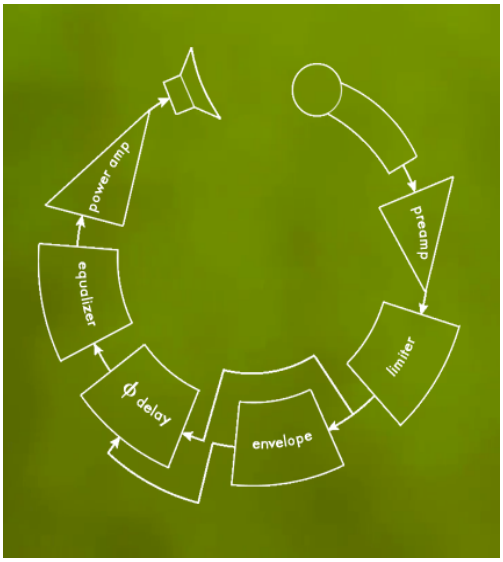
***Pea Soup* (1974; software rev. 2025)**
Nicolas Collins
Instructions for set-up and performance

In *Pea Soup* (1974) a self-stabilizing network of analog circuitry (originally three Countryman Phase Shifters) nudges the pitch of audio feedback to a different resonant frequency every time the feedback starts to build. Feedback's familiar shriek is replaced with unstable patterns of hollow tones, a site-specific raga reflecting the acoustical personality of the room. These architectural melodies can be influenced by moving in the space, making other sounds, or even by letting in a draft of cold air. The piece exists in a concert version, in which musicians perform activities intended to influence the feedback, as well as an installation that responds to the movement of visitors.

In the late 1990s I began replicating the now unavailable Countrymen, initially in hardware, and by 2002 developed a fair emulation in software, which I have periodically updated. I started touring the piece again, and re-positioning what was a typical 1970s task-oriented work of strict Minimalism with a freer occasion for "improvising with architecture." The software is downloadable from my website (http://www.nicolascollins.com/software.htm). This document describes the sound system and the operation of the software, and provides guidelines for performance.

HOW IT WORKS
The technical set-up is straightforward: three microphones connect to the inputs of an audio interface into a computer; the outputs go to three loudspeakers. Each microphone passes through a chain of software modules that emulate the hardware devices used in the 1974 version: microphone>> audio limiter>>envelope follower>>phase shifter>>equalizer.



The "engine" of *Pea Soup* is feedback between an omnidirectional **microphone** and a **speaker**. A **limiter** prevents the feedback from running up to maximum system gain and distorting, and maintains the signal as a controlled sine wave of moderate volume. A **phase shifter** introduces a very short frequency-dependent delay in the audio signal path, effectively changing the distance between the microphone and the speaker -- which causes the feedback to jump to different pitches. An **envelope follower** increases the amount of phase delay in direct proportion to the loudness of the feedback, to create a self-stabilizing system by applying *negative* feedback to control *positive* audio feedback, in emulation of a nervous sound engineer jerking a microphone away from a speaker at the onset of feedback. The **equalizer** adjusts the bass and treble balance as needed. When three independent channels are set up in a room the resulting feedback patterns produce a minimalist raga based on the resonant frequencies of the space – one that slowly drifts through permutations of pitches, and can be influenced by movement and other sounds.

TECHNICAL REQUIRMENTS

- *Pea Soup* software (a run-time application built in Max/MSP).
- Macintosh computer running OSX 11.1 or later.
- Multi-channel audio interface, minimum 3 input channels with good microphone preamplifiers, and 3 output channels.
- 3- or 4-channel sound system. Matched loudspeakers are not necessary, but feedback demands strong speakers with wide, smooth frequency response.
- 3 omnidirectional microphones, preferably *dynamic* rather than condenser (i.e., ElectroVoice 635a or RE50, AKG D230, Beyer M58 or M101, Sennheiser MD42, Audio-Technica AT 8004, Shure SM63 or VP64, Sony F112). Cardioid or other unidirectional or bi-directional (figure-8) microphones are less suitable; condenser microphones have extended low- and high-frequency response that must be cut with equalization to maintain pleasing feedback behavior.
- Microphone stands and cabling.
- One or more performers with portable acoustic instruments capable of producing sustained tones, such as: clarinet, trombone, trumpet, double bass, accordion, voice, musical saw, etc.
- A technician to set up the system and oversee audio and software during performance.

