PYTHAGORAS LOOP

Deterministic Mathematical Synthesizer

Hear the Mathematics.

User Guide
Version 1.0.1
Uryan Audio

Welcome to Pythagoras Loop

Pythagoras Loop turns mathematical systems into playable, tempo-synchronised musical phrases.

Hold a MIDI note and it becomes the root of a deterministic sequence. A selected formula generates the source contour; traversal decides how it is visited; pitch, gate and velocity mapping translate the result into music; and a focused two-sine-oscillator signal path renders it with clarity.

The same settings always produce the same phrase. There is no hidden random layer: variation comes from mathematics, mapping and performance choices you can see, understand and recall.

Key features

Control / Area	Use
94 mathematical systems	Waves, Geometry, Sequences, Chaos and Bitwise families.
Musical mapping	14 scales, 1-24 scale-degree range, four value wraps and four pitch sources.
Independent rhythm	Eight gate sources, five velocity sources, adjustable gate length and velocity depth.
Visual mathematics	Live sequence display plus a centred X-Y phosphor scope for the mathematical path.
MIDI drag-and-drop	Drag the generated phrase directly from the display to a DAW timeline as editable MIDI.
Focused sound engine	24 voices, two precision sine oscillators, clean TPT filter, delay and reverb.

> Pythagoras Loop is both an instrument and a composition tool: use its internal sound, export its MIDI to another instrument, or combine both in one arrangement.

Quick Start

A complete musical phrase is only a few steps away.

1. **Load the instrument**
   Insert Pythagoras Loop on an instrument track and route a MIDI keyboard or MIDI clip to it.

2. **Hold a root note**
   With Math Engine enabled, the newest held note becomes the root for the generated sequence.

3. **Choose a family and formula**
   Start with Waves / Sine or Geometry / Circle, then explore the remaining systems.

4. **Set timing**
   Choose a host-synchronised Rate, a 4-64 step length and a Traversal mode.

5. **Make it musical**
   Select a Scale, set Range and shape rests, note length and dynamics in Gate / Velocity Mapping.

6. **Shape or export**
   Use Synth / FX, Env and Filter for sound design, or drag the display's DRAG ME handle to the DAW.

What happens when you press a key?

Formula – Traversal – Pitch mapping – Scale quantiser – Gate + velocity – Sine synth / MIDI

> Tip: press RESET for the clean reference state, then change one section at a time. This makes the audible role of every mathematical control easy to learn.

Global Interface

The top bar remains available on every page, keeping navigation, safety controls and output level consistent.

Control / Area	Use
Page tabs	Open Core, the five formula families, Oscilloscope, Synth / FX, Env or Filter.
Product + breadcrumb	Shows Pythagoras Loop and the currently active family / formula.
RESET	Restores every parameter to the factory default, stops active voices and clears effect tails.
PANIC	Immediately silences voices and clears delay/reverb tails without changing parameters.
ABOUT	Shows product identity, version and the design summary.
OUTPUT	Final stereo output trim from -36 dB to +6 dB; the clean reset value is -6 dB.

> Knobs can be automated by the host. Integer parameters such as Steps, Order and Iterations use stepped movement; dropdowns show discrete choices.

Core — Engine and Timing

Core is the main performance page. The upper-left modules choose the mathematical source and determine when and how it is read.

Control / Area	Use
Math Engine	On: held notes trigger the mathematical sequencer. Off: Pythagoras Loop behaves as a directly playable sine synthesizer.
Reset On Note	Restarts the sequence when a new root note is played. Disable it to keep the current phase when changing roots.
Active Family / Formula	Selects one of five families and the formula inside it. The matching family tab updates automatically.
Rate	Host-synchronised straight, dotted or triplet division from 1/1 to 1/32.
Steps	Sets the base sequence length from 4 to 64. Ping Pong uses an outward-and-return cycle.
Traversal	Forward, Reverse, Ping Pong, Golden Jump, Prime Jump or Bit Reverse order.

> When several notes are held, the newest held note becomes the sequence root. Sustain pedal is supported, and pitch bend has a ±2 semitone range.

Core — Pitch, Gate and Velocity Mapping

The lower Core modules translate a raw mathematical value into notes, rests, duration and dynamics.

