

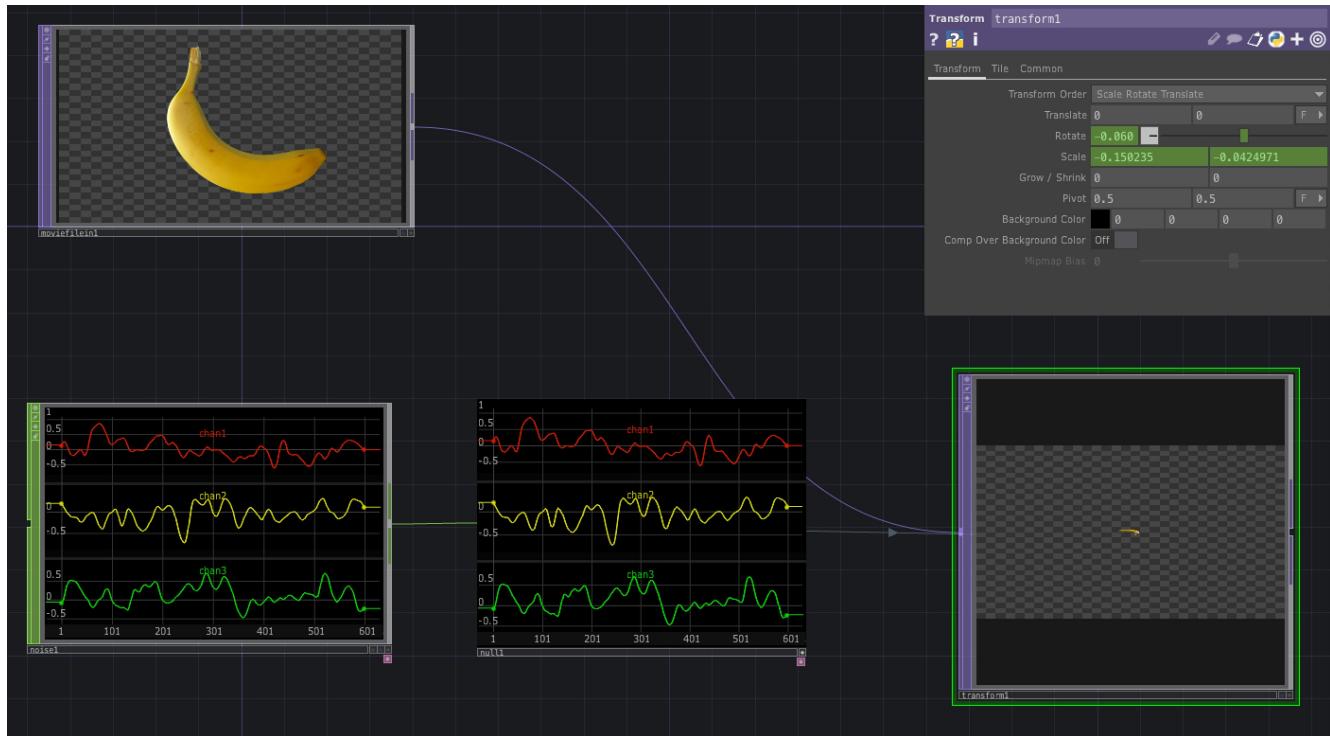
Channel Operators (CHOPs) in TouchDesigner

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Sources

- User guide page on CHOPs
 - <https://derivative.ca/UserGuide/CHOP>

Channel Operators (CHOPs)



