Computer Music Techniques: DSP
Week 1

Section 1:

Installing, configuring, testing and troubleshooting Pure Data

Installing Pure Data (Pd):

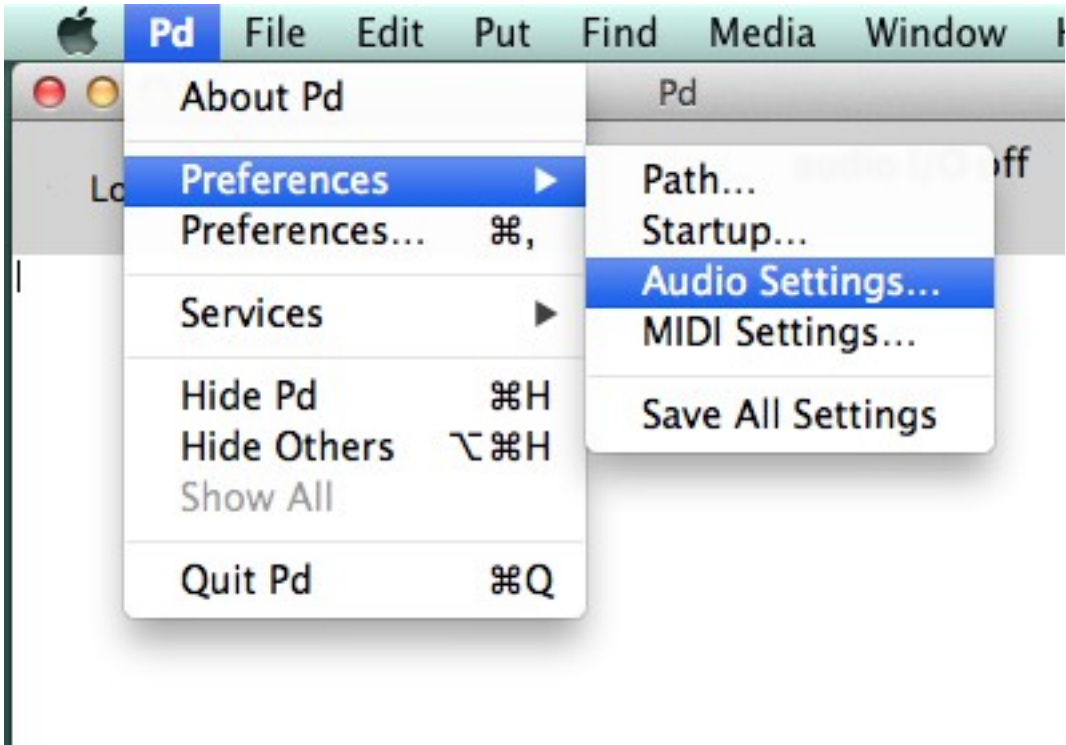
- Go to:

  http://msp.ucsd.edu/software.html
- Choose your platform, download, and uncompress the file.
- In Windows and OS X (Mac) you will see a clickable Icon.
- Current version is 0.45-2

