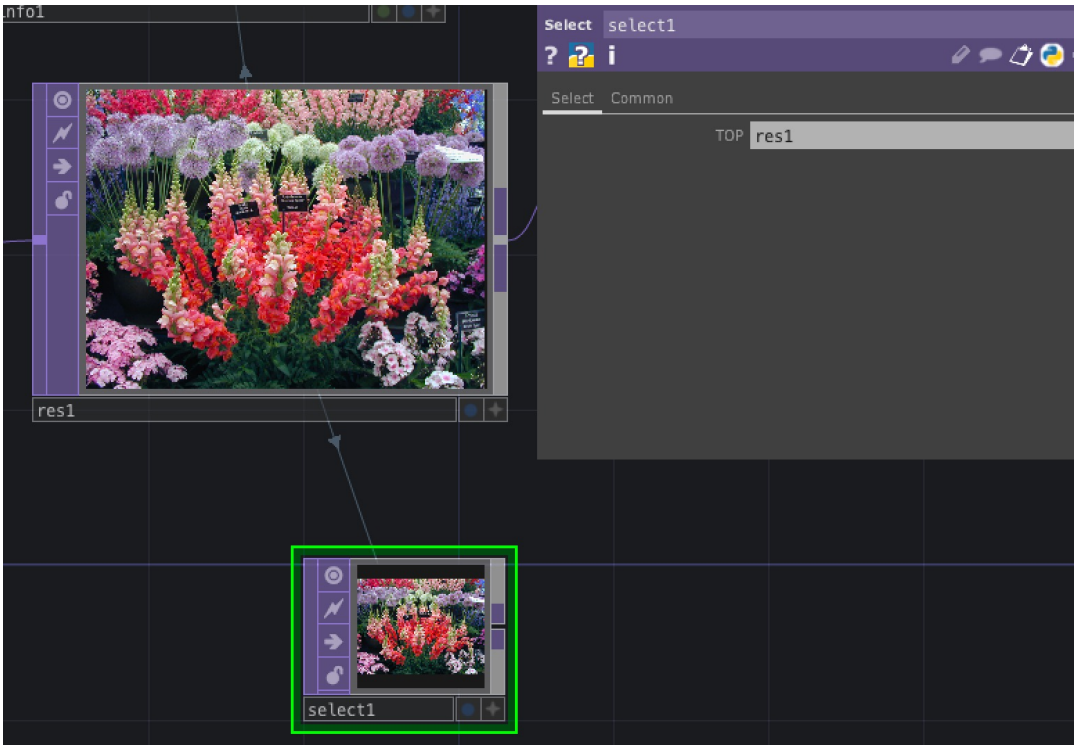
https://docs.derivative.ca/Crop_TOP



- Crops image by specifying left, right, bottom and top edges
- You can also specify how image is extended

Select TOP

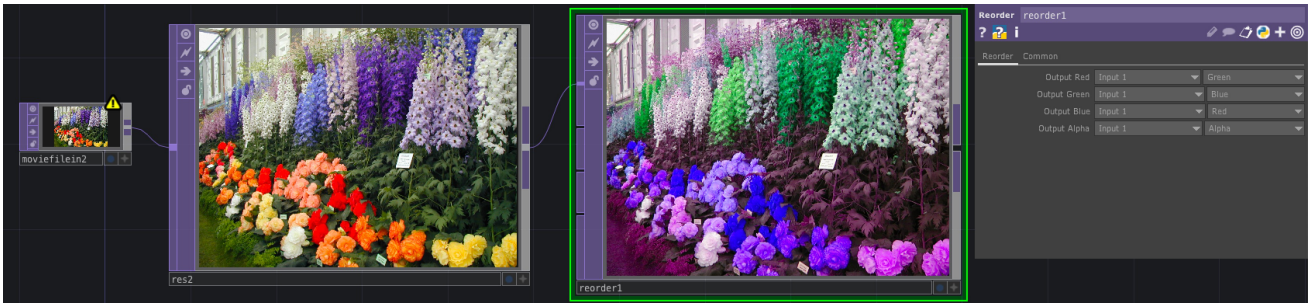
https://docs.derivative.ca/Select_TOP



- Select TOP allows you to reference a TOP from any other location in TouchDesigner
- The TOP parameter contains the path of the TOP being referenced

