Programming, Problem Solving, and Algorithms

CPSC 203, 2024 W2
(January – April 2025)
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Lecture 11A

Slides from the Assigned Video

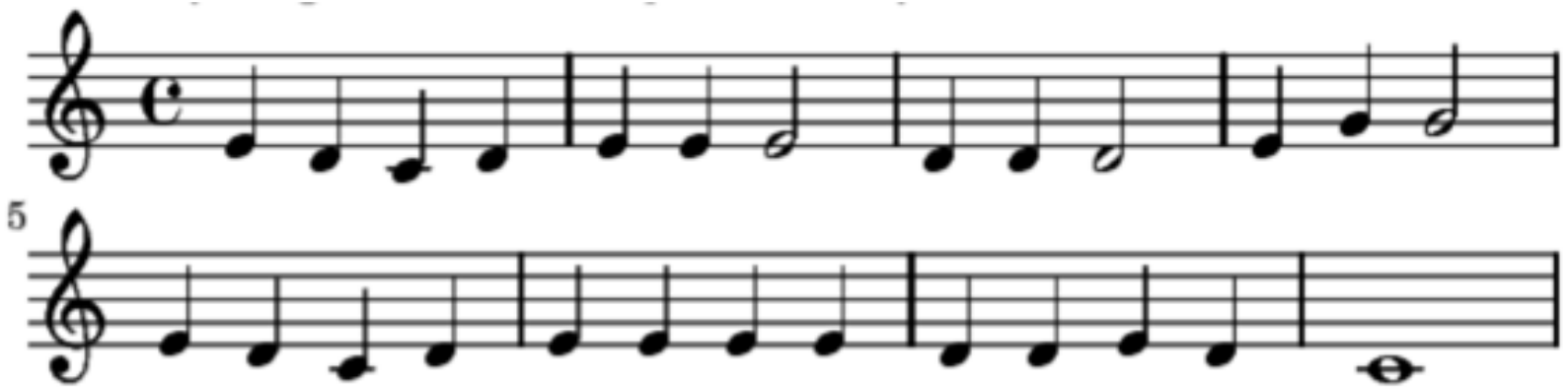
Following Ada

Supposing, for instance, that the fundamental relations of pitched **sounds** in the science of harmony and of musical composition were **susceptible of such expression** and adaptations,

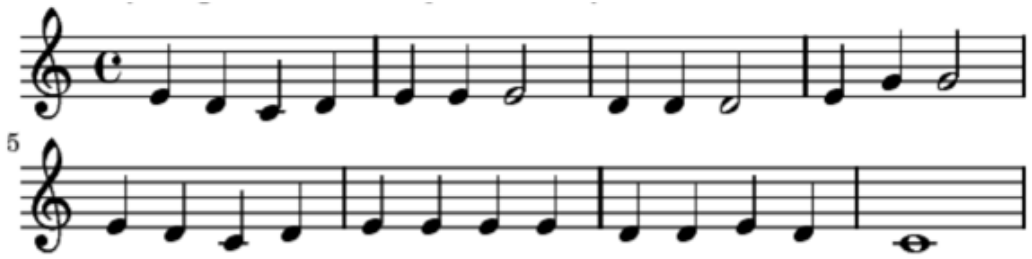
the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent.

(Ada Lovelace -- 1842)

Prelude



Characterizing Mary



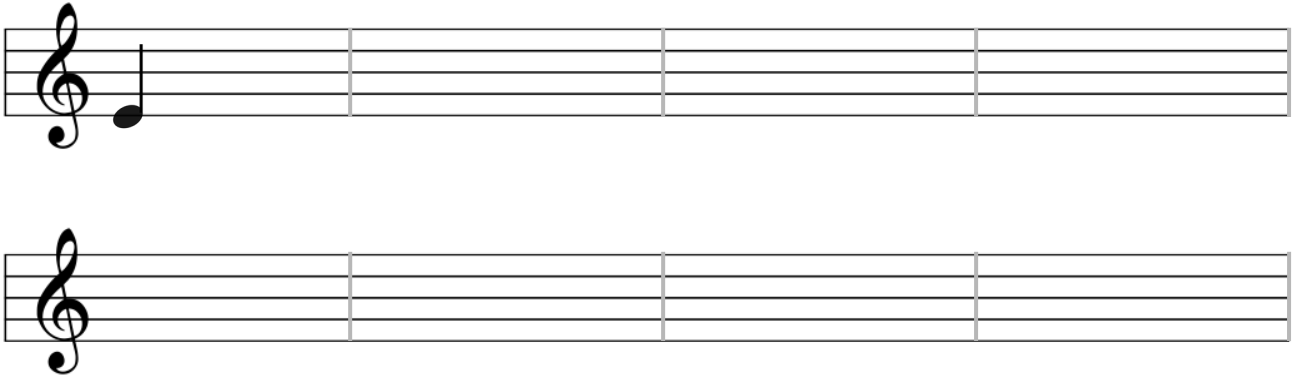
	C	D	E	G
C	0	2	0	0
D	3	3	4	0
E	0	5	5	1
G	0	0	1	1

