MUS_TECH 342 Computer Sound Synthesis
Syllabus

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Who Should Take This Class? This class is designed for students intending to be active professionally in music technology. It is especially appropriate for students who may work professionally in the music/audio technology industry generating audio content or implementing technological tools.

Scope of the Class.   The focus of the class is primarily on the theory behind sound synthesis and audio processing algorithms. It is only secondarily focused on implementation and composition. This class will cover topics ranging from simple acoustics and additive synthesis to modulation and waveshaping. Topics relating to digital filtering and reverberation will be covered in MUS-TECH 335 Selected Topics: Advanced Synthesis in the winter quarter. Topics relating to fast Fourier transform techniques are covered in the class MUS_TECH 450 Advance Audio Signal Processing in the spring quarter. More in-depth compositional applications are covered in Advance Computer Composition in the spring. (Music programming is covered in much greater depth in the class MUS_TECH 338 Programming during the fall.)

Textbook "The Computer Music Tutorial" by Curtis Roads. Order it on-line right away!

Software SuperCollider is a *free* downloadable program. The primary version that we will be using is available for the Mac OS X. There is also version for Windows that lacks the support of GUI programming (among other things). There is even a Linux version that doesn't have very good reviews. I strongly recommend using the Mac version.

To download SuperCollider for Mac OS or Windows:
1. Go to http://www.audiosynth.com/
2. Click on "Download SuperCollider Server for MacOS X from here" (Windows people do this even though it doesn't make sense.)
3. Following the instructions and download where you want it.
4. Has to be decompressed before being installed where you put your applications.

Kresge 1-360 (Animate Arts room). Our classroom space is also a lab space. It is available for use whenever classes are not in session. Individual access to the room is available with a specially coded key. The requires a $50 deposite.

Music Library. SuperCollider is also installed on the Macs in the Listening Center/Computer Lab of the Deering Hall Music Library. The hours of the Music Library Lab are Monday - Thursday: 10:00 a.m. - 10:00 p.m., Friday: 10:00 a.m. - 5:00 p.m., Saturday: 1:00 p.m. - 5:00 p.m. and Sunday: 1:00 p.m. - 10:00 p.m. In order to start SuperCollider in the Music Library Lab:

      1. Double-click on the Macintosh HD icon.
      2. Double-click on the Home icon.
      3. Double-click on the Applications folder.
      4. Double-click on the SuperCollider_f folder.
5. Double-click on the SuperCollider application icon.

SuperCollider comes with a huge amount of built in documentation. It is your best source of helpful information. You will also be receiving copies of the lectures as SuperCollider documents that you can read. There is a supplemental text by David Cottle that you might want to have a copy of. It is available at:

      http://home.comcast.net/~dmcottle/rb2/

Assignment: Sound Synthesis Notebook

Over the span of the course, you will construct a notebook that reflects the knowledge you have acquired. The Notebook should both capture the evolution of your experience in the class and represent a summary of what you have learned.

Each person comes to this class with a unique background. One function of the Notebook is to be a vehicle for you to construct a representation of what <u>you</u> have gathered from this course in a way that is relevant to you. This assignment also puts the course's emphasis on your process of integrating information from lectures, readings, etc. The Notebook ought to be an information resource you can keep after the class is over. The Notebook assignment also asks that you take time to reflect on the nature of your learning experience in the class and seek to relate the class to your everyday experience.

Work on the Notebook should be accumulative. This assignment preferences consistent day-by-day, week-by-week work. Don't even think about putting it off. Get started today.

Format. The Notebook must be created with a word processing program that enables the various sections to be expanded incrementally. For your own protection, be sure to make back-up copies of your computer files on separate disks! Programming assignments will be SuperCollider files.

Organization. Your Notebook <u>must</u> contain the following two sections:

    I. Synopsis of Audio Synthesis and Processing Theory as Presented in Lecture and Readings. Write a synopsis of the topics covered in the class. Nearly every topic is supported by class lectures and readings. <u>Synthesize</u> the information into a whole

and construct an organized, concise summary of the material. (Do not simply include your lecture notes!) Organize your text by topics like the "Schedule of Topics" and use subject headings and subheadings to help organize the material. (Do not include lecture dates or general impressions of lectures!) Write full sentences and complete paragraphs. (Do not write sentence fragments and constantly make lists.)

II. Diary. Personal reflections (at least one for every week) that capture the evolution of your reactions to and ideas about the class topics. This is also the place to provide feedback (positive and negative) to the instructor on how well the course is serving you. Organize the Diary by the date of the entry.

Periodic Review by Instructor. The Notebook will be turned in for periodic review and comments by the instructor during the 3rd-4th and 6th-7th weeks. You may be requested to turn in Notebooks on additional dates.

Final Version. The Final Version is due on **Monday, December 5, by 9am.** Don't be late and don't ask for an extension. Turn it in.

Turning In Your Notebook. Turn in your Notebook at room 123 of the Music Administration Building.

Picking Up Your Notebook. Notebooks will be available for pickup in room 123 after grades have been submitted.

Assignment: Synthesis in SuperCollider

The programming of synthesis examples in SuperCollider will be assigned in class. These programs should be turned in to the instructor electronically.

Final Grade. The course grade will be based 75% on the notebook and 25% on SuperCollider assignments.

Schedule of Topics

Abbreviation for Cited Source
    ROADS   Curtis Roads, *The Computer Music Tutorial,* MIT Press, 1996.

I. Fundamentals of Digital Signals (Weeks 1-3)
    Topics:
        Background: History of Digital Audio Recording, Fundamentals of Physical Acoustics, Analog Representation, Digital Representation, Dynamic Range, Introduction to SuperCollider
    Reading:

"Digital Audio Concepts" Curtis Roads with John Strawn, Chapter 1, ROADS

Synthesis Assignment:
Assignment #1: Getting Started with SuperCollider

II. Sound Synthesis Software and Tone Generation (Week 3-5)
Topics:
Background: History of Digital Sound Synthesis, Fixed-waveform Table-lookup Synthesis, Table-lookup Noise and Interpolating Oscillators, Time-varying Waveform Synthesis, Structure of Software Synthesis Programs, Real-time Digital Synthesis with SuperCollider

Reading:
"Introduction to Digital Sound Synthesis" Curtis Roads with John Strawn, Chapter 3, ROADS

Synthesis Assignment:
Assignment #2, Tones and Envelopes

III. Timbre of Musical Instruments (Week 6)
Topics:
Analysis of musical tones, dynamic spectra, perceptual studies of timbre

IV. Modulation (Weeks 7-8)
Topics:
Ring Modulation, Amplitude Modulation, Frequency Modulation. Multiple-Carrier FM, Multiple-Modulator FM, Feedback FM, Phase Distortion, Waveshaping Synthesis

Reading:
"Modulation Synthesis," Chapter 6, ROADS

Synthesis Assignment:
Assignment #5, FM
Assignment #6, Waveshaping

V. Special Signals, Sampling and Additive Synthesis (Weeks 9-11)
Topics:
Special Signals, Sampling Synthesis, Additive Synthesis, Additive Analysis/Resynthesis, Multiple Wavetable Synthesis, Wave Terrain Synthesis, Granular Synthesis

Reading:
"Sampling and Additive Synthesis," Chapter 4, ROADS
"Multiple Wavetable, Wave Terrain, Granular, and Subtractive Synthesis," excerpt, Chapter 5, pp. 159-184, ROADS

Synthesis Assignment:
Assignment #7, Additive Synthesis
Assignment #8, Granular Synthesis