CTP 431 Music and Audio Computing

Course Introduction

Graduate School of Culture Technology (GSCT)
Juhan Nam

Who We Are

- Instructor: Juhan Nam (남주한)
  - Assistant Professor in GSCT
  - Music and Audio Computing Lab: http://mac.kaist.ac.kr
  - Previously worked for Qualcomm and Young Chang Music (Kurzweil)

- TA: Dasaem Jung (정다샘)
  - 1nd year Ph.D. Student in GSCT
  - KAIST Orchestra Maestro

- TA: Changheun Oh (오창현)
  - 1st year Ph.D. Student in GSCT
  - (Former) Leader of the EE Band

KAIST

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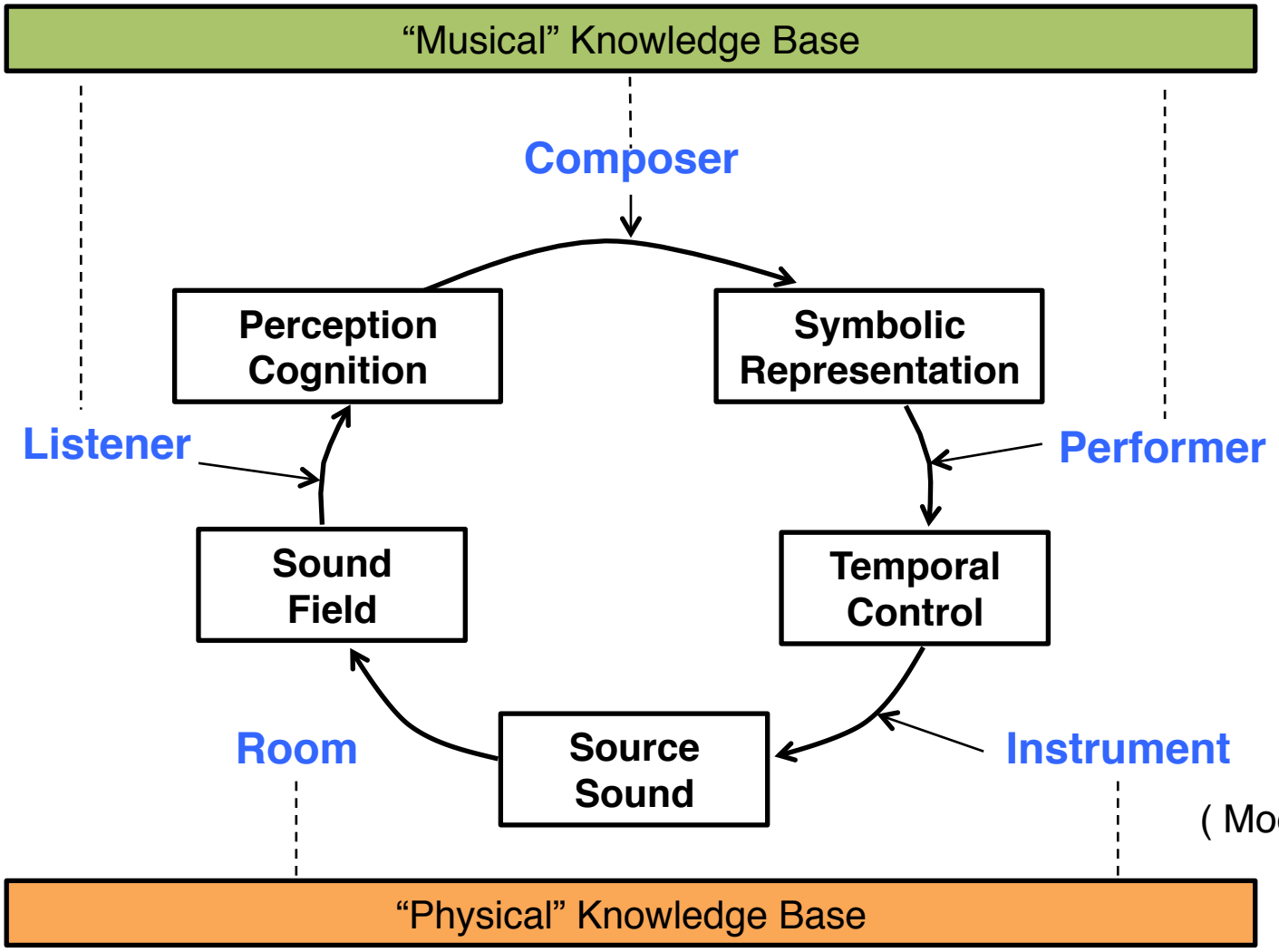
Music and Human

