MUCP 4690/5690: Topics in Electroacoustic Music

Digital Audio Synthesis and Signal Processing
Csound/Cabbage

Instructor: Jon Christopher Nelson, jon.nelson@unt.edu
Time: Tuesdays and Thursdays, 9:30-10:50 AM
Location: https://unt.zoom.us/s/5065606613
Office Hours: online meetings arranged as per student request

OBJECTIVES:

Digital Audio Synthesis and Signal Processing will focus on developing audio programming techniques using Csound within the Cabbage framework. Csound is a very powerful audio programming language that is a direct descendant of Max Matthew's MUSIC1, the first computer music language. The course will cover a wide variety of different digital signal processing topics, audio synthesis techniques, and analysis/synthesis paradigms. Participants will study GUI (graphic user interface) design as it pertains to developing audio software. Students will create virtual instruments and virtual effects. Students will demonstrate their understanding of the course materials through programming assignments and the development of midterm and final projects.

GRADING:

Final course grades will be determined according to the following formula:

- 65% class participation (attendance, class discussion, daily assignments)
- 35% final programming project

ATTENDANCE/CLASSROOM COURTESY:

Attendance is expected and factors into the class participation component of the grade. Out of courtesy to others, please make every effort to arrive at class on time. If you must miss a class, it is your responsibility to find out about any missed materials. More than two unexcused absences will result in the final grade being docked one full letter grade.

COVID-19 impact on attendance

While attendance is expected as outlined above, it is important for all of us to be mindful of the health and safety of everyone in our community, especially given concerns about COVID-19. Please contact me if you are unable to attend class because you are ill, or unable to attend class due to a related issue regarding COVID-19. It is important that you communicate with me *prior*

to being absent as to what may be preventing you from coming to class so I may make a decision about accommodating your request to be excused from class.

If you are experiencing cough, shortness of breath or difficulty breathing, fever, or any of the other possible symptoms of COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider. While attendance is an important part of succeeding in this class, your own health, and those of others in the community, is more important.

CLASS PARTICIPATION:

Students are expected to come to class prepared, having read the required readings and prepared assignments. Assignments listed for a class date must be completed BEFORE the class begins. Participation in classroom discussion will be a primary factor for demonstrating class preparation. Assignments may include, but will not be limited to quizzes, programming assignments (Csound/Cabbage), and listening assignments.

ONLINE MATERIALS: can be found at https://unt.instructure.com/login/canvas

FINAL PROJECT:

Design and program a virtual instrument or effect (or combination of both) that incorporates multiple sound generation and/or manipulation options, interesting GUI features, and the incorporation of some stochastic elements. The project must be approved in advance by the instructor. Important Final Project Dates are as follows:

- March 2—final project proposal due—The proposal will consist of a paragraph or two describing the instrument or effect you plan to build and the features it will incorporate
- March 30—turn in draft code for your final project
- April 29, 8:00-10:00 AM—8 minute final project demos/presentations

REQUIRED READING:

http://write.flossmanuals.net/csound/preface/
http://cabbageaudio.com/docs/
https://csound.com/docs/manual/index.html

V. Lazzarini, S. Yi, J. Ffitch, J. Heintz, Ø. Brandtsegg, and I. McCurdy. *Csound: A Sound and Music Computing System.* Cham, Switzerland: Springer, 2016. (UNT Library E-book)

R. Boulanger, ed., in *The Csound Book*. Cambridge, Massachusetts: The MIT Press, 2000. (MT723 .C77 2000, also UNT library E-Book)

LIBRARY MATERIALS:

R. Bianchini and A. Cipriani. *Virtual Sound.* Rome, Italy: ConTempoNet, 2011. (MT723.B52 2011)

R. Boulanger, ed., in *The Csound Book*. Cambridge, Massachusetts: The MIT Press, 2000. (MT723 .C77 2000, also UNT library E-Book)

J. Heintz, A. Hoffman and I. McCurdy. *Ways Ahead: Proceedings of the First International Csound Conference.* Newcastle upon Tyne, UK: Cambridge Scholars Publishing, 2013. (UNT Library E-Book)

A. Horner and L. Ayers. *Cooking with Csound Part 1: Woodwind and Brass Recipes.* Middleton, Wisconsin: A-R Editions, Inc., 2002. (MT723 .H67 2002)

