Sonic Programming | MART 420 Syllabus

Date modified: Aug-30-2021

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Course Overview

- Name: Sonic Programming
- Course Number: MART 420.01
- CRN: 76029
- Term: Fall, 2021
- Credits: 3
- Location: McGill 127 (Mac Lab) and McGill 123 (Sound Studio)
- GitHub Link: https://github.com/Montana-Media-Arts/sonic-programming
- Date/Time: Fridays 10:00 am - 12:50 pm
- University Unit: School of Visual and Media Arts (SVMA), College of the Arts and Media (CAM), University of Montana

Professor/Instructor

- Michael Musick, PhD
- E-Mail: michael.musick@umontana.edu.
- Office: McGill Hall, 232
- Office Hours:
- In-person (McG 232): Monday's noon-1pm
- Virtual via Appointment from Link: calendly.com/michael-musick
    - Please select a meeting time from availability via the Calendly web service. This will then provide you with a zoom link

Description

In *Sonic Programming* students will learn how to utilize computer science based techniques to create, process, and distribute original sonic art and sound based work. This course will spend a majority of its time focused on the real-time creation of sonic art, as well as the application of concepts from interactive theory and interactive systems. This course combines students skills and technique in creative coding and sonic arts together.

In a time with an increasing number of job opportunities that require individuals to be capable of not only creating custom content, but of creating custom content that is live with interactive opportunities, it is important that artists become capable of utilizing technologies that allow for this. There are many tools available to artists to create these types of artworks. Fortunately, the principles underlying most of these technologies are transferable. Therefore, it is critical that artists learn at least one of these environments at a deep level. The knowledge and skills developed in one are then transferable to others.

This course will involve engaging classes that involve hands-on work. These will be complimented with in-class lectures on technique, critical listening to ground your work, and discussions of aesthetics as it relates to this type of sonic art. Assessment of students will be conducted through weekly sketches and two larger artworks.

Objectives & Student Learning Outcomes

Through this course, students are expected to demonstrate an ability to:

- Discuss technical and aesthetic concerns within sonic arts that relate to creating custom art via specific programming environments.
- Employ the Unit Generator paradigm in relation to real-time signal based digital environments.
- Explain an understanding of digital audio signal flow as it relates to a non-DAW based sonic art creative process.
- Create organized code and have an ability to asses organization structures in other's code as it relates to artistic ideas.
- Synthesize creative sonic art works that consider both relevant aesthetics of the medium and the technical demands of working with code.
- Present one significant sonic art work to the public.

Students are expected to bring ideas to explore these techniques and skills. The goals of the projects are not simply about the successful application of the technical processes. Instead, the goal is to integrate these elements to make work that is meaningful.

Course Format

This course will be offered as an in-person experience. Classes will include lectures on both technical topics and aesthetic considerations; critiques of student work; and lab time for student experimenting.

Pre-Requisites

Students should have completed MART 120 - Creative Coding I. It is also suggested that students have taken MART 220 Creative Coding II and MART 245 - Introduction to the Language and Practice of Sonic Art and Audio.

Books and Supplies

There are no required texts that you must purchase for this course. All readings, music, or sound examples will be available to you through web links, the library, or the class Moodle.

Headphones

You will need to acquire a pair of headphones for work in this class. I would suggest you invest in a good pair, as part of your grade will be based on the technical quality of your work. If you cannot hear issues because you have poor quality headphones, then you are risking poor grades.

You are looking for reference quality headphones. That means headphones that present your audio to you as honest and neutral as possible. A bad mix should sound like a bad mix. Hyped headphones that accentuate bass or high frequencies in flattering ways can hide detail and mix issues.

A discussion of headphones will occur on the first day of the course.

Suggested Headphones

Headphones, like all professional media gear can be cheap or incredibly expensive. With that in mind, you can get good quality headphones that don't break the bank. Here are a few of my suggestions.

Highly Suggested

- Sony MDR7506 Professional Large Diaphragm Headphone - $90 - (An industry standard for recording and working with headphones)
- Sennheiser HD280PRO Headphone - $100 - (I have had a pair of these since I was an undergrad. They are still my main pair of headphones for work when I need them. They are built to last and sound great.)