Control / Area	Use
Scale	Chromatic, Major, Natural Minor, Dorian, Phrygian, Lydian, Mixolydian, Harmonic Minor, Major/Minor Pentatonic, Melodic Minor, Whole Tone, Diminished or Hungarian Minor.
Range	Sets the pitch span in scale degrees from 1 to 24.
Value Wrap	Clamp limits extremes; Wrap cycles them; Fold reflects them; Soft compresses them smoothly.
Pitch Source	Value uses the contour; Absolute mirrors negatives; Delta follows change; Alternating changes sign on successive steps.
Offset / Curve	Moves the mapped centre and reshapes sensitivity before scale quantisation.
Gate Source	Fixed, Positive, Threshold, Fibonacci Word, Thue-Morse, Prime, Sierpinski or Magnitude.
Threshold / Gate Length	Threshold is used by conditional gates. Gate Length sets note duration to 5-98% of a step.
Velocity Source / Depth	Fixed, Magnitude, Height, Golden or Logistic dynamics; Depth blends the variation amount.

Live Mathematical Output and MIDI Drag

The display shows the complete musical result before you export it.

MIDI drag-and-drop workflow

1 Prepare the phrase
Choose a root note, rate, steps, mapping, gate source, gate length and velocity source.

2 Check the note row
Wait until the display is ready and confirm the notes and rests shown beneath the curve.

3 Drag to the DAW
Press and drag DRAG ME to an instrument or MIDI track. Do not drag the curve itself.

4 Edit freely
The clip contains notes, rests, lengths and velocities at 960 PPQ and follows the selected straight/dotted/triplet step value.

Control / Area	Use
Pitch trace	The blue-to-magenta stepped line is the mapped, scale-quantised phrase.
Gate row	Teal cells show active gates; closed steps become rests.
Sequence Notes	Displays every note name in the traversal cycle. The sounding step receives a warm glow.
DRAG ME	Drag this handle to a DAW timeline to create a Standard MIDI File containing the displayed phrase.

> Exported MIDI is independent of the plug-in after dropping. It can drive any instrument, be transposed, edited or rearranged like a normal MIDI clip.

The Mathematical Signal Flow

Every phrase follows one visible and deterministic path from formula to sound.

Family + formula – Variables – Traversal – Value wrap + pitch source – Scale + range →

Gate + velocity – Synth / MIDI

Control / Area	Use
1. Source	The active formula is evaluated from step index and family-specific variables.
2. Path	Traversal reorders the sample positions without changing the selected formula.
3. Pitch preparation	Offset, Curve, Value Wrap and Pitch Source shape the normalised result.
4. Quantisation	The root note, Scale and Range convert the value into a legal MIDI note.
5. Articulation	Gate Source creates notes/rests; Gate Length and Velocity Mapping set articulation.
6. Output	The result drives the internal sine synth and is mirrored by the display for MIDI export.

Determinism

A seed is an initial condition, not a random command. If family, formula, variables, mapping, root and timing are unchanged, the generated phrase is unchanged as well.

This makes complex chaos and bitwise patterns usable in real productions: once a phrase works, it can be recalled exactly or committed to MIDI.

Waves Family

Continuous and piecewise wave functions create smooth cycles, ramps, spectral curves and quasiperiodic motion. They are the most immediate family for tonal, clearly shaped arpeggios.

Family variables

Control / Area	Use
Frequency	Sets the base cycle count or harmonic order. Higher values repeat the contour more often.
Warp	Bends phase and symmetry, creating stronger curvature and sharper timing changes.
Damping	Controls decay or attenuation where the selected wave supports it.
Modulation	Adds secondary phase, harmonics or fractal depth.

Included formulas (14)

Sine	Sinc	Fourier Saw
Cosine	FM Sine	Fourier Square
Triangle	Weierstrass	Chebyshev
Damped Sine	Harmonic Blend	Golden Quasiperiodic
Chirp	Pulse Curve	

> The left panel explains the selected formula and its musical use. Equation View shows the phrase, Equation shows the symbolic relation and current values, and Control Guide explains the four variables.

Geometry Family

Parametric curves are scanned as two-dimensional paths. Rotation, proportion and traversal can turn circles, spirals, knots and classic curves into symmetric or continuously evolving pitch contours.

