Programming, Problem Solving, and Algorithms

CPSC203, 2019 W1

Announcements

Project 1 is released. Due 11:59p, Oct 17. OH today 12:30-2p

"Problem of the Day" continues! Exam 10/24 here. — pls ask "do we have to..."

Today:

BFS application to Voronoi Art.

BFS Art analysis

Graphs Intro

Pointillism

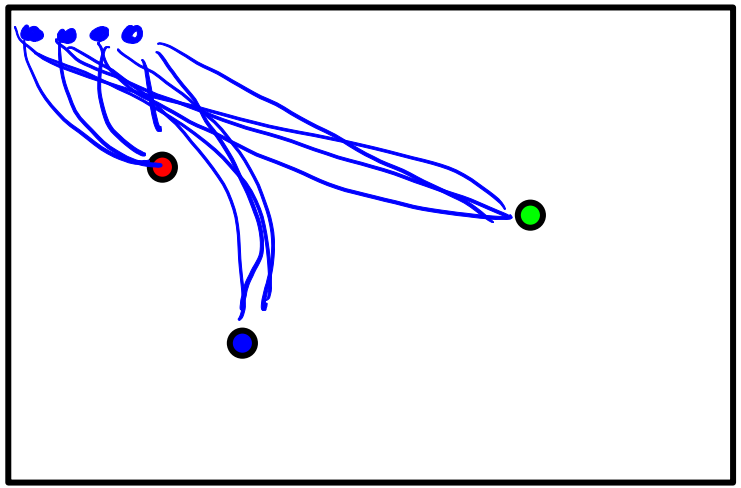
A Sunday on La Grande Jatte, Georges Seurat

Demo and Analysis OLD

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

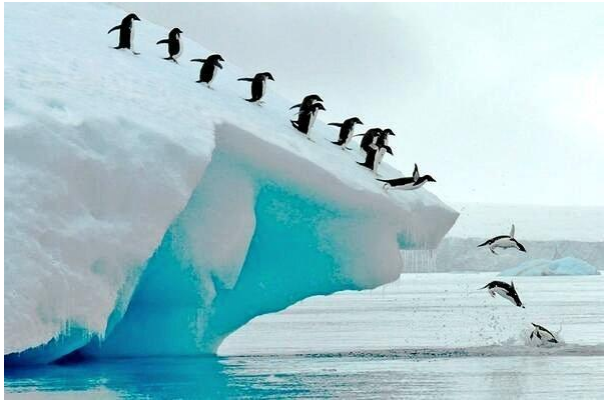
How much work is done?

1) Read image: $w * h$
2) Choose centers: $c = density^2 * w * h$
3) Build new image: $c * w * h$ given $density^2 * w^2 * h^2$
4) Write out new image: $w * h$



Data Structure: Queue

To orchestrate the fill, we'll use a data structure called a QUEUE.



we use a deque

Queue:

enqueue(k) -- places data k onto the structure, at the "end" append

dequeue() -- removes and returns the "first" element from the structure

popleft.

Designing the solution

1) enqueue the centers to start
2) while the queue is not empty:
   a) v = dequeue
   b) for each valid neighbor w, of v:
      i) color w
      ii) enqueue w

1. What info should we put on the queue?
   locations and colors — "centers"
2. Remember we're using `deque` as our queue (Python).
   ok — Python — abstract
3. Do `deque`s have a way to check for empty?
   boolean for existence, or len() → details would be in prob specification.
4. What are the "neighbors" of pixel (x,y)?
   (x, y-1), (x-1, y), (x, y+1), (x+1, y)
5. What would be an *invalid* neighbor?
   - One which has already been colored
   - One which is off the image

