New Directions in Computing:

Audio Plugin Software Engineering

COMS 3997: Spring 2021

Instructor Info

Mark Santolucito

Office Hrs: TBA

505 Milstein

msantolu@barnard.edu

Course Info —

Prereq: COMS 3157

Monday

75 min Lecture, 1x/week

Virtual

Capped at 15 students

Overview

In this course, we explore how audio plugins are made, from conception to deployment. Audio plugins are a critical component of modular digital audio production and Digital Audio Workstations (DAWs). Our focus will be on the modern audio plugin format of VST3, though the lessons we learn will apply to the development of many audio applications. We will cover the software engineering "best practices" that are employed for audio plugin development (and software engineering projects more generally). In addition to frameworks for handling digital audio, we will cover techniques such as version control, continuous integration, testing, and software protection and licensing. We will additionally gain hands-on experience with the UI/UX design and prototyping process for audio plugins. This course assumes a basic familiarity with audio DSP concepts, such as delays, filters, and additive synthesis. This course also assumes a basic familiarity with C++ concepts.

Grading Scheme

10%	Participation
15%	Audio Plugin project with JUCE (individual)
15%	Audio Plugin project tool of your choice (individual)
20%	In-class presentation
30%	Final Project (group)

Learning Outcomes

- Ability to organize and manage software development infrastructure
- An understanding of the tools and technologies used in the audio industry for plugin development
- A conceptual framework for the thought, design, and development processes that go into the creation of commercial software products.
- Hands-on experience with state-of-the-art software engineering techniques

Material

Required Text (available through Columbia Library)

Designing Audio Effect Plugins in C++ For AAX, AU, and VST3 With DSP Theory, Will C. Pirkle, 2019

Recommended Text

Intro to Audio Plugin Development, Jacob Penn, Output `https://www.kadenze.com/courses/intro-to-audio-plugin-development/info`

Late Policy

Any late assignment (that is submitted before the due date) will be docked 10% of total possible points on that assignment, up to two weeks after original due date, at which point no credit will be awarded. This policy does not apply to the final project, which cannot be accepted after the due date except in exceptional circumstances.

Class Attendance Policy

Beyond the 10% of your grade that is allocated to participation as stated above, you are expected to attend every class period. Excessive absences will require consultation.

Class Laptop Policy

Some classes will require the use of laptops. If using a laptop in class is not possible for any student, we will pair program. In class meetings that do not explicitly note the need for a laptop, all digital assistants (laptops, phones, smart watches, AR glasses, etc) should be stored for the entirety of class.

FAQs

Will I learn how to use a DAW?

No, this course will focus the technology underlying DAWs, but only touch on their use a musical tool.

Will we spend time producing music in the class?

We will dedicate no more time to the use of audio plugins than is necessary for understanding their development process.

Do I need to have a strong background in music?

No, but you should have a background in audio DSP.

Can I make a career from developing audio plugins.

Possibly. To be safe, this course will teach you software engineering foundations that will be useful both the development of audio plugins, as well as program code in general.

Honor Code

You are expected to hold yourself to the highest standard of academic integrity and honesty, as reflected in the Barnard Honor Code. Approved by the student body in 1912 and updated in 2016, the Code states:

We, the students of Barnard College, resolve to uphold the honor of the College by engaging with integrity in all of our academic pursuits. We affirm that academic integrity is the honorable creation and presentation of our own work. We acknowledge that it is our responsibility to seek clarification of proper forms of collaboration and use of academic resources in all assignments or exams. We consider academic integrity to include the proper use and care for all print, electronic, or other academic resources. We will respect the rights of others to engage in pursuit of learning in order to uphold our commitment to honor. We pledge to do all that is in our power to create a spirit of honesty and honor for its own sake.