Other Recommendations

- Samson SR850 Semi-Open-Back Studio Reference Headphones - $34 - These are the cheapest that will still "get the job done".
- AKG K240STUDIO Semi-Open Studio Headphones - $67 - These are great headphones. However, they are "semi-open" which will both improve sound quality for mixing and make anyone sitting within 10 feet of you potentially stare in annoyance.
- Sennheiser HD 202 II Professional Headphones (Black) - $40
- Audio-Technica ATH-M50x Professional Studio Monitor Headphones - $145
  - There is also a wireless/bluetooth version of these, that additionally includes an optional wired connection. If you want bluetooth headphones, I would recommend these.
- beyerdynamic DT 770 PRO 32 Ohm Studio Headphone - $179

For more info, the following guide provides good information on the two major types of headphones and suggestions.

- Best Studio Headphones: The Ultimate Musician's Guide

Computer

You will need access to a computer capable of running modern audio synthesis and signal processing environments, as well as digital audio workstations (DAWs) and editing software. This computer should also be capable of real-time signal processing through analog inputs and outputs (i.e., using an audio interface or web cam). Please leverage departmental resources whenever necessary.

Software

For this semester, we will primarily be utilizing SuperCollider (SC). This tool is chosen because it is open-source, cross-platform compatible, widely used, and incredibly powerful.

> SuperCollider is a platform for audio synthesis and algorithmic composition, used by musicians, artists, and researchers working with sound. It is free and open source software available for Windows, macOS, and Linux.
>
> SuperCollider features three major components:
>
> **scsynth**, a real-time audio server, forms the core of the platform. It features 400+ unit generators ("UGens") for analysis, synthesis, and processing. Its granularity allows the fluid combination of many known and unknown audio techniques, moving between additive and subtractive synthesis, FM, granular synthesis, FFT, and physical modeling. You can write your own UGens in C++, and users have already contributed several hundred more to the sc3-plugins repository.
>
> **sclang**, an interpreted programming language. It is focused on sound, but not limited to any specific domain. sclang controls scsynth via Open Sound Control. You can use it for algorithmic composition and sequencing, finding new sound synthesis methods, connecting your app to external hardware including MIDI controllers, network music, writing GUIs and visual displays, or for your daily programming experiments. It has a stock of user-contributed extensions called Quarks.
>
> **scide** is an editor for sclang with an integrated help system.

Additionally, you will need to utilize a DAW from time to time. You are welcome to use any DAW of your choice. *Please speak with the instructor if you have questions about this.*

Course Policies

Course Evaluation

Student work and progress will be assessed through:

- In-class discussions and critiques
    - You are expected to engage with class discussions about technical and artistic issues.
    - You are expected to engage with class discussions about outside readings and listenings.
    - You are expected to engage in class critique days of the two projects.
- Sketches
    - You will be assigned sketches/compositions/exercises to practice the techniques being discussed in class.
    - These are critical to your development.
- Projects
    - There will be two larger assigned projects throughout the semester that relate to the current topics being discussed. These are the students opportunity to synthesis creative concerns and technical concerns from multiple weeks of content into singular sonic artworks.
- Project Documentation
    - Each project will require project documentation, including; a demo video, academic report describing aesthetic and technical success in relation to the larger field, and a written description.

Projects

We will have two projects throughout the course that are relevant to concepts, techniques, and creative ideas from recent content. These are the students opportunity to synthesis creative concerns and technical concerns from multiple weeks of content into singular sonic artworks.

Project grades will be based primarily on the student's ability to:

1. Demonstrate an understanding of the specific characteristics and integrative capabilities of the assigned topic through artistic output, written documentation, and technical achievement.
2. Articulate a clear and concise perspective within the artwork.
3. Present an organized artistic piece, as well as; technical report, file/program structure, and demo video.
4. Demonstrate engagement with an iterative process of ideation → creation → presentation → assessment.
5. Demonstrate creativity beyond the expected technical requirements.
6. Properly and punctually deliver all assignment files.

Please Note: All Projects are required for this course. Failure to complete and submit a project will result in a failing grade for the course. There are no exceptions to this rule. Completion of this course requires all projects be completed.

Participation

This class will be participatory, and you are expected to participate in discussions and give feedback to other students.