HARDWARE

Speakers can be arranged symmetrically (i.e., in the corners of the room), or placed in odd locations within the space. Mount the microphones in stands at some distance from the speakers -- it's best if the various speaker-to-microphone distances are different. The area between the speakers and microphones becomes the active performance zone, through which players will move; please bear this in mind when configuring the sound system around public seating.

Connect each microphone to one microphone preamp input of the audio interface for the computer.

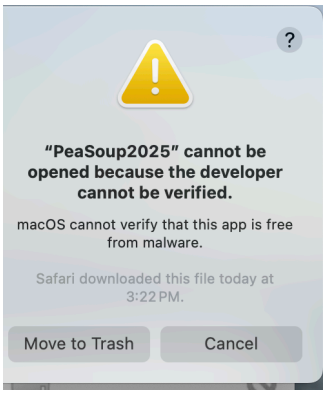
Connect each output channel of audio interface to one amplifier and speaker channel -- typically through a mixer so that a technician can set the levels during sound check and adjust them during the performance as necessary. It is essential that each audio output from the interface is routed only to its own amplifier and speaker -- not mixed down to fewer channels (i.e., to two computer channels mixed down to a single speaker) or distributed amongst several speakers (do not send one output channel to two speakers).

Connect the audio interface to the Macintosh computer before running the *Pea Soup* software.

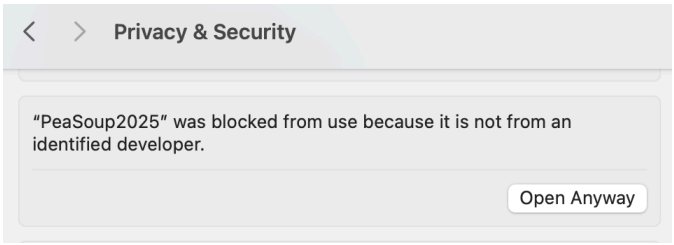
SOFTWARE

The *Pea Soup* program and related documentation can be downloaded from http://www.nicolascollins.com/software.htm.

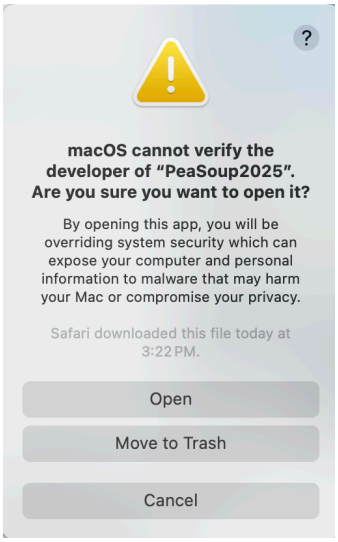
Unzip the downloaded file and double click on the icon for "PeaSoup2025". Mac OS will refuse to open the program since the app is from an unauthorized developer (me):



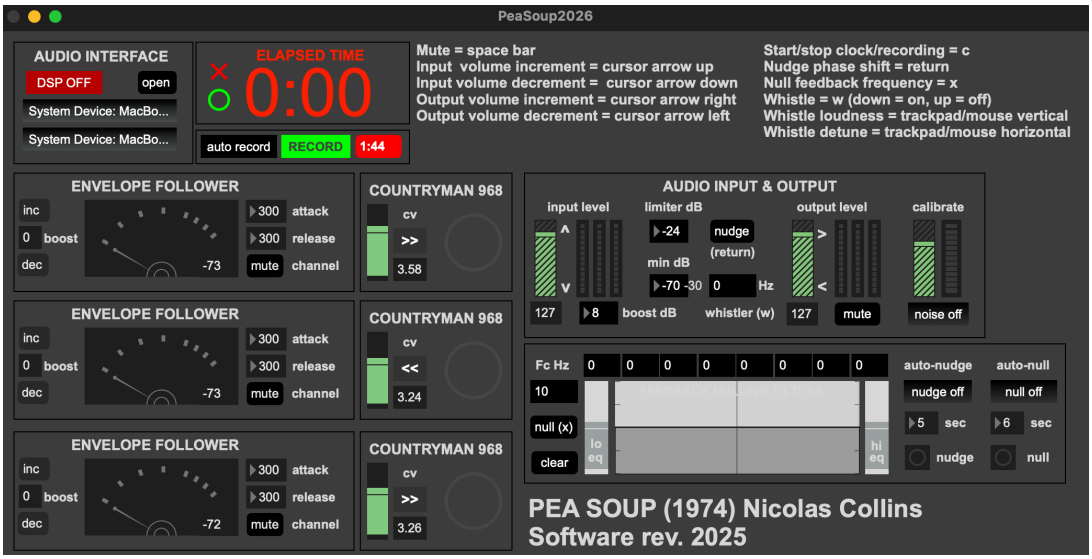
Instead of cancelling or trashing go to **System Settings – Privacy & Security** through the Apple menu and click "Open Anyway":



