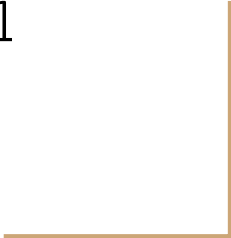


Programming, Problem Solving, and Algorithms

CPSC203, 2019 W1



Announcements

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

“Problem of the Day” continues!

Today:

Graphs Intro

MHALL

Graphs: A new model for representing images

00	10	20	30	40	50	60	70	80	90
01	11	21	31	41	51	61	71	81	91
02	12	22	32	42	52	62	72	82	92
03	13	23	33	43	53	63	73	83	93
04	14	24	34	44	54	64	74	84	94
05	15	25	35	45	55	65	75	85	95

A *Graph* is a collection of *vertices*, and *edges* between them. They're used as a general model for many problems.

In our images every _____ is a vertex, and every _____ is an edge. How many edges are there in the graph representing the image on the left?

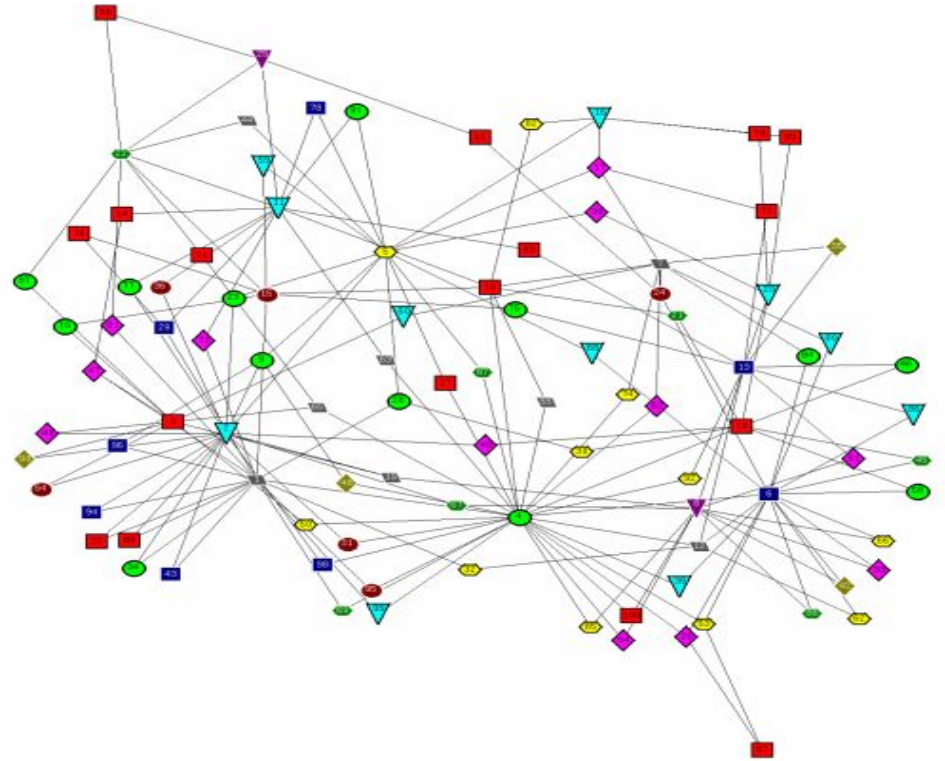
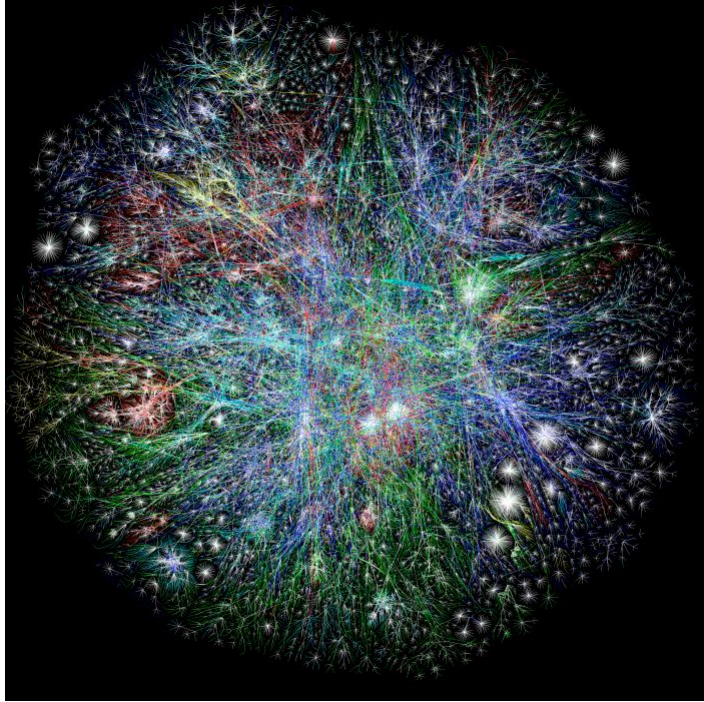
Our fast algorithm for Voronoi Art mirrors a classic algorithm on graphs called Breadth First Search.