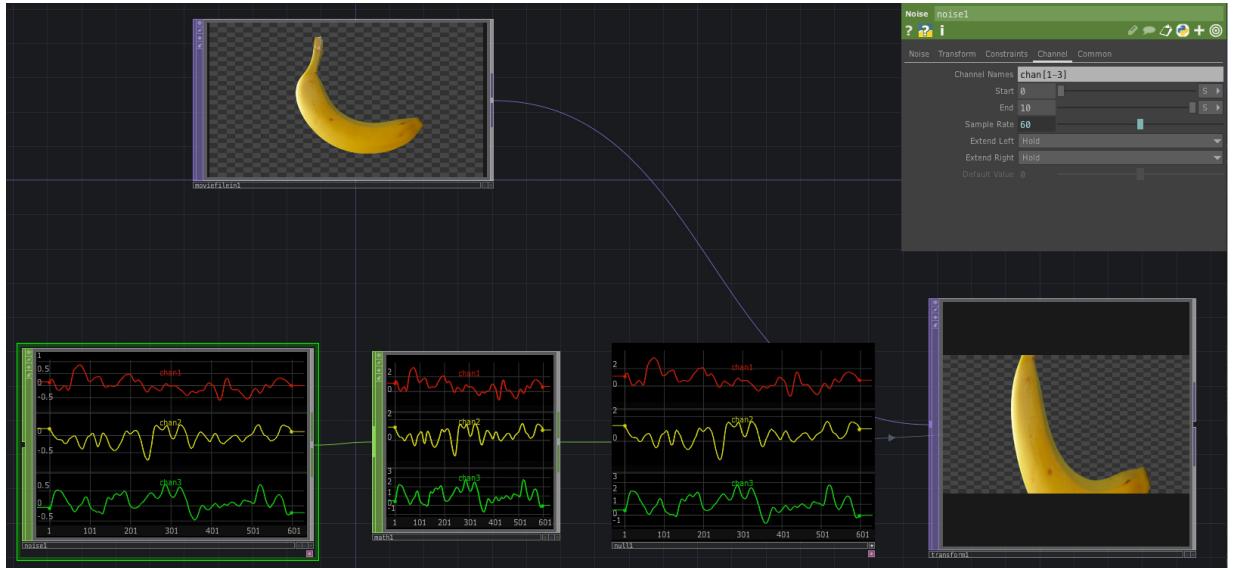
- CHOPs allow you to process any data in the form of a digital signal or a collection of signals
- They can be used to process motion data, audio, MIDI, data from input devices or, indeed, any streams of numerical data
- Each CHOP can contain 1 or more **channels**
- A CHOP modifies a channel and passes the data on to the next node in the network
- CHOPs control parameters in other nodes through exporting and channel references
- Remember to export from a null CHOP so that you can precede it with other CHOPs if necessary without having to change the export

Sweet 16 CHOPs

CHOP	Purpose	Related CHOP
<u>Constant</u>	Create new channels.	<u>Pattern</u>
<u>LFO</u>	Low Frequency Oscillator.	<u>Audio Oscillator</u>
<u>Noise</u>	Create semi-random patterns.	
<u>Select</u>	Grab a channel from any other CHOP.	<u>Switch</u> , <u>Cross</u>
<u>Merge</u>	Merge channels from two or more CHOPs.	<u>Shuffle</u>
<u>Math</u>	Add, multiply or scale channels.	<u>Logic</u> , <u>Script</u>
<u>Lag</u>	Smooth and delay a channel.	<u>Filter</u>
<u>Speed</u>	Use speed to calculate distance.	<u>Count</u> , <u>Slope</u>
<u>Lookup</u>	Use one channel to get values from another CHOP.	<u>Keyframe</u>
<u>Trail</u>	Watch a time-history of CHOP channels.	<u>Perform</u>
<u>SOP to</u>	Record a time-history of channels.	<u>DAT to</u> , <u>TOP to</u>
<u>Limit</u>	Restrict channels to a range or certain step values.	<u>Analyze</u>
<u>Audio Device In</u>	Get audio from input device.	<u>Audio File In</u>
<u>OSC In</u>	Open Sound Control, MIDI.	<u>MIDI In Map</u>
<u>Panel</u>	Get state, u, v etc values from any panel gadget.	<u>Info</u>
<u>Timer</u>	Run timers, loops, delays and trigger events.	<u>Beat</u>

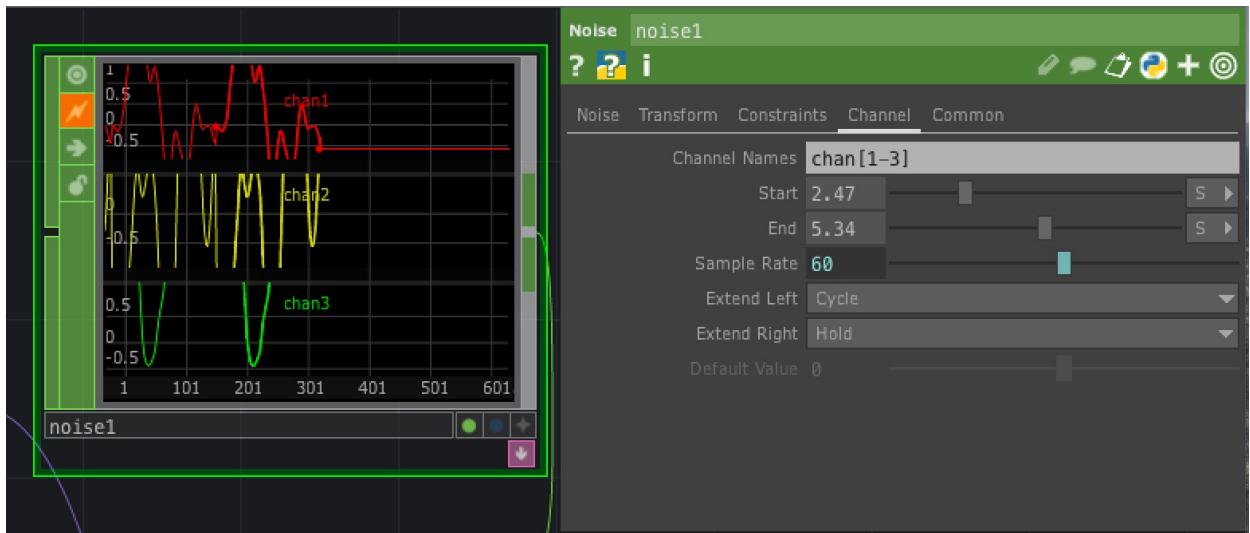
- These 16 CHOPs are commonly used and you should familiarize yourselves with them