Grades

Final Grades

Grades will be determined according to the following breakdown:

- In-class discussions and critiques: 10%
- Sketches: 50%
- Project 1: 10%
- Project 2: 30%

Letters are assigned according to the following final course percentages:

Grade	% Range
A	`[93–100]`
A-	`[90–93)`
B+	`[87–90)`
B	`[83–87)`
B-	`[80–83)`
C+	`[77–80)`
C	`[73–77)`
C-	`[70–73)`
D	`[60–70)`
F	`[0–60)`

Late Work

IMPORTANT: Since projects are experienced as a group in class or through a public presentation, late projects are not permissible and will not be accepted.

Documentation assignments or weekly sketches handed in after the due date and time will have points deducted for lateness. This will be in addition to any points deducted for content. Those that are uploaded late but within one day of the due date will lose 5% for lateness. For those uploaded after that, the number of deducted points will be at the discretion of the professor.

Attendance

- Attendance will be taken at the beginning of every class
- Critique days are mandatory. No exceptions. No tardiness.
- Contact me in advance if you will not be in class. (email is preferred)
- Unexcused absences will affect your grade.
    - One absence is allowed; after that, your final overall grade for the course will drop by 2.5% for each additional absence.
- You are expected to work with colleagues to catch-up on what you missed.

Course Workload

This course takes time. Some things might be easier than others.

Some week's will be more intense than others. But generally, you should plan to spend 3-9 hours a week on course work outside of class.

In addition, there will be a final presentation of materials, including both a public show and potentially a broadcast on KGBA. These events will both be mandatory and dates will be provided at the start of the semester.

SVMA, CAM, and University Policies and Information

School of Visual and Media Arts

Information about the School of Visual and Media Arts (SVMA) is available at:

- https://svma.umt.edu

Please join SVMA social media to stay informed about events and happenings in our school.

- Instagram: https://www.instagram.com/umt_svma/
- Facebook: https://www.facebook.com/UMTsvma

Student Art Collective (this is primarily for art students) The collective is a student –organized and student-led group that sponsors art related workshops, events, and the Annual Juried Student Art Show. Look for informational posters. The Director recommends soliciting student participation in art classes.

Academic Honesty, Plagiarism, and Cheating Policy

Students are expected to adhere to academic conduct policies of the University of Montana as explained in Section V of your University of Montana Student Conduct Code: "Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. Academic misconduct is defined as all forms of academic dishonesty, including but not limited to: (1) plagiarism, (2) misconduct during an examination or academic exercise, (3) unauthorized possession of examination or other course materials, (4) tampering with course materials, (5) submitting false information, (6) submitting work previously presented in another course, (7) improperly influencing conduct, (8) substituting, or arranging substitution, for another student during an examination or other academic exercise, (9) facilitating academic dishonesty, and (10) Altering transcripts, grades, examinations, or other academically related documents."

Dishonesty will not be tolerated in this course. This includes, but is not limited to, cheating on tests, cheating on assignments, fabricating information or citations, having unauthorized possession of examinations, submitting work of another person or work previously used, or tampering with the academic work of other students. Academic misconduct is defined within the Student Conduct Code handbook.

Students who cheat or plagiarize will receive academic sanctions, which may include an "F" grade on the assignment, examination, and/or in the course. Students will also be reported to the Dean of Students for possible further disciplinary action.

Using Code or Media Found Elsewhere

It is easy to find code and media (i.e. videos, sounds, images, etc.) online. If you use code or media from elsewhere (which you will at times), I expect you to cite the work and author.

If you use found code, you are expected to comment each line, as to what each line does programmatically. *Do not* summarize several lines of code from a high level (i.e., TV Guide). I expect you to comment each line on a granular level. In addition, in these cases, I am also looking for significant modification of the code, for you to enact your own ideas and to experiment heavily. Significant modification means beyond variable name and value changes. It is bending these concepts to your idea, especially graphically. It is not a copy and paste job. Also, never more than 40% of your code may be supplied from elsewhere. Period. If you use code from online, whether for inspiration, modification or reference, I expect to see a link in your comments from where you got the code and who wrote it. Otherwise it will be considered as plagiarism, and you will fail the assignment. The code must have a reference, along with URL and be commented out LINE BY LINE.

If you use found media, *YOU* are responsible to ensure it is used according to fair-use guidelines. The pieces you make in this course are intended to be portfolio-quality works. Therefore, you should not utilize found media with restrictive use guidelines or licenses. You can read more about various licenses at;

- opensource.guide
- choosealicense
- GNU Licenses
- Creative Commons Licenses
- opensource.org

For found media, you are also expected to cite the media in your documentation for the project.