Demo and Analysis NEW

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

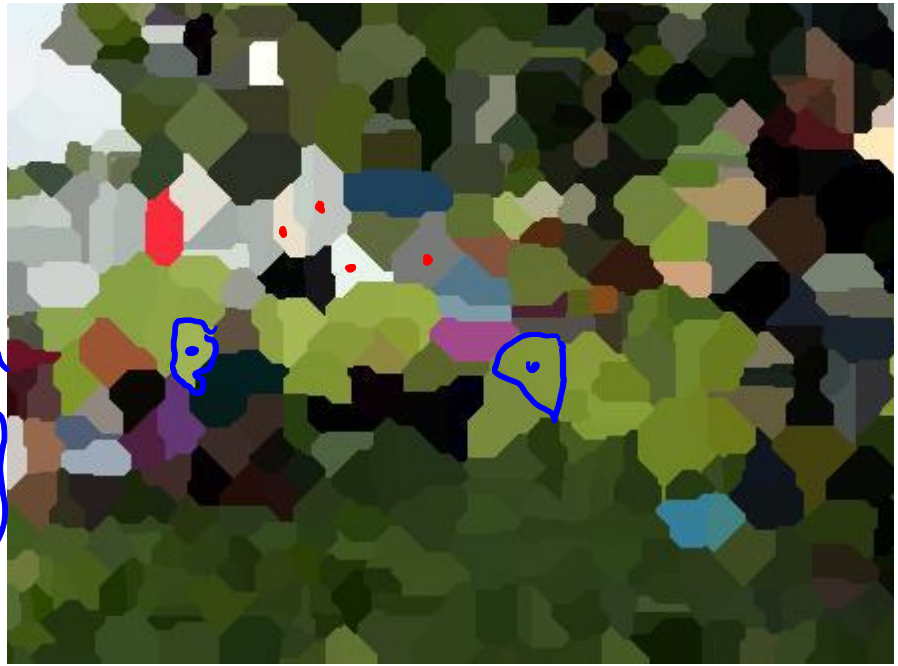
How much work is done?

1) Read image: $w * h$
2) Choose centers: $c = density * w * h$
3) Build new image: $w * h$ WAY faster

   #of pixels + ____ + ____ + ... + ____

   center 1 | ctr 2 | ... | last ctr

4) Write out new image: $w * h$



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?

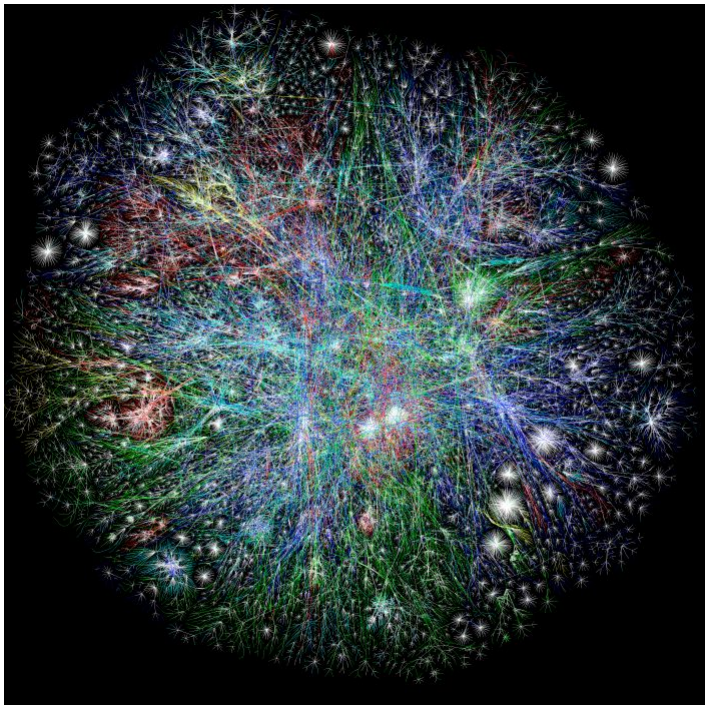
Our fast algorithm for Voronoi Art mirrors a classic algorithm on graphs called Breadth First Search.