CHOPs create and process channels



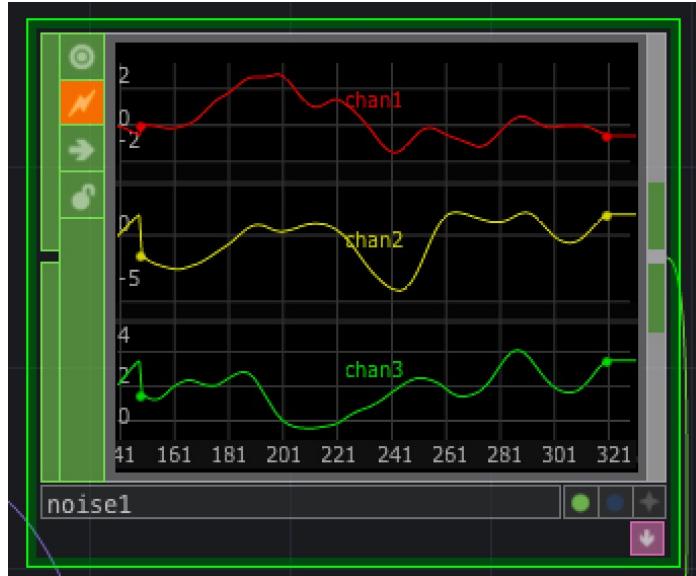
- CHOPs are “procedural networks”
 - means they can be chained together so that the output of one CHOP flows into the input of one or more other CHOPs
- data flows automatically once for each frame (i.e., 60 times per second, by default)
- **Generator CHOPs** create CHOP channels from scratch
 - e.g., Constant CHOP, Wave CHOP, Timing CHOP, Noise CHOP
- CHOPs can also take data from
 - sliders, buttons, menus, XY-controlers, XYZ values from clicking in 3D viewers
 - hardware devices via MIDI or OSC protocols
 - other processes or applications via pipes

Parts of a CHOP



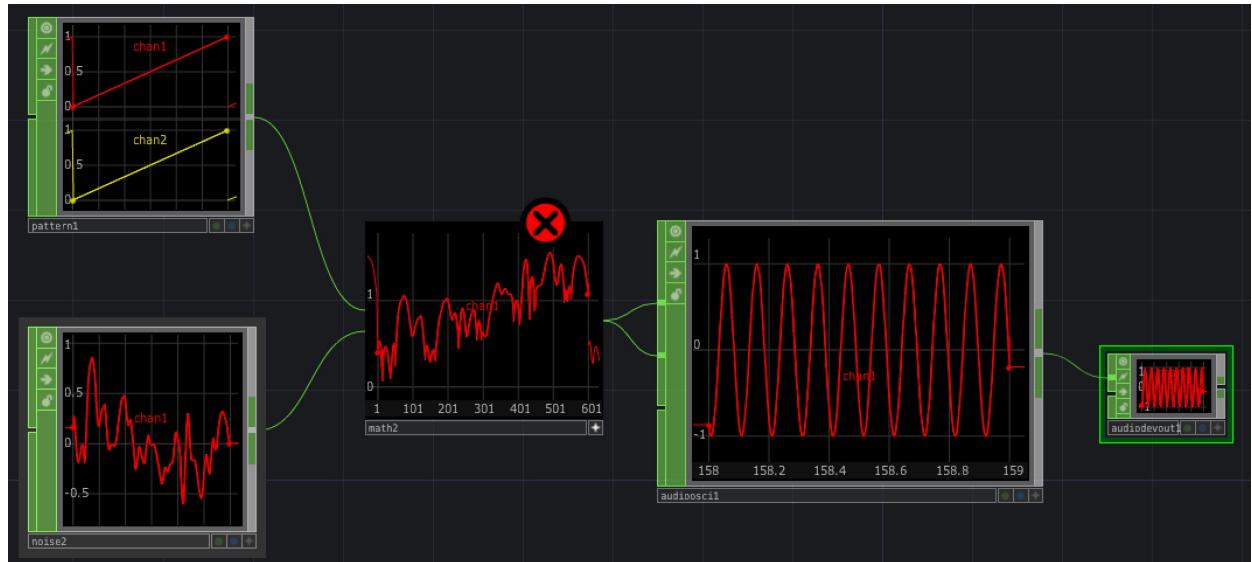
- A CHOP contains
 - a set of **Channels**
 - control **Parameters**
 - a **sample rate**
 - some **on/off flags**
 - a **start/end interval**
- The channels in a CHOP can represent motion, MIDI, audio, color maps, roll-off curves or lookup tables
- Any data that can be represented as a sequence of numbers can be represented as a CHOP channel
- The numbers themselves are called **samples**
- CHOP parameter values can often be expressed in a variety of units – samples (indices), frames, seconds
 - the unit is usually selected in a menu to the right of the parameter whose value is being set
- Sample indices start at 0 and each sample corresponds to a frame
- **Sample rate** is used if a CHOP contains time-dependent motion or audio data
 - audio has a much higher sampling rate (typically 44.1kHz) than animated motion (typically 30-60 Hz)