Sensitive Subject Matter & Censorship

This course operates under a no censorship policy, and you should feel free to experiment with challenging topics in your projects. That said - if you submit work with violent or sexually explicit themes, containing hate speech, racial slurs or other sensitive subject matter, I might contact you to request more background information on your choices.

Art scholarship and art practice along with teaching and learning involve a critical exploration of ideas, theories, art-making practices, and art movements that encompass such things as the human body, sexuality, race, gender, religions, and cultures. This course can touch upon any of the above categories with an expectation that students will actively participate in all course assignments, discussions, and tests. Given this information, it is the student's obligation to determine that the requirements conflict with his or her core beliefs. If the student determines that there is a conflict with his or her beliefs, one of the following actions needs to be taken: 1) drop the

class before the last day to drop a course without penalty; 2) meet with the instructor within the first week of classes to determine if an accommodation can be made. (Note, faculty, are not required to grant content accommodations.)

Be Kind

Be respectful to each other, help each other, and be considerate in your communications with the instructional team. No trolling shared work and ideas. Be constructive with any critical feedback you give.

Diversity Statement

Your experience in this class is important to me. I welcome individuals of all backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, races, national origins, religious affiliations, sexual orientations, ages, abilities, and other visible and nonvisible differences. Please know that I will gladly honor your request to address you by an alternate name or gender pronoun. All members of this class are expected to contribute to a welcoming, respectful, and inclusive environment for every other member of this class.

Student Support Resources

Disability and Equity Accommodations

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and the Office for Disability Equity (ODE). If you anticipate or experience barriers based on disability, please contact the ODE at: (406) 243-2243, ode@umontana.edu, or visit www.umt.edu/disability for more information. Retroactive accommodation requests will not be honored, so please, do not delay. As your instructor, I will work with you and the ODE to implement an effective accommodation, and you are welcome to contact me privately if you wish.

The Writing and Public Speaking Center

The Writing and Public Speaking Center provides one-on-one tutoring to students at all levels and at any time in the writing process. Visit now. Visit often. They're ready when you are. www.umt.edu/writingcenter.

Mental Health and Wellbeing Policy

The University of Montana is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, visit https://www.umt.edu/diversity/resources/mental-health.php

COVID-19 Specific Information

- Mask use is required within the classroom or laboratory.

- NOTE: All CAM buildings are considered active classrooms and laboratories, due to the nature of work we conduct in the arts. Therefore masks are required within all CAM buildings (including the entirety of McGill)

- If you feel sick and/or are exhibiting COVID-19 symptoms, please don't come to class and contact the Curry Health Center at (406) 243-4330.

- If you are required to isolate or quarantine, you will receive support in the class to ensure continued academic progress.

- Please reach out if you need further accommodations due to a COVID-19 case.

- UM recommends students get the COVID-19 vaccine. Please direct your questions or concerns about vaccines to Curry Health Center.

- Where social distancing (maintaining consistent 6 feet between individuals) is not possible, specific seating arrangements will be used to support contact tracing efforts.

- Class attendance and seating will be recorded to support contact tracing efforts.

- Drinking liquids and eating food is discouraged within the classroom.

- Please note this class is being recorded. Notifying students is a requirement if this is the case.
- Up-to-Date COVID-19 Information from the University of Montana
    - UM Coronavirus Website: https://www.umt.edu/coronavirus
    - UM COVID-19 Operations Plan: https://www.umt.edu/coronavirus/campus-covid-plan/default.php

As a final reminder, we (The University Community) strongly encourage you to remain vigilant outside the classroom in mitigating the spread of COVID-19. The only way for this semester to be successful and to maintain minimal interruptions to our educational mission is to ensure the safety and health of all members of our community. Please remember that, and make all decisions and choices during this time with this idea above all others; that the safety and health of our entire community is our most important goal.

In Case the Instructor Becomes Sick

If I become sick from COVID-19 during the course of this semester, I will do everything I can to maintain my teaching and mentorship, utilizing the existing modalities established for this semester. However, I will obviously be unable to utilize my university office and will therefore have to make adjustments.

If I become unable to attend weekly class sessions, I will alter the course such that you may continue with your individual projects in an appropriate manner. I will also likely ask that you continue to meet as a cohort, so that you can support each other in your research and artistic pursuits.

