

“This might get loud” – an Introduction to Sonification and SuperCollider



Agenda:

- 1) Introducing Sonification
- 2) SuperCollider – Introduction and Hands-On Session
- 3) What can sonification do for you? Q&A Session.

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<http://github.com/jrimland/supercollider>

Giving Credit Where Credit is Due



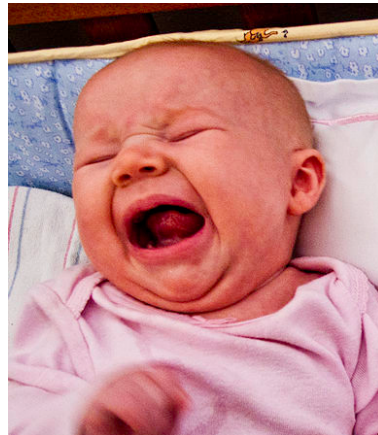
Dr. Mark Ballora

- Sonification Pioneer
(<http://music.psu.edu/faculty/mark-ballora>)
- TEDxPSU Presentor:
(<http://www.youtube.com/watch?v=aQJfQXGbWQ4>)
- Featured on recent Mickey Hart album

My Ph.D. committee member and introduction to sonification.

Why Sonification?

- We rely on audio information constantly in our daily lives.



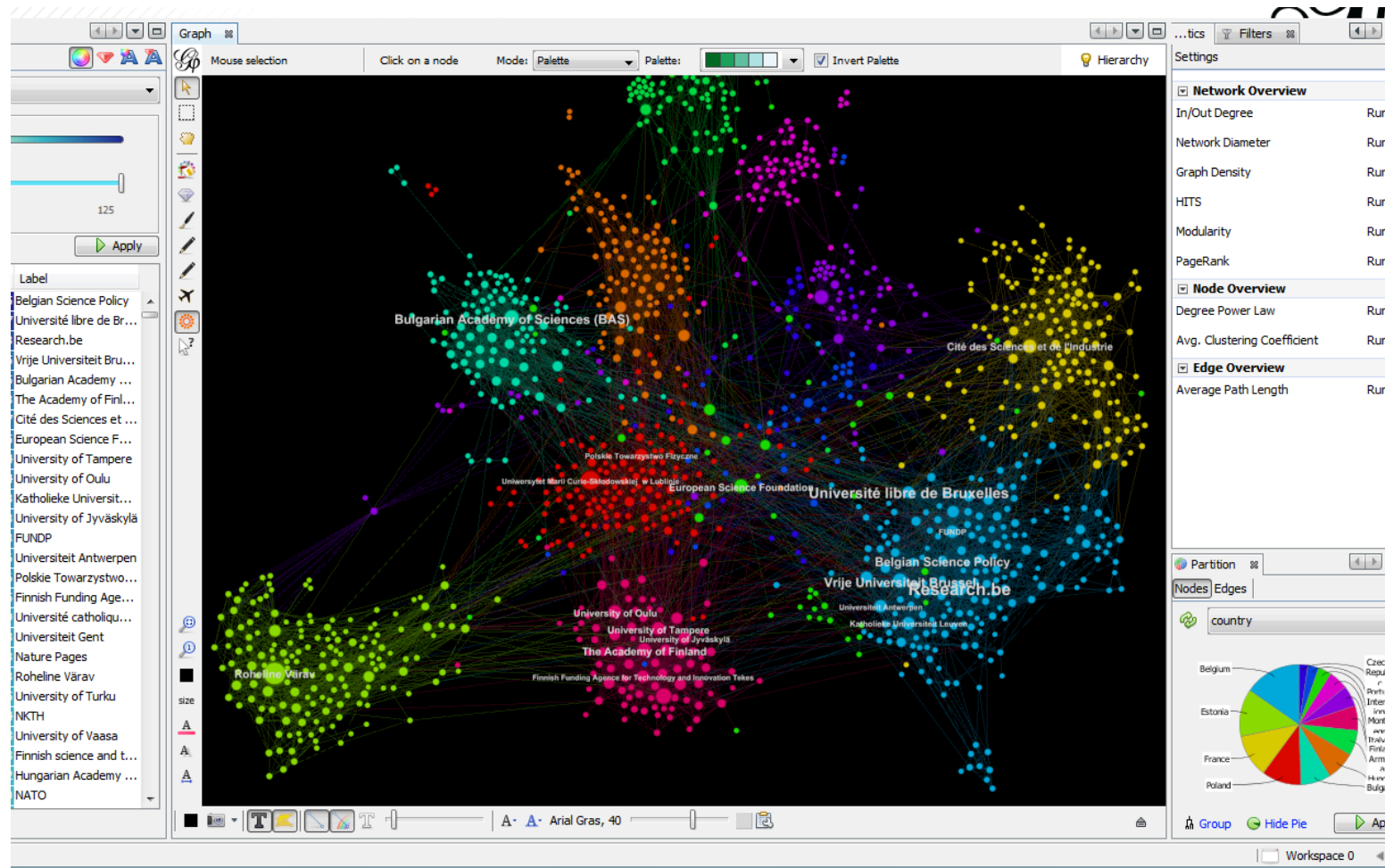
Why Sonification?