Building a Music Generator

	C	D	E	G
C	0	2	0	0
D	3	3	4	0
E	0	5	5	1
G	0	0	1	1

	C	D	E	G
C	0	1.0	0	0
D	0.3	0.3	0.4	0
E	0	0.45	0.45	0.1
G	0	0	0.5	0.5

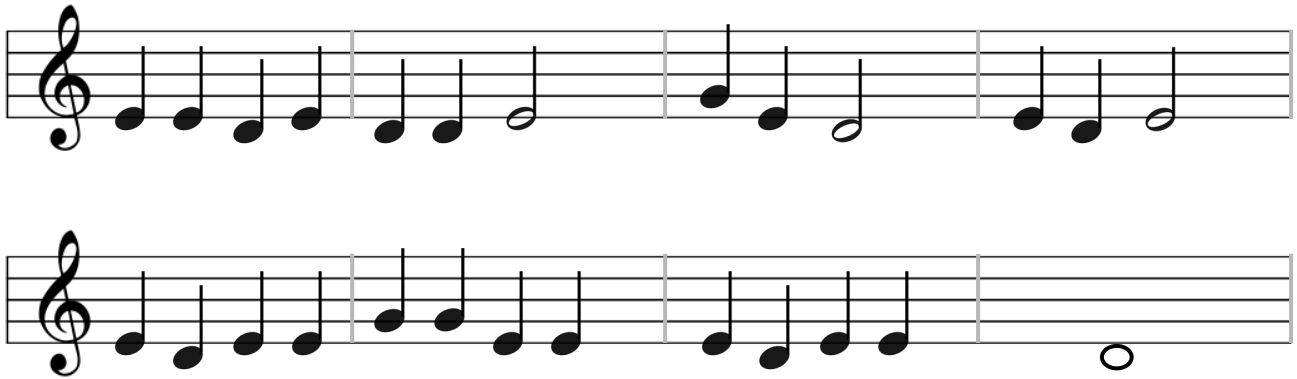
Building a Song



1. Randomly choose a start note and put it in a list
2. for 25 notes, in the rhythm of MHaLL
    a. Generate a new note
    b. Put the new note in the list
3. play the list of notes

	C	D	E	G
C	0	1.0	0	0
D	0.3	0.3	0.4	0
E	0	0.45	0.45	0.1
G	0	0	0.5	0.5

Building a Song



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The Technical Details

You have just learned about a particular type of random process called a *Markov Chain*.

https://brilliant.org/wiki/markov-chains/

We modelled it using a *transition table*, or a *finite state machine*, and we used it as the basis for an algorithm to generate music.

Graphs?

	C	D	E	G
C	0	1.0	0	0
D	0.3	0.3	0.4	0
E	0	0.45	0.45	0.1
G	0	0	0.5	0.5

What does it look like?
https://setosa.io/markov/

This table can be interpreted as an *adjacency matrix* representation of a graph.

Vertices:

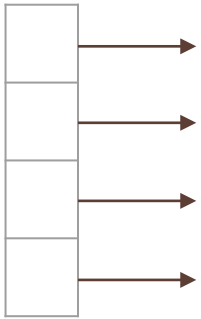
Edges:

Special characteristics:

Graphs Representation

	C	D	E	G
C	0	1.0	0	0
D	0.3	0.3	0.4	0
E	0	0.45	0.45	0.1
G	0	0	0.5	0.5

A graph can also be represented using an adjacency list



Other Applications

PageRank: Google's first search algorithm

- Some pages are likely to "follow" (be linked from) others.
- Rank of page is based on the probability that you'll be there at any moment

Natural Language Processing

- Some words are more likely to follow others.
- "I just ate the whole desert" probably has a misspelling.
- "For dinner I ___ … " next word is probably "ate"

DNA matching

Chemical reaction simulation

Many others…