Flags



- **Display** flag marks CHOP to be displayed in a CHOP viewer
- **Export** flag toggles CHOP channel exports
- **Lock** flag locks CHOP so that it can be manually edited
- **Bypass** flag disables CHOP and lets input flow straight through the CHOP unmodified
- **Clone immune** flag prevents CHOP from being automatically modified when a modification takes place in a clone of it
- All channels in a single CHOP have the same **start-end interval** that extends from a **start index** to an **end index**
- Every CHOP has a **comment field** that lets you add an explanatory note
- The **info pop-up** lists channel names, intervals, sample rates etc.
- **Extend conditions** determine what you get when a value is requested whose index is outside the start-end interval

Inputs and outputs



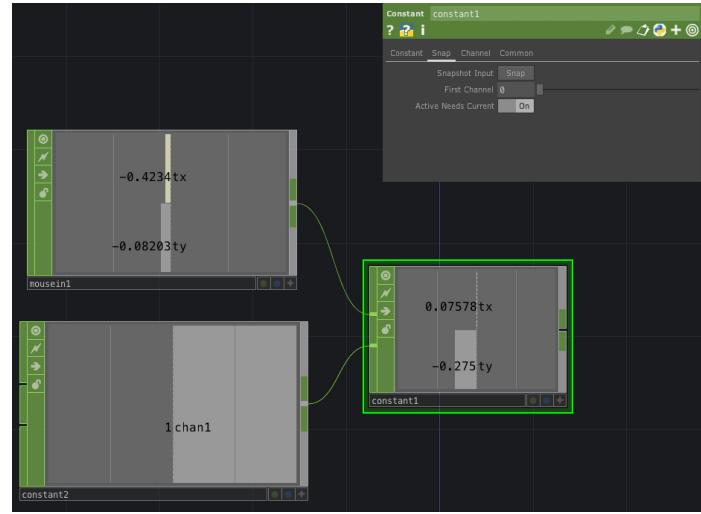
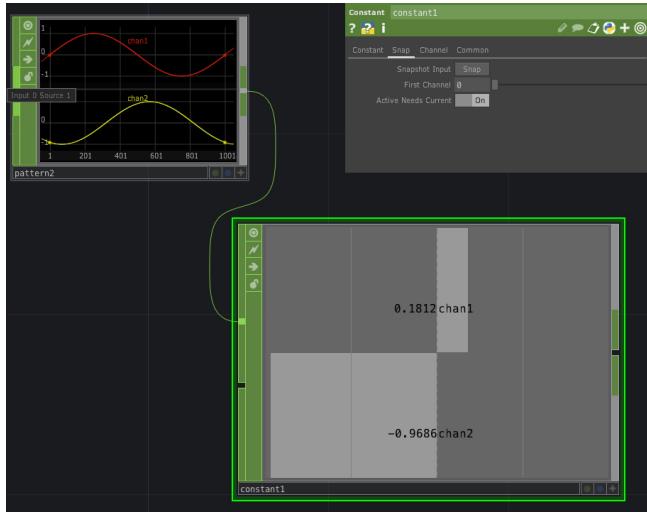
- A CHOP receives channels at its inputs, then cooks, which may combine values at the inputs, and then outputs the resulting channels to other CHOPs
- Each data channel is an array of numerical values, not keyframed or interpolated segments
 - some CHOPs retain interpolated segments internally (e.g., Keyframe CHOP and Spline CHOP)
- If a CHOP's inputs are not changing and control parameters are not time-dependent, then the CHOP will not cook on each frame
- Example shows how to combine a noise CHOP and a pattern CHOP to control pitch of an audio oscillator