V. Lazzarini. *Computer Music Instruments: Foundations, Design and Development.* Cham, Switzerland: Springer, 2017.

V. Lazzarini. *Computer Music Instruments II: Realtime and Object-Oriented Audio.* Cham, Switzerland: Springer, 2019.

V. Lazzarini, S. Yi, J. Ffitch, J. Heintz, Ø. Brandtsegg, and I. McCurdy. *Csound: A Sound and Music Computing System.* Cham, Switzerland: Springer, 2016. (UNT Library E-book)

C. Roads, *the Computer Music Tutorial*. Cambridge, Massachusetts: The MIT Press, 1996. (MT56 .R6 1995)

U. Zölzer, ed. *DAFX Digital Audio Effects*. West Sussex, England: John Wiley & Sons Ltd., 2002. (UNT library E-Book)

G. Zucco. *Inside Csound.* Torino, Italy: Giancarlo Zedde, 2014.

WEB RESOURCES:

- **http://write.flossmanuals.net/csound/preface/ (FLOSS manual—very good information, good tutorials, this is required)**
- **https://cabbageaudio.com/ (This is where you should download Cabbage, which will contain the necessary Csound files as well. It is also where you will find Cabbage documentation, this is also required and you will find yourself referring to it often while you are programming)**
- **https://csound.com/ (The DOWNLOAD menu will link you to various "flavors" of Csound LEARN pull-down menu has lots of links to a "get started" tutorial as well as the FLOSS manual and the official Csound Reference Manual, one which you will also be referring to often while programming)**
- https://csound.com/docs/manual/index.html **(the online Csound reference manual—something that all of you should have on youro personal machines already once you download Cabbage and get it installed)**
- https://csound.com/docs/manual/MiscQuickref.html **(this is a handy abbreviated quick reference manual with opcodes organized by type of opcode, synthesis, filter, etc.)**
- https://www.dropbox.com/s/b7p9d0med6w34ti/CsoundBook-2011_Second_Printing_NEW_DVD_Master.zip?dl=0 **(you can grab all of the material from the Csound Book accompanying DVD here, includes all of the code examples from the printed book, tons of additional chapters that weren't included in the printed book, example audio files, etc.)**
- https://github.com/csound/book **(this site contains all of the code examples from Csound: A Sound and Music Computing System)**
- http://www.csounds.com/scanned/toot/index.html **(provides a decent tutorial about scanned synthesis)**
- https://en.wikipedia.org/wiki/Csound

- http://iainmccurdy.org/csound.html **(tons of example code by Iain McCurdy, one of the Cabbage developers and the author of most of the Cabbage example instruments and effects)**
- https://github.com/csound/csound **(Csound code, examples, varied platforms on github)**
- http://freaknet.org/martin/audio/csound/ **(some works composed entirely with Csound)**
- https://ww.generativeart.com/on/cic/99/0599.htm **(information about hyper-vectorial-synthesis for people who want to explore using 3D vectors within Csound)**

SUPPLEMENTAL BIBLIOGRAPHY:

Acousmatic Topics:

Barriere, Francoise and Gerald Bennett, eds. *Analysis in Electroacoustic Music.* Proceedings volume 2 of the International Academy of Electroacoustic Music/Bourges. Bourges, France: Editions Mnemosyne, 1996.

_____. *Composition/Diffusion in Electroacoustic Music.* Proceedings volume 3 of the International Academy of Electroacoustic Music/Bourges. Bourges, France: Editions Mnemosyne, 1997.

_____. *Electroacoustic Music: Reflections and Prospects.* Proceedings volume 4 of the International Academy of Electroacoustic Music/Bourges. Bourges, France: Editions Mnemosyne, 1998.

_____. *Time in Electroacoustic Music.* Proceedings volume 5 of the International Academy of Electroacoustic Music/Bourges. Bourges, France: Editions Mnemosyne, 2000.

_____. *Composition and Technology in Electroacoustic Music.* Proceedings volume 6 of the International Academy of Electroacoustic Music/Bourges. Bourges, France: Editions Mnemosyne, 2001.

Bennett, Gerald, Christian Clozier, Sten Hanson, Curtis Roads, and Horacio Vaggione, eds. *Aesthetics and Electroacoustic Music.* Proceedings volume 1 of the International Academy of Electroacoustic Music/Bourges. Bourges, France: Editions Mnemosyne, 1995.

