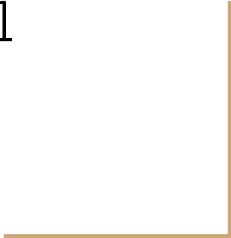


# Programming, Problem Solving, and Algorithms

CPSC203, 2019 W1



# Announcements

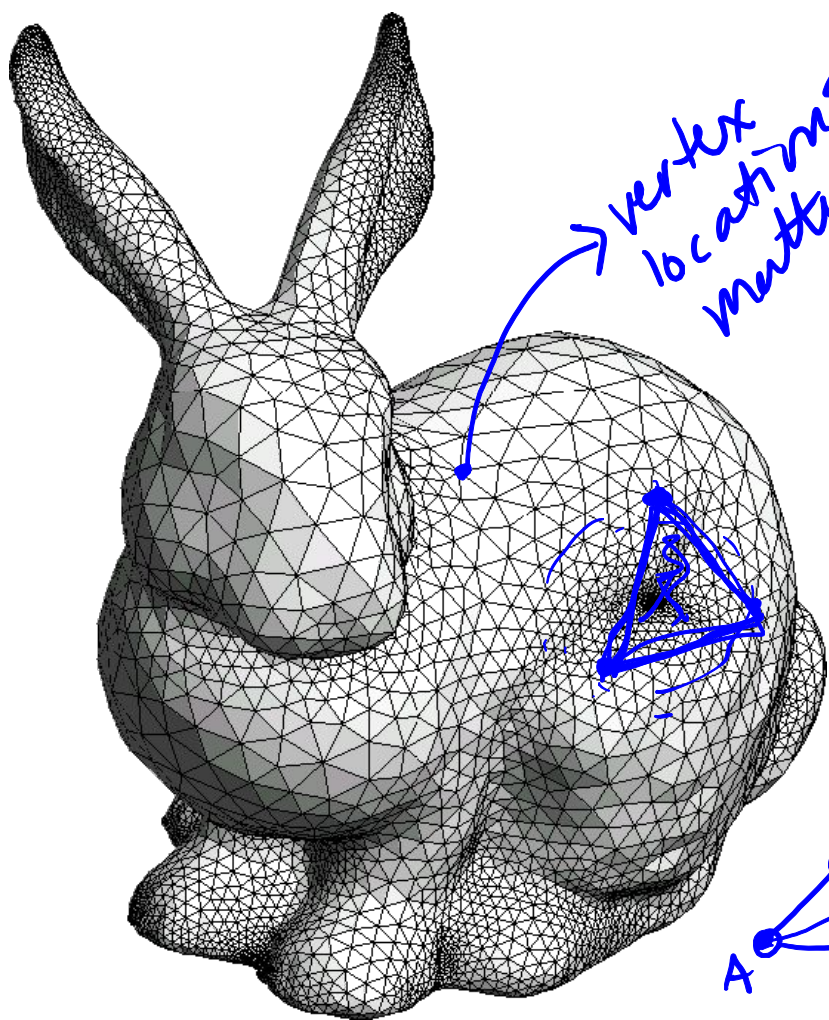
Project 1 is released. Due 11:59p, Oct 19.

“Problem of the Day” continues!

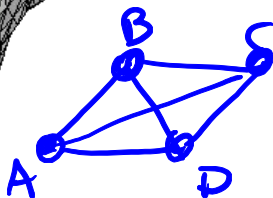
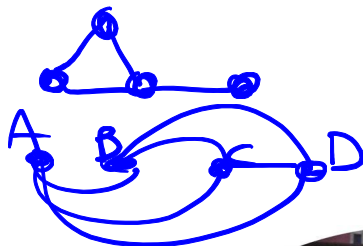
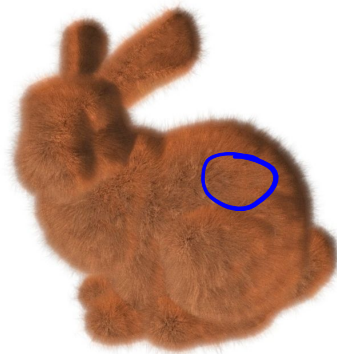
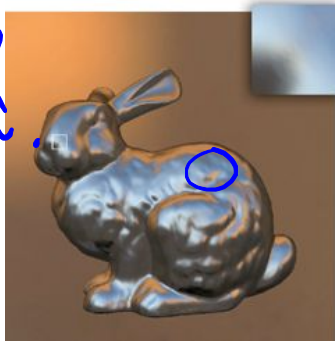
## Today:

Graphs

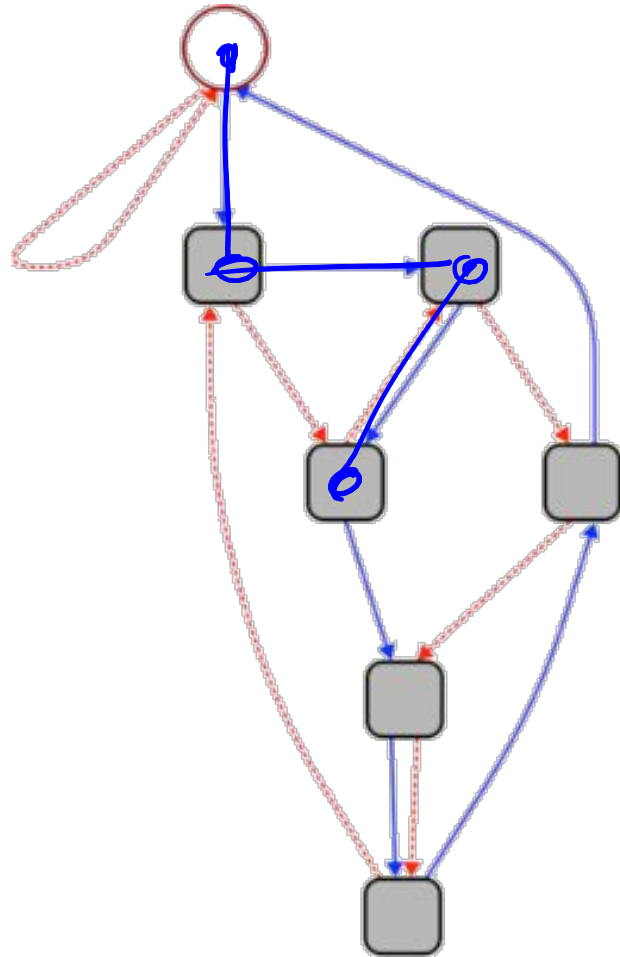
MHALL



vertex  
locations  
matter!



This graph can be used to quickly calculate whether a given number is divisible by 7.



1. Start at the circle node at the top.
2. For each digit  $d$  in the given number, follow  $d$  blue (solid) edges in succession. As you move from one digit to the next, follow 1 red (dashed) edge.
3. If you end up back at the circle node, your number is divisible by 7.

3703

The only thing that we could have a little more of the same kind words and the answers are very very important

# Following Ada



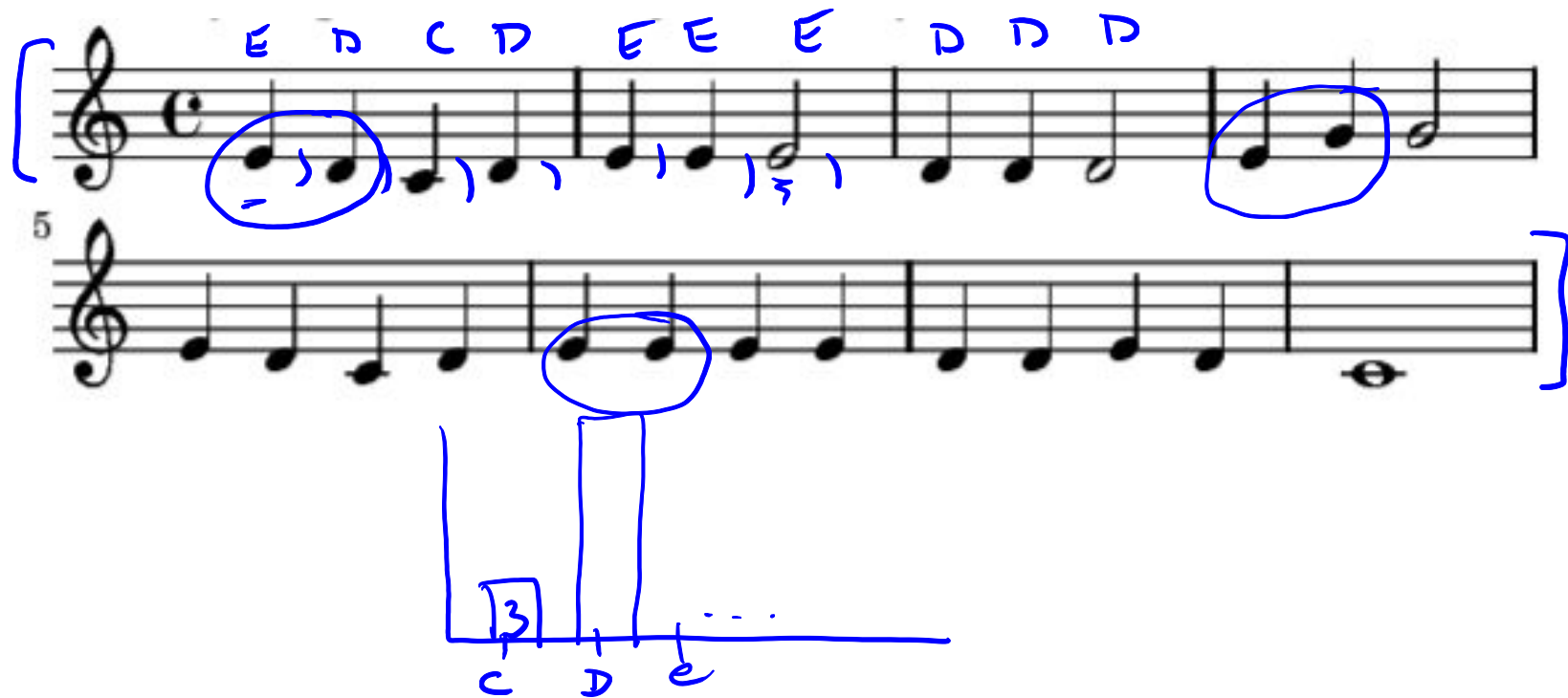
Supposing, for instance, that the fundamental relations of pitched **sounds** in the science of harmony and of musical composition were **susceptible of such expression** and adaptations,

