MARE 502, Advanced Topics in Computer Music

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What is the Csound Course About?

- Introduction to various sound synthesis techniques (see preliminary syllabus)
- Hands on exercises using Csound
Outline of this Lecture

- Introduction and motivation
- Digital audio theory: sampling
- Csound basics
Why Programming?

Question

Why do we bother programming? There are so many ready-made sound synthesis applications available (e.g. VST synthesizer plugins ...).
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**Question**

What is your programming experience?
Why Csound?

Question

Which sound synthesis environments do you know? Which environments did you use before?
Why Csound? (Cont’d)

Csound

- Good balance between ease of use and sound synthesis features
- Arguably the largest number of sound synthesis techniques supported
Why Csound? (Cont’d)

Csound

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This course focuses on sound synthesis techniques, not systems
- You can later use these techniques in other systems as well
Digital Audio Theory: Sampling

- Digital audio quantises in time and values
- Quantising introduces errors
- One way to deduce such errors is selecting a suitably high bit rate and sampling frequency (e.g., CD uses 16 bit and 44.1 kHz)
Csound Overview

Csound definition consists of

- An orchestra definition
- A score definition
- Optional: options
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Possible formats
- Orchestra and score as individual text files (classical format)
- Unified single text file (XML format)
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Score and orchestra have their own (relatively simple) format
An orchestra starts with some global settings, e.g.,

- **sr** sample rate
- **kr** control rate (explained later)
- **ksmps** number of samples in a control period: sr/kr (optional)
- **nchnls** number of audio output channels (e.g., 2 for stereo)
- **0dbfs** value of full scale amplitude; default is 32767 (16 bit bipolar: $2^{16}/2 - 1$)

**Example**

```
sr=44100
kr=4410
ksmps=10
nchnls=1 ; mono
```
Instrument Definition

After the header, one or more instrument definitions follow.

**Syntax**

```
instr numberOrName
   code
endin
```
Opcode Syntax

Sound modules (opcodes) generate or modify signals. Csound provides a large number of opcodes.

Syntax

result opcode arg1, ..., argN
Score: Introduction

Question

What do you know about the MIDI file format?
Csound Note Statements (i-statements)

Csound note statements play a single note on a Csound instrument.

Syntax

i numberOrName start duration parameter1 ... parN
Csound Note Statements (i-statements), Cont’d

Example

Instrument 1 starts at time 2 (two seconds/beats after the beginning), for 3 beats.

; instrument start duration pitch
i 1 2 3 61

Note

The first three parameters (*p-fields*) instrument, start and duration and obligatory. Any later parameter is user-defined.
A function table is an array of numbers, e.g., a sound file, an envelope or a wavetable. Csound provides about 40 different data generators for function tables (GEN routines).

**Syntax**

```
f number time size GEN-routine parameter1 ... parN
```
Function Table Definitions (f-statements), Cont’d

Example

GEN 1 reads a sound file into a table.

; # time size GEN file skiptime format channel
f 1 0 0 1 "test.wav" 0 0 0 0

- **size** number of points in the table; size 0 means number of samples in the file.
- **skiptime** begin reading at skiptime seconds into the file.
- **format** numeric sound file format encoding; 0 means take format from sound file header.
- **channel** channel number to read; 0 means all channels.
Recommended Literature I

Books (important books marked with a star)


  (preview available at books.google.com)

  ConTempo

Recommended Literature II

Example collections

  http://iainmccuridy.org/csound.html

- A collection of instrument collections:
  http://www.csounds.com/instruments

- Boulanger’s collection of Tutorials and Models (without references of origin)
  http://csounds.com/4csound_DrB_Examples.zip

- John Philipp Gather. Amsterdam Catalog of Csound Computer Instruments.
  http://www.music.buffalo.edu/hiller/accsi/
Recommended Literature III

Community

- Csound website: http://www.csounds.com
- A collection of tutorials:
  http://www.csounds.com/tutorials
- Csound Journal:
  http://www.csounds.com/journal/index.html
- Mailing lists: http://www.csounds.com/community
Summary

- Introduction: Why programming? Why Csound?
- Digital audio theory: sampling
- Csound basics
  - Orchestra definition
  - Score definition
- Literature recommendations
## Exercises for Next Week

- Read pp. 5-18 of Csound book (up to but excluding Etude 2) available online at http://www.csounds.com/chapter1/index.html
- Do all "Exercises for Etude 1" on p. 15