Digital Sound for the Arts

Syllabus

Instructor: David Kant

OVERVIEW

This course is an introduction to digital sound. Sound is an interdisciplinary medium, used not just in music, but in film, animation, theater, sound design, poetry, anthropology, and beyond. Intended for students of any discipline, this course teaches the theory, tools, and techniques of digital sound. We will work with a variety of freely available software tools to explore sound perception, construction, and manipulation. This course will also survey the use of sound across the arts and sciences, including guest presentations by UCSC faculty from a range of disciplines. The goal of this course is to give students the knowledge and tools to work with digital sound in any field.

This course is designed for all students—non-majors, music majors, arts majors, and graduate students. While there are no prerequisites, the course will be taught at a high level, sophisticated enough to suit majors and graduate students. This course is intended for a wide, general audience, teaching the use of sound across disciplines. The class sessions are structured as a series of workshop / lectures on selected topics in modern digital sound, beginning with foundations and ending with sophisticated topics in modern audio signal processing. The accompanying assignments are short exercises and tutorials.

LEARNING OBJECTIVES

[1] understand digital sound theory and the physical phenomena of sound

[2] literacy in the tools and the technologies of digital sound

[3] produce work in digital sound media

[4] critical thinking about both the technical and artistic merit of digital sound work

[5] knowledge of the digital sound art repertoire, both historical and contemporary

COURSE MATERIALS

Textbooks

There are two main textbooks. Both are available online for free.

- Polansky, Larry, Douglas Repetto, Dan Rockmore, Mary Roberts, and Phil Burk. *Music and Computers: A Theoretical and Historical Approach.* Columbia University CMC, 2011. Online textbook. (http://music.columbia.edu/cmc/musicandcomputers/)

- Farnell, Andy. *Designing Sound.* Cambridge, Mass: MIT Press, 2010. UCSC Electronic Resource.

Software

Regular access to a computer is necessary. Students are encouraged to work on their own machines. All software will also be available in the Music Center and Porter College Arts Computer Labs. All software is available online for free.

- **Reaper**
  a digital audio workstation environment
  (http://www.reaper.fm/)

- **Audacity**
  an audio editor and sound recorder
  (http://audacity.sourceforge.net/)

- **Pure Data**
  a visual programming language for audio and multimedia
  (http://puredata.info/)

- **SuperCollider**
  a text-based programming language for audio synthesis
  (http://supercollider.sourceforge.net/)

- **SoundHack**
  an application for sound manipulation
  (http://www.soundhack.com/)

- **SPEAR**
  an application for spectral analysis, editing, and re-synthesis
  (http://klingbeil.com/spear/)

WORK and CRITERIA

There will be weekly readings, weekly assignments, and a final project. While the class lectures will focus on digital sound theory, the assignments will focus on software tools. The assignments will explore the practical implementation of the ideas introduced in lecture. Students will be asked to make small creative pieces, do technical exercises, complete software tutorials, and explore software examples.

The final project is an opportunity for students to work in the contexts of their own fields. The course covers a range tools, techniques and approaches to digital sound. Ideally, the students will represent a range of disciplines. Students may work individually or in groups.

Students will be evaluated on weekly assignments and final projects. Weekly assignments will be evaluated according to demonstration of technical skill and understanding. Final projects will be evaluated according to a clear idea for the use of sound, how well that purpose is accomplished, and the technical treatment of sound. Work is weighted 20% class participation, 30% weekly assignments, and 50% final projects.

SCHEDULE

week 1	**Course Introduction** • overview, syllabus, my work **Principles of Digital Audio** • sampling theory • decimation / bitcrushing **Pd:** intro to Pure Data (Pd)	**Reading** • Designing Sound – [3] Using Pure Data • Music and Computers – The Digital Representation of Sound Part One **Assignment** • Assignment 1: Hello Pd!
	Digital Sound Synthesis • oscillators • additive synthesis • subtractive synthesis • modulation synthesis • waveshaping synthesis • granular synthesis **Pd:** audio patching in Pd	**Reading** • Designing Sound – [4] Pure Data Audio • Music and Computers – The Digital Representation of Sound Part Two **Project** • Project 1: Musical Automaton
week 2	**Project 1 Presentations** • student presentations, ~10min each **Modular Design Structures in Pd** • abstraction • encapsulation • I/o	**Reading** • Designing Sound – [5] Abstraction **Assignment** • Assignment 2: Polyphony
	Sonification • history • examples • techniques Start thinking about your Final Projects	**Reading** • Barrass, Kramer – Using Sonification • Scaletti – Sound Extract Meaning **Project** • Project 2: Sonification
week 3	**Project 2 Presentations** • student presentations, ~10min each **Spectral Analysis, Editing, & Synthesis I** • history of spectrum analysis • overview of the Fourier Transform • FFT in Pd	**Reading** • Music and Computers – The Frequency Domain • Computer Music Tutorial – [13] Spectrum Analysis **Assignment** • Assignment 3: Final Project Proposals

	Spectral Analysis, Editing, & Synthesis II • FT, FFT, DFT, STFT **FERP** listening 8-channel playback **E-mu** synth demonstration	**Reading** • SoundHack • Spear • iZotope RX • Sony Layers **Project** • Project 3: Spectral Processing
week 4	**Project 3 Presentations** • student presentations, ~10min each **Visual Music** • history / examples • visual programming in Pd • Pd + Processing via OSC	**Reading** • Dupuis – Extending the Optical **Assignment** • Assignment 4: Spectral Filtering
	Video Game Sound • guest speaker Phillip Hermans	**Reading** • Hermans – Composing Video Games • Video Game Music Reading List • Musicy Games / Gamey Musics **Project** • Final Projects (due last class meeting)
week 5	**Project 4 Presentations** • student presentations, ~10min each **Machine Listening** • auditory scene analysis • source separation (NMF, PLCA) • music similarity • bregman toolkit	**Reading** • Casey – Soundspotting: a new kind of process? • Foote – Visualing Music and Audio Using Self-Similarity • Bregman – Auditory Scene Analysis • Kant – Source Separation Primer **Assignment** • Work on your final projects
	Final Project Presentations	