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

(Ada Lovelace -- 1842)

# Prelude

Mary Had a Little Lamb.



# Characterizing Mary



		to			
		C	<u>D</u>	E	G
from	C	0	<u>2</u>	0	0
	D	3	3	4	0
	E	0	5	5	1
	G	0	0	1	1



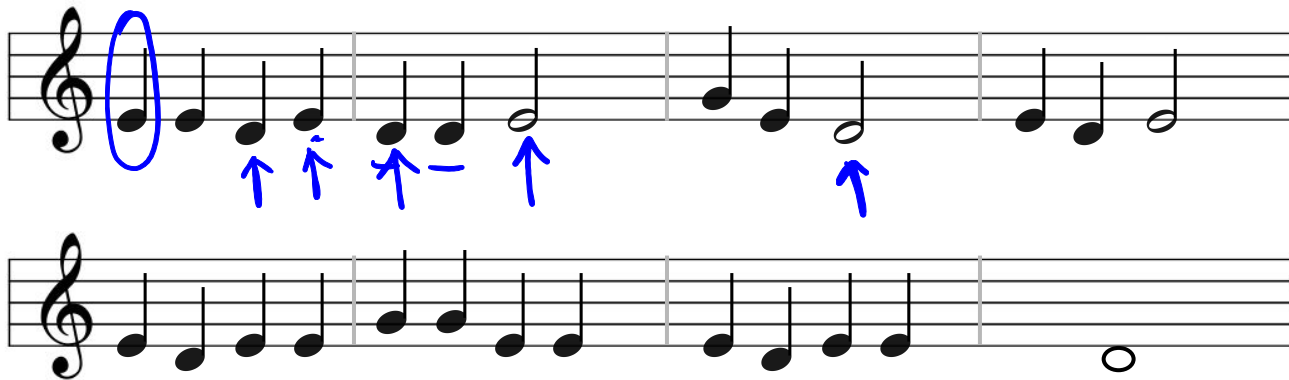
# Building a Music Generator

	C	D	E	G	Sum
C	0	$\frac{2}{2}$	0	0	2
D	$\frac{3}{10}$	$\frac{3}{10}$	$\frac{4}{10}$	0	10
E	0	$\frac{5}{11}$	$\frac{5}{11}$	$\frac{1}{11}$	11
G	0	0	$\frac{1}{2}$	$\frac{1}{2}$	2



	C	D	E	G
C	0	<u>1.0</u>	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 → "roll the die"
  - 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 only thing that we could have a little more of the same kind words and the answers are very very important

# 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
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

<http://setosa.io/markov>

# POTD #20 Thu

<https://github.students.cs.ubc.ca/cpsc203-2019w-t1/potd20>

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>