Land Acknowledgement

he Séliš-Qĺispé Cultural Committee created the language, *"The University of Montana acknowledges that we are in the aboriginal territories of the Salish and Kalispel people Today, we honor the path they have always shown us in caring for this place for the generations to come."*

Changes to the Course

I reserve the right to change the intended content of this course throughout the semester. This may be done to adjust for the speed of the class, to better meet educational goals, or to account for changes in technology.

Weekly Breakdown

Week 1

Part 1

Welcome and course overview

- Course Overview
- Syllabus
- Discussion of Technologies, Tools, and Supplies
    - SuperCollider
    - Headphones
- Critique Days (Mandatory)
    - Project 1 - Critique in Class; Friday, October 29th
    - Project 2 - Critique in Class; Monday, December 3rd
- Extra Meetings (Mandatory)
    - Concert Showing (Project 2) - Friday, December 3rd. From 7pm-9pm
    - KGBA Presentation (Virtual Attendance Requested) - Wednesday, December 8th. From 8pm-10pm
    - Finals Meeting (Wednesday, December 15th; 8:00AM-10:00AM)
- Class Discussion

Part 2

Listening, Inspiration, and Software Installation

- Headphone Listening and Evaluation Discussion
    - Spotify List of Suggested Tracks
- Discussion and Listening to artists that will inspire our semester.
- Install SuperCollider
- Review git & GitHub.com

Week 2

Part 1

No Class Likely for Musick Baby!

Week 3

Part 1

Installation Revisited, "Hello World", and lang vs. engine

- Review install of SC
- Discussion of
    - SCSynth
    - SCLang
    - SCIDE
- Start Your Engines (SCSynth) - Booting the Server
- String-based "Hello World"
    - `.postln`
- An SC Approach to "Hello World" (aka. your first sine wave)
    - `{SinOsc.ar()}.play;`
- Executing code by lines (shift + return)
- Declaring Code Blocks (`(  )`)
- Executing Code Blocks (cmd/cntrl + return)
- Comments
    - line comments (`//`)
    - block comments (`/* */`)

Part 2

Moving beyond static sine waves with modulation

- Controlling Amplitude
    - `mul:`
    - BinaryOpUGen
        - `SinOsc.ar() * 0.2`
- Using the mouse to change parameters.
    - `MouseX.kr` & `MouseY.kr`
    - Let's make a Theremin
- Introspection with polling
    - `.poll`
    - `.plot`
- Using `SinOsc.ar` to modulate UGen input arguments
    - Two ways of approaching Amplitude Modulation (AM Synthesis)
    - Frequency Modulation Synthesis via oscillators
- `mul` and `add`
- Error Messages
- Altering parameters in example code
- What is a "UGen"
    - Unit Generators and Synths - SuperCollider help files
    - Unit generator - Wikipedia
- Mathematical Order of Precedence
- Review Basic Data Types
    - Int

- Float
- Char
- String
- Symbol
- Array

Sketch TODO: Use MouseX/Y or Additional SinOsc UGens to play. Make an "interesting" synth that explores the relationships between these UGens. Can you recreate what we have been doing in class on your own? Do you understand what is happening? We will share results at the start of next class.

Week 4

Part 1

Audio Rate vs. Control Rate, Signal Flow, Variables, and Arguments

- Audio Rate (`.ar`) vs. Control Rate (`.kr`)
- `.plot(duration:1)`
- Variables in SynthDefs
    - `var`
- *"Global"* Variables
    - `a` - `z`
        - interpreter variables
    - `~var`
        - environment variables
- Variable scope in SC
- Arguments in SynthDefs
    - `arg`
    - using `.set(\argname, value)` to alter running synths
- Signal Flow
    - Representing Signal Flow in Code
    - Pyramid Structure or Nested Code
    - Using Variables (`var`)
    - variable reassignment

Part 2

Tour of Basic Deterministic Generator UGens, and Functions

- Tour of UGens
- Tour of Deterministic Generator UGens
    - UGens → Generators → Deterministic | SuperCollider Help
- Functions
    - `{}`

- Easy SynthDef via function notation (`{}.play;`)

Sketch TODO: Create a simple synth utilizing additive synthesis, subtractive synthesis, amplitude modulation, frequency modulation, or any other deterministic or stochastic UGens that you can play and change via mouse interaction or argument setting. We will share these at the next class.