- Technology often utilizes audio alerts and cues.



Why Sonification?

...yet we still rely on this:



...and ignore our auditory data analysis capabilities.

Bottom Line

- Research suggests that auditory presentation of certain data can be superior to visualization.
- Combined auditory and visual displays can reduce workload and improve rapid understanding of data.
- Sonification of data has great potential for the visually impaired.

Getting Started

- 1) Determine goal (e.g., EDA, aesthetics, specific task)**
- 2) Choose a sonification type**
- 3) Design a mapping from your data to sound properties**
- 4) Normalize your data to an appropriate range**
- 5) Decide on a time interval**

Sonification Types

- 1) Continuous Representation** – direct mapping of data to an audio wave (e.g. airplane altitude mapped to pitch) -- a.k.a “Audification”
- 2) Discrete Point Representation** – data points map to sound events (often in multiple dimensions) – (e.g. rainfall amt., temp., humidity mapped to volume, pitch, timbre).
- 3) Model-based Representation** – more complex interaction using formulae or models to define interactions.

Mapping Data to Audio¹

- 1) Pitch (Frequency)** – Approx. 400 steps within human JND (Just Noticeable Difference)
- 2) Loudness(Amplitude)** – Approx. 50-100 steps of JND, but ideal for emphasizing background or foreground significance of data.
- 3) Timbre** – “anything that cannot be labeled pitch or loudness”² (e.g. coloration, attack, brightness, tremolo...)
- 4) Localization** – Spatial panning is useful for geospatial representation and improving audio channel separation.

[1] Adapted from Chapter 13 of “The SuperCollider Book”, MIT Press, 2011

[2] McAdams and Bregman, 1979

Choosing a Time Interval

- 1) How much time does the user have to listen?
- 2) What patterns is the user listening for?
- 3) How well do the sound attributes tolerate time compression?
- 4) Will it be interactive or fixed playback?

Sonification for “Data Fusion”

- Sonification can be used to merge difficult heterogeneous data

Naïve method:

- 1) Pick a sound for each data type
- 2) Play both sounds simultaneously

Better method:

Create a sound that incorporates each data modality to generate a coherent effect.

Challenges

- 1) Mapping data to sound can be difficult for high-dimension data.
- 2) Difficult to take a “snapshot” or compress longitudinal data.
- 3) A poor design can be distracting
- 4) The user probably won't be a sonification/audio expert.

SuperCollider Download and Install

1) Installation:

<http://supercollider.sourceforge.net/>

(Binaries for Mac / Windows / Linux)



2) Launching:

Mac: Applications/SuperCollider/scide

PC: C:\Program Files\SuperCollider-3.6.2\scide.exe

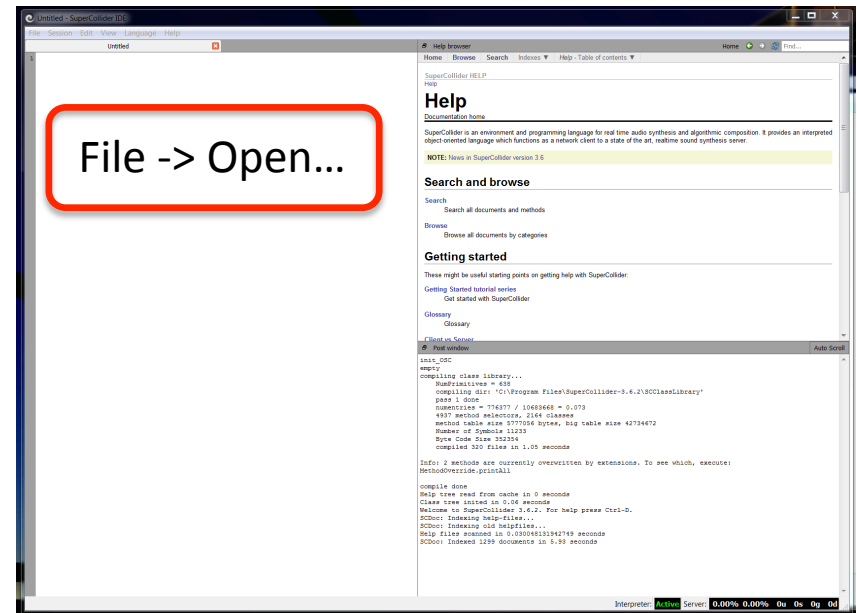
Source Code

Please download: GettingStarted.scd

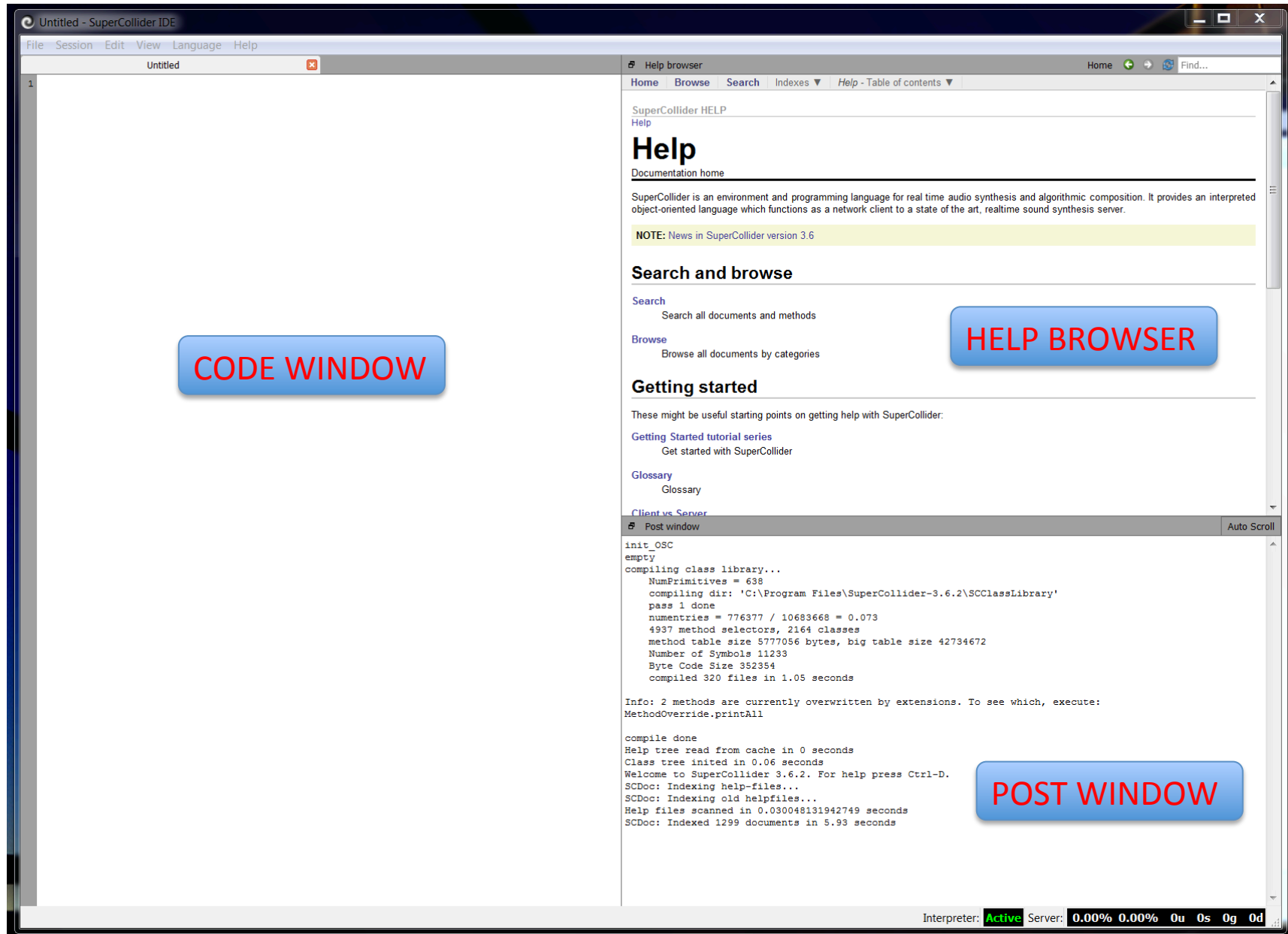
from:

<http://github.com/jrimland/supercollider>

and open it in SuperCollider.



