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LOOP/COPY/MUTATE : I Am Legion

version 1.01 (2017.12.05)
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ABOUT

Loop/Copy/Mutate: I Am Legion is an Artificial Intelligence singer modeled after the improvisational method of the Genetic Choir. The Legion listens to sounds and mimics them with a voice of its own, made up from vocal sounds donated by many contributors. Say something on the microphone, wait a few seconds, and then listen to how the software copies, loops, and mutates what it heard.

The software combines Machine Listening with Machine Learning to analyze, understand and respond to sound. The Legion is trained with a user-defined database of sounds, and can be instructed to focus on different sonic aspects: melodic contours, textures (i.e. timbral characteristics), or dynamics. The default database is 37 minutes long and was collected during Genetic Choir's soundwalks at Amsterdam Central Station; it consists of participants' vocalizations of the train station's sounds. A second database used by the project is also provided, with vocalizations of Fransien Bal's graphic poems by 28 contributors (39 minutes).

The software was created for 'Loop-Copy-Mutate: Music from People and Places', a project by the Genetic Choir in collaboration with Stelios Manousakis and Robert van Heuman. For more information visit: http://www.genetic-choir.org/loop-copy-mutate/

Software concept, design & programming: Stelios Manousakis
Project idea and direction: Thomas Johannsen

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HOW DOES IT WORK?

A database of sounds is used to train the model. This must be provided as a single soundfile. Depending on the processing power of your computer and your patience, 35-45 minutes should be a good compromise between obtaining interesting results that resemble the input and speed of analysis and execution.

Sounds are first split into separate sound events (i.e. notes or sound objects). These events are analyzed and their sonic features are extracted. The system uses about 20 different features, such as pitch, loudness, MFCCs, spectral entropy, sensory dissonance, slope of attack and release, and more. The specific configuration of features that the system uses depends on what it is instructed to focus on - for example, 'texture' uses primarily timbral features.

The system generates a two-layered representation of every sound event consisting of:
  - Its overall sonic qualities, represented by an average value per feature for the entire event.
  - Information about micro-modulations within the event, given through statistical representations of each feature's contour within the event itself. This allows, for example, to distinguish between a sound that has a static pitch to another sound whose pitch fluctuates

within the event, to another sound whose pitch rises, etc.

Using this process, the system creates a perceptual map of the database. Incoming sounds are analyzed and categorized in the same manner; they are then matched to the most similar sound events from the database, and output as a new soundfile. This is done with a k-dimensional tree, an algorithm that finds similarities in multidimensional data, such as the audio features used to describe sound in this software. The Legion's response to your voice is then looped, mutated, and played back for your enjoyment!

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INSTALLATION

The .zip package contains all necessary code, as well as the macOS SuperCollider application. There are different ways to go about installing it:

• Non-programmer-friendly installation for the casual user who does not plan to use SuperCollider (macOS only):

Put the two folders in the appropriate locations, as the path suggests i.e in:
    - /Applications/
    - /Users/<yourUserName>/Library/Application Support/
Please note that the 'Library' folder is hidden in newer macOS versions; you can find it by selecting 'Go' on Finder's menu while pressing Option.

• For SuperCollider users:
Version 1.01 of the software was made on SuperCollider 3.8.0. It should work on later versions and will likely work on earlier ones (at least until 3.6), but your mileage may vary. If you are using a different release than 3.8.x, you will need to download the appropriate versions of the SC-plugins.

There will likely be conflicts if you use the installation method above and have another version of SuperCollider installed. If you just want to give the program a quick try with minimum hassle, please archive (.zip) your previous SuperCollider installation first, including the Application Support folder. Unfortunately, the program cannot run as a standalone application as of yet because of a bug in Score and scsynth, which would had been more straightforward.