Week 5

Part 1

"In Living Stereo", Signal Arrays, and Output

- Stereo Expansion
  - `SinOsc.ar([400, 440])`
  - `sig ! 2`
  - `.dup`
  - `[sig, sig]`
- Stereo UGens
  - `Pan2.ar()`
- Mixing down signal arrays
  - `Mix([])`
- The output UGen
  - `Out.ar()`
  - 0-based language (*including audio output Buses*)

Part 2

Envelopes and Randomness

- 1-dimensional envelopes
  - `Line.kr()` & `XLine.kr()`
  - `Decay.ar()`
- Linear Envelope
  - `linen.kr()`
- ADR, ADSR, Perc, and Custom Envelopes
  - `Env.`
  - `EnvGen.kr()`
- Using envelopes beyond amplitude control
- Plotting envelopes w/ `.plot`

- `doneAction: x`
- Looping/Triggering Envelopes
- Random Number generation on the language and server
- Data manipulation
  - `.linlin`
  - `.linexp`
  - `.range`
  - `.exprange`
  - `.clip`

Week 6

Part 1

Server-Side Sequencing

- Clock UGens
  - `Impulse`
  - `Dust`
  - `LFNoise0/1/2`
- Trigger UGens
  - `Stepper`
  - `Select`
  - `Trig1`
  - `Latch`
- Envelope Gates

Sketch TODO: Create a short algorithmic work that utilizes envelopes and server-side sequencing/triggering.

Week 7

Part 1

SynthDefs and Synths

- `SynthDef`'s
  - Loading and storing them
- Playing `Synths`
- Initializing Arguments
- Altering Synths
- Load and Play a SynthDef
- The Synth Tree/Graph
- free-ing synths

Part 2

Language-Side Scheduling and Sequencing

- Scheduling with `{}.fork` & `t.wait`
    - `.do{}` loops
    - `.stop`

- `TempoClock()`'s

- `Task({})`

- `Routine({})`

Launch Project 1
- Create a significant sonic artwork using the skills you have thus far acquired with SuperCollider and in Sonic Programming.
- This artwork may be presented as a live work that you "perform" or a fixed-work that is played back from a sound file or SC itself.
- If you create a fixed-work, please feel free to utilize a DAW to edit, mix, and master your content.
- This does not have to be a worked fully realized within SuperCollider.
- However, all sounds should originate from SC, but may be further edited together and mixed in an external environment.
- These are to be significant pieces that show engagement with the creative process as it relates to working with sonic programming.
- To that end, you should document your creative process, including;
- ideas
- tests
- personal responses
- iteration
- creative goals
- desired artistic outcomes
- Documentation should be completed through a combination of recording, git commits, and personal reflection.

Sketch TODO: Write a short work that encapsulates your synth's as SynthDefs. Then utilize language-side scheduling to launch and alter synths algorithmically.

Week 8

Part 1

Sound Input and Buses

- Processing Audio from the Real World

- - `SoundIn.ar()`
    - Warnings about feedback
  - Server Options
    - Specifying number of input or output bus channels
  - An in-depth discussion of Buses
  - Audio Buses
    - `a = Bus.audio(s,1)`
      - `a.index`
    - `Out.ar()`
    - `In.ar()`
    - `InFeedback.ar()`
    - `LocalIn.ar()`
    - `LocalOut.ar()`
    - Overwriting Buses
    - Block Processing Explained
  - Control Buses
    - `c = Bus.audio(s,1)`
    - `c.index`
    - `c.set(9)`
  - Using Buses as Synth Arguments Maps
    - `'Synth__00'.map(\freq, c.index)`

Part 2

Nodes, Groups, Effects, and Synth Order
- Nodes and the Synth Node Tree
- Order of operation
- specifying node order
- `.tail`
- `.head`
- `.before`
- `.after`
- Using Synths as Effects Processors
- Tour of Delay UGens
- `CombN/L/C`
- `Delay`
- `DelayN`
- Delay UGens | SuperCollider Help
- Tour of Filter UGens
- `LPF`
- `RLPF`
- `HPF`
- `RHPF`
- `BPF`

- `BRF`
- `Resonz`
- [Filter UGens | SuperCollider Help](#)

Week 9 - Crit Day #1

Crit Day #1

- Present Project 1 artworks in class.
- These will be critiqued in class with the whole class participating.
- Regardless of whether you work is a live or fixed piece, you should submit a fixed version to the instructor. This should be accompanied with a program/gallery note as well as longer artistic description.

