Music and Computer Science: Motivation, Analogies, and Experience

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Music and Time

- Music has no material or dimension other than time
- The first concept of time as a unit of measure comes from Ars Nova (12th C)
- Music notation preceded graphs and calculus by centuries,
- Time intervals in music preceded time intervals in Kepler (1600) by centuries
Structure in Music
- Hierarchy: notes, motives, phrases
- Sections: verse, chorus, theme, coda
- Repetition
- Choice

Analogies to Programming
- Procedural Abstraction
- Sequential Execution
- Iteration
- Conditional Execution
- Beyond Music Notation
Procedural Abstraction

def part1()
    note("c5", 0.5)
    note("b4", 0.5)
    note("c5", 0.5)
    note("a4", 0.5)

Sequential Execution

def my_music()
    part1()
    part2()
    part3()
Iteration

def twice():
    for i in [1, 2]:
        part1()
        part2()

Conditional Execution

def my_music():
    for i in [1, 2]:
        part1()
        if i == 1:
            first_ending()
        else:
            second_ending()
Beyond Music Notation

- Random choice
- Recursion — Fractal Music
- Graph Models
- Parameterized Music
- Algorithmic Composition
- Interactive Music

Experience

- Computer Music Camp
  - American Center, 1983
  - Handful of students, age 8 to 14
  - Simple music compositions
  - Procedures, Loops, Conditionals

- Computer Music for Music Majors
  - CMU, 1984-87
  - Programming in C with music I/O library
  - Concurrent, interactive music systems
Experience (cont’d)

- Highly motivating
- *Debugging and program understanding aided by listening to output while reading the code*
- Avoid traditional data structures, data types, program syntax
  - Use a domain (music) that is “real” and familiar

Other Domains

- Java-based music programming in UG CS courses
- Computational, generative algorithms for sculpture
Other Domains

- ALICE
  (Randy Pausch and Caitlin Kelleher, CMU)
  Be your own animated movie director.
  - Partnering with EA (providing Sims characters and artwork)
  - Widely used now in schools
  - Positive outcomes: better grades in CS

Conclusions

- Arts & Sciences connections can be:
  - Natural
  - Useful
  - Mutually reinforcing
- Prior domains (music, drama, sculpture, …) can be highly motivating