Reorder TOP

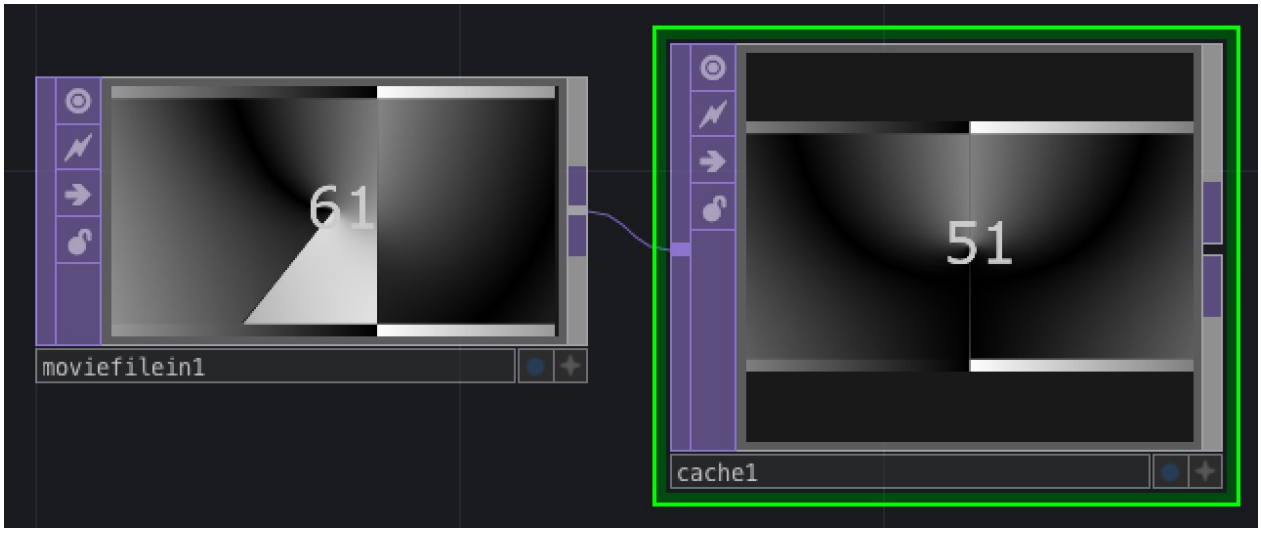
https://docs.derivative.ca/Reorder_TOP



- Multi-input TOP that lets you choose any of the input channels for the R, G, B and A output
  - Allows you to give several images as input
- You can also choose zero, one or the input luminance for any of the output channels.

Cache TOP

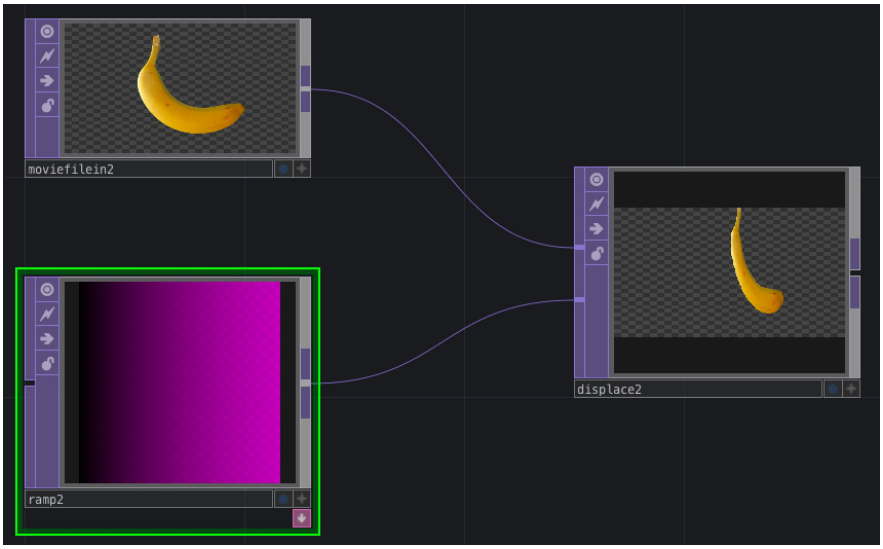
https://docs.derivative.ca/Cache_TOP



- Cache TOP stores a sequence of images in GPU memory
- These cached images can be read much faster by the graphics card than an image cache in main memory reading off the disk
- Can freeze image by turning the Active parameter off
- Can create a delay if you set Output Index to a negative value and leave Active parameter On

Displace TOP

https://docs.derivative.ca/Displace_TOP



- Displace TOP causes one image to be warped by another image
- Takes two input images – an input image and a displace image
- The value of the pixel at (u,v) in the output image is determined by the value of a pixel at a position (x,y) in the input image where x is u displaced using the value of the red channel of the pixel at (u,v) in the input image, and y is v displaced using the value of the blue channel of the pixel at (u,v) in the input image
- The value is given by the following expression
  - Col(Out(u,v)) = Col(In(u * W * (R(Disp(u,v)) – 0.5),
    v * W * (0.5 - B(Disp(u,v))))

  where W is the Displace Weight