Click "Open" on any subsequent warnings:



Accept any subsequent requests for access to directories, folders, microphones, etc. Eventually you should be greeted by the main screen:



The software boots in a state suitable for most performance situations with only minor user interaction, but contains a number of variables that can be adjusted – some during sound check, others in the course of the performance – to optimize *Pea Soup*'s behavior. The main screen is divided into panels for the various functions that make up a software emulation of the original *Pea Soup* analog network, along with added features now possible in the software environment.

AUDIO INTERFACE

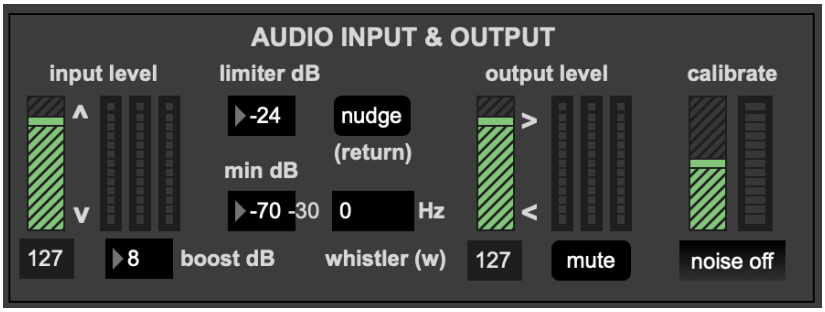
Use the pull-down menus in this panel to select your interface as the input and output device, then click **DSP OFF** to turn on the software; the button should switch from red to green and say **DSP ON**. Click the **open** button if troubleshooting the interface is necessary.

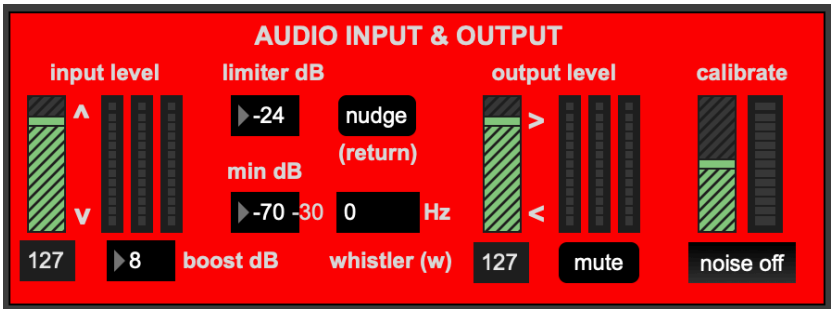
AUDIO INPUT & OUTPUT

This panel is used primarily to set the **input** and **output levels** and the **limiter** threshold. The **levels** can be adjusted with the on-screen faders, or the cursor control keys on the computer keyboard can be pressed to nudge those levels up and down: "**<**" decrements the input level; "**>**" increments it; "**v**" decrements the output level; "**^**" increments it. Clicking the **mute** button or pressing the **space bar** on the computer keyboard toggles output muting – the panel turns red when the audio is muted. The **boost dB** number box under the **input level** meters can be adjusted to boost the level of the audio input if more gain is need to initiate feedback.

The **limiter** number box indicates the maximum audio level (in dB) that the feedback is allowed to reach; this should not need adjustment by the user, and should generally be kept in the range of -30 (quiet) to -20 (louder). The **min dB** setting for the envelope follower sensitivity should not need adjustment.

This panel also contains a button to **nudge** control settings when the feedback becomes too static, a **whistling** voice that can be enable to interact with the feedback, and a pink-noise source to **calibrate** the microphone levels during sound check (see details of these features below).