Importing and exporting CHOP channels

- Preferred way to export a channel to a parameter is to export it by dragging the channel onto the parameter
- You can export CHOP data channels to numerical parameters in any other operator
- You can turn off exporting with the Export flag

Constant CHOP

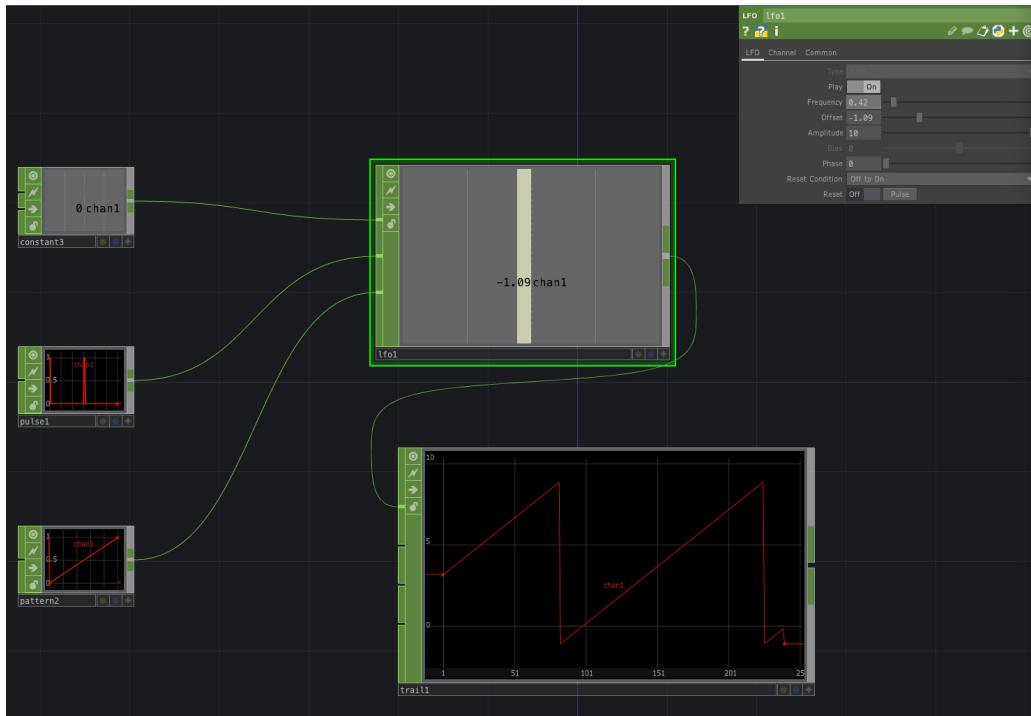
https://derivative.ca/UserGuide/Constant_CHOP



- Constant CHOP creates new constant- value channels
- Each channel can be named and assigned a different value on the Constant parameter page
- Interval is 1 sample long with one sample at index 0, corresponding to frame 1
 - You can change this on the Channel page, where you can choose for the CHOP not to be a single sample, adjust sample rate etc.
- Usually used without input, but channel names and values can be set by pressing the Snapshot Input button on the Snap page (see above left for example)
- Constant page
 - Create/delete channels with the +/- button or by writing expressions in the Name box, e.g.,
 - `geo[1-5:2]:s[xyz]`
- Snap page
 - If second input is > 0, then press Snap button, then sends first input to output
 - Try with Mouse In CHOP attached to first input and constant CHOP with value greater than 0 attached to second input

LFO CHOP

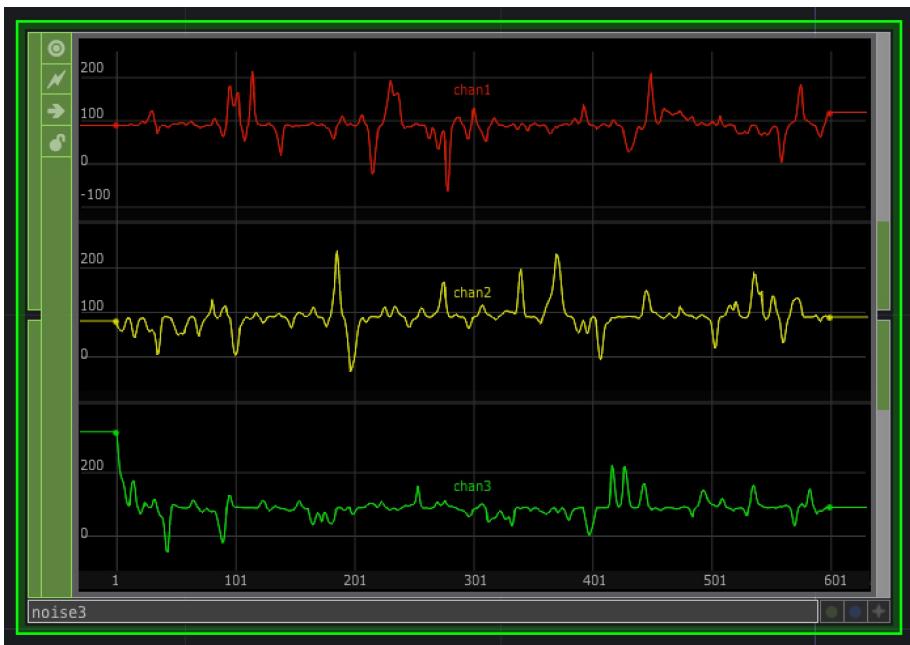
https://derivative.ca/UserGuide/LFO_CHOP



