Berkeley
UNIVERSITY OF CALIFORNIA

CNMAT

CARMINE-EMANUELE CELLA

MUSIC 158B
SYLLABUS – SPRING 2020

INSTRUCTOR

Carmine-Emanuele Cella
Assistant professor, CNMAT/Music
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PhD musical composition
PhD applied mathematics

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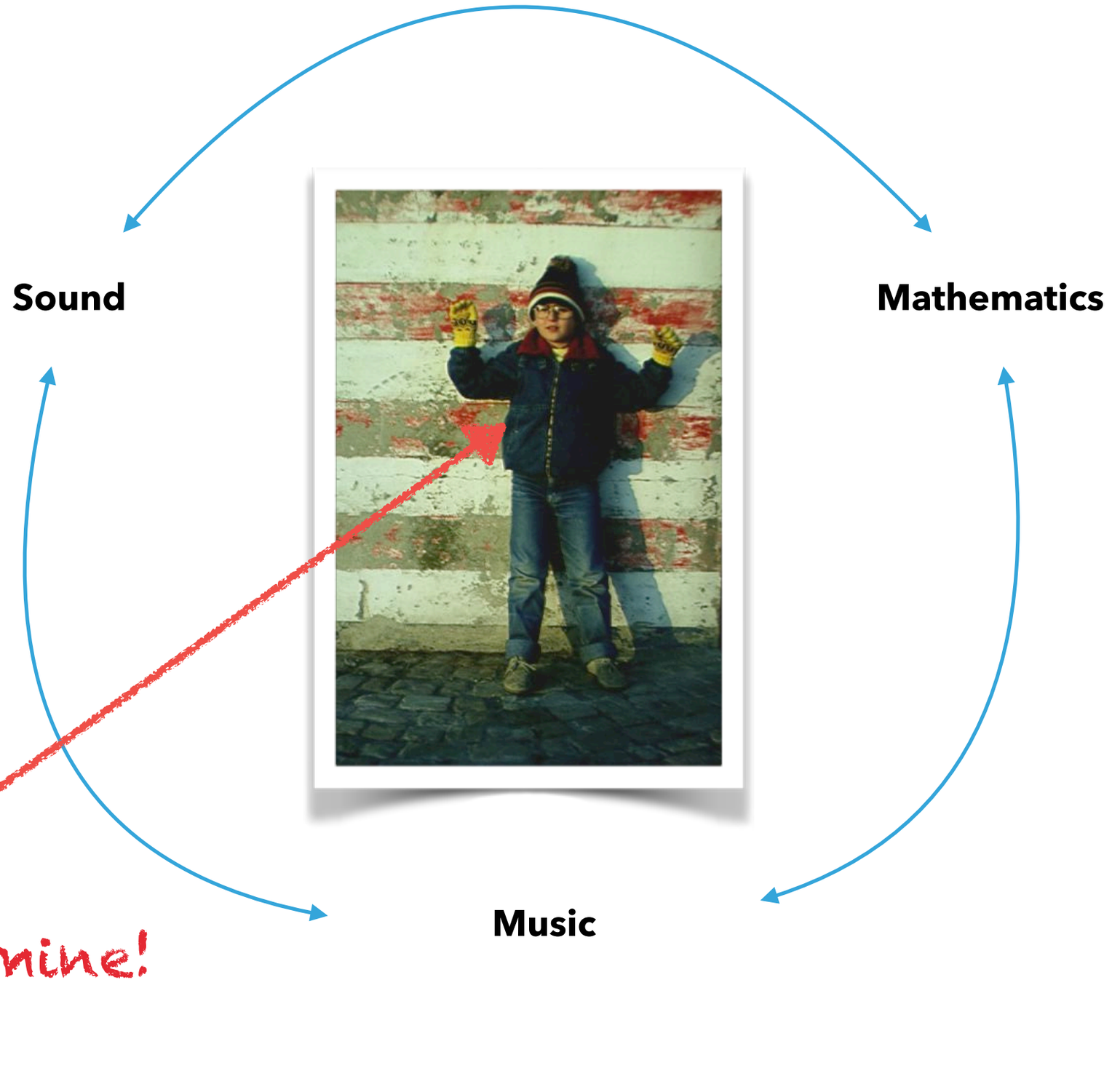
Office hour:
Friday, 11am-12pm



COURSE

Music 158 B!

Situated instrument design for musical expression

Schedule: MF 9:00A-10:29A | McEnerney (CNMAT)

(…in sequence with Music 159)

INTRODUCTION

In 158b we will cover the basic mathematics and physics of acoustic signals (no math background required) and we will have an overview musical acoustics (Unit I). We will develop state of the art physical models of musical instruments and we will connect these models with ad-hoc machine learning for gesture recognition (Unit II). This will let us to create *augmented* instruments based on new human-computer interaction paradigms (Unit III). An example of such instruments can be found here: **www.carminecella.com/inside-out**

Music 158b and 159 constitute a sequence in music sciences. The two courses are meant to give to the students the foundation of music signal processing and to bring them towards the frontiers of machine creativity for musical creation. Moreover, these courses will provide very valuable information for composers and will help their musical career.