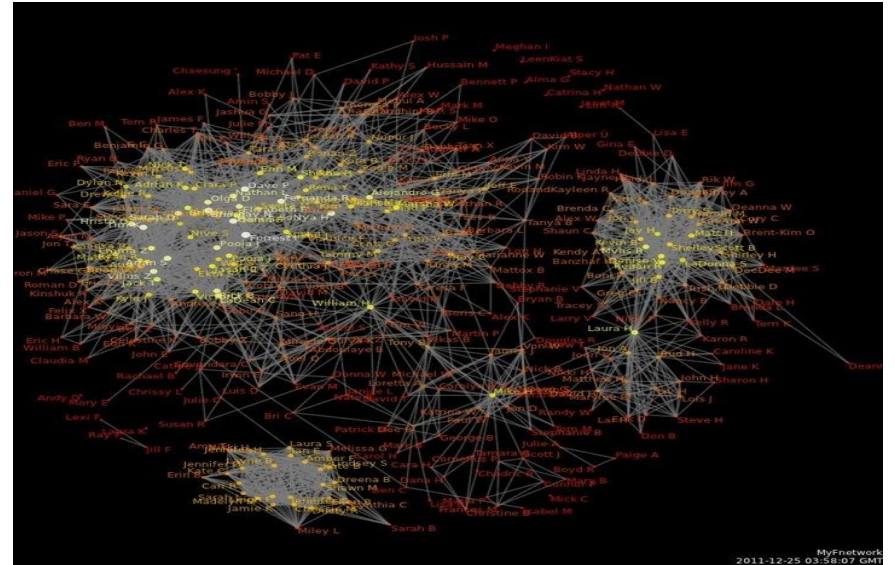
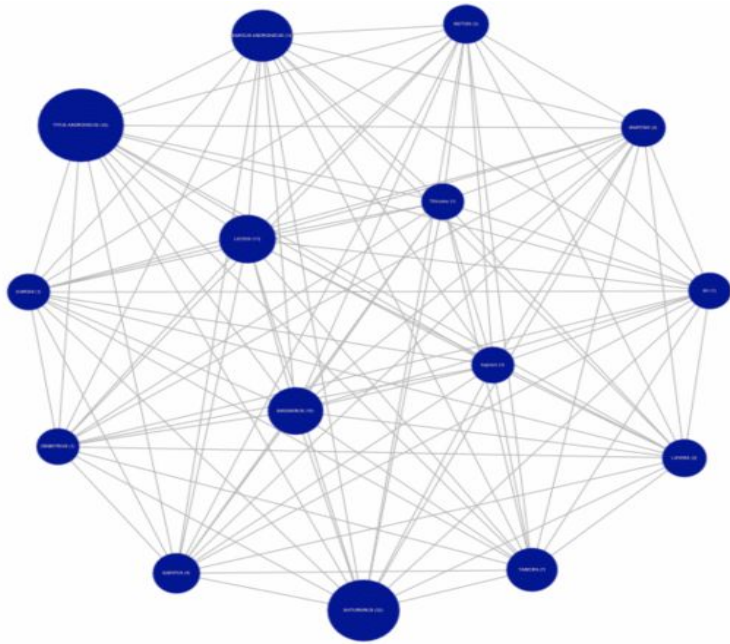
Breadth First Search