Emmerson, Simon, "Aural Landscape: Musical Space." *Organized Sound,* Vol. 3, No. 2, 135-140.

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Licata, Thomas. Electroacoustic Music: Analytical Perspectives. Westport, Connecticut: Greenwood Press, 2002.

Roy, Stéphane. *L'analyse des musiques électroacoustiques: Modèles et propositions.* Paris: L'Harmattan, 2003.

Schaeffer, Pierre. *A la recherche d'une musique concrète.* Paris: Editions du Seuil, 1952.

_____. *Solfège de l'objet sonore.* Paris: Ina-Publications, 1998

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Simoni, Mary, ed. *Analytical Methods of Electroacoustic Music.* New York: Routledge, 2006.
Smalley, Denis. "The Listening Imagination: Listening in the Electroacoustic Era." *Contemporary Music Review,* 13, 77-107.
_____. "Defining Transformations." *Interface,* Vol. 22, 279-300.
_____. "Spatial Experience in Electroacoustic Music" in *L'espace du son II.* Francis Dhomont, ed. Belgium: Editions Musiques et Recherches, 1991, pp. 121-124.
_____. "Spectro-Morphology and Structuring Processes." In *The Language of Electroacoustic Music.* Simon Emmerson, ed., London, England: The Macmillan Press Ltd., 1986, pp. 61-96.
_____. "Spectromorphology: Explaining Sound Shapes." *Organized Sound,* Vol. 2, No. 2, 107-126.
Wishart, Trevor. *Audible Design.* England: Orpheus the Pantomime Ltd., 1994.
_____. "From Architecture to Chemistry." *Interface,* Vol. 22, 301-315.
_____. *On Sonic Art.* New York: Harwood Academic Publishers, 1996.

General Computer Music Theory:

Dodge, Charles. *Computer Music: Synthesis, Composition, and Performance.* New York: Schirmer Books, 1985.
Matthews, Max V. and John R. Pierce, eds. *Current Directions in Computer Music.* Cambridge, Massachusetts: The MIT Press, 1989.
Moore, F. Richard. "An Introduction to the Mathematics of Digital Signal Processing. Part 1: Algebra, Trigonometry, and the Most Beautiful Formula in Mathematics," CMJ, 2:1, 38-47.
_____. "Part 2: Sampling, Transforms, and Digital Filtering," CMJ, 2:2, 38-60.
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Roads, Curtis. *Composers and the Computer.* Los Altos, Ca.: William Kaufmann, Inc., 1985.
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_____. "An Interview with Gottfried Michael Koenig," CMJ, 2:3, 11-15, 29.
_____. "Interview with Marvin Minsky," CMJ, 4:3, 25-39.
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_____, Stephen Travis Pope, Aldo Piccialli, and Giovani De Poli, eds. MUSICAL SIGNAL PROCESSING. Exton, PA: Swets & Zeitlinger Publishers, 1997.
Strawn, John, editor, *Digital Audio Engineering.* Los Altos, Ca.: William Kaufmann, Inc., 1985.
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Tempelaars, Stan. *Signal Processing, Speech and Music.* Exton, Pennsylvania: Swets & Zeitlinger Publishers, 1996.

Digital Signal Processing:

R. Allred. *Digital Filters for Everyone.* Indian Harbor Beach, Florida: Creative Arts and Sciences House, 2010.

J. Broesch. *Digital Signal Processing Demystified.* Solana Beach, California: HighText Publications, 1997.
K. Steiglitz. *A Digital Signal Processing Primer*. Menlo Park, California: Addison-Wesley Publishing Company, 1995.
S. Templaar. *Music Signal Processing.* Exton, Pennsylvania: Swets, 1996.
U. Zölzer, ed. *DAFX Digital Audio Effects*. West Sussex, England: John Wiley & Sons Ltd., 2002. (on reserve) (available through UNT library electronic resources)
http://www.dafx.de/ This is the DAFX annual conference web site with PDFs of all conference papers. The site contains many articles on both DSP and Physical Modeling.