- LFO CHOP generates waves in real time by either
 - synthesizing common waveforms like sine or pulse
 - or repeating a prepared incoming curve
- Steps through the waveform at a rate that depends on Frequency parameter and Octave Control input
 - Watch behaviour by attaching a Trail CHOP to its output and changing the Frequency parameter
- Can take three inputs
 - **Octave Control:** controls how much the frequency is multiplied – 0 → no change; 1 → × 2 (increase octave by 1), -1 → /2 (decrease octave by 1)
 - **Reset:** 2nd input causes oscillator to restart when input value is greater than 0
 - **Source wave:** can use this input to replace the waveform defined in Type parameter
- LFO can serve as a general repeater and time-scaler
 - Change the frequency to alter the time-scaling
- This is a time-sliced CHOP, meaning that it speeds up and slows down as the frequency is changed (cf. Wave CHOP)
- LFO CHOP is designed for non-audio frequencies

Noise CHOP

https://derivative.ca/UserGuide/Noise_CHOP



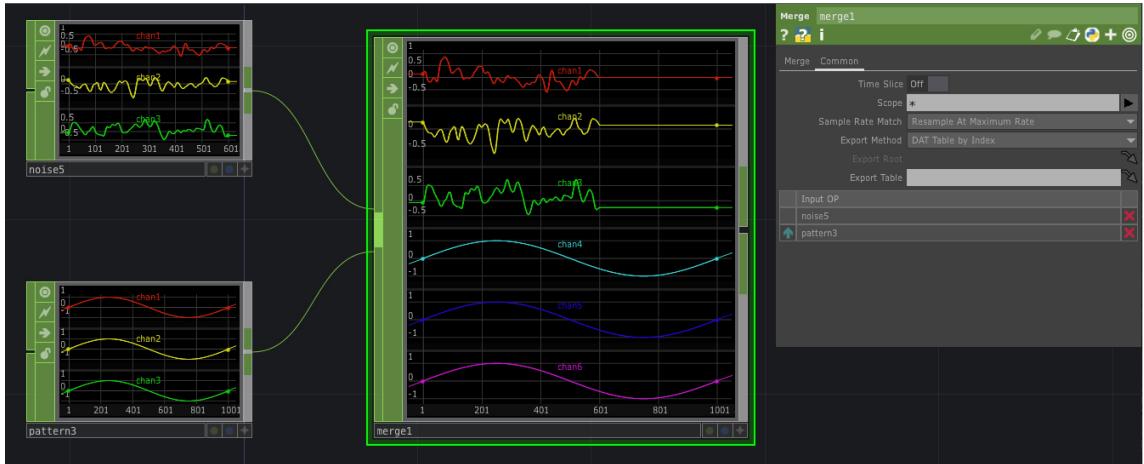
- Noise CHOP creates an irregular wave that never repeats, with values approximately in the range [-1,1]
- It can generate both smoothed curves and signals in which each sample is intended to be independent of the previous one
- You can create several curves with different shapes
- You can adjust period, amplitude, harmonics, etc.

Select CHOP

- Selects and renames channels from other CHOPs
- You can select channels from control panel gadgets like sliders and buttons
- Retrieves channels from one or more CHOPs
- Selects only the channels you specify
 - e.g., “c2 c5 c3 c3” will select four channels of which the last two will be identical
- You can get channels either
 - from the CHOP and Channel Name parameters, or
 - from a CHOP connected to the input