Family variables

Control / Area	Use
Aspect	Changes the horizontal-to-vertical proportion using an exact 0.5x-2x axis ratio.
Rotation	Rotates the coordinate system through 0-360 degrees before its Y projection becomes pitch.
Order / Sides	Selects polygon sides, petals, winding count or related integer geometry.
Scan	Chooses how much of the path is traversed, from half a cycle to three cycles.

Included formulas (20)

- Circle
- Ellipse
- Parabola
- Hyperbola
- Lissajous
- Archimedean Spiral
- Golden Spiral
- Cycloid
- Astroid
- Cardioid
- Lemniscate
- Polygon
- Rose Curve
- Epicycloid
- Hypotrochoid
- Spiral Lissajous
- Superellipse
- Fermat Spiral
- Butterfly Curve
- Torus Knot

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Sequences Family

Integer recurrences, number-theory functions and symbolic words create exact deterministic patterns. Seeds and strides provide variations without introducing randomness.

Family variables

Control / Area	Use
Modulus	Folds unbounded integer values into a finite 2-64 range and often defines the repeat structure.
Seed	Sets the starting integer or initial state.
Stride	Advances through indices in larger steps, changing density, phase and repetition length.
Variant	Adjusts formula-specific slope, offset or rule balance where supported.

Included formulas (20)

- Fibonacci
- Lucas
- Tribonacci
- Golden Ratio
- Fibonacci Word
- Thue-Morse
- Prime Walk
- GCD
- Collatz
- Modulo
- Recaman
- Van der Corput
- Ruler
- Pascal Parity
- Beatty
- Quadratic Residues
- Pell
- Jacobsthal
- Stern Diatomic
- Paperfolding

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Chaos Family

Iterated maps and attractors move from stable cycles to sensitive deterministic chaos. The result can sound unpredictable, yet remains fully repeatable for the same settings.

Family variables

Control / Area	Use
Seed X	Sets the first initial condition; tiny changes can produce a different but repeatable path.
Seed Y	Sets the coupled state or coefficient used by two-dimensional systems.
Energy	Moves the selected system from stable behaviour toward stronger chaos.
Iterations	Sets settling and integration depth; higher values reveal a later part of the attractor.

Included formulas (20)

Logistic	Ikeda X	Clifford X
Tent	Ikeda Y	Clifford Y
Henon X	Gingerbread X	Rossler X
Henon Y	Gingerbread Y	Rossler Y
Lorenz X	Circle Map	Rossler Z
Lorenz Y	Standard Map X	Sine Map
Lorenz Z	Standard Map Y	

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Bitwise Family

Integer time, masks, shifts and cellular rules produce precise digital interference, bytebeat-like contours and fractal gate structures.

Family variables

Control / Area	Use
Shift A	Selects the first binary time scale by shifting bits right by 0-15 positions.
Shift B	Selects a second binary scale for interference and nested timing.
Mask	Restricts active low-order bits and sets the normalisation or modulo range.
Stride	Multiplies the integer counter, increasing digital speed and changing repeat structure.

Included formulas (20)

Saw Modulo	Ska Beat	Bit Rotate
Roof Modulo	Bit Reverse	Walsh
XOR Interference	Sierpinski	Rule 110
AND Shift	Gray Code	Morton Interleave
OR Shift	Rule 30	XOR Fold
Visionary	Rule 90	Dragon Turn
Robot Arp	Popcount	

> The left panel explains the selected formula and its musical use. Equation View shows the phrase, Equation shows the symbolic relation and current values, and Control Guide explains the four variables.

Mathematical Function Scope

This is an X-Y mathematical scope, not a conventional audio waveform display. Its centre is the exact (0,0) origin of the selected formula.

Control / Area	Use
Engine + Timing	The left modules control the same parameters as Core. Family-specific variables remain on the named family tab.
Math Scope / Freeze	Enable the live trace or freeze the current phosphor image.
HUD Note Format	Show MIDI number, note name, both, or hide the active-note readout.
XY Scale	Zooms both axes uniformly so circles remain circular and geometric proportions stay correct.
Phosphor	Controls the brightness and persistence of the fading trail.
Trail Length / Style	Choose 4, 8, 16, 32 or 64 points and Line, Comet or Dots.
Point Size	Sets the size and glow of the active coordinate.