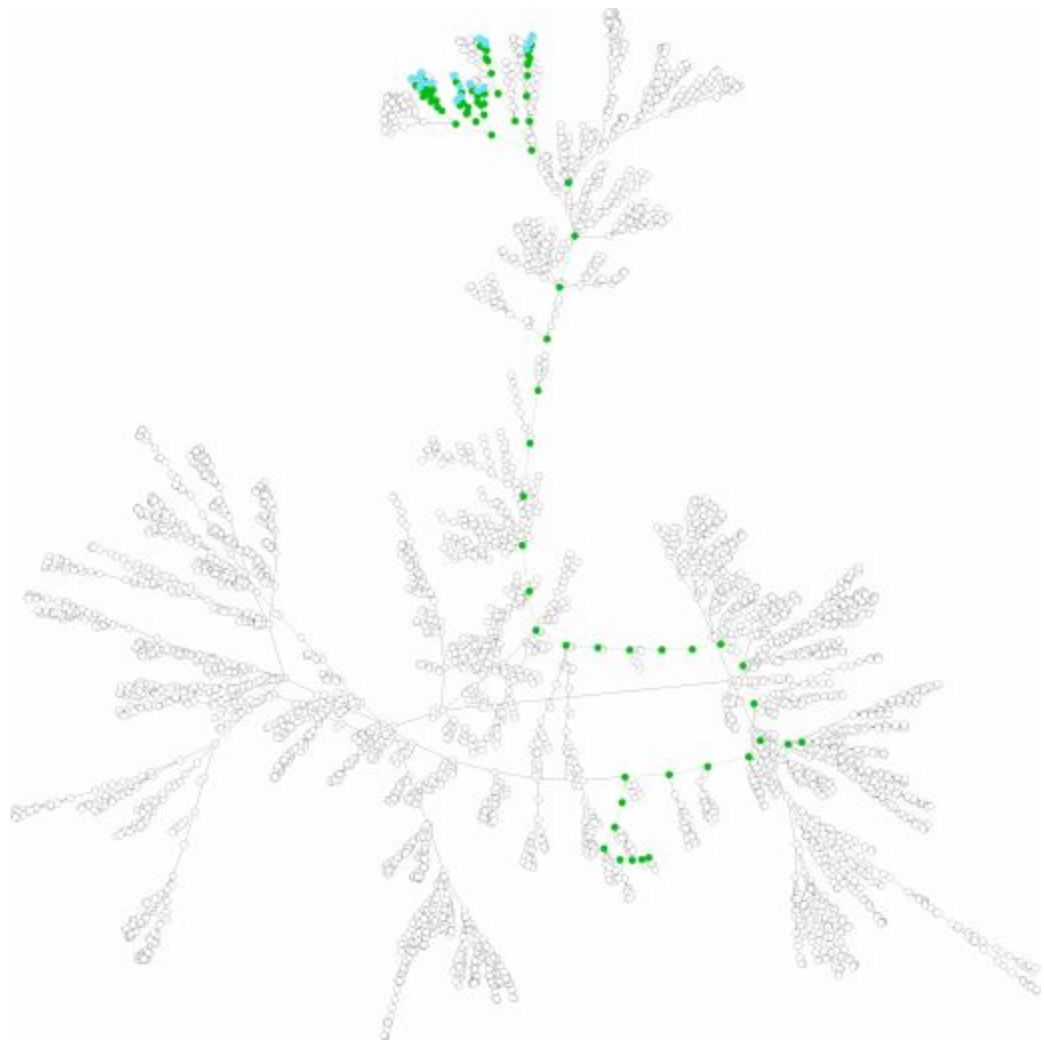
Breadth-first search (BFS) is an [algorithm](#) for traversing or searching [tree](#) or [graph](#) data structures. It starts at the [tree root](#) (or some arbitrary node of a graph, sometimes referred to as a 'search key'^[1]), and explores all of the neighbor nodes at the present depth prior to moving on to the nodes at the next depth level. (--Wikipedia)

Simplified description:

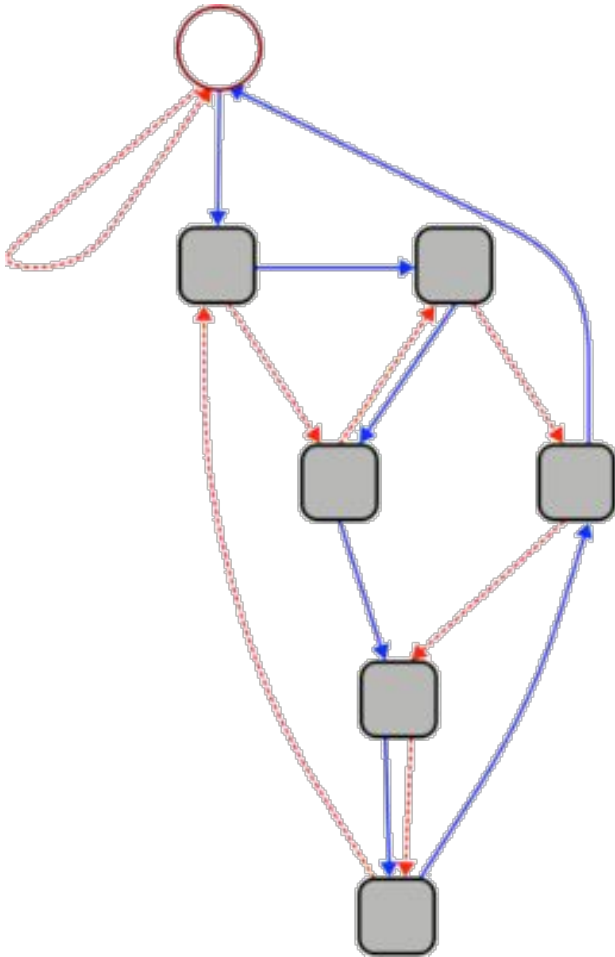
Introduction to Graphs:





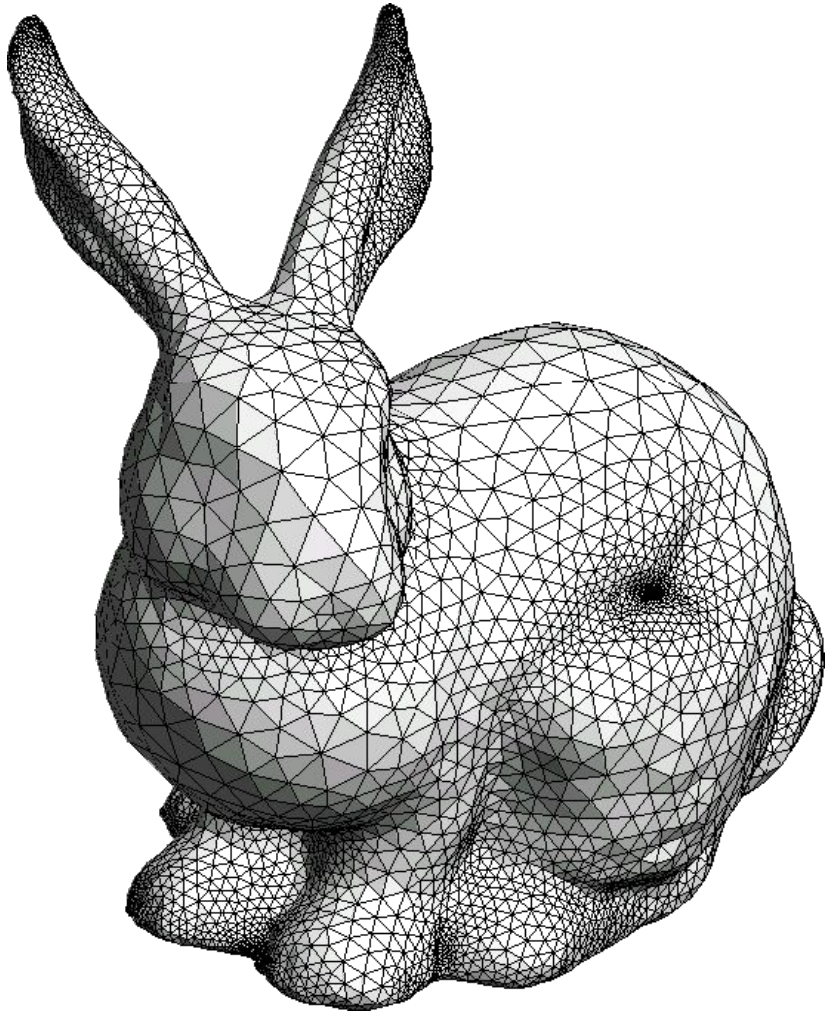


This graph can be used to quickly calculate whether a given number is divisible by 7.



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



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

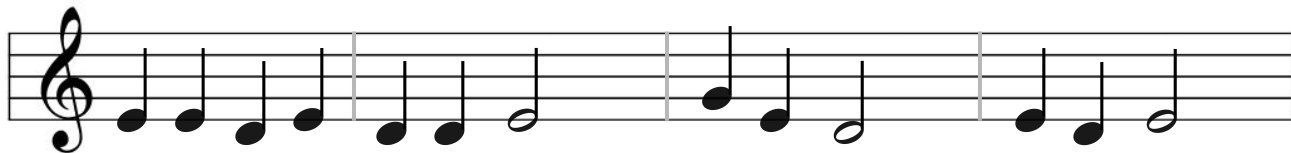
Building a Music Generator

	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

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.

<http://setosa.io/markov>

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...

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>