Merge CHOP

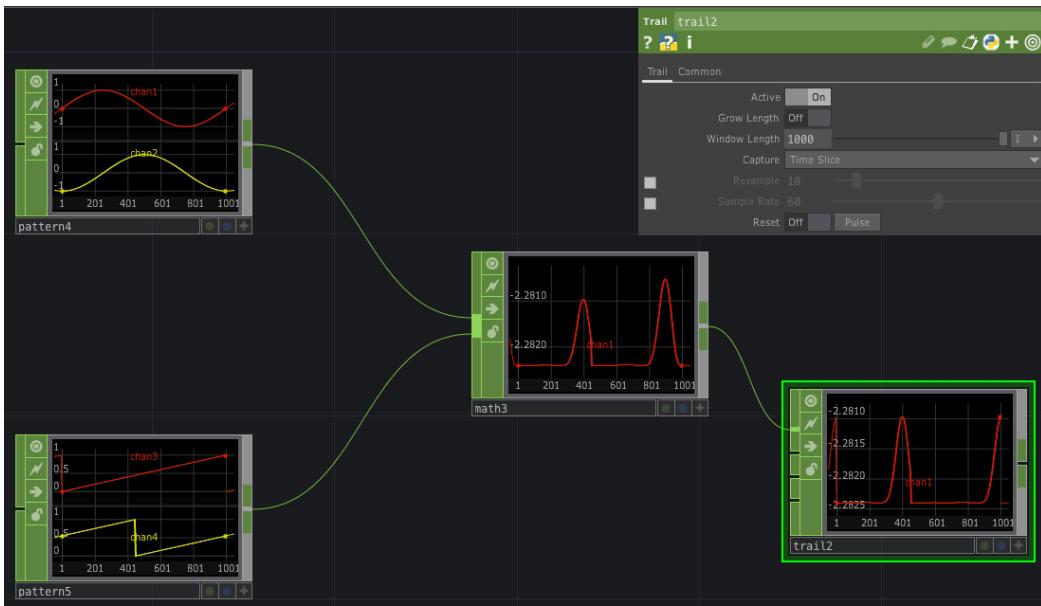
https://derivative.ca/UserGuide/Merge_CHOP



- Takes multiple inputs and merges them into a single output
- All channels in the input appear in the output, in the order in which they appear in the input
- If two or more input channels have the same name, then they are renamed using the method specified in the Duplicate Names menu on the Merge parameter page

Math CHOP

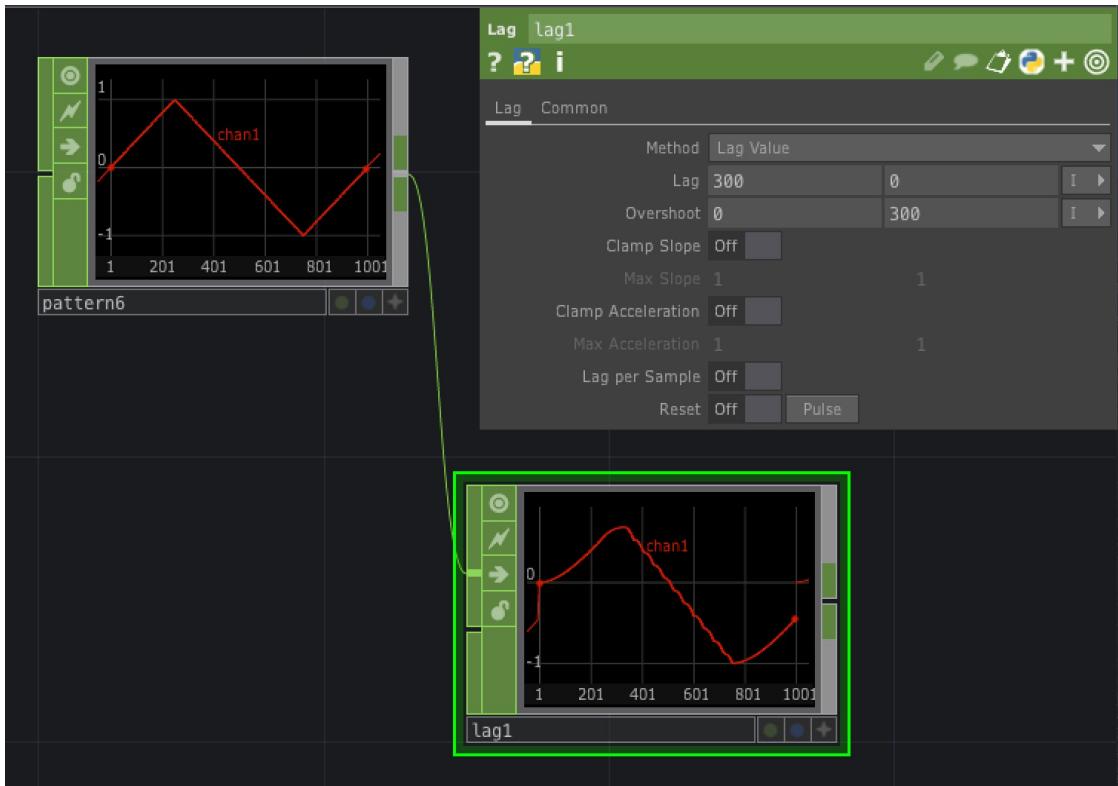
https://derivative.ca/UserGuide/Math_CHOP