REQUIREMENTS

Prerequisite:

158a or permission (programming practice)

Textbook:

No full books but notes, papers, etc.

All course materials online:

bcourses.berkeley.edu

Computer access:

Personal laptop and specific hardware (provided)

Software:

Max/MSP and Python (with packages), audio editor

GRADING

30% attendance and participation

70% final project
(60% making + 40% presentation)

The grade distribution is: 100% -- 90% A; 89% -- 89% B; 79% -- 70% C; 69% -- 60% D; 59% -- 0% F

Plusses are awarded for the top three percent and minuses are reserved for the bottom three percent of each grade distribution above.

LAB AND FINAL PROJECT

Lab sessions are structured as group activities where each student is assessed independently according to their work contribution and engagement in group collaboration.

During the labs we will use the Cycling'74 MaxMSP and Python programming environments.

Students must have access to a laptop computer with MaxMSP, please see the instructor for computer access options. Students may choose to purchase MaxMSP, or alternatively there are student authorization options for under $100 available at http:// cycling74.com/ products/max/ individual-academic/ (Links to an external site.). Lab materials, including software, tangible user interfaces, sensors, actuators, will be made available to students by the Center for New Music and Audio Technologies throughout the semester. Lab materials are not available for home use. Students will learn techniques for prototyping instrument design away from the lab.

Final Project Presentations

Music 158B students do not take a standardized final exam. In *lieu* of a standardized final exam, students will work together to put on an hybrid installation/performance, to take place at CNMAT.

STRUCTURE

Unit I: fundamentals (acoustics, basic DSP, …)

Unit II: instrument design (sound models, interaction models, ..)

Unit III: lab (you will build your own instrument!!!)

SCHEDULE: UNIT I – FUNDAMENTALS

#	Date	Topic	Slides	Readings	Code/Examples
1	1/24	Overview of the content; structure of the course	Yes		
2	1/27	Introduction to musical acoustics: sound waves; harmonic series; representation of musical signals.	Yes	[Benson] chapter 1.1-1.7 [Dodge] 2.1-2.5	
3	1/31	Musical timbre: partials, transients, spectral and perceptual interpretations.	Yes	[Dodge] 2.6, 2.7 [Grey]	Musical examples (Xenakis, Ligeti, Stockhausen, Tenney, Chowning).
4	2/3	Introduction to digital signals: A/D conversion, sampling theorem; linear time-invariant systems.	Yes	[Rocchesso] 1.1, 1.2, 1.4	8-bit one liners in C (just for fun).
5	2/7	Convolution: characterisation of physical systems by impulse responses.	Yes	[Cella2017]	Python implementation of: convolution-based reverb.
6	2/10	Introduction to digital filters I: FIR and IIR systems.	Yes	[Rocchesso] 2.2, 2.3 [Cella2020]	
7	2/14	Introduction to digital filters II: study of the 1-pole filter; principal filters for audio applications.	Yes	[Cella2020]	Implementation in Python and Max/MSP of the 1-pole filter.
8	2/21	Introduction to subtractive synthesis: history and high-level control rules.	No	[Cella2013]	Implementation in Max/MSP; musical examples (Eimert, Hindemith, Ligeti).
9	2/24	Physical modelling synthesis I: history and context; derivation from subtractive synthesis.	Yes	[Dodge] 9.1-9.4	Implementation in Max/MSP of Karplus-Strong.
10	2/28	Physical modelling synthesis II: introduction to modal synthesis.	No	[Rocchesso] 5.4 [Dodge] 9.5-9.7	Implementation of modal synthesis in Max/MSP.

SCHEDULE: UNIT II – INSTRUMENT DESIGN

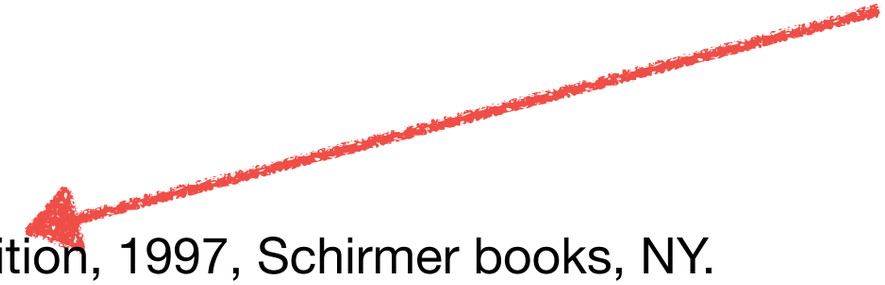
#	Date	Topic	Slides	Readings	Code/examples
11	3/2	**GUEST: D. Coll** Interactive systems and sensors.	No		Practical examples.
12	3/6	**GUEST: A. Harlan** Introduction to transducers and actuators.	No		Practical examples.
13	3/9	Low-level features for audio description: principal families and interpretation.	Yes	[Peeters]	Implementation of spectral centroid in Max/MSP.
14	3/13	Augmented instruments I: history and design.	Yes		Musical examples (Ircam composers).
15	3/16	Augmented instruments II: design of a *smart-percussion* (sound model with modal synthesis).	No		Implementation in Max/MSP of the sound model.
16	3/20	Augmented instruments III: design of a *smart-percussion* (interaction model with low-level features).	No		Implementation in Max/MSP of the interaction model.