Configuring Audio in Pd

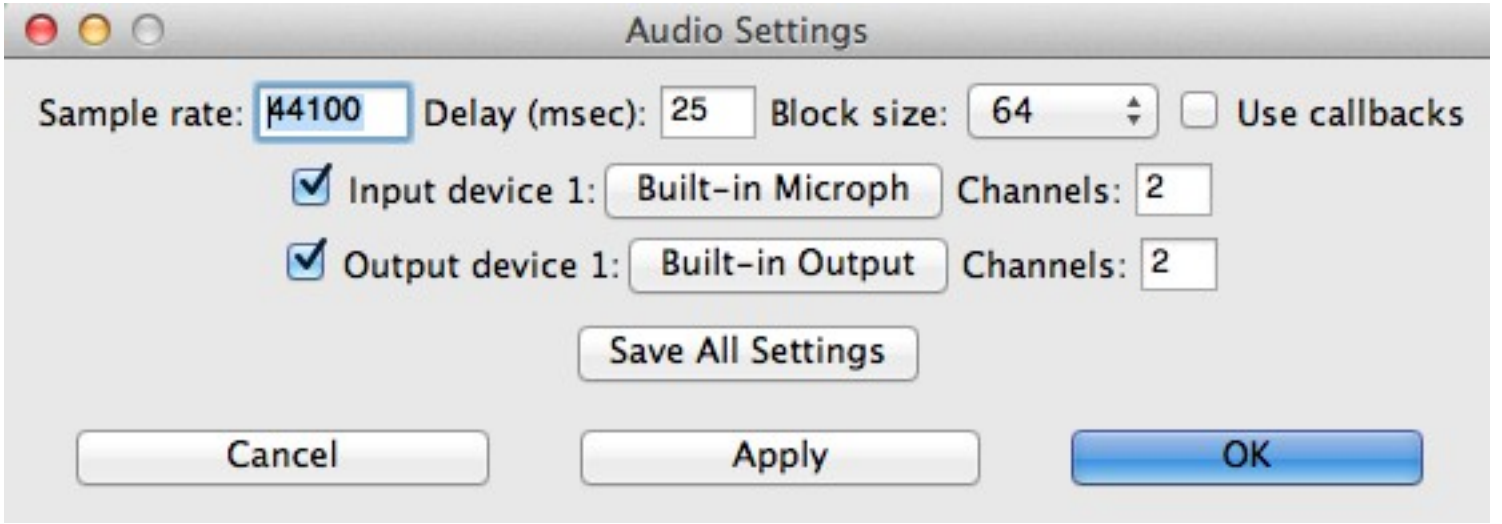
- Open Pd and open the drop down menu:
  - Pd/Preferences/Audio Settings, or
  - Media/Audio Settings

    as shown:



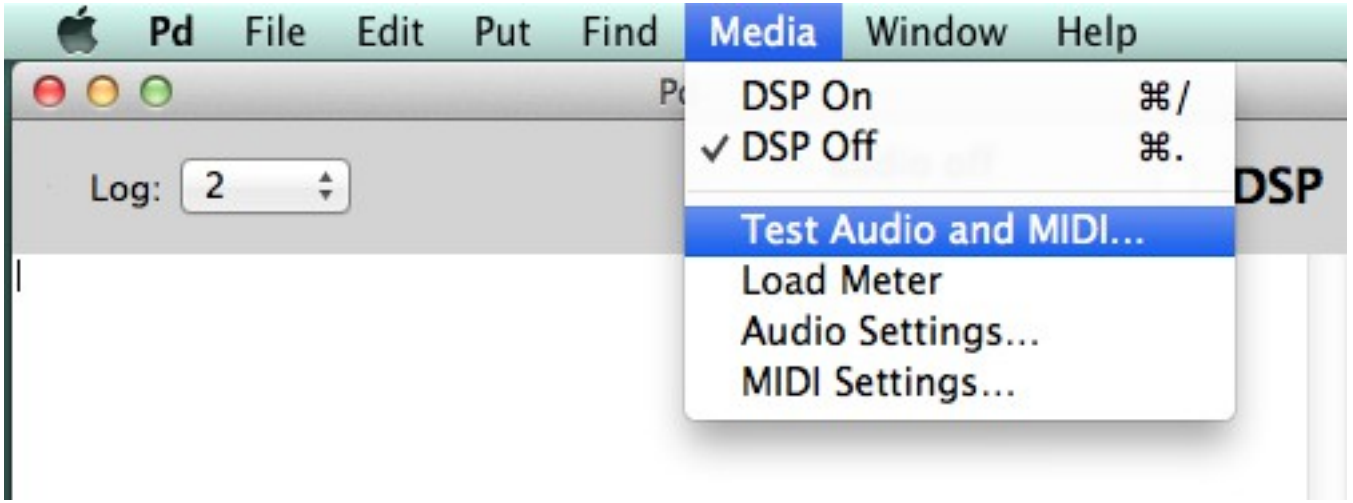
Configuring Audio in Pd

- The following window will open, and you must make sure that you have input and output devices selected. In this case the devices are the default Apple soundcard.
- Take a note of the value “Delay (msec)”



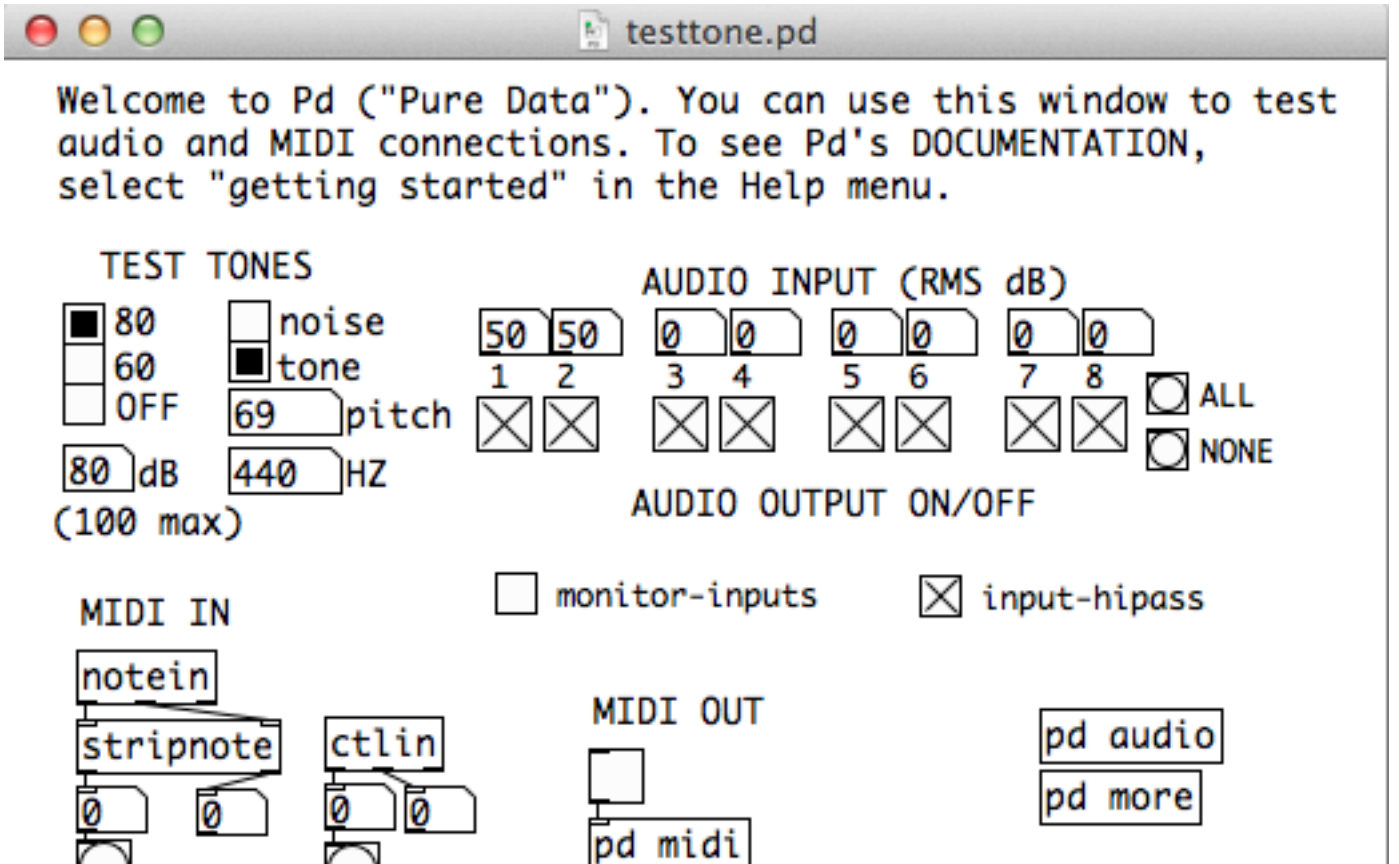
Testing Audio in Pd

- In order to test audio, go to the dropdown menu:
  - Media/Test Audio and MIDI...



Testing Audio in Pd

- The following window will open:
  - When you click in 80 (in test tones at the left, you should here a sine wave at 440Hz)...



Troubleshooting Audio in Pd

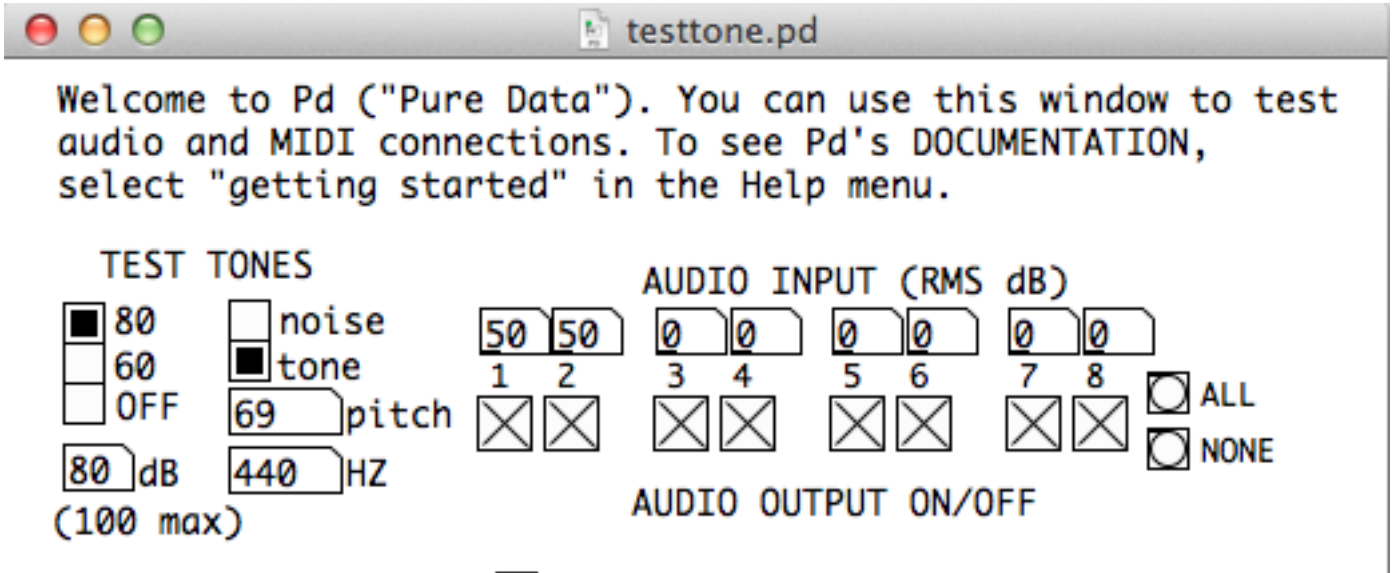
- If you have no sound at all:
  - Check the obvious, speakers/volume are on, your headphones are connected, etc.
  - Make sure a sound device is chosen in Audio Settings, that it is actually connected to your computer (if it is external), and the channels aren't more than the card can do (test by default with 2 in and 2 out).

Troubleshooting Audio in Pd

- If the sine wave has clicks and pops or is simply discontinuous:
  - Go back to Audio Settings and increase the number of milliseconds of “Delay (msec)”. If this solves it then either your soundcard is not very good or your operating system or drivers are not very good. (Very good in this case means very good for real time audio). Decent numbers should lie below 50 msec.

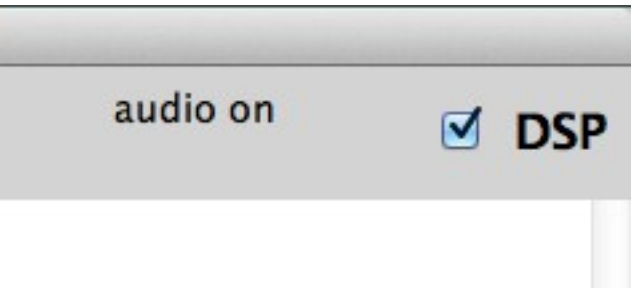
Testing Audio in Pd

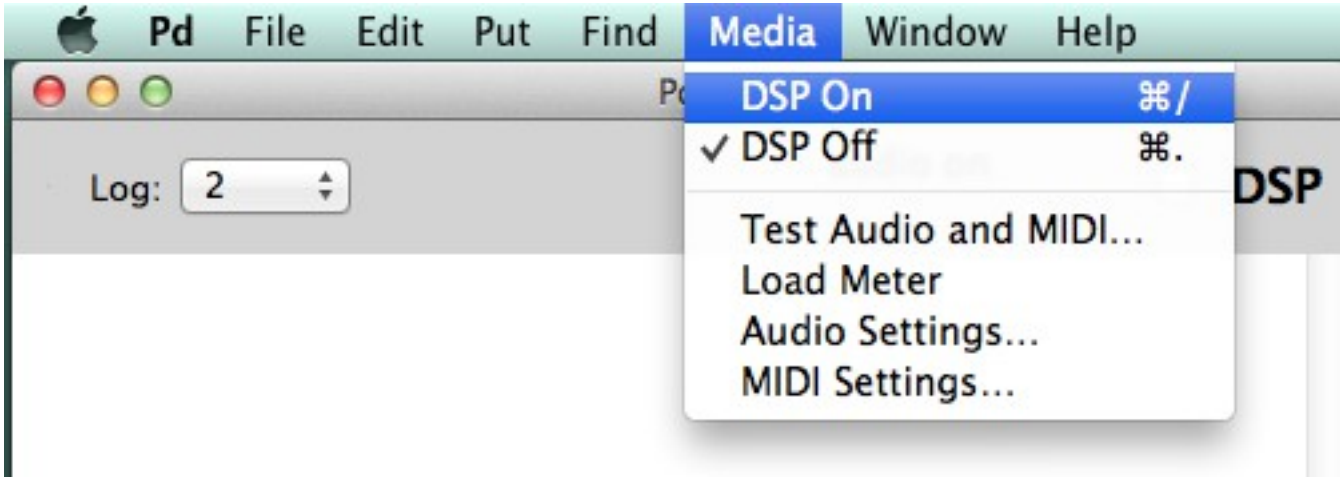
- To test input:
  - Go back to “Media/Test Audio and MIDI...”.
    - If a mic is connected you should see the numbers grow when there is sound input.
    - If a mic is not connected, the lower the number, the better your soundcard. If this number is very high, then your sound card is noisy...



Turning DSP on

- Finally, the “Media/Test Audio and MIDI...” patch will turn on DSP automatically, but you can turn it on manually:
  - By ticking the DSP box in the Pd Console.
  - Choosing “Media/DSP On”.
  - Typing “Command + / ”.





Section 2:

Larger Discussion Points

Why Pd?

Everybody has their reasons, but Pd :

- Is Free / Open Source
  - Free
  - Source is available to learn from.
- Has Less “visual features”.
- Is Written in C.
- Has Separate GUI thread.
- Is supported by an online Community.
- Is Version Compatible...

Miller Puckette <msp@ucsd.edu> August 9, 2013 2:30 PM
To: András Murányi <muranyia@gmail.com> Hide Details
Cc: pd-list <pd-list@iem.at> Inbox - Gmail 4
Re: [PD] abstraction penalty benchmarks

> Hi Miller,
>
> Just very generally BTW:
> Do you mean binary compatibility or patch compatibility?
> Either way, what are your thoughts about the possibility of a future Pd-1.0 which would break (some kind of) compatibility for the sake of revolutionary progress?
>
> András

I'm unwilling to break either patch or binary compatibility - Pd's original purpose is for interactive music and art and there is a big repertory now depending on Pd to remain runnable.

I'm willing to make minor compatibility changes protected by compatibility switches. Pd now maintains a global compatibility version number to try to facilitate this. (It was necessitated by two bugs in DSP objects, one rather serious, that I wanted to fix without breaking old patches that might depend on the buggy behavior.)

On a side note, the reason I'm so slow to add fetures to Pd is that I want to be sure that everything I do is something I'm willing to maintain for as long as I can.

cheers
Miller

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Pd-list@iem.at mailing list
UNSUBSCRIBE and account-management ->
http://lists.puredata.info/listinfo/pd-list

About this course...

4-7pm?

1 hour “lab”, and

2 hours “class”?

About this course...

Generate

Transform

Analize

Audio Signals

About this course...

- DSP or Digital Audio Signal Processing.
  - Building blocks or elements for projects.
  - Techniques focus.
- Currently considering a course for next semester, that can build on this knowledge and aim to complete patches for installations, programs ,tools, compositions, etc..
  - Interested?

Recommended Books

- Dodge, Charles, and Thomas A. Jerse. *Computer Music: synthesis, composition and performance*. Macmillan Library Reference, 1997.
- Moore, F. Richard. *Elements of computer music*. Prentice-Hall, Inc., 1990.
- Puckette, Miller. *The theory and techniques of electronic music*. World Scientific, 2007.
- Roads, Curtis. *The computer music tutorial*. The MIT press, 1996.

Section 3:

Back to Pd...

Why Sinusoids?

- One harmonic (Pure?).
- Delicate: if you hear a problem with a sinusoid, you will probably hear it with other sounds.
- You can think of a sinusoid as a single harmonic of a sound so if you do something to a complex sound, you will affect each of its harmonics.
- Fourier theorem: Any sound can be expressed as a sum of sinusoids.
- Additive synthesis: end of the semester.

Sine Wave

- Digital signals are sequences of numbers indexed by n, which we will call the sample number:

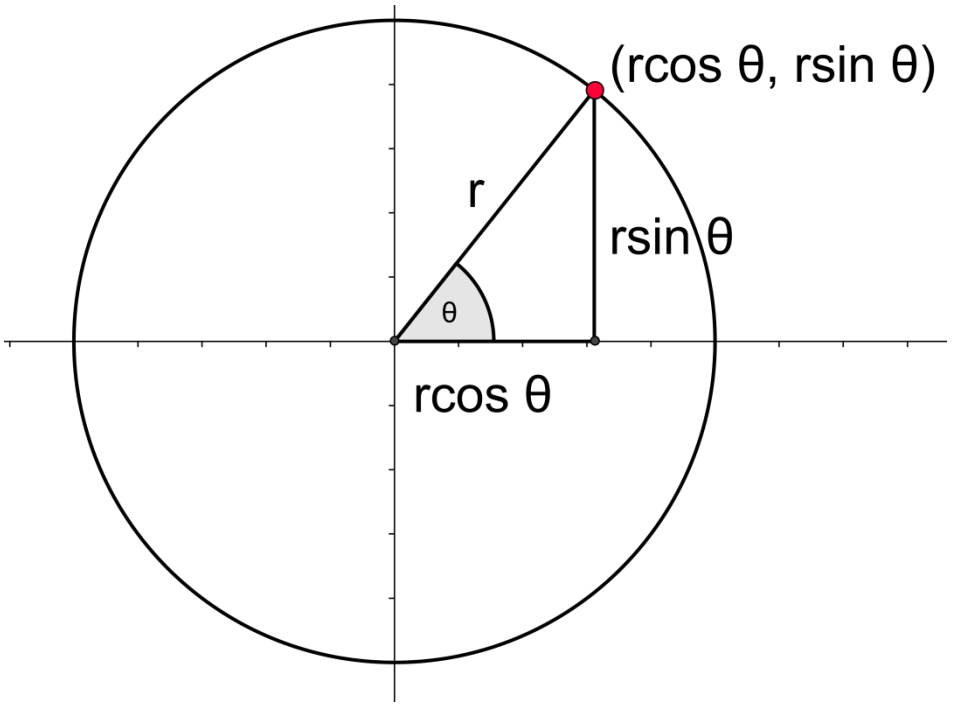
  $$\ldots, n-2, n-1, n, n+1, n+2, \ldots$$

  and audio signals can be expressed as functions of these sample numbers:

  $$\ldots, x(n-2), x(n-1), x(n), x(n+1), x(n+2), \ldots$$

Sine Wave

- A Sine is a trigonometric property:



Sine Wave

- A Sine wave can be expressed with the formula:

$$x(n) = a * sin(\omega n + \phi)$$

Where,

n = sample number,

a = amplitude,

ω = angular frequency, and

ø = phase.

Operating Pd

Edit Mode:

- “Edit/Edit Mode”, or
- Command + E.

- Edit Mode:
  - Make and Edit Patches, (values in number boxes cannot be changed, bangs cannot be banged, etc.)
- Run Mode:
  - Running patches (values in number boxes can be changed, bang can be banged, etc.)

Operating Pd

- Objects, Message, Number, Symbol, and Comment.
- To create an object, for example:
  - switch to Edit Mode,
  - then go to “Put/Object” or type “Command+1”,
  - then type the object name, in this case:

“osc~”

Operating Pd

- Signal Objects (audio rate)

  vs. Control Objects (on demand)
- Signal objects have a ~ termination.
- Signal connections are two pixels wide.