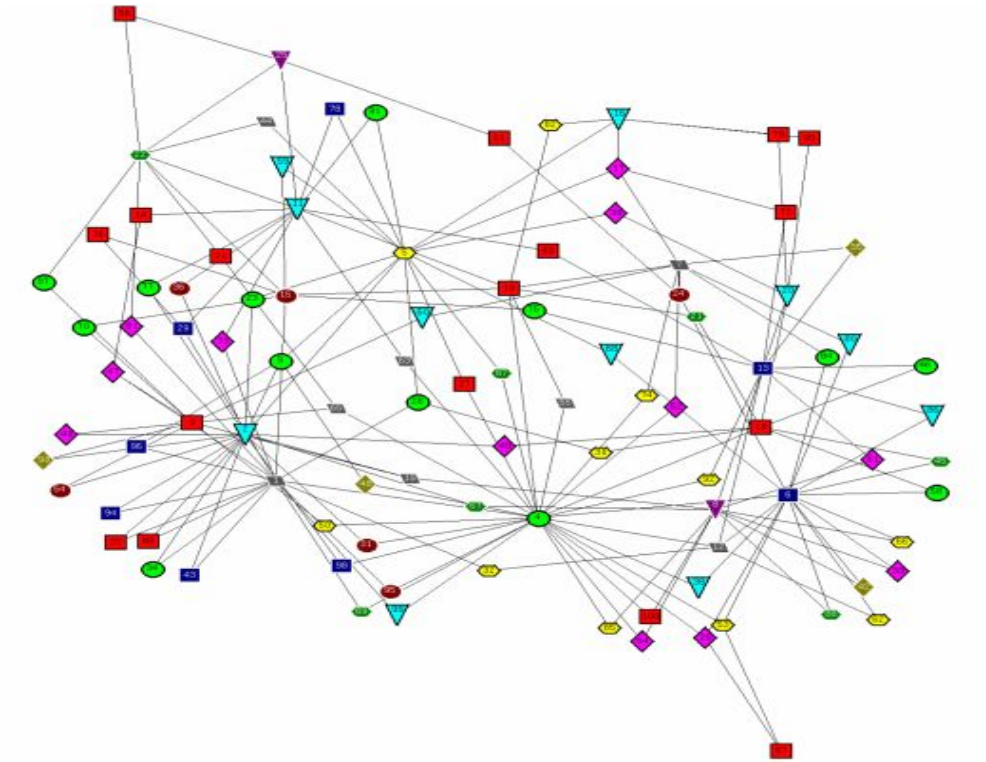
Breadth First Search

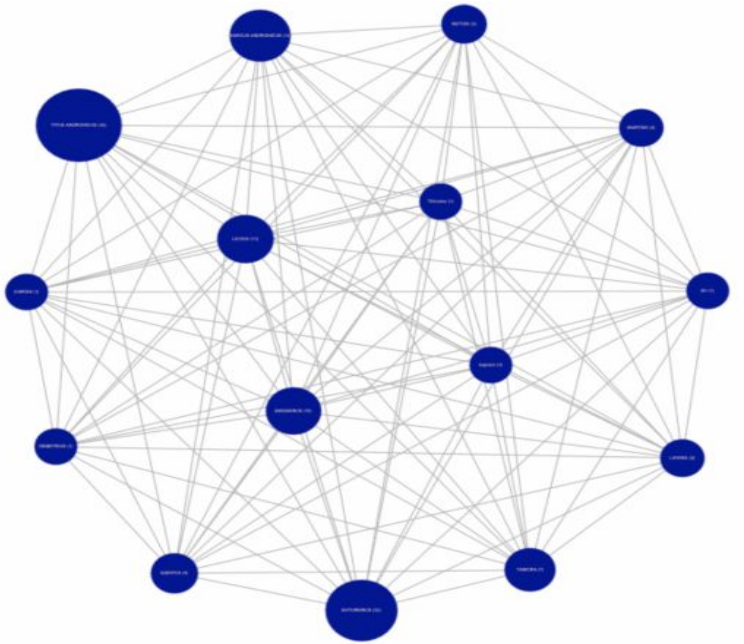
Breadth-first search (**BFS**) is an algorithm for traversing or searching tree or graph data structures. It starts at the tree root (or some arbitrary node of a graph, sometimes referred to as a 'search key'[1]), and explores all of the neighbor nodes at the present depth prior to moving on to the nodes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