Physical Modeling:

P. R. Cook. *Real Sound Synthesis for Interactive Applications.* Natick, Massachusetts: Peters, A K, Limited, 2002. (on reserve)
J. O. Smith, *Physical Audio Signal Processing.* December 2008 ed., Stanford, California: W3K publishing, 2008. THIS BOOK CAN BE FOUND ONLINE AT: http://www.dsprelated.com/dspbooks/pasp/
J. O. Smith. *Introduction to Digital Filters.* Stanford, California: W3K publishing, 2007. THIS BOOK CAN BE FOUND ONLINE AT: http://www.dsprelated.com/dspbooks/filters/
L. Trautman and R. Rabenstein. *Digital Sound Synthesis by Physical Modeling Using the Functional Transformation Method.* New York: Kluwer Academic/Plenum Publishers, 2003.
V. Välimäki, J. Pakarinen, C. Erkut and M Karjalainen. *Discrete-Time Modeling of Musical Instruments.* Online. IOP Publishing Limited, 2006. http://stacks.iop.org/RoPP/69/1
A more comprehensive bibliography with more than 500 physical modeling citations can be found at Julius Smith's web site: https://ccrma.stanford.edu/~jos/pasp/Bibliography.html

Mathematics:

G. Loy. *Musimathics, vol. 1.* Boston, Massachusetts: MIT Press, 2006. (available through UNT library electronic resources)
G. Loy. *Musimathics vol. 2.* Boston, Massachusetts: MIT Press, 2007. (on reserve)
O. Bishop. *Understand Electrical and Electronics Math.* Boston: BH Newnes, 1993.
M. Kline. *Mathematics for the Non-Mathematician.* New York: Dover, 1967.
Transnational College of LEX. *Who Is Fourier?* Boston: Language Research Foundation, 1995.
J. O. Smith. *Mathematics of the Discrete Fourier Transform (DFT*). Stanford, California: W3K Publishing, 2008. THIS BOOK CAN BE FOUND ONLINE AT: http://www.dsprelated.com/dspbooks/mdft/
J. O. Smith. *Spectral Audio Signal Processing.* Stanford, California: W3K Publishing, 2011. THIS BOOK CAN BE FOUND ONLINE AT: http://www.dsprelated.com/dspbooks/sasp/

ACADEMIC INTEGRITY

Students caught cheating or plagiarizing will receive a "0" for that particular assignment or exam [or specify alternative sanction, such as course failure]. Additionally, the incident will be reported to the Dean of Students, who may impose further penalty. According to the UNT catalog, the term “cheating" includes, but is not limited to: a. use of any unauthorized assistance in taking quizzes, tests, or examinations; b. dependence upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; c. the acquisition, without permission, of tests or other academic material belonging to a faculty or staff member of the university; d. dual submission of a paper or project, or resubmission of a paper or project to a different class without express permission from the instructor(s); or e. any other act designed to give a student an unfair advantage. The term “plagiarism” includes, but is not limited to: a. the knowing or negligent use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgment; and b. the knowing or negligent unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.

See: Academic Integrity

LINK: https://policy.unt.edu/sites/default/files/06.003.AcadIntegrity.Final_.pdf

STUDENT BEHAVIOR

Student behavior that interferes with an instructor’s ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The university's expectations for student conduct apply to all instructional forums, including university and electronic classroom, labs, discussion groups, field trips, etc. (*Also see below, UNT Care Team*)

See: Student Code of Conduct

Link: https://deanofstudents.unt.edu/conduct

ACCESS TO INFORMATION – EAGLE CONNECT

Your access point for business and academic services at UNT occurs at my.unt.edu. All official communication from the university will be delivered to your Eagle Connect account. For more information, please visit the website that explains Eagle Connect.

See: Eagle Connect

LINK: eagleconnect.unt.edu/

ODA STATEMENT

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide

you with an accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the Office of Disability Accommodation.
See: ODA
LINK: disability.unt.edu. (Phone: (940) 565-4323)

UNT Policy Statement on Diversity
UNT values diversity and individuality as part of advancing ideals of human worth, dignity and academic excellence. Diverse viewpoints enrich open discussion, foster the examination of values and exposure of biases, help educate people in rational conflict resolution and responsive leadership, and prepare us for the complexities of a pluralistic society. As such, UNT is committed to maintaining an open, welcoming atmosphere that attracts qualified students, staff, and faculty from all groups to support their success. UNT does not discriminate on the basis of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, or veteran status in its application and admission process, educational programs and activities, employment policies and use of university facilities.
See: Diversity Statement
Link: https://policy.unt.edu/sites/default/files/04.018_PolicyStateOnDiversity.pub8_.18.pdf