Week 10

Part 1

Sound Files and Buffers

- What is a Buffer?
- The various ways the Buffers are used in audio processing environments
- Allocating Buffers
    - `b=Buffer.alloc(s, 10*)`
- Freeing Buffers
    - `b.free`
    - Discussion of the importance of freeing buffers
- Loading Audio Files into Buffers
- Playing Buffers
    - Rate
    - Direction
    - Amplitude
- Playing Back LOOOOOOONG Audio Files
- Recording SC

Part 2

Granular Synthesis

- Granular Synthesis
    - Discussion and Description
    - Theoretical Underpinnings
- Playing with Grains
- Grain Rate

- Window Functions
- Precise Timing in SC

Sketch TODO: Create a short sound work that explores the use of sound input or soundfiles along with inter-synth bussing.

Week 11

Part 1

Patterns & PBind

- Please Read:
    - "Part II - Patterns" from Bruno Ruviaro's *A Gentle Introduction to SuperCollider*
- This week is a deep dive into the world of algorithmic composition, as allowed through SuperColliders Pattern capabilities.
- Basic Pattern techniques with PBind
- Effecting and controlling everything with patterns
- Patterns Math
- Patterns in Patterns, effecting patterns.
- Creative Approaches to Algorithmic Driven Art
- **Launch Project 2**
    - You are to create a significant sonic artwork that will be presented to the public the night of December 3rd.
    - This artwork can be a performance-based work or gallery-based work.
    - This is a significant work.
    - This work is to be made exclusively within SuperCollider
        - NOTE: You may bring other media into SC, but you may not create works that are finished outside of SC as in Project 1.
    - This is to be significant pieces that show engagement with the creative process as it relates to working with sonic programming.
        - To that end, you should document your creative process, including;
            - ideas
            - tests
            - personal responses
            - iteration
            - creative goals
            - desired artistic outcomes
        - Documentation should be completed through a combination of recording, git commits, and personal reflection.

Part 2

Performance Issues with SC & Inter-App Audio Routing

- Technical considerations for SC when performing or presenting live.
- How to setup SC as a performance environment.
- How to setup SC as an installation engine.
- Inter-Application Audio Routing

Sketch TODO: Create a short artwork utilizing patterns and pattern manipulation

Week 12

Part 1

Fast Fourier Transform (FFT) Processing

- Overview of the mathematical concepts behind Fourier transforms.
- Signal Analysis in the Frequency-Domain
- Converting signals between time-domain and frequency-domain
- Frequency-Domain based processing

Part 2

Analysis and Basic Machine Listening

- How can we use audio signals as control data?
- Amplitude following
- Peak following
- Fundamental Frequency Estimation
- Frequency-Domain Analysis Techniques

{% comment %}

Week 13

Part 1

Open Sound Control

- What is the Open Sound Control (OSC) protocol
- OSC and your computer
- OSC between SCSynth and SCLang
- Inter-app communication with OSC
- Computer to Computer communication with OSC
- Using your phone to control SC
- TouchOSC
- Lemur

Part 2

Physical Computing

- Review of Arduinos, Teensy, etc.
- Communicating between Arduino and SC with Serial connection
- OSC Libraries for Arduino and Teensy
- Using an Arduino as a controller
- Controlling Arduino from SC

{% endcomment %}

Week 13

No Class: Due to Thanksgiving Break

Work on Project 2

Week 14 - Public Presentation

Part 1

Public Performance and Presentation

- During class we will setup the presentation areas and performance space for the evening show.
- For those of you presenting gallery-works, you will be responsible for setting up, cleaning, and preparing the gallery spaces.
    - After setup is complete of the spaces themselves, you may install your works and test them.
- For those of you presenting performance/concert works, you will be responsible for setting up, cleaning, and preparing the performance space.
    - After setup is complete, we will briefly sound-check each piece.
- Call for the evening presentation will be 5:00pm. Please plan to be to the space by that time.
    - Gallery spaces will open at 5:30pm.
    - The show will start around 7pm.
    - Gallery spaces will remain open for 30 minutes after the shows conclusion.

Part 2

Performance in the Evening

Week 15

Formal Critique and Wrap-up Discussion

- We will have a formal critique of presentations from last week. Please be prepared with a fixed video/audio-representation of your work.
- We will also discuss the semester, future opportunities, and directions that this work can take you.