Introduction to Sound Synthesis  
John Harrison and Steve Wilson

*Fall 2006, Tuesdays and Thursdays from 8:05 to 9:20AM in Duerkson Fine Arts Center B202*

**Description:** Introduction to Sound Synthesis is a hands-on course where students design and create their own sounds. In doing so, the students will learn to program using *Pure Data* (Pd), a graphical, open-source, cross-platform programming language for sound and video. Students registering for the course are expected to have some background in the arts, electrical engineering, computer science, or mathematics, and are not expected to be proficient at each. Additionally, students are expected to have daily access to a computer for correspondence through email and the Internet.

The course will meet for between 8:05 and 9:20AM on Tuesday and Thursdays each week, and will count for three elective (790) credits. Students cannot audit the course. They must register by September 15th.

Since the course material is fairly complex and course meeting times are limited, students enrolling in the course should be self-motivated and ready to seek help from each other and from the Pd community at large, as well as from the instructors.

**The course topics will include a subset of the following:**

- A brief history of sound synthesis
- Data types used to manipulate sound
- Classic Synthesis Techniques (including additive, subtractive, FM, and wave table)
- Enveloping
- Ring Modulation
- Granular Synthesis
- Reverberation techniques
- Pitch shifting and Time stretching/shrinking
- Wave Terrain techniques
- Chorusing, vibrato, vocoder, linear predictive coding
- Filters: FIR, IIR, low-pass, band-pass, poles, Butterworth, Chebyshev, etc.
- Generators: since wave, square wave, sawtooth, pink noise, white noise, etc.
- Sequencing audio and MIDI
- Waveform editing
- The frequency domain: Discrete, Short Time, and Fast Fourier Transform, Wavelets
- A brief overview of advanced topics: including, Interfacing to microcontrollers, manipulating video

**Goals:** While it is beyond the scope of the course to give a solid background in either sound synthesis or the mathematics behind it, students who have completed the course should:

- Understand the principles of creating, manipulating, and altering synthesized sounds; have some intuition in being able to use synthesized sounds artistically and emotionally effectively; and have some appreciation of the history and development of synthesized sounds and music.

**Weekly Assignments:** Each week students will build a new software tool in Pd. These tools will later be used to construct the midterm and final project. In addition, there may be a weekly listening assignment to expose students to electronic music including both series and commercial genres. Over the course of the semester students must submit three music reviews selected from the required listening. There will also be two essays required expressing views on various philosophical issues raised in class including the
aesthetics of electronic music as well as the implications of electronic and computer-generated music.

**Midterm and Final Projects:** In place of written exams, the course will consist of a midterm project and a final project. In these projects, students will use the techniques they have been taught in the class to create their own sound sculptures or music. At least one of the projects may include integrating another media (e.g. video, live acoustic performance) with the created sounds. The final projects will be performed in at least one concert at the end of the semester. There will be weekly assignments to prepare the students for the midterm and final projects.

**Course Structure:** Although the course is purposely structured loosely, it can roughly be divided into three parts. The third part will be largely dedicated to working towards the final project.

- **Part I** will introduce concepts of sound synthesis
- **Part II** will introduce concepts of digital signal processing
- **Part III** will introduce waveform editing as well as audio and midi sequencing, and may offer an introduction to advanced topics if time allows.

**Software and Computers:**

- The primary software used in the class will be a graphical programming language called Pure Data or Pd for short. Pd was originally developed as a language tailored for sound synthesis, but has expanded to address the needs of the artist and technical community. Pd is a cross-platform open-source program, meaning it is free and will run on any operating system (Windows, OS X, or Linux).
- The course will be much easier for students logistically if they have their own computer and install the software for the class on it. For those without a computer, C-6 in Duerkson Fine Arts Center will have some available with the course software installed. The software will also be available on the Macintosh computers in the music office in Duerkson, as well as in the computer laboratory in Wallace Hall. Students needing an account for to use the computers in Wallace Hall should speak with the instructors.
- In preparation for the midterm and final project, students may wish to use some proprietary software such as Peak for waveform editing, Logic 7 for audio sequencing, and T-Racks for mastering. These applications will be available in the CRATEL lab located in Duerkson Fine Arts Center C6. Instruction on these applications will be available during the last third of the semester and outside of class time, by appointment.

**Format:** The course is structured in a non-traditional manner. Rather than the more conventional role of a teacher giving information to the students, the course will function as a community and the teacher as a facilitator. In this way, students and the teacher get to practice communicating and sharing information for the betterment of the class community. The format will be supported by:

**Class wiki:**
A wiki is a type of website that allows users to easily add and edit content and is especially suited for collaborative writing. Most of the material for the *Intro to Sound Synthesis* course is set up as a wiki, meaning that any student in the class can change the site, adding or clarifying material. Students are expected to continually add to the class wiki as a contribution to the entire class. For example, if a student finds a great resource for Pd programming tips and it is not listed on the wiki, that student should add it. If installation instructions for a particular Pd external are incorrect or missing important information, the student should also add this information to the wiki.

**Electronic mailing list:**
- All students in the class will subscribe to the course electronic mailing list. All members of the list will be able to post to it simply by writing an email to the list.
• Students will use the electronic mailing list as a way to share assignments, ask questions, seek help, or just share information pertaining to or of interest to the class. For example, most weekly assignments, such as Pd patches will be emailed into the email list/forum. **When faced with a problem in class, as an alternative to contacting the instructor, send an email to the electronic mailing list to draw upon the resources of the class community for help.**

• In addition to sharing assignments and ideas, students are strongly encouraged to respond to each other’s assignments, projects, and ideas through free discussion on the mailing list.

**Plagiarism:** It is okay for students to work together on projects, provided that each student develops in the collaboration a full understanding of all parts of the project and all students are credited. Moreover, it is okay for students to borrow from each other’s projects as long as credit is given. Plagiarism, however, is the act of stealing somebody’s work without giving credit to that person. **Anybody caught plagiarizing will receive an F for the course and will be penalized to the full extent allowed by University policy. No excuses for plagiarism will be accepted. There are no exceptions to this policy.**

**Grading:**

- Attendance and Participation: 5%
- Weekly assignments: 20%
- Listening assignments: 5%
- Music reviews (3): 10%
- Essays (2): 10%
- Midterm project: 20%
- Final project: 30%

**Late assignments and extensions:** Late assignments are marked at 10% down for each school day that they are late. As a general policy, the instructor does not give extensions for any assignments, including the midterm and final project. Once a grade has been marked down 50%, the student will receive an F for that assignment. **It is better to hand in an incomplete or non-working assignment on time than to hand in any assignment late.**

**Feedback:** The instructors will always welcome feedback about the class. Since it is sometimes easier to give feedback confidentially, a Yahoo email account is provided for anybody in the class to log into and send email from. The Yahoo email username is “cratel.comments@yahoo.com” and the password is “wsu123”.

**Responsibility:**

- Since the course material is broad and course meeting times are limited, students enrolling in the course should be self-motivated and ready to seek help from each other and from the Pd mailing list, as well as from the instructors. Resources to facilitate this will be given in the class.

  **Students are expected to check the email discussion list daily,** so that they may stay informed of announcements and changes in assignments, and they may participate in various other conversations that may be happening on the list.

- If a student misses class without receiving instructor approval beforehand, it will be the student’s responsibility to catch up on the class material.

- Students enrolling in the course should expect to spend five hours on assignments outside of the class each week.