Wellness Statement

It is important for undergraduates to recognize and identify the different pressures, burdens, and stressors you may be facing, whether personal, emotional, physical, financial, mental, or academic. We as a community urge you to make yourself–your own health, sanity, and wellness–your priority throughout this term and your career here. Sleep, exercise, and eating well can all be a part of a healthy regimen to cope with stress. Resources exist to support you in several sectors of your life, and we encourage you to make use of them. Should you have any questions about navigating these resources, please visit these sites:

- `http://barnard.edu/primarycare`
- `https://barnard.edu/about-counseling`
- `http://barnard.edu/wellwoman/about`
- Stressbusters Support Network

Center for Accessibility Resources & Disability Services

If you believe you may encounter barriers to the academic environment due to a documented disability or emerging health challenges, please feel free to contact me and/or the Center for Accessibility Resources & Disability Services (CARDS). Any student with approved academic accommodations is encouraged to contact me during office hours or via email. If you have questions regarding registering a disability or receiving accommodations for the semester, please contact CARDS at (212) 854-4634, cards@barnard.edu, or learn more at `barnard.edu/disabilityservices`. CARDS is located in 101 Altschul Hall.

Affordable Access to Course Texts & Materials

All students deserve to be able to study and make use of course texts and materials regardless of cost. Barnard librarians have partnered with students, faculty, and staff to find ways to increase student access to textbooks. By the first day of advance registration for each term, faculty will have provided information about required texts for each course on CourseWorks (including ISBN or author, title, publisher, copyright date, and price), which can be viewed by students. A number of cost-free or low-cost methods for accessing some types of courses texts are detailed on the Barnard Library Textbook Affordability guide (library.barnard.edu/textbook-affordability). Undergraduate students who identify as first-generation and/or low-income students may check out items from the FLIP lending libraries in the Barnard Library (library.barnard.edu/flip) and in Butler Library for an entire semester. Students may also consult with their professors, the Dean of Studies, and the Financial Aid Office about additional affordable alternatives for having access to course texts. Visit the guide and talk to your professors and your librarian for more details.

Class Schedule

The semester will consist of student presentations each week. The week you present, you should also submit demo code on the topic of your presentation - this constitutes Assignment 2. Before your presentation, you must meet with the instructor at least two times prior to review your presentation.

Three weeks are *grab-bag* topics. Choices could be:

- Pirkle, Chapters 10.1-10.15, 11, 12, 13, 16, 17, 18, 19, or 20
- Writing Audio Plugins in Rust
- Writing Audio Plugins in iPlug2
- Using Audio Plugins in SuperCollider

MODULE 1: Audio Plugins with JUCE

Week 1	Class introduction + Intro to DAWs and Audio Plugins	
Week 2	Audio Plugins with JUCE (Setup + Hello world/gain control)	Pirkle, Ch. 1: Introduction
		Penn: Session 2: Parameters, Components & Listeners
Week 3	Student Presentation	Pirkle, Ch. 2: Anatomy of an Audio Plugin
		Pirkle, Ch. 8: C++ Conventions and How to Use This Book
		Assignment 1 due - Gain control plugin
Week 4	Student Presentation	Pirkle, Ch. 14: Delay Effects and Circular Buffers
		Penn: Session 3: Delays, Circular Buffers & Interpolation
Week 5	Student Presentation	Pirkle, Ch. 15: Modulated Delay Effects
		Penn: Session 4: Chorus, Modulators, and Statefulness
Week 6	Student Presentation	grab-bag topic - see above
Week 7	Student Presentation	grab-bag topic - see above
Week 8	Student Presentation	grab-bag topic - see above

MODULE 2: Audio Plugin Deployment

Week 9	Audio Plugin Industry Insights (Guest Lecture)	
Week 10	Student Presentation (Prototyping and User Testing with WebAudio)	
Week 11	Student Presentation (Deploying Executables, Rights Protections, and Open Source)	
Week 12/14	Final Project work	Submit an Audio Plugin of your design. You may work as a group.

Disclaimer

This syllabus, the nature and number of projects, readings, topics, etc, are subject to change either by necessity or design. Any changes will be reflected in a new syllabus and/or announced in class and on Courseworks.