KAIST

CT

Musical Data and Processes



(Moore, 1990)

Music Listening

Phonograph

LP

Cassette Tape

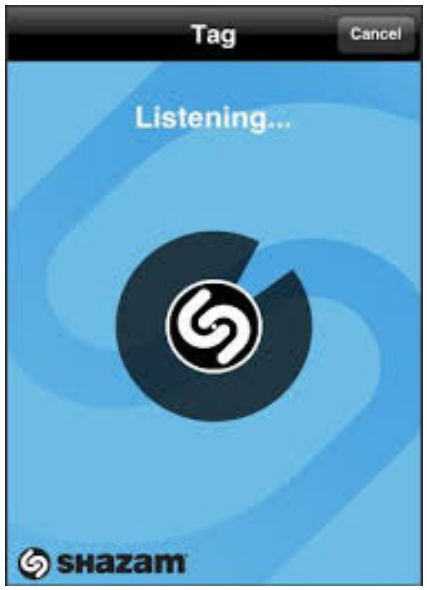
CD

Music Listening

- MP3, streaming
- Music search and recommendation, Internet Radio

Smartphone

Online Music Services



Shazam
(Music Search)

Music Performance and Instrument

Cristofori's FortePiano (1772)

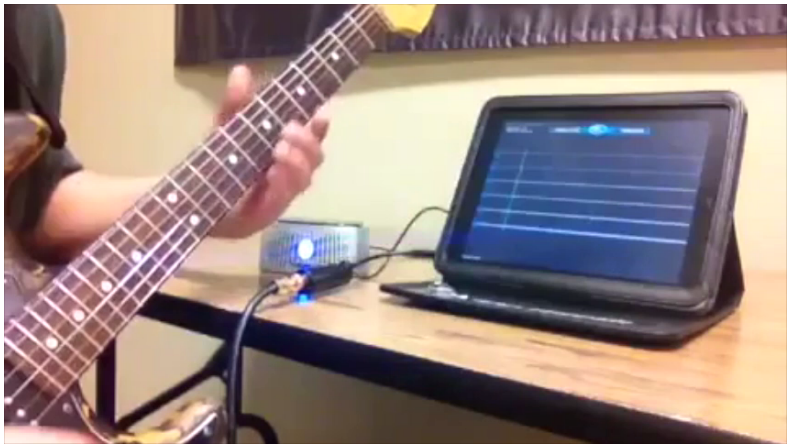
Steinway
Model D
(1884 -)