ENVELOPE FOLLOWER

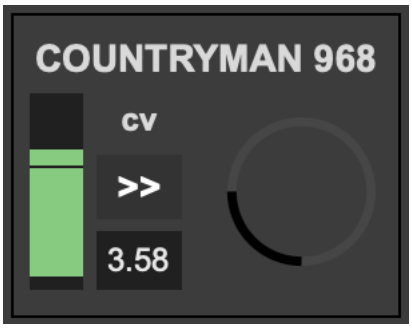
Each of the three **ENVELOPE FOLLOWER** panels contains the **limiter** and **envelope follower** for one channel of feedback processing. It usually should not be necessary to adjust any of the settings. The **Vu meter** and number box in its lower right corner indicates the current signal level. If the meter shows that one of the channels is significantly louder or quieter than the others you can click the **dec** or **inc** buttons at the left of the meter to lower or raise the level, as indicated in dB in the **boost** number box. The **mute** button to the right of the meter toggles the channel off/on – useful for isolating the behavior of individual channels. The **attack** and **release** number boxes can be adjusted to change the attack and release times (in msec) of the **envelope follower** – these settings affect the speed of changes in the feedback.

COUNTRYMAN 968

To the right of each **ENVELOPE FOLLOWER** is an emulation of the **COUNTRYMAN 968** phase shifter, the heart of the original *Pea Soup*. Increasing the phase delay effectively moves the microphone farther away from its speaker, while decreasing the delay emulates moving it closer – either of these virtual

changes in distance can force the feedback to shift to another frequency. The amount of phase delay is controlled by the **envelope follower** which tracks the loudness of the feedback. The vertical **fader** at the left of the patch (which you can adjust on-screen) sets the amount of phase-change in response to the **envelope follower** – the sensitivity of the channel – with its value displayed in the adjacent number box. Clicking the button with the "**>>**" symbol switches the *polarity* of the envelope's control (and toggles the legend between **>>** and **<<**): **>>** indicates that the delay *increases* as the loudness of the feedback increases, effectively pulling the microphone away from its speaker; **<<** indicates that the delay *decreases* with increasing volume, pushing the microphone toward the speaker. The circular line at the right of the panel displays the current degree of phase delay (0° - 360°). Setting the fader and polarity to different values for each channel increases the variation in the resulting feedback patterns.

Clicking the **nudge** button in the **AUDIO INPUT & OUTPUT** panel or pressing **return** on the keyboard will offset the phase delay by small amounts in all three channels, gently disrupting feedback if it becomes too static.

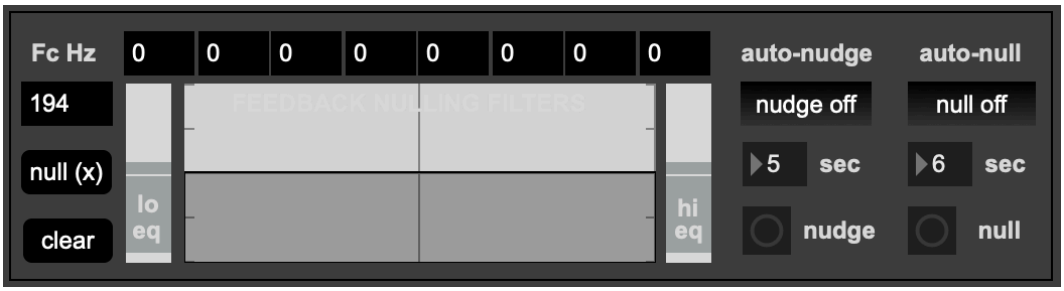


EQUALIZATION

This panel contains bass and treble shelving filters for overall tonal balance, as well as eight notch filters for nulling out specific unwanted frequencies. The two vertical sliders labeled **lo eq** and **hi eq** can be adjusted on-screen to increase or decrease the amount of low and high frequencies in the feedback.

If the feedback locks onto one pitch for too long, click the **null** button or press "**x**" on the keyboard: a filter will lower the gain at that frequency, as displayed in the number box below the legend **Fc Hz**. Each dipped frequency will be displayed on the filter graph and in a number box above. Nulling is a useful way to introduce new pitches into the feedback by knocking out the more dominant ones (like shutting up the boor at a dinner table who's monopolizing the conversation).