- Performs arithmetic operations on channels
- Channels of a CHOP can be combined into one channel
- Several CHOPs can be combined into one CHOP
- OP page
 - **Channel Pre OP** defines operation to carry out first on channels, applied to each sample individually
 - **Combine Channels** combines, for each input CHOP, all the channels it contains using the specified operator
 - Remember this occurs *after* the Pre OP has been applied sample-wise to all the channels in the input
 - **Combine CHOPs** combines the result of Combine Channels using the specified operator, to get a single curve
 - **Channel Post OP** gives the option to apply a final sample-wise operation to all the samples individually
- Mult-Add page lets you offset and scale sample values individually
- Range page lets you do linear scaling and map output to a specified range

Lag CHOP

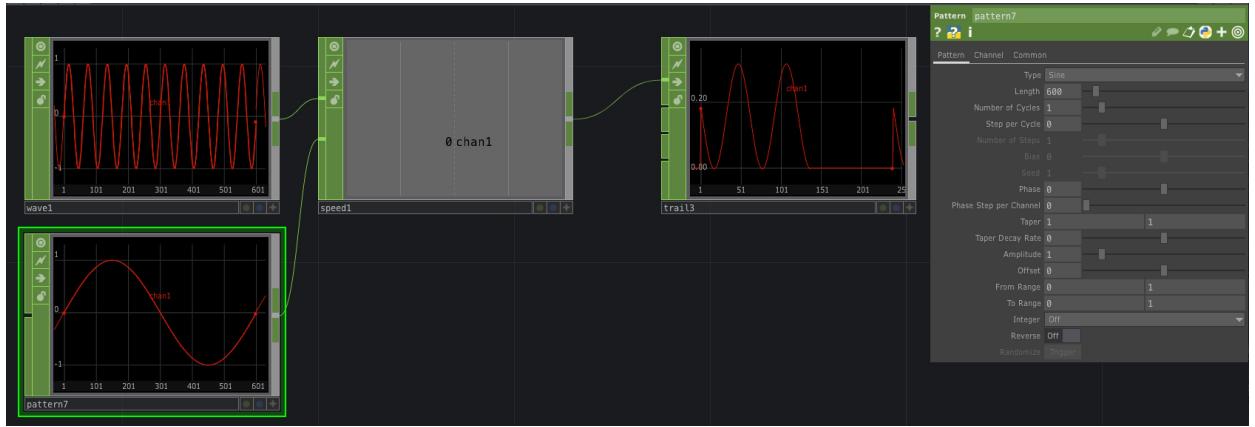
https://derivative.ca/UserGuide/Lag_CHOP



- Adds lag and overshoot to channels
- Can also limit velocity and acceleration of channels
- Lag slows down rapid changes in input channels
- Overshoot amplifies changes in input channels
- Lag and Overshoot parameters have two values:
 - First one determines what happens input channel is rising
 - Second determines what happens when input channel is falling

Speed CHOP

https://derivative.ca/UserGuide/Speed_CHOP



- Converts a rate into a cumulative value
 - e.g., a speed in units per second into a distance (units)
 - Technically, it *integrates* the input signal, i.e., calculates the cumulative area under the curve of sample value against time
- If you send a Constant CHOP whose channel value is 1 into a Speed CHOP, then the value of the Speed CHOP will increase by 1 every second
 - Use a Trail CHOP to see the effect
- You can reset the Speed CHOP by pressing its reset parameter or by sending a value greater than 0 into the second input
 - Set the Reset Value parameter to determine the initial value after reset
 - If a wave is sent into the second input that is greater than zero for half of its period, then the speed chop is set at its reset value for this interval

Exercises

1. Create a network using an Audio Oscillator CHOP and an Audio Device Out CHOP. Use a Constant CHOP, a Speed CHOP, a Math CHOP and a Pattern CHOP to make it so that the output audio signal consists of short periods in which the frequency rises alternating with silence.
2. Create a network in which you use a Composite TOP to composite two images (e.g., the banana and the first Nature movie). The background of the overlay image should be transparent so that you can see the fixed layer image behind it. Now add a Mouse In CHOP and set it up so that the mouse position determines the position of the overlay over the fixed layer texture in the Composite TOP. When you move your mouse, you should see a corresponding movement in the Overlay.
3. Make a composite of a radial ramp and a movie file. Control the phase of the ramp with an LFO. Control the octave of the LFO with a step pattern that increases from 0 to 1 and then to 2 over the length of the timeline.