Music Performance and Instrument

Amplifier
Electric Guitar

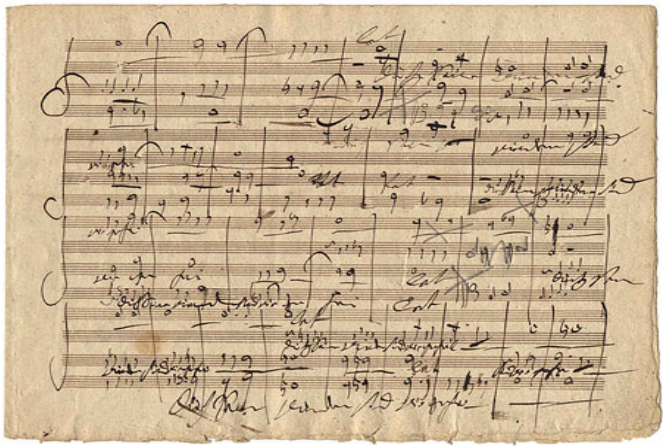
Synthesizers

Karaoke App



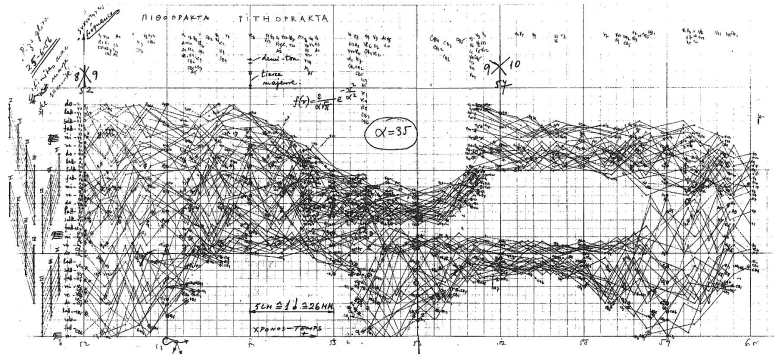
Rock Prodigy

Music Composition and Production



Handel's "Messiah," notated by Beethoven

Pithoprakta (1955-56), mesures 52-59 : graphique de Xenakis
Source : Iannis Xenakis, *Musique. Architecture*, Tournai, Casterman, 1976, p. 167



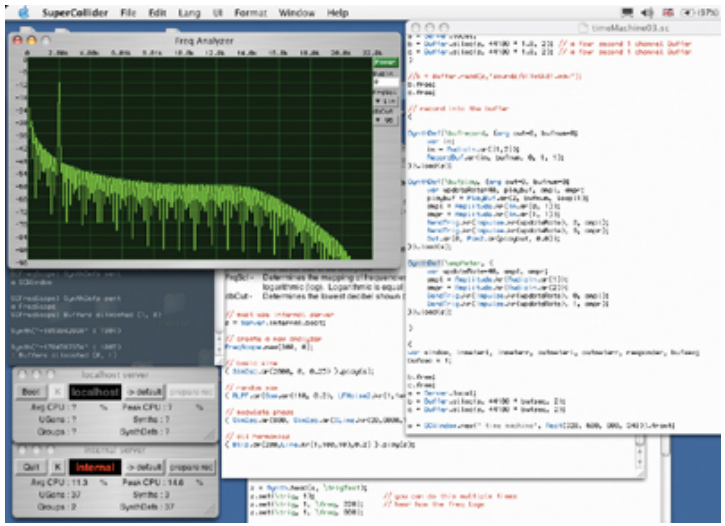
Xenakis “Pithoprakta”

Recording in the early 20th century

Multi-track recorders

Music Composition and Production

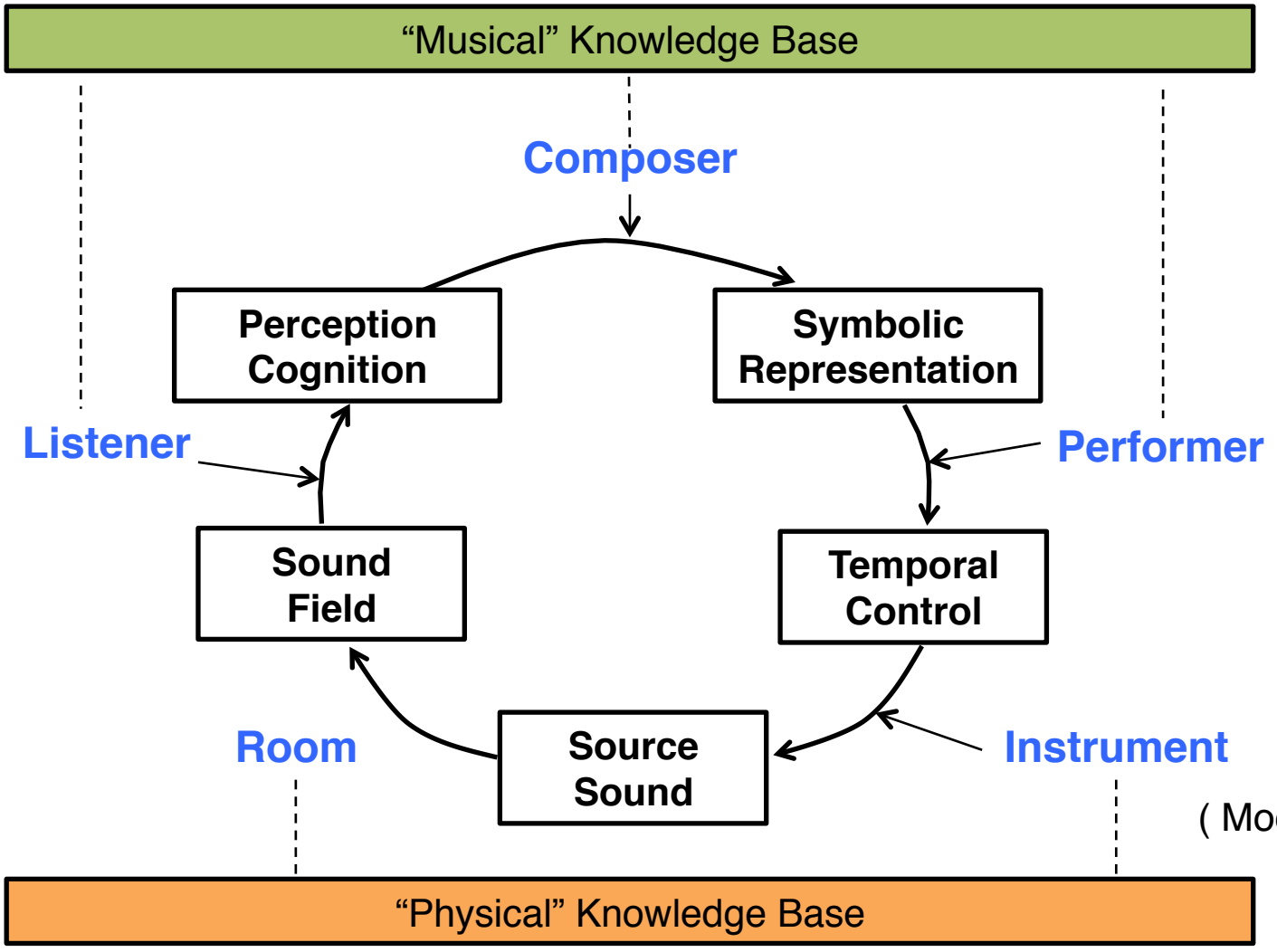
- Audio programming: algorithmic composition
- DAW: recording, editing, processing and mixing