2020-2021 Semester Academic Schedule (with Add/Drop Dates)
See: Spring, 2021 Registration Guide
Link: https://registrar.unt.edu/registration/spring-registration-guide

Academic Calendar at a Glance, 2020-2021
See: Academic Calendar
Link: https://www.unt.edu/catalogs/2020-21/calendar

Final Exam Schedule
See: 2021 Final Exam Schedule
https://registrar.unt.edu/exams/final-exam-schedule/spring

FINANCIAL AID AND SATISFACTORY ACADEMIC PROGRESS

Undergraduates
A student must maintain Satisfactory Academic Progress (SAP) to continue to receive financial aid. Students must maintain a minimum 2.0 cumulative GPA in addition to successfully completing a required number of credit hours based on total registered hours per term. Students cannot exceed attempted credit hours above 150% of their required degree

plan. If a student does not maintain the required standards, the student may lose their financial aid eligibility.

Students holding music scholarships must maintain a minimum 2.5 overall cumulative GPA and 3.0 cumulative GPA in music courses.

If at any point you consider dropping this or any other course, please be advised that the decision to do so may have the potential to affect your current and future financial aid eligibility. It is recommended that you to schedule a meeting with an academic advisor in your college or visit the Student Financial Aid and Scholarships office to discuss dropping a course being doing so.
See: Financial Aid
LINK: http://financialaid.unt.edu/sap

Graduates
A student must maintain Satisfactory Academic Progress (SAP) to continue to receive financial aid. Students must maintain a minimum 3.0 cumulative GPA in addition to successfully completing a required number of credit hours based on total registered hours per term. Music scholarships require a 3.5 cumulative GPA. Students cannot exceed maximum timeframes established based on the published length of the graduate program. If a student does not maintain the required standards, the student may lose their financial aid eligibility.

If at any point you consider dropping this or any other course, please be advised that the decision to do so may have the potential to affect your current and future financial aid eligibility. It is recommended you schedule a meeting with an academic advisor in your college, an advisor in UNT-International or visit the Student Financial Aid and Scholarships office to discuss dropping a course.
See: Financial Aid
LINK: http://financialaid.unt.edu/sap

RETENTION OF STUDENT RECORDS
Student records pertaining to this course are maintained in a secure location by the instructor of record. All records such as exams, answer sheets (with keys), and written papers submitted during the duration of the course are kept for at least one calendar year after course completion. Course work completed via the Canvas online system, including grading information and comments, is also stored in a safe electronic environment for one year. You have a right to view your individual record; however, information about your records will not be divulged to other individuals without the proper written consent. You are encouraged to review the Public Information Policy and the Family Educational Rights and Privacy Act (FERPA) laws and the university's policy in accordance with those mandates.
See: FERPA
Link: http://ferpa.unt.edu/

COUNSELING AND TESTING

UNT's Center for Counseling and Testing has an available counselor whose position includes 16 hours per week of dedicated service to students in the College of Music and the College of Visual Arts and Design. Please visit the Center's website for further information:
See: Counseling and Testing
Link: http://studentaffairs.unt.edu/counseling-and-testing-services.

For more information on mental health issues, please visit:
See: Mental Health Issues
Link: https://speakout.unt.edu.

The counselor for music students is:
Myriam Reynolds
Chestnut Hall, Suite 311
(940) 565-2741
Myriam.reynolds@unt.edu

ADD/DROP POLICY
Please be reminded that dropping classes or failing to complete and pass registered hours may make you ineligible for financial aid. In addition, if you drop below half-time enrollment you may be required to begin paying back your student loans. After the 12th class day, students must first submit a completed "Request to Drop" form to the Registrar's Office. The last day for a student to drop a class in Spring, 2021 is April 2. Information about add/drop may be found at:
See: Add Drop
Link: https://registrar.unt.edu/registration/spring-registration-guide

STUDENT RESOURCES
The University of North Texas has many resources available to students. For a complete list, go to:
See: Student Resources
Link: https://www.unt.edu/sites/default/files/resource_sheet.pdf