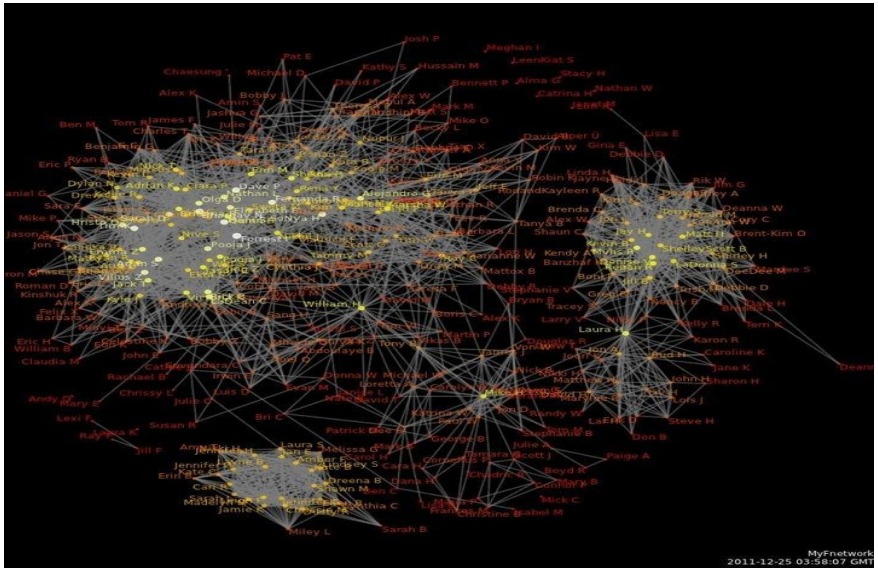
Simplified description:

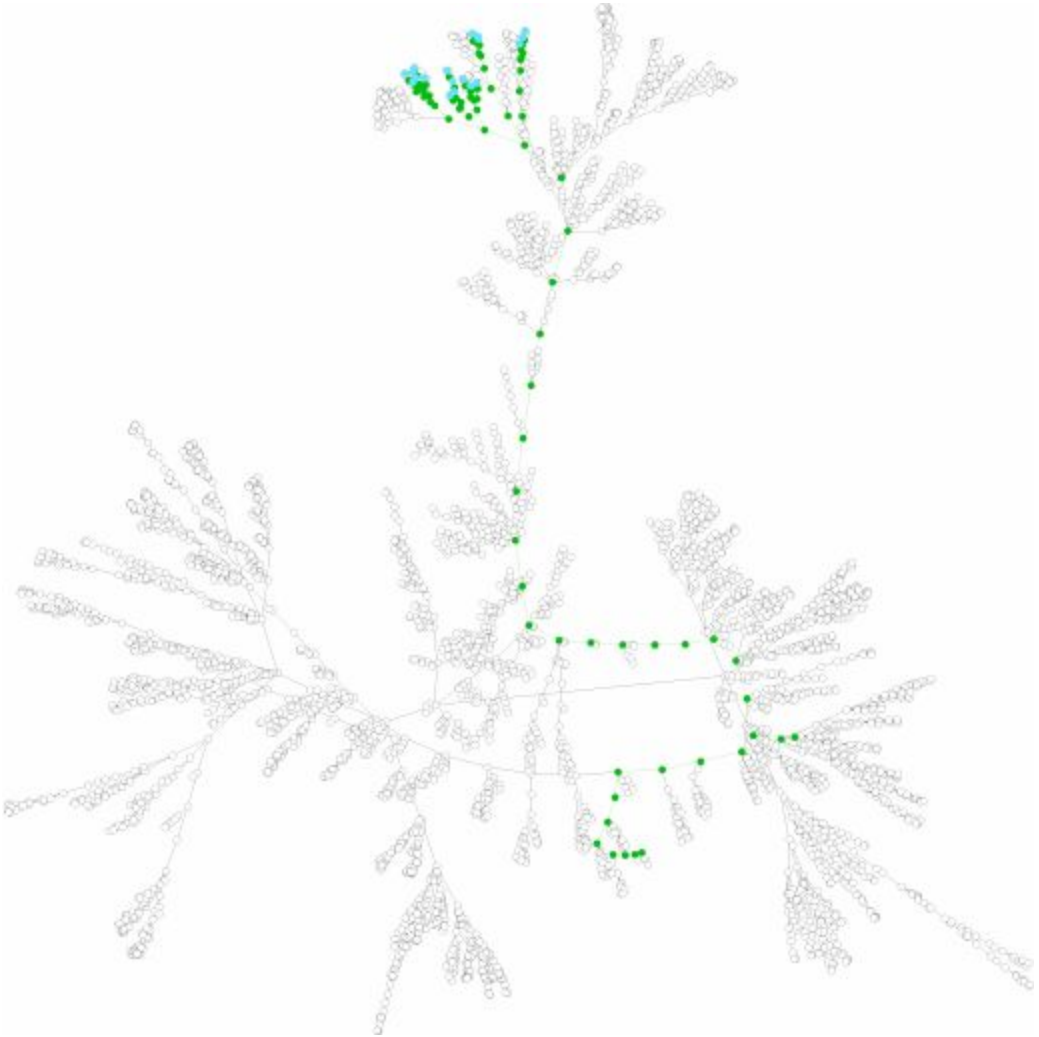
Introduction to Graphs:



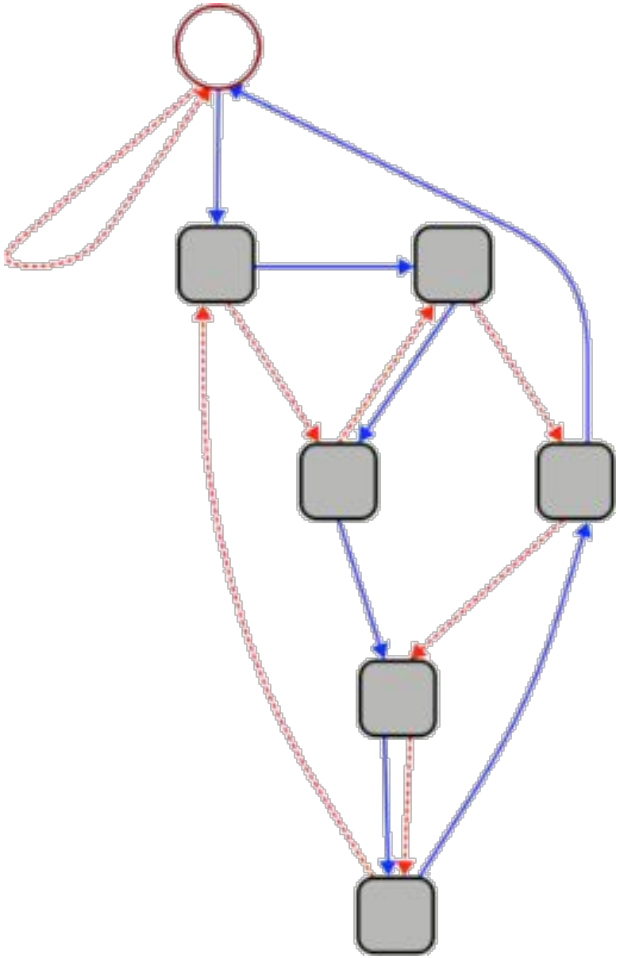





MyFnetwork
2011-12-25 03:58:07 GMT