Supercollider

Digital Audio Workstation (DAW)

Musical Data and Processes (Today)



(Moore, 1990)

Data → Digital representations Processes → Algorithms

Course Goals

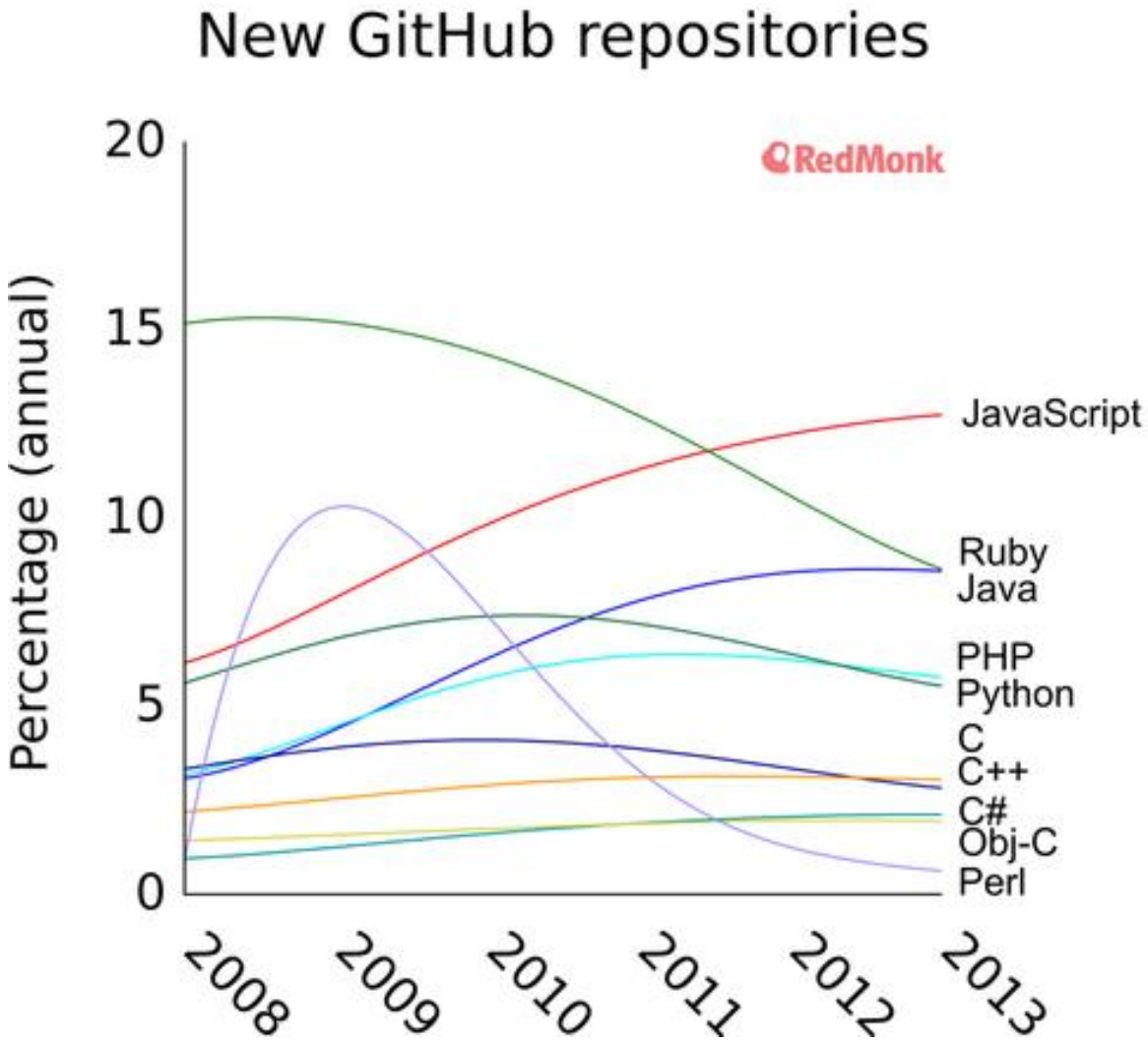
- Understanding the theoretical backgrounds in music technology today
  - Acoustics
  - Digital signal processing
    - Digital Audio
    - Filters and FFT
  - Computer music
    - Sound analysis and synthesis
    - Symbolic representations: e.g. MIDI
  - Combine all together