SuperCollider

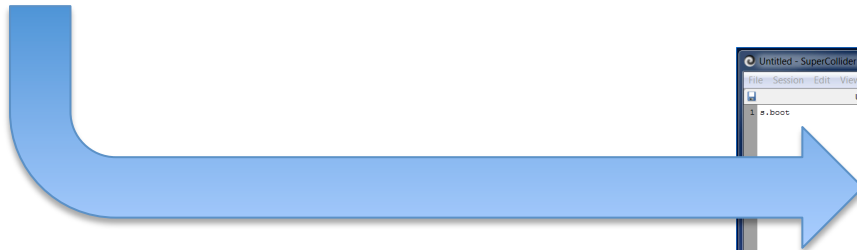


Starting The Server

`Server.default = s = Server.internal.boot`

...or just...

`s.boot`

The screenshot shows the SuperCollider IDE interface. The top menu bar includes File, Session, Edit, View, Language, and Help. The main window is divided into two panes. The left pane, titled 'Help browser', displays the 'SuperCollider HELP' page, which includes sections for 'Help', 'Search and browse', and 'Getting started'. The right pane, titled 'Post window', shows the output of the 's.boot' command. The output text includes: 'Info: 2 methods are currently overwritten by extensions. To see which, execute: MethodOverride.printAll', 'compile done', 'Help tree read from cache in 0 seconds', 'Class tree loaded in 0.04 seconds', 'Welcome to SuperCollider 3.6.2. For help press Ctrl-D.', 'SCDoc: Indexing help-files...', 'SCDoc: Indexing old helpfiles...', 'Help files scanned in 0.03048131942749 seconds', 'SCDoc: Indexed 1299 documents in 5.93 seconds', 'booting 57110 localhost', 'Device options:', a list of audio devices (Microphone, Speakers, etc.), 'Booting with:', 'In: Microphone (High Definition Audio)', 'Out: Speakers (High Definition Audio)', 'Sample rate: 44100.000', 'Latency (in/out): 0.013 / 0.091 sec', 'SC_AudioDriver: sample rate = 44100.000000, driver's block size = 64', 'SuperCollider 3 server ready.', 'Receiving notification messages from server localhost', and 'Shared memory server interface initialized'. The status bar at the bottom right indicates 'Interpreter: Active Server: 0.00% 0.00% 0u 0s 2g 58k'.

Playing a Sound

CAUTION: Turn your volume WAY down first or you may damage your hearing!

```
{SinOsc.ar(440,0,0.1)}.play
```

...then...

Mac:

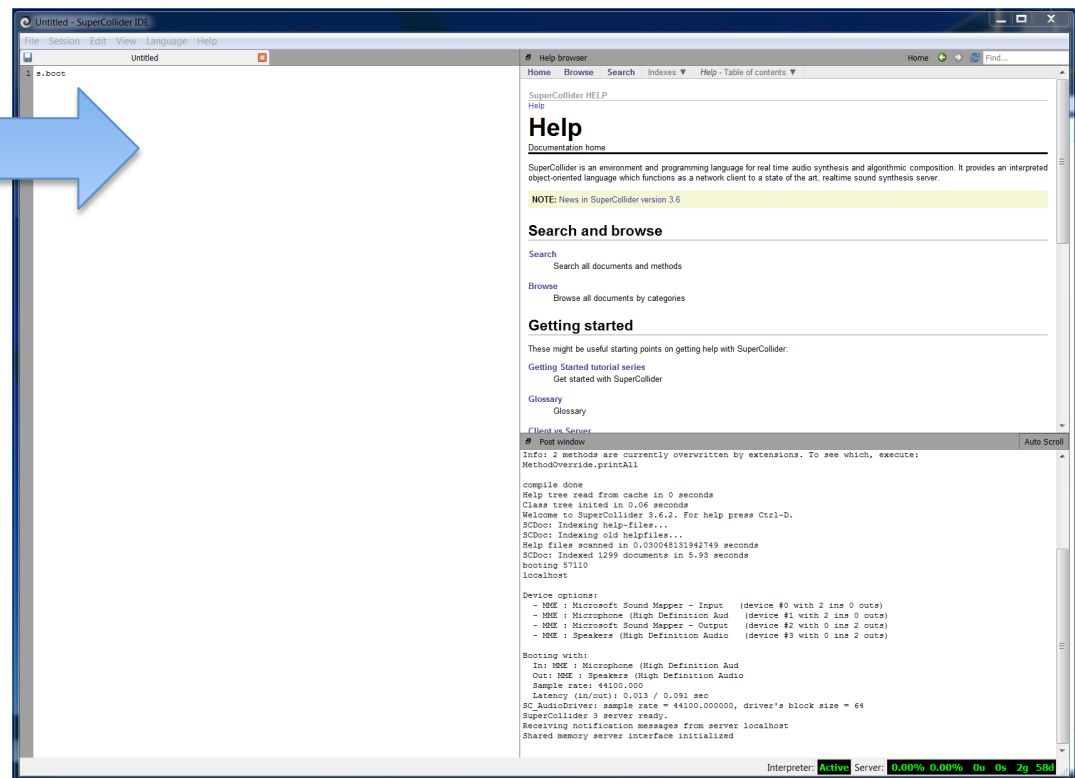
CMD + Enter (to play sound)

CMD + . (to stop sound)

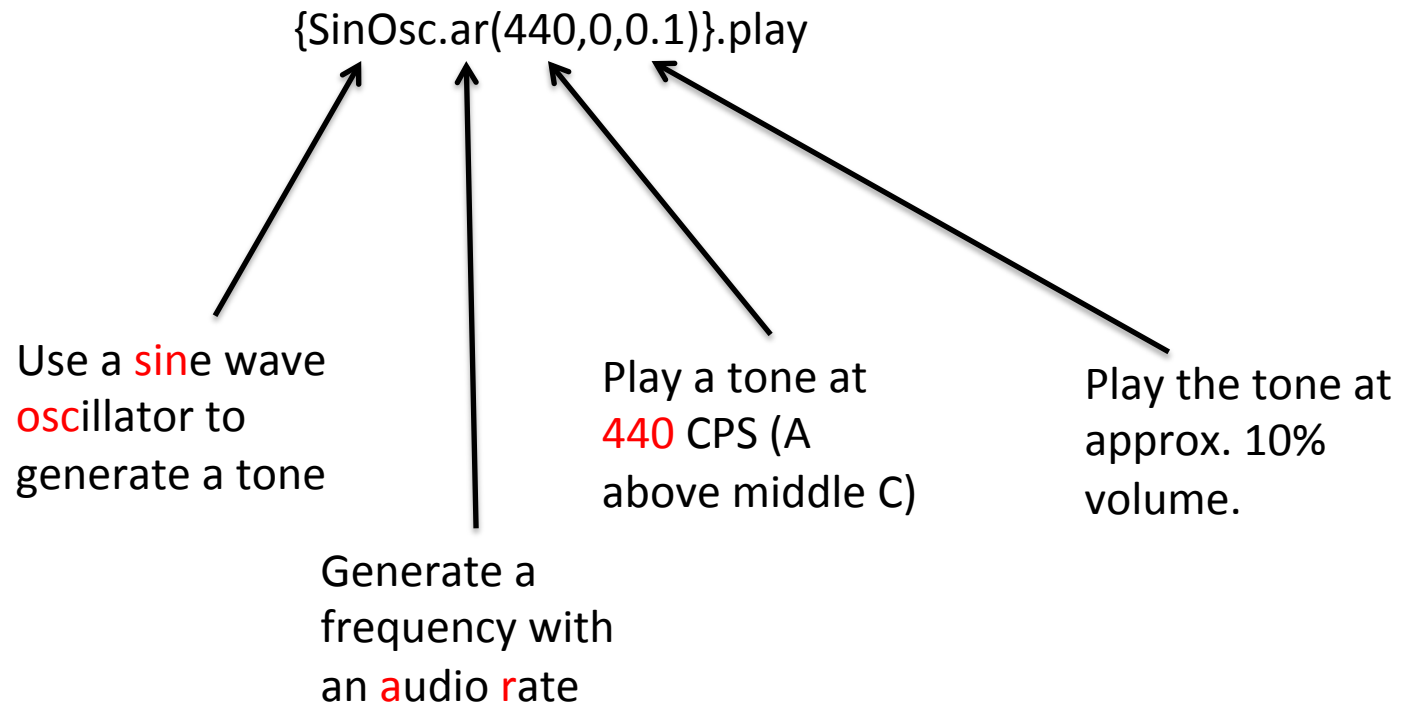
PC:

Ctrl + Enter (to play sound)

Ctrl + . (to stop sound)



Playing a Sound



(Note: This is confusing, but hang in there! This code structure pays off down the road!)