These **nulling filters**, as well as the **nudge** function in the **COUNTRYMAN** panel (described above), can be automated in this panel, under the headings **auto-null** and **auto-nudge**. Clicking the button labeled **null off** turns on software that automatically dips any frequency that has been stable for longer than the number of seconds you set in the number box beneath it; the button to the left of the **null** legend will blink when such an **auto-null** occurs, and the filter graph and number boxes will confirm the notched frequency. Likewise, clicking the button labeled **nudge off** will enable an automatic **nudge** of the phase delays in the **COUNTRYMAN** panels after the feedback has locked onto a single frequency for longer than the number of seconds you set in its number box. When enabled, either of these functions will cause the feedback pitch material to evolve slowly over the course of a performance without direct performer intervention on the computer.



CLOCK

Clicking the red **X** in this panel or the "**c**" on the keyboard toggles the timer on and off, the green **O** resets it. Easier than remembering to start the stopwatch on your phone.

RECORDER

Clicking **RECORD** in this panel will start recording a three-channel AIF audio file from the three feedback microphones connected to the interface. Clicking **STOP** will stop recording. The file will be stored on the computer desktop with the name "PeaSoup_year_month_day_hour_minute.aif" (i.e., "PeaSoup_2025_6_10_14_26" – time is displayed in 24-hour format). If the menu to the left of the **RECORD** button is set to "**auto record**" recording will start and stop in synch with the **clock**. The red panel displays the elapsed time of the recording. An easy way to document performances.

MICROPHONE CALIBRATION

Clicking the button labeled **noise off** under the **calibrate** legend at the right side of the **AUDIO INPUT & OUTPUT** panel sends pink noise out all 3 speakers, at a level set with the fader (when noise is on, the feedback is automatically muted). The noise can be used to calibrate the level of the three microphones: adjust the preamp gains on the interface and/or change the **boost** amount on individual **ENVELOPE FOLLOWER** panels using the **inc** and **dec** buttons until all three display approximately the same level on the Vu meters.

WHISTLE

Pressing the "**w**" key causes two sine wave oscillators to lock onto the current feedback frequency and fade up in the audio output; one oscillator is sent out channel 1 of the audio interface, and the other out channel 2. The frequency of the whistle is displayed in the number box above the legend **whistler** in the **AUDIO INPUT & OUTPUT** panel. The vertical axis on the trackpad/mouse controls the *loudness* of the oscillators (louder as you move the cursor higher on the screen), while moving the cursor to the right will increase the *detuning* between the two voices, producing a gentle beating pattern. This

feature provides a way to interact sonically with the feedback when no instrumental performers are available.

KEYBOARD CONTROLS

- **Mute** = space bar
- **Input volume increment** = cursor arrow up
- **Input volume decrement** = cursor arrow down
- **Output volume increment** = cursor arrow right
- **Output volume decrement** = cursor arrow left
- **Start/stop clock** = c
- **Nudge** phase shift = return
- **Null** feedback frequency = x
- **Whistle** = w (key down = on, key up = off)
- **Whistle** loudness = trackpad/mouse vertical (higher = louder)
- **Whistle** detune = trackpad/mouse horizontal (right = greater detuning)

PERFORMANCE

Start the performance with the PA silent, then slowly fade up the volume until feedback begins. Allow 1-3 minutes for the basic *Pea Soup* feedback patterns reveal themselves before any performer activity.

Pea Soup will respond to played or sung pitches, as well as to body movement within the space. Musicians should start with simple "probing" of the acoustics by long tones with long attacks. Play harmonically related pitches initially; detune to induce beating patterns. As the performance progresses increase the complexity of playing. Every five minutes or so walk slowly to a new location in the space; pause every few steps for the feedback to stabilize, and do not play while moving. With two or more instrumentalists: do not play at the same time until the last quarter of the performance.

All actions should be followed by pauses in which their effect on the feedback is evaluated. Since some of the feedback patterns have a long cycle (especially in reverberant spaces), pauses should be proportionally long. Each instrumentalist should remain tacit at least 50% of the time if playing solo, 66% of the time in a duo, 75% in a trio, etc.

Performers should wait for a signal from the technician that the system is fully "tuned" before beginning, and should not play or move during the fade out at the end.

The performance may be of any duration, typically in the range of 10-20 minutes. *Pea Soup* should end with a slow fade of the **output level** to the point that feedback no longer sustains, then the fade can be faster until fully off. Performers should be cued to stop playing and moving before the fadeout begins.