- Hand-on practice
  - Programming: HTML/CSS/Javascript with Web Audio

Why Web Audio?

- HTML5 standard
- Contain a number of audio signal processing components used in modern DAWs
- Easy to integrate with other multimedia components (e.g. WebGL)
- Free and no installation
- Platform-independent (but browser-dependent)
- Slow but keep being improved
- Many more …

Why Web Audio?



Syllabus: Outline

- Introduction (week 1)
- Part 1: basic acoustics and sound analysis (week 2 – 4)
- Part 2: sound processing and synthesis (Week 5 – 10)
- Part 3: symbolic representations and sound control (Week 11 – 12)
- Advanced topics (Week 13 - 15)
- Midterm (Week 9) / Final (Week 16)

Syllabus

- Week 1
  - Course introduction
  - Web audio introduction
- Week 2
  - Basic acoustics
- Week 3-4
  - Digital audio
  - Fourier transform
  - Spectral analysis and feature extraction

Syllabus

- Week 5-6
  - Sound processing overview
  - Linear processing
    - Filter and convolution
    - Delay and reverberation
    - Spatial processing
- Week 7-8
  - Sound synthesis overview
  - Subtractive synthesis
  - FM synthesis

Syllabus

- Week 10 – 11
  - Pitch shifting
  - Non-linear processing: compressor or distortion
  - Vocoder
- Week 12 – 13
  - MIDI, OSC and sensors
  - Algorithmic composition
- Week 14 – 15
  - Music Information Retrieval
  - Advanced Topics

Your Part

- Homework (40%)
  - 3 mini projects (candidates)
    - Music player/visualizer
    - Analog synthesizers
    - Step Sequencer
  - HTML/CSS/Javascript
- Midterm (20%)
  - Paper exam
- Class Participation (10%)
  - 10 % of grade
- Final Project (30%)
  - Proposal + presentation / demo

Pre-requisite

- Prior experience with programming languages
- Signals and systems: desired but not required

Textbook

- Main Text
  - Introduction to Computer Music, N. Collins

- Supplementary
  - Computer Music Tutorial, C. Roads
  - Elements of Computer Music, F. Richard Moore

Course Information

- Course webpage
  - http://mac.kaist.ac.kr/~juhan/ctp431/
  - Basic course info, schedule and resources

- KLMS
  - Announcement
  - Question and Answers
  - Homework
  - Grading