To use **Loop/Copy/Mutate: I am Legion** with an existing SuperCollider installation, you will need to do the following with the files in the package:
    - Copy the folder *"put in_ Applications/SuperCollider/LoopCopyMutate_I-am-Legion"* to the folder *"Applications/SuperCollider/"* in your computer. This contains the core source code of the project.
    - Copy the contents of the folder *"put in_ Applications/SuperCollider/sounds/"* into the *"/Applications/SuperCollider/sounds/" folder* in your computer. These are the soundfiles the project uses.
    - Copy all database files from *"/Applications/SuperCollider/"* to the equivalent location (their name starts with 'gc_')
    - The project also uses a number of quarks and additional plugins, found in *"put in_ Application Support/SuperCollider/Extensions/"*. Copy these to your SuperCollider Extensions folder, or install the ones you don't have by evaluating *Quarks.gui*. Make sure there are no duplicate classes, as SuperCollider will not be able to run in that case.

THE INTERFACE & USING THE SOFTWARE

The interface window contains 6 tabs. You can navigate using the tabs on the left.

You do not need to write code to use the application, so you do not need to use the IDE (code editor) for anything more than watching for the messages on the Post window.

IMPORTANT: Please wait until a process is complete. If messages are being posted, it means that the system is still processing. Do not press any buttons at that moment, as the legion's brain may get confused!

PLAYER tab

This is the main interface; use it to prepare, play, record, analyze, listen.

A. PREPARATION / INTRODUCTION

1. MAKE NEW SESSION [BUTTON]

Press button to start a new session. This will make a new folder in your hard disk where all recorded sounds and all created loops will be stored. Use this when you want a clean slate. In Loop/Copy/Mutate concerts, this was used when a new audience group arrives. Files recorded in previous sessions will not be deleted

2. PLAY SOUNDSCAPE [BUTTON]

Press button to hear a computer-generated soundscape from the database, so you can get an idea of its sounds (the soundscape will be different every time).

3. Output volume control (SLIDER)

To adjust the output volume, use the cyan slider with the red triangle next to the buttons, or the volume of your hardware.

To adjust the input volume, use your hardware's control knob.

B. INTERACTION

3. Record new sound [BUTTON]

Press the button to record your sound, analyze it, and hear the software-generated response. The text in the button will change to inform you of what is happening (Recording / Processing / Analysis Complete / Playing Loop).

4. Focus on: Melody/Texture/Dynamic [MENU]

Choose a different way to listen to recorded sounds, focusing on: a) Melody, b) Texture, or c) Dynamics. You can proceed by:
   - Recording a new sound, or
   - Listening again with a new focus
Please make sure to give the computer enough time for this before pressing any buttons, as the software may need a few seconds to load the database (depending on how long that database is). You can look at the Post window for a 'Listening to...' message.

5. Listen again with new focus? [BUTTON]

You can create a new loop using the already recorded input. You can also use this button after you change databases, to make sure the new database is used.

6. Select a file to preview for saving [MENU]

Use the menu to select a file to listen to. This can be original input or the generated loop. The software timestamps all files, and adds a tag with the focus used to generate each loop.

7. Export for the concert? [BUTTON] – N/A

The software was designed for use in Loop/Copy/Mutate concerts, therefore this is a button you will not be needing at home. By pressing the button the software wirelessly sends the sound that is selected on the menu to another laptop for in-concert use. This requires some additional networking setup.

8. STOP ALL SOUND! [BUTTON]

Automatically stop all sounds.

OPTIONS tab

Use this tab to change the overall preferences.
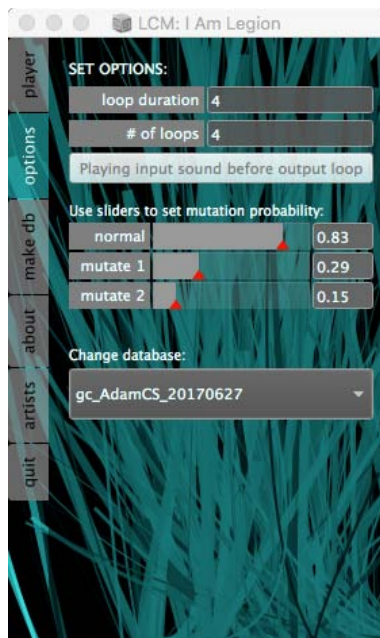
1. loop duration [NUMBER]

Choose how many seconds your input sound will last

2. # of loops [NUMBER]

Choose how many times to loop the generated output

3. Playing input sound before output loop / Not playing input sound before output loop [SWITCH]

Choose whether you want to listen to the recorded input sound before the output or not.

