MUSI 6202: Syllabus

Music DSP

Spring 2017

Course Details

class time	MW 3:05–4:25pm
location	Clough 129
credits	3 credit hours

Instructor Information

	instructor	**teaching assistant**
name	Alexander Lerch	Ashis Pati, Siddharth Gururani
email	alexander.lerch@gatech.edu	{ashis.pati,siddgururani}@gatech.edu
location	Couch 205 (840 McMillan St)	
office hours	by appointment (https://calendly.com/alexanderlerch)	

1 General Information

1.1 Course Description

Research in music, as well as music production and composition increasingly relies on sophisticated digital signal processing techniques. This course will review fundamental elements of digital audio signal processing, such as sinusoids, spectra, digital filters, and Fourier analysis and their application to the fundamental music processing problems. We will discuss audio effects and techniques such as fast convolution, phase vocoder, reverb, chorus / flanger, pitch-shifting, time compression, etc. The class will include practical in-class exercises and assignments on frequently used music processing algorithms.

1.2 Prerequisites

Prior coursework in signals and systems is expected. Programming experience and familiarity with Matlab will be helpful.

1.3 Learning Outcomes

Upon successful completion of the course, the students will demonstrate

- the ability to comprehend typical representations of digital systems such as block diagrams and difference equations,
- an understanding of typical transforms in DSP such as the Fourier transform or the Z-transform,
- an understanding of typical signal processing approaches to audio and music signals,
- the ability to use this understanding to design audio processing systems such as audio effects, and
- the ability to implement such designs in a programming language such as Matlab.

2 Grading

The following evaluative tools will be utilized in measuring progress towards obtaining the learning outcomes:

quizzes	15%
assignments	40%
midterm exam I	10%
midterm exam II	10%
coding competition	20%
class participation	5%

2.1 Description of Graded Components

- **quizzes:**
  Quizzes might take place unannounced at any time during the semester. Each student will have one "joker", meaning that the worst result will be discarded and will not contribute to the overall grade.
- **assignments:**
  Assignments will be posted according to the tentative schedule outlined in Sect. 4.1. All assignments will contribute to the assignment grade with equal weight.
- **midterm exams:**
  The two exams will be mid-semester and at the end of the semester.
- **competition:**
  Each group (2 students) will submit Matlab code for the code competition. There will be a minimum goal and a default goal defined. The procedure and reachable points will be defined in an announcement within the first weeks of the semester.
- **class participation:**
  Each student is expected to actively participate in class. This is measured through attendance, direct class participation with discussions and answers, and posts in the accompanying forums (piazza).

2.2 Grading and Grading Policies

All graded components will be graded in points. The final grade for the course will be determined by dividing the total points earned by the number of points possible for each of the categories listed above.
These numbers will be converted into a letter grade according to the following scale:

A	100–90%
B	89–80%
C	79–70%
D	69–60%
F	59% and below

Grades may be assigned per group or individually as announced (e.g., projects are in some cases per group, quizzes are usually per individual).

3 Course Materials

3.1 Text book

The class will be roughly based on

- Zolzer, Udo: "Digital Audio Signal Processing", Wiley 2008

3.2 Recommended Reading

The following books can provide additional insights into the topics discussed in class

- *DSP* — Lyon, Richard: "Understanding Digital Signal Processing", Prentice Hall 2011
- *Audio Effects* — Zolzer, Udo: "DAFX: Digital Audio Effects", Wiley 2011

3.3 Software

The assignments, project work, and exercises will be done in Matlab. This might include implementation of functions for signal synthesis, system analysis (transfer functions), and signal processing (audio effects). Please note the following license information:

`www.matlab.gatech.edu`

Additional tools and programming languages can be used if approved by the instructor.

4 Course Expectations & Guidelines

4.1 Course Schedule

week	topics	exercise	assignment	notes
1	introduction, signals, periodicity, random processes, pdf, expectation values/moments, correlation	correlation		
2	convolution, power spectral density, Fourier series	FIR filter	filter & convolution	MLK Hldy.
3	Fourier transform	DFT	Fourier analysis	
4	sampling, quantization, SNR, number formats	quantization		
5	oversampling, dither, noise-shaping, non-linear quant.		dither, ns	
6	z-transform, digital audio filters, FIR/IIR, FFT filtering	biquad		
7	sample rate conversion, real-time systems	resampling		
8	delay-based FX and reverb	vibrato	mod. fx	
9	dynamics processing	PPM	limiter	guthman
10	time-segment processing (OLA)	ola		
11				spring break
12	phase-vocoder		phase voc	
13	source coding: LPC, ADPCM			
14	source coding: Huffman, AAC			
15	denoising			
16	competition results			
17	final exam			

Since all classes do not progress at the same rate, it may be necessary to modify the above schedule as circumstances dictate. For example, the number and frequency of assignments may be altered or the schedule of the classes may be changed. In either of these cases, adequate notification will be given and be discussed in class.

4.2 Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit:

- `http://www.catalog.gatech.edu/rules/`.

Students are encouraged to support each other, but each artifact has to be clearly executed by the individual/group being graded. Any student suspected of cheating or plagiarizing on a quiz, exam, assignment, or other artifact will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

4.3 Accommodations for Individuals with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (often referred to as ADAPTS) at (404)894-2563 or

- `http://disabilityservices.gatech.edu`

as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

4.4 Assignment Turn-In

All assignments as well as the project work including code have to be turned in as a link to a online repository such as github. Documentation has to be submitted to t-square unless announced otherwise.

4.5 Attendance and Participation

Regular attendance is expected. Missed classes might impact your learning experience and have negative influence on the participatory grade.

4.6 Extensions, Late Assignments, Missed Exams

All assignments, papers, and other artifacts are due **ON THE DUE DATE**. The due date will be announced per assignment on t-square. A penalty of **TEN POINTS PER DAY** will be applied to all late assignments and late project papers. Documented illnesses and family emergencies are excepted. Quizzes and exams cannot be made up unless you have a valid, documented excuse.

4.7 Student Use of Mobile Devices in the Classroom

The use of mobile devices in the classroom is not allowed unless explicitly allowed by the instructor.

4.8 Student-Faculty Expectations

At Georgia Tech we believe that it is important to continually strive for an atmosphere of mutual respect, acknowledgment, and responsibility between faculty members and the student body. See

- `http://www.catalog.gatech.edu/rules/`

for an articulation of some basic expectations — that you can have of me, and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.