Playing an *interesting* Sound

```
{SinOsc.ar(MouseX.kr(220,5000),0,MouseY.kr(0.1,0.9))}.play
```

Use the X
coordinate of
the mouse to
control pitch

Use the Y
coordinate of
the mouse to
control volume

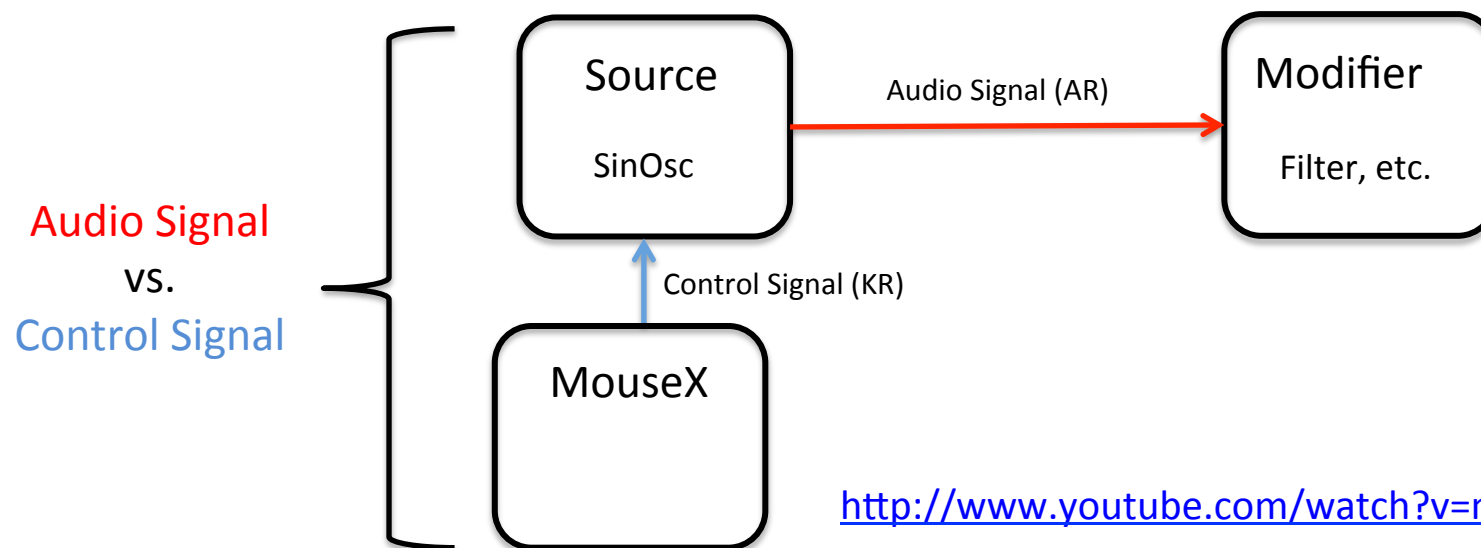
Generate a
frequency with
a **k**ontrol **r**ate

Reality Check...

- Many SuperCollider features are derived from hardware synthesizers.



```
{SinOsc.ar(MouseX.kr(220,5000),0,MouseY.kr(0.1,0.9))}.play
```



http://www.youtube.com/watch?v=ml_9ztYDP84

Other UGens

- SinOsc is just the start – SuperCollider has around 300 unit generators!*

Categories:

- sources
- filters
- distortion
- panning
- reverbs
- delays and buffer UGens
- granular synthesis
- control: envelopes, triggers, counters, gates, lags, decays
- spectral