4. Set probability of mutation [3 SLIDERS]

The three sliders allow you to tune the amount of mutation probability in the generated loop. 'Normal' will pick sounds closest to the input (no mutation); 'mutate 1' will pick sounds closest to the sound closest to the input; 'mutate 2' will pick the closest of the closest of the closest (which may correspond to 'normal'). For example, with the configuration of the image on the right, 'normal' will occur about 65% of the time, 'mutate 1' about 23% and 'mutate 2' about 11%.

5. Change the database [MENU]

The software package comes preloaded with two databases from the Loop/Copy/Mutate project:

- Sounds from Genetic Choir sound walks recorded in Amsterdam Central Station ('gc_AdamCS_20170627').
- Sounds by Fransien Bal's MusiVisualLanguage project ('gc_Fransien28voices').

New databases that you make will be added here automatically.

MAKE DATABASE tab

Use this tab to make a new database. You can open or drag-drop your own sound-file from anywhere on your drive by going to the 'make db' tab. The application will copy your sound to: */Applications/SuperCollider/sounds/databases/*

The database must consist of a single soundfile. If you want to make a database from many sound files, you will need to stitch them together in another program.

ATTENTION: Making a new database can take a considerable amount of time - the larger the file, the longer it will take. A 40 minute file may take over 40 minutes to render into a database, depending on your computer's processing power.
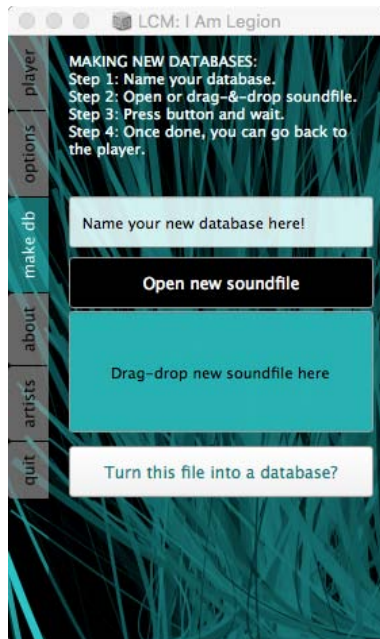
A. How to **ADD** your own databases:

1. Name your database (if you do not, a generic time-stamped name will be given)

2. Select a soundfile to use as database, by either:
   - Clicking on the 'Open new soundfile' button, or
   - Dragging & dropping your soundfile to the field below this button

3. Click on 'Turn this file into a database?' and wait while the software is processing. This will take a while, and will use quite some CPU and RAM. The button will be updated to show you the progress

4. Once the bottom button shows the process is done, you can go back to the player and use the new database. You can select between the existing and new databases in the Options tab.

B. How to **DELETE** databases:

1. Delete the soundfile that the application is using, which has been copied to: */Applications/SuperCollider/sounds/databases/*
2. Delete all database(s) that use this file, as they will not be usable without it. Tip: give meaningful names to your databases so you can clean up later on!

ABOUT tab

Contains some information on the software

ARTISTS tab

Contains some information on the artists involved

QUIT tab

Quit the software

FINDING FILES & CLEANING UP

The application stores the files it uses and generates in the following locations:
- Analysis files in the folder:
    /Applications/SuperCollider/sounds/databases_analysis/
- Its archive of database data in the folder:
    /Applications/SuperCollider/
- Recorded and generated sounds are stored on the Desktop, in the folder:
    /Desktop/Loop-Copy-Mutate_sounds/sessions

You will have to manually clean up any files you do not wish to keep.

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LICENSE

Loop/Copy/Mutate: I Am Legion is free software made in SuperCollider. You can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation. Like with SuperCollider, you can use version 2 of the License, or (at your option) any later version. See the file [LICENSE.txt] for the license text.

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ABOUT SUPERCOLLIDER

SuperCollider is an environment and programming language for real time audio synthesis and algorithmic composition. It provides an interpreted object-oriented language which functions as a network client to a state of the art, realtime sound synthesis server.
http://supercollider.github.io/