Digital Signal Processing for Music

Part 1: Organizational

alexander lerch

organizational
links & contact

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- **contact info**
  - *alexander lerch*
    - ▶ email: mailto:alexander.lerch@gatech.edu
    - ▶ www: www.audiocontentanalysis.org
    - ▶ office: Couch 203
    - ▶ office hours: **by appointment**: https://go.oncehub.com/alexanderlerch
  - *teaching assistant*
    - ▶ Karn Watcharasupat: kwatchar3@gatech.edu

- **classes**
  - Mon, Wed 3:00–4:15pm in WV175
  - additional *tutorial group*: TBD

- **class resources**
  - *canvas*:
    - ▶ syllabus, grades, slides: https://canvas.gatech.edu

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organizational
goals & requirements

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- **goals**

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

- **requirements**
  - math
  - rudimentary programming skills, familiarity with Matlab

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organizational
outline

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date	topics	exercise	assignment	notes
01/09	introduction, signals, periodicity, random processes, pdf, expectation values/moments, correlation	correlation		
01/16	convolution	FIR filter	filter & convolution	
01/23	Fourier series & Fourier transform	DFT	Fourier analysis	MLK Hldy.
01/30	Fourier transform, sampling, quantization, SNR, number formats	quantization		
02/06	oversampling, dither, noise-shaping, non-linear quant.		dither, ns	
02/13	z-transform, digital audio filters, FIR/IIR, FFT filtering	biquad		midterm I
02/20	sample rate conversion, real-time systems	resampling		
02/27	denoising			
03/06	delay-based FX and reverb	vibrato	mod. fx	guthman?
03/13	dynamics processing	PPM	limiter	midterm II
03/20				spring break
03/27	time-segment processing (OLA)	ola		
04/03	phase-vocoder		phase voc	
04/10	source coding: LPC, ADPCM			

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course materials

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- **roughly based on**:
  - Zölzer, Udo (2008): *Digital Audio Signal Processing*, Wiley

- **additional reading**:
  - Lyon, Richard (2011): *Understanding Digital Signal Processing*, Prentice Hall
  - Zölzer, Udo (2011): *DAFX: Digital Audio Effects*, Wiley

- **additional additional reading**:
  - Pohlmann, Ken (2000): Principles of Digital Audio, 4th, McGraw-Hill
  - Watkinson, John (2001): The Art of Digital Audio, Focal Press

- **software**:
  - Matlab: www.matlab.gatech.edu
  - github.com etc

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assessment

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- **40%: assignments** (equally weighted): projected deadlines see syllabus
  1. convolution and FIR filters
  2. Fourier analysis
  3. Dither & Noise Shaping
  4. modulated audio effects
  5. compressor & limiter
  6. (phase vocoder)

- **10%: mid-term exam I**
- **10%: mid-term exam II**
- **5%: participation**
- **15%: quizzes**
  - every week?!

- **20% denoising competition**

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to do

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1. **install Matlab** (Octave/Freemat)

2. **brush up** your math and Matlab

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