SCHEDULE: UNIT III – LAB

#	Date	Topic	Slides	Code/examples
17	3/30	Presentation of the topics for individual projects and creation of workgroups.	TBD	
18	4/3	**GUEST: D. Coll** Introduction to light and sound interactions.		Practical examples.
19	4/6	**TBD**		
20	4/10	Project design and implementation.	No	Practical session.
21	4/13	Project design and implementation.	No	Practical session.
22	4/17	Project design and implementation.	No	Practical session.
23	4/20	Project design and implementation.	No	Practical session.
24	4/24	Project design and implementation.	No	Practical session.
25	4/27	Project design and implementation.	No	Practical session.
26	5/1	Project design and implementation.	No	Practical session.
27/28	5/4-5/8	RECITATION WEEK.		
29	5/11	**EXAM** Presentation of the individual projects to the class.		

REFERENCES

Starred items are free!



Books

- [Dodge] R. Dodge, Computer music, 2nd edition, 1997, Schirmer books, NY.
- [Benson]* D. Benson, Music: a mathematical offering, freely available on author's web page.
- [Rocchesso]* D. Rocchesso, Introduction to sound processing, freely available on author's web page.

Lecture notes

- [Cella2013]* C. E. Cella, Generalized series for spectral design, 2013, available on www.carminecella.com
- [Cella2012]* C. E. Cella, On physical-inspired synthesis of sounds, 2012, available on www.carminecella.com
- [Cella2017]* C. E. Cella, On room impulse response measurements with sine sweeps, 2017, available on www.carminecella.com
- [Cella2020]* C. E. Cella, Introductory notes on digital filters, 2020, available on www.carminecella.com

Papers

[Peeters]* G. Peeters, A large set of audio features for sound description (similarity and classification) in the cuidado project, in CUIDADO I.S.T. Project Report, April 2004, pp. 1–25.
[Chafe]* C. Chafe, A Short History of Digital Sound Synthesis by Composers in the U.S.A.
[Grey]* J. M. Grey, Multidimensional perceptual scaling of musical timbres, J. Acoust. Soc. Am., Vol. 61, No. 5, 1977.

SUGGESTIONS

POLICIES

COURSE ENVIRONMENT

Names/Pronouns

You deserve to be addressed in the manner you prefer. To guarantee that I address you properly, you are welcome to tell me your pronoun(s) and/or preferred name at any time, either in person or via email.

Diversity

We embrace diversity of age, background, beliefs, ethnicity, gender, gender identity, gender expression, national origin, religious affiliation, sexual orientation, and other visible and non-visible categories. I do not tolerate discrimination.

Accessibility

I want you to succeed in this course.
Contact me if you have special circumstances. I will find resources for you.

Title IX

You deserve a community free from discrimination, sexual harassment, a hostile environment, sexual assault, domestic violence, dating violence, and stalking. If you experience or know of a Title IX violation, you have many options for support and/or reporting

Academic Integrity

The honor code is a cornerstone of our learning community and of this course. It is your responsibility to know and follow academic integrity policies. I will gladly answer any questions you have.

SEXUAL HARASSMENT

The University of California strives to prevent and respond to harassment and discrimination. Engaging in such behavior may result in removal from class or the University. If you are the subject of harassment or discrimination there are resources available to support you. Please contact the Confidential Care Advocate (sa.berkeley.edu/dean/confidential-care-advocate) for non-judgmental, caring assistance with options, rights and guidance through any process you may choose. Survivors of sexual violence may also want to view the following website: survivorsupport.berkeley.edu.

For more information about how the University responds to harassment and discrimination, please visit the Office for the Prevention of Harassment and Discrimination website: ophd.berkeley.edu.

EMERGENCY PROCEDURES

Your emergency evacuation assembly area is **the steps directly across Arch St. leading to the Pacific School of Religion.**
In the event of an emergency please follow instructions from your instructor and CNMAT staff.
Take note of emergency procedures posted in your classroom. If the fire alarm is sounding, exit the building immediately. In the event of an earthquake, duck when possible and hold in place, covering your head with your arms, a binder or your laptop. Then exit the building when the shaking stops.

EMERGENCY SERVICES:

- UC Police and all emergencies number from campus phones: **911**
- UC Police and all emergencies number from cell phones: **(510) 642-3333**
- UC Police non-emergency number: **(510) 642-6760**

RESTROOM ACCESS:
Restrooms at 1750 Arch Street are available to all genders.