

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

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- This course focusses 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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- Unified single text file (XML format)

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Score and orchestra have their own (relatively simple) format

Orchestra Header

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)

Odbfs 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.

Function Table Definitions (f-statements)

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
```

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)

- * Barry Vercoe et al. Csound Reference Manual.
<http://www.csounds.com/manual/html/index.html>
- * Richard Boulanger ed. (2000). The Csound book. MIT.
(preview available at books.google.com)
- Riccardo Bianchini et al. (2000). Virtual sound: sound synthesis and signal processing, theory and practice.
ConTempo
- Andrew Horner, Lydia Ayers (2002). Cooking with CSound, Volume 1. A-R Editions. (preview available at books.google.com)

Recommended Literature II

Example collections

- Iain McCurdy. Csound Realtime Examples.
<http://iainmccurdy.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/accci/>

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