> Geometry uses true parametric X-Y coordinates. Waves use x→f(x), while sequence/bitwise systems use index/value coordinates and chaos systems use their native map or attractor coordinates.

Synth / FX — Oscillators

The sound engine is intentionally focused: two precision sine oscillators provide a clean, transparent carrier for the mathematical movement.

Control / Area	Use
Oscillator 1	Fixed pure sine waveform and the primary tone source.
OSC Balance	Crossfades the two oscillators. With OSC 2 off, Oscillator 1 remains at full internal level.
Velocity	Sets how strongly incoming and generated velocity affects amplitude.
Oscillator Coordinates	Displays both sine waves, frequency ratios and current mix.
OSC 2	Enables the second sine oscillator. Reset leaves it off for the cleanest reference sound.
Musical Interval	-2 Oct, -1 Oct, Unison, +5th, +1 Oct, +12th or +2 Oct.
Fine	Detunes Oscillator 2 by ±25 cents.

> For a perfectly pure sine, leave OSC 2 off, Filter Drive at 0 dB, Delay/Reverb off and Output at or below -6 dB.

Synth / FX — Delay and Reverb

Delay and reverb are optional finishing stages. Both are disabled by RESET so the initial tone remains dry and uncoloured.

Control / Area	Use
Delay	Enables the tempo delay. Sync selects host divisions; when Sync is off, Time uses milliseconds.
Division	1/2, 1/4, 1/8, 1/16 plus dotted and triplet variants.
Feedback	Sets the number and strength of repeats, limited to a safe maximum.
Ping Pong	Alternates repeats between left and right channels.
Delay Mix	Blends the delayed signal with the dry sound.
Reverb	Enables the spatial processor.
Size / Damping	Sets perceived space size and high-frequency absorption.
Width / Mix	Controls stereo spread and equal-power dry/wet balance.

> Start with short, low-mix ambience. Long tails can blur fast mathematical phrases; PANIC clears all active delay and reverb tails immediately.

Envelope Page

The amplitude envelope has an interactive display matching the Aether Drift X control language, while the filter envelope provides independent spectral articulation.

Control / Area	Use
Amplitude display	Drag the A, D/S and R handles directly. The drawn curve and the handles always represent the same parameters.
Live voice markers	Coloured points move along the active envelope stages; brightness reflects audible contribution.
Amp Attack	Time from silence to the peak.
Amp Decay / Sustain	Time from peak to the held level, and the level maintained while a note is gated.
Amp Release	Time from note-off to silence.
Filter ADSR	Independent envelope applied to filter cutoff through the Filter page's Env Amount control.

> Short releases keep fast sequences articulate. Longer releases create overlap; reduce output or effect mix if many voices accumulate.

Filter Page

A clean topology-preserving state-variable filter shapes the sine core without forcing colour into the reset sound.

Control / Area	Use
Filter	Enables or bypasses the filter.
Mode	Low Pass, Band Pass, High Pass or Notch.
Slope	12 dB or true two-stage 24 dB response.
Interactive Response	Drag horizontally for Cutoff and vertically for Resonance.
Cutoff / Resonance	Sets corner frequency and emphasis around the cutoff.
Env Amount	Bipolar filter-envelope depth from -72 to +72 semitones.
Key Track	Raises cutoff with played pitch so brightness follows the keyboard.
Drive	Adds controlled pre-filter saturation from 0 to +12 dB. Leave at 0 dB for pure sine output.

Performance and MIDI Behaviour

Pythagoras Loop is designed to work naturally from a keyboard, a DAW clip or both.

Control / Area	Use
Root note priority	The newest currently held MIDI note is the mathematical root.
Reset On Note	When enabled, each new root begins at the first step. When disabled, the playhead keeps its phase.
Sustain pedal	CC64 keeps roots held. Releasing the pedal removes notes that are no longer physically held.
Pitch bend	Applies a ±2 semitone bend to active voices.
Math Engine off	Incoming MIDI notes play the sine synthesizer directly instead of generating a sequence.
Host tempo	Rate and synced Delay follow the DAW tempo.
MIDI export	The DRAG ME file uses MIDI channel 1, 960 PPQ, the selected step length, gate duration and generated velocity.
Saved state	Host projects recall all parameters, including family/formula choices and scope settings.

