Programming, Problem Solving, and Algorithms

CPSC203, 2019 W1

Announcements

Project 2 is released. Due 11:59p, Nov 7.

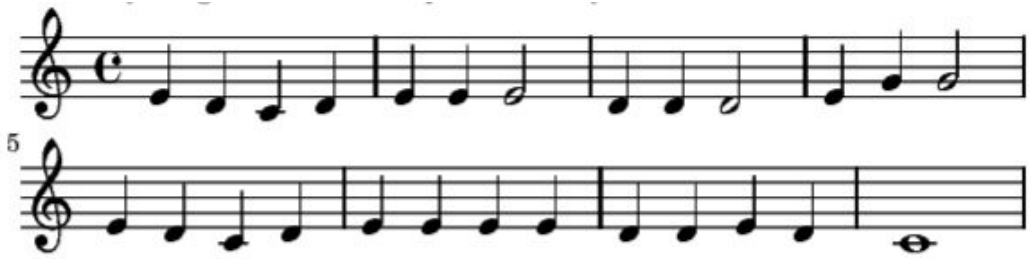
“Problem of the Day” continues!

Today:

Dictionaries

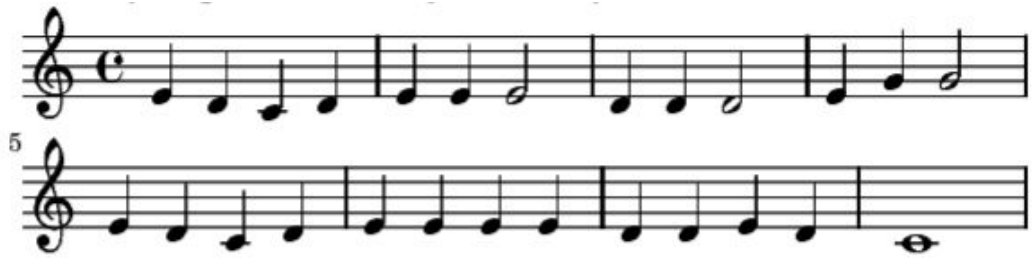
MHALL

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

Dictionaries



Data structures for storing (key, value) pairs.

Suppose we just want to count the notes in a song…

```
song = ['E','D','C','D','E',...]

d = {}

For note in song:

    d[note] += 1

print(d['E'])
```

Does this work?

Dictionaries

```
freq = {
    "C": [16.35, 32.70, 65.41, 130.81, 261.63, 523.25, 1046.50, 2093.00, 4186.01],
   "Db":   [17.32, 34.65, 69.30, 138.59, 277.18, 554.37, 1108.73, 2217.46, 4434.92],
    "D":   [18.35, 36.71, 73.42, 146.83, 293.66, 587.33, 1174.66, 2349.32, 4698.64],
   "Eb":   [19.45, 38.89, 77.78, 155.56, 311.13, 622.25, 1244.51, 2489.02, 4978.03],
    "E":   [20.60, 41.20, 82.41, 164.81, 329.63, 659.26, 1318.51, 2637.02],
    "F":   [21.83, 43.65, 87.31, 174.61, 349.23, 698.46, 1396.91, 2793.83],
   "Gb":   [23.12, 46.25, 92.50, 185.00, 369.99, 739.99, 1479.98, 2959.96],
    "G":   [24.50, 49.00, 98.00, 196.00, 392.00, 783.99, 1567.98, 3135.96],
   "Ab":   [25.96, 51.91, 103.83, 207.65, 415.30, 830.61, 1661.22, 3322.44],
    "A":   [27.50, 55.00, 110.00, 220.00, 440.00, 880.00, 1760.00, 3520.00],
   "Bb":   [29.14, 58.27, 116.54, 233.08, 466.16, 932.33, 1864.66, 3729.31],
    "B":   [30.87, 61.74, 123.47, 246.94, 493.88, 987.77, 1975.53, 3951.07]
}
```

Is this a dictionary?

Describe the keys:

Describe the values:

How do you refer to the entry whose quantity is 440.00?

What's freq['F']?

Weird and useful things: freq.keys() freq.values()

Dictionaries

So how can we use a dictionary to represent this table?

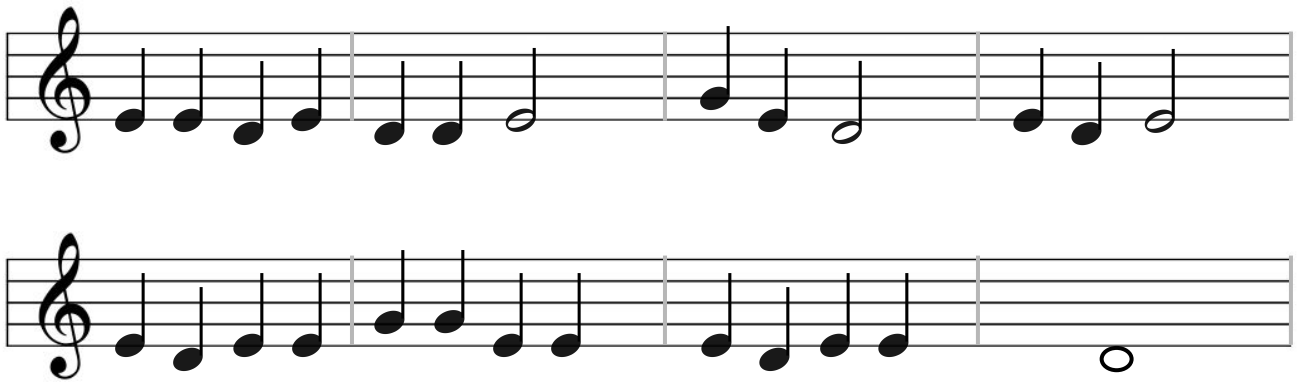
Sketch what we want:

Declaration:

Build the table, given a song.

	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 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

The Technical Details

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

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.

Now let's look at some code!

https://github.students.cs.ubc.ca/cpsc203-2019w-t1/LecMHALL/

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…

But I thought we were talking about graphs...

	C	D	E	G
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E	0	0.45	0.45	0.1
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http://setosa.io/markov

POTD #26 Tue

https://github.students.cs.ubc.ca/cpsc203-2019w-t1/potd26

Describe any snags you run into:

1. Line ___: _____
2. Line ___: _____
3. Line ___: _____
4. Line ___: _____
5. Line ___: _____

ToDo for next class...

POTD: Continue every weekday! Submit to repo.

Reading: TLACS Ch 10 & 12 (lists and dictionaries)

References:

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

https://medium.com/@eightlimbed/counting-on-pythons-defaultdict-b652204780bd