* Check out the “Tour of UGens” in SuperCollider Help for an exhaustive guide

Multichannel Expansion

- Single Channel Example: {SinOsc.ar(440,0,0.1)}.play
- Stereo Example: {SinOsc.ar([440,550],0,0.1)}.play
- 8-Channel Example: {SinOsc.ar([110,220,330,440,550,660,770,880],0,0.1)}.play
- 2 Channels mixed down to 1: {Mix.new(SinOsc.ar([440,550],0,0.1))}.play;

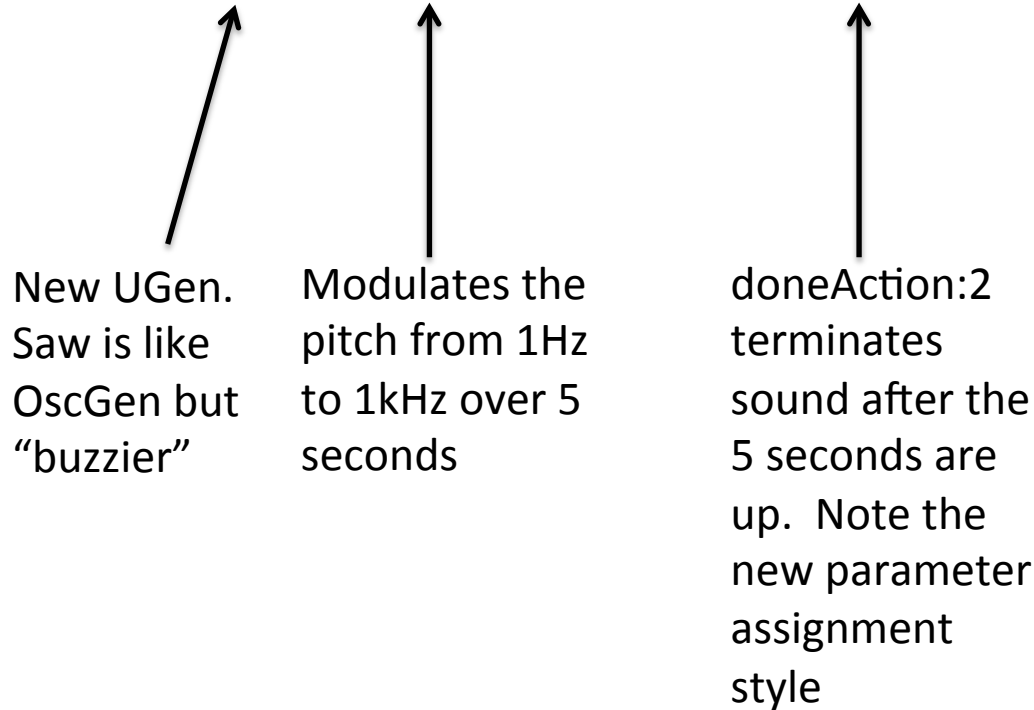
- Use the Scope to see the difference when using Mix

Line Generators

- Generate a “line” from one audio value to another (like a for-loop for sound)

```
{LFSaw.ar(XLine.kr(1,1000,5,doneAction:2),0,0.2)}.play;
```

New UGen.
Saw is like
OscGen but
“buzzier”



Modulates the
pitch from 1Hz
to 1kHz over 5
seconds

doneAction:2
terminates
sound after the
5 seconds are
up. Note the
new parameter
assignment
style

A Simple Sonification

Data: Average number of days/month where the temperature was ≤ 32 degrees F (by month).

J	F	M	A	M	J	J	A	S	O	N	D
25.4	21.8	15.3	3.8	0.2	0	0	0	0	2.3	11.8	23.0

Available as: SimpleSonification.scd

from:

<http://github.com/jrimland/supercollider>

*Indianapolis, IN from 1981-2010, Source: <http://www.crh.noaa.gov>

Sonification Examples

- Sonification of Everyday Items: <http://vimeo.com/49484255#>
- Changes in tide levels(Mark Ballora -- 1:14):
<http://www.youtube.com/watch?v=aQJfQXGbWQ4>
- Sounds the Universe Makes (Janna Levin):
http://www.ted.com/talks/janna_levin_the_sound_the_universe_makes.html
- Stock trends Sonified:
<http://www.youtube.com/watch?v=S0FsBfoWLWE>

Other Cool Stuff

SoundIn – Lets you work with your voice or real instruments

OSC Interfaces – Control SuperCollider from iPads, Kinect, Wiimote, etc.

Quarks – Allow easy installation of 3rd party add-ons.

Buffer.read – Import external sound files.