Why the plug-in itself does not need to output live MIDI

Pythagoras Loop renders its mathematical notes internally for dependable instrument behaviour. The display creates a portable Standard MIDI File only when you drag it, avoiding host-specific live-MIDI routing while keeping the composition completely editable.

Practical Workflows

A — Clean melodic loop
RESET → Waves / Sine → Major → Range 8 → 16 steps → Gate Length around 65-75%. Keep OSC 2 and both effects off.

B — Symmetric geometric phrase
Geometry / Parabola or Circle → adjust Rotation and Scan → try Ping Pong → use Fold for a mirrored pitch range.

C — Evolving deterministic chaos
Chaos / Sine Map or Rossler X → lower Energy first → raise Iterations gradually → use a pentatonic scale to keep wide motion consonant.

D — Digital rhythm
Bitwise / XOR Interference or Rule 90 → select a structured Gate Source → adjust Mask and Stride → keep note range narrow.

E — DAW composition
Build a phrase, drag it to the timeline, duplicate the MIDI, then change the root or formula and drag a second variation to another instrument.

A useful order of work

Choose contour – Set timing – Quantise pitch – Design rests – Set velocity – Shape sound → Drag MIDI

> Change one mathematical layer at a time. Family variables alter the source; Core mapping alters its musical interpretation. Keeping those roles separate makes deliberate sound design much faster.

Factory Reset Reference

RESET returns Pythagoras Loop to a clean, medium-length, release-safe starting point.

Control / Area	Use
Core	Math On; Reset On Note On; Waves / Sine; 1/16; 16 Steps; Forward; Major; Range 8; Fold; Value; Fixed gate/velocity; Gate 72%; Velocity Depth 65%.
Oscillators	OSC 2 Off; Balance 30%; Unison; Fine 0 ct; Velocity Response 72%.
Amp envelope	Attack 10 ms; Decay 350 ms; Sustain 68%; Release 450 ms.
Filter	On; Low Pass; 24 dB; 7.60 kHz; Resonance 12%; Env +16 st; Key Track 32%; Drive 0 dB.
Filter envelope	Attack 5 ms; Decay 400 ms; Sustain 25%; Release 450 ms.
Delay	Off; Sync On; 1/8; Time 375 ms; Feedback 30%; Ping Pong On; Mix 24%.
Reverb	Off; Size 68%; Damping 46%; Width 100%; Mix 22%.
Scope	On; Freeze Off; MIDI Number; 16 Points; Comet; Point Size 35%; XY Scale 1.00x; Phosphor 72%.
Output	-6.0 dB.

Technical summary

24-voice stereo synthesizer • 94 deterministic systems • 4-64 steps • 14 scales • two sine oscillators • TPT filter • host-synchronised delay • reverb • MIDI drag-and-drop • VST3, Audio Unit and Standalone project formats.

Troubleshooting and Support

Control / Area	Use
No sound	Check Math Engine, hold a MIDI note, confirm the track receives MIDI, raise Output and use PANIC once if the host retained a stuck state.
The sequence stops	The mathematical sequencer runs while at least one root note is held or sustained.
DRAG ME does not start	Wait until the note row is ready and ensure the gate source produces at least one note. Begin the drag on the handle itself.
The DAW rejects the drop	Drop onto a MIDI/instrument track or the timeline. Some hosts require the target track to exist before the drag.
The sound distorts	Return Drive to 0 dB, disable OSC 2 and FX, shorten Release, lower resonance and reduce Output. RESET restores the clean reference state.
The scope does not show a complete shape	It intentionally shows only the active coordinate and its fading trail. Increase Trail Length or use Freeze to inspect more of the path.
A circle looks cropped	Reduce XY Scale. Both axes use the same scale, so the underlying geometry is not stretched.
Old effect tail remains	Press PANIC to clear all active voices, delay memory and reverb tail.

Support

Website: www.uryanmodular.com

Email: sales@uryanmodular.com

Product: Pythagoras Loop 1.0.1 • Uryan Audio

When requesting support, include the plug-in version, operating system, DAW/version and a short description of the steps that reproduce the issue.

> Pythagoras Loop is a deterministic instrument: save the project or exported MIDI whenever a mathematical phrase becomes part of an arrangement.