**Creating a pure data instrument utilising random generative patterns whilst maintaining user playability.**

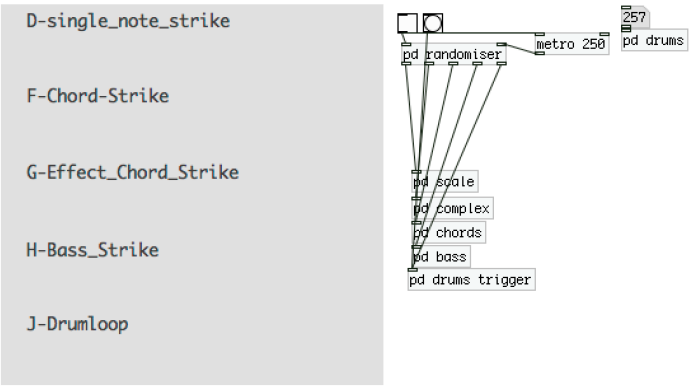
## Equipment Needed

- **Pure Data** available free from **https://puredata.info**
- **Au Lab** available free from **http://mac.softpedia.com/get/Audio/AU-Lab.shtml**

*Au lab is suitable for mac only, for windows a similar VST host can be used for example

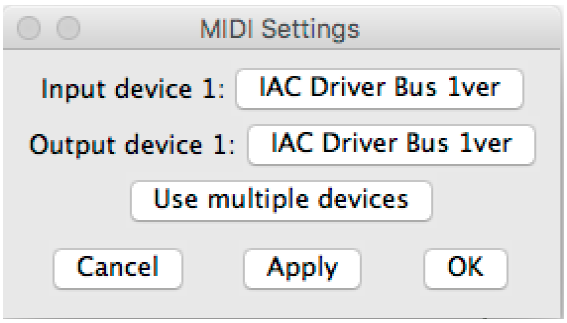
- **Cantabile Lite** available free from **https://www.cantabilesoftware.com**
- A selection of virtual instruments, in AU or VST format depending on operating system.

## Setting Up

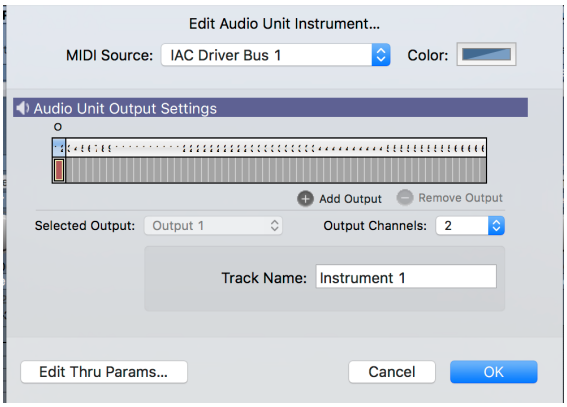



## About

When a scale or selection of notes are chosen they are mapped across several midi channels, creating a patch that is both playable and generative.
Pure data is used to select, order and edit note values, whilst the midi instruments are hosted in AU lab, a software that allows AU instruments to be loaded and mixed without the use of a digital audio workstation. The main aim of the instrument is to create a playable instrument controlled by rules such as metronome speed and note values, the note selection is completely random meaning the phrase will more than likely never be repeated.

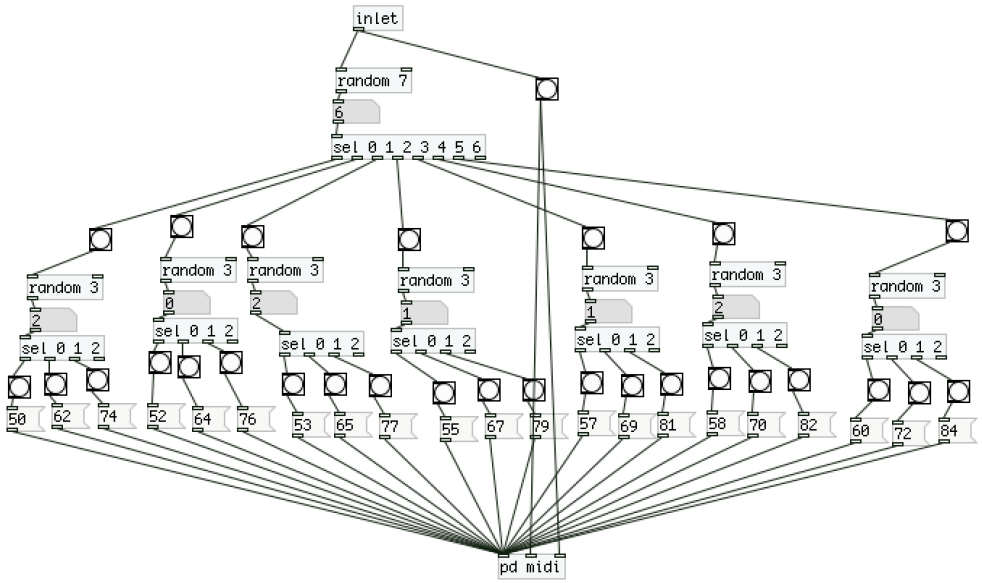



To begin creating the patch, pure data must be able to communicate with the instrument hosting software, the IAC driver allows the machine to pass midi data within itself over different forms of software. Selecting the driver as the output, means when using the “noteout” object in pure data the information is being sent out through this channel. By selecting the same driver in AU lab, you are allowing the two programmes to communicate.

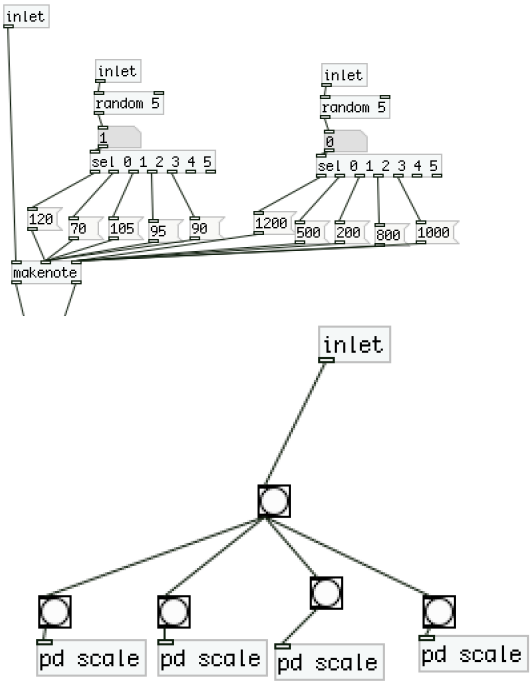



Loading an instrument in AUlab is as simple as selecting edit-add au instrument generator.

**Instruments**



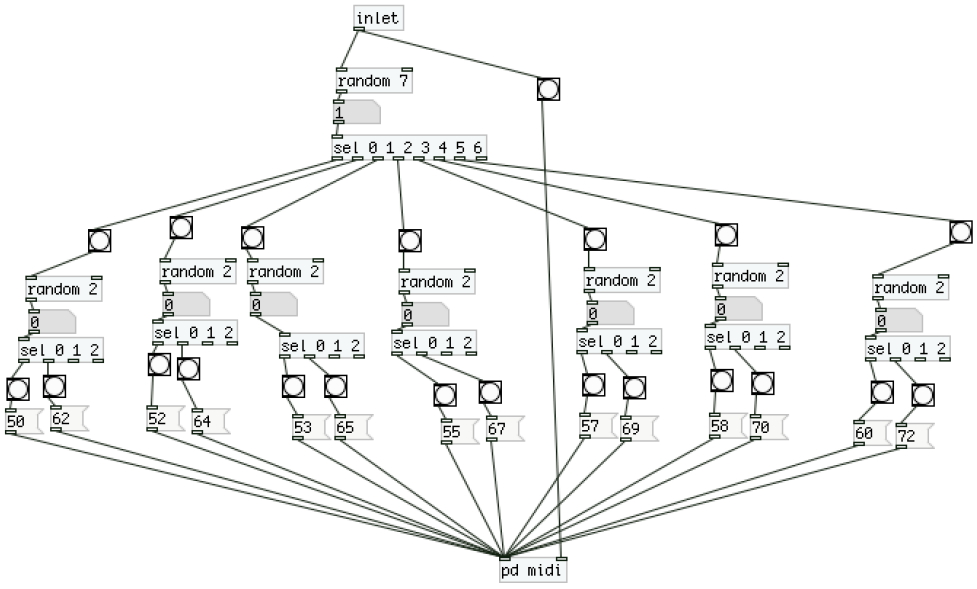

the scale sub-patch consists of the random selection of pre defined notes, for this example the D minor scale is used. The D minor scale consists of six notes, when the random 7 object receives a bang it generates a number between 0 and 6. The “sel" object then allows the generated number to trigger a note. After a note is chosen another random selection then takes place, the random 3 object makes the decision on the octave of the chosen note. When using midi adding or subtracting 12 will give a higher or lower octave.
“Pd midi” is how the patch communicates with Au lab. Make note creates a midi note, and note out sends the note through the IAC driver. Note values are again chosen at random, the middle inlet establishes note velocity, the right inlet establishes note length. “Note out” would send the information over channel 1, “Noteout 2” would send the information over midi channel 2.



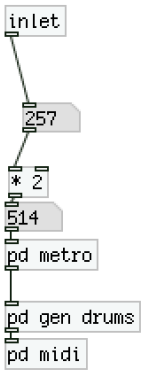

A simple chord patch can be created by replicating the scale sub-patch several times, by connecting them to a single bang four random notes will be selected simultaneously, creating a random chord.

The chord sub-patch in this example requires the same instrument to be triggered (midi channel 1) however, by selecting a different channel, for example “noteout 2” a different instrument can be played.

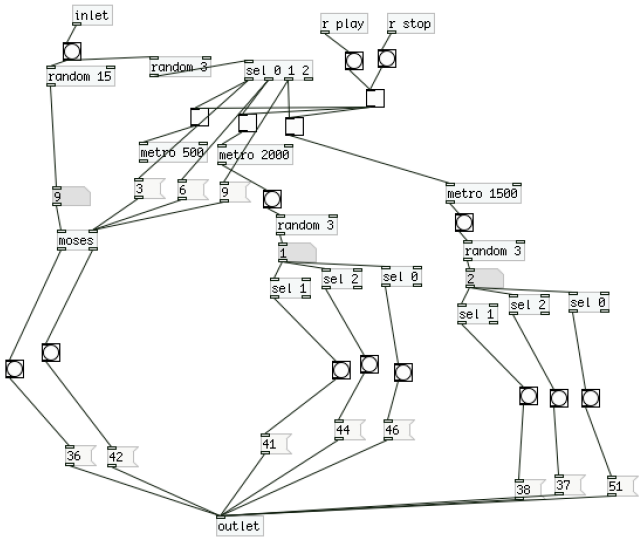
For this example the bass is in the same scale however it is restricted to only 2 octaves, purely for creative reasons, the amount of octaves can be changed by adding or subtracting note values, this can be done by modifying the random and sel object.



## Drums



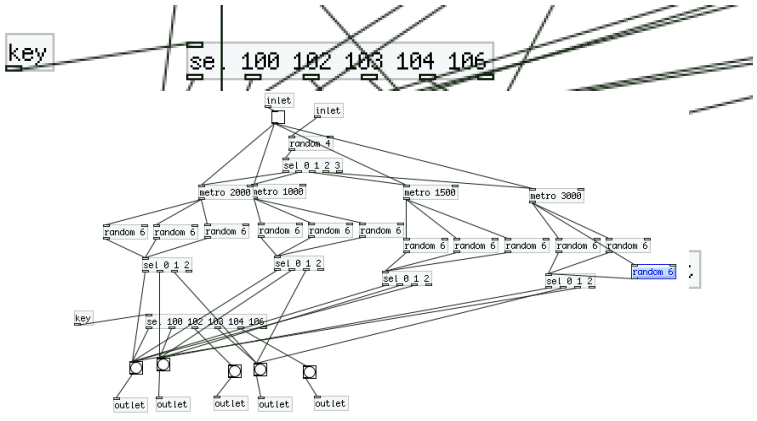

The drums are also created by triggering midi notes, however the sub-patch is less playable and relies more on generative techniques. A metronome is required to trigger the drums, for this example the metronome works loosely to assist the feeling of “real drums”.




once the sub-patch is triggered by the “play” bang, a series of randomly selected metro objects and bangs take place. The 3 metronomes within the patch are adjustable and will affect the way the drums swing, the “moses" object affects the kick and hi hat, this is to allow the amount of kicks to be controlled the probability can be controlled using the right inlet, in this patch this is randomly chosen. When opening an instrument drum kit in au lab the midi note numbers are available in the options window, this will allow for the drum kit to be mapped accordingly.

## Playability

as can be seen in screenshot one, the patch utilises the pure data key feature, when attached to a select object keys can be connected to bangs, in this patch for example key d triggers the single scale note.




once mapped, the instrument can be played across several keys.

**Randomness**
The patch also features a “randomiser”. Similar to the way the drums are triggered, this allows the patch to create music without human input this can be triggered by a single toggle switch.

By selecting an initial metro speed, the musical output can be changed.

**Playing the instrument**
When opening the patch, the keys D,F,G,H,J will instantly be playable, if you would like to hear the patch create a piece with no human input simply toggle the randomiser button. Opening and editing the sub patch allows the scale of the piece to be altered. speed can be controlled by editing metro objects, and instruments can simply be changed by opening or creating an AU lab project with different instruments, expression can also be edited by changing the number going into the right inlet of the “makenote” object.

| Note No. | Name | Note No. | Name | Note No. | Name | Note No. | Name |
|---|---|---|---|---|---|---|---|
| 0 | C -2 | 32 | G#0 | 64 | E 3 | 96 | C 6 |
| 1 | C#-2 | 33 | A 0 | 65 | F 3 | 97 | C#6 |
| 2 | D -2 | 34 | A#0 | 66 | F#3 | 98 | D 6 |
| 3 | D#-2 | 35 | B 0 | 67 | G 3 | 99 | D#6 |
| 4 | E -2 | 36 | C 1 | 68 | G#3 | 100 | E 6 |
| 5 | F -2 | 37 | C#1 | 69 | A 3 | 101 | F 6 |
| 6 | F#-2 | 38 | D 1 | 70 | A#3 | 102 | F#6 |
| 7 | G -2 | 39 | D#1 | 71 | B 3 | 103 | G 6 |
| 8 | G#-2 | 40 | E 1 | 72 | C 4 | 104 | G#6 |
| 9 | A -2 | 41 | F 1 | 73 | C#4 | 105 | A 6 |
| 10 | A#-2 | 42 | F#1 | 74 | D 4 | 106 | A#6 |
| 11 | B -2 | 43 | G 1 | 75 | D#4 | 107 | B 6 |
| 12 | C -1 | 44 | G#1 | 76 | E 4 | 108 | C 7 |
| 13 | C#-1 | 45 | A 1 | 77 | F 4 | 109 | C#7 |
| 14 | D -1 | 46 | A#1 | 78 | F#4 | 110 | D 7 |
| 15 | D#-1 | 47 | B 1 | 79 | G 4 | 111 | D#7 |
| 16 | E -1 | 48 | C 2 | 80 | G#4 | 112 | E 7 |
| 17 | F -1 | 49 | C#2 | 81 | A 4 | 113 | F 7 |
| 18 | F#-1 | 50 | D 2 | 82 | A#4 | 114 | F#7 |
| 19 | G -1 | 51 | D#2 | 83 | B 4 | 115 | G 7 |
| 20 | G#-1 | 52 | E 2 | 84 | C 5 | 116 | G#7 |
| 21 | A -1 | 53 | F 2 | 85 | C#5 | 117 | A 7 |
| 22 | A#-1 | 54 | F#2 | 86 | D 5 | 118 | A#7 |
| 23 | B -1 | 55 | G 2 | 87 | D#5 | 119 | B 7 |
| 24 | C 0 | 56 | G#2 | 88 | E 5 | 120 | C 8 |
| 25 | C#0 | 57 | A 2 | 89 | F 5 | 121 | C#8 |
| 26 | D 0 | 58 | A#2 | 90 | F#5 | 122 | D 8 |
| 27 | D#0 | 59 | B 2 | 91 | G 5 | 123 | D#8 |
| 28 | E 0 | 60 | C 3 | 92 | G#5 | 124 | E 8 |
| 29 | F 0 | 61 | C#3 | 93 | A 5 | 125 | F 8 |
| 30 | F#0 | 62 | D 3 | 94 | A#5 | 126 | F#8 |
| 31 | G 0 | 63 | D#3 | 95 | B 5 | 127 | G 8 |

Here is a useful conversion chart from notes into midi values.

Credit
http://yagizmungan.com/ACinPD.pdf

**Future Progression**
Future progression could include further development in the expressive aspects of the patch, this could include velocity and length being mapped to the keyboard in order to allow greater human control. Effects could also be incorporated into the patch to allow for further expression.