AUDI 311 Digital Audio Effects Programming

SP2024

Course Details

Credits: 3
Prerequisites: AUDI 103 Audio Theory and Systems and PROG 101 Programming I or AUDI 103 Audio Theory and Systems and PROG 110 Art of Code
Time: Thursday, 12:30-3:20 PM
Place: Building 33, Room 618
Instructor: Teerath Majumder
Instructor Email: tmajumder@colum.edu
Office Hours: Wednesday and Thursday, 3:30-5:30 PM

Course Description

This course provides an in-depth exploration of the real-time digital audio processes behind the most common types of audio effects. These processes include basic signal modification (e.g. gain, pan, combining signals), filtering and equalization, delay-based effects and modulators, dynamic range processors, distortion effects, and analysis/resynthesis. Students will design and program working examples of these processes in a high-level audio programming language, preparing the ground for designing, programming, and implementing audio plug-ins.

Learning Outcomes

Students successfully completing this course will

- understand the audio processes underlying some of the most common digital audio effects,
- create functional examples of digital audio effects using a high-level programming language, and
- demonstrate basic, effective design and workflow strategies for creating audio processing software tools.

Activities

- Lectures on concepts and theories behind audio effects, and implementing such effects using Max
- Demonstration of tools used to program audio effects
- Readings
- Quizzes
- Programming assignments
- Final project

Evaluation

Students will be evaluated on their performance in three quizzes, three programming assignments, a proposal for a final project, and a final programming assignment accompanied by a short paper (1000-2000 words). The assignments will be weighted as follows:

- Quizzes - 30%
- Programming assignments - 40%
- Final project - 30%
    - Proposal - 5%
    - Program - 15%
    - Paper - 10%

The grading rubric for the programming assignments and the program for the final project is as follows:

Meeting technical requirements	5
Elegance of code	3
Clarity of comments	2
Total	**10**

The grading rubric for the proposal is as follows:

Description of program	2
Timeline of implementation	1
Research plan	1
Bibliography	1
Total	**5**

The grading rubric for the paper is as follows:

Implementation process	1
Research findings	1
Evaluation of outcome	1
Difficulties faced	1
Possible improvements	1
Total	**5**

If a student is unable to turn in their work by the posted deadline, they must inform the instructor in advance. Otherwise,10% of the score will be deducted for every 24 hours beyond the posted deadline.

Grading Scale

93% ≤ A ≤ 100%	73% ≤ C < 77%
90% ≤ A- < 93%	70% ≤ C- < 73%
87% ≤ B+ < 90%	60% ≤ D < 70%
83% ≤ B < 87%	0% ≤ F < 60%
80% ≤ B- < 83%	I = Incomplete
77% ≤ C+ < 80%	

Texts

There are no required textbooks. However, the following are some resources that students are encouraged to consult:

- Wakefield and Taylor, *Generating Sound and Organizing Time: Thinking with gen~ Book 1*
- Dobrian et al., *Max Cookbook*
- Dobrian et al., *Computer Music Programming*

Hardware Requirements

Students must bring their own laptop and a pair of headphones to the class to participate fruitfully in the classroom activities.

Software Requirements

Students are expected to install Max on their computers. The software will be used for demonstrations, class activities, and assignments. Temporary licences for Max will be provided by the college as needed.

Communication

Students are encouraged to reach out to the instructor with any questions regarding the course through Canvas messages.

Academic Honesty

Collaboration between students in this course is strongly encouraged. Students are urged to exchange ideas, opinions, and information constantly, and to help each other with research and projects. However, each student is responsible for the completion of their own assignments.

In this class, you will be expected to attribute due credit to the originator of any ideas or words that you incorporate into your own work. **Any borrowed text, code, and sound must be cited.**

Disability

If there are conditions that prevent a student from attending classes or participating fully in academic activities, the student is encouraged to consult Services for Students with Disabilities as soon as such conditions present themselves.

General Reference

School of Media Arts: Tom Dowd, Interim Dean - tdowd@colum.edu
Department of Audio Arts and Acoustics: Ben Sutherland, Chair - bsutherland@colum.edu (department phone: 312-369-8820)

Semester Schedule

Week	Module	Lecture Topic	Activity	Assignment
1		Introduction to Max	Introductions, experimenting with buffer, introducing gen~	
2	Time domain	Understanding delay	Exploring the effects of different delay times, and feedback and feedforward loops	
3		Delay and reverb	Creating space with delay	Quiz 1
4		Filters I	Affecting the frequency content of sounds with delay	
5		Filters II	Affecting phase relations with delay	Programming assignment 1
6		Modulating delay	Creating chorus and flange effects	
7		Dynamics processing	Creating compressors and expanders	Quiz 2
8		Distortion	Experimenting with different transfer functions	
9		Amplitude modulation	Creating a frequency shifter	Programming assignment 2
10	Frequency domain	Understanding FFT	Performing DFT by hand	Final project: proposal
11		Spectral filtering	Experimenting with vocoder	
12		Phase vocoding	Creating a pitch shifter/ time stretcher	Programming assignment 3
13		Spectral distortion	Exploring unusual techniques of resynthesis	
14	Hybrid	Granular techniques	Experimenting with granular reverb	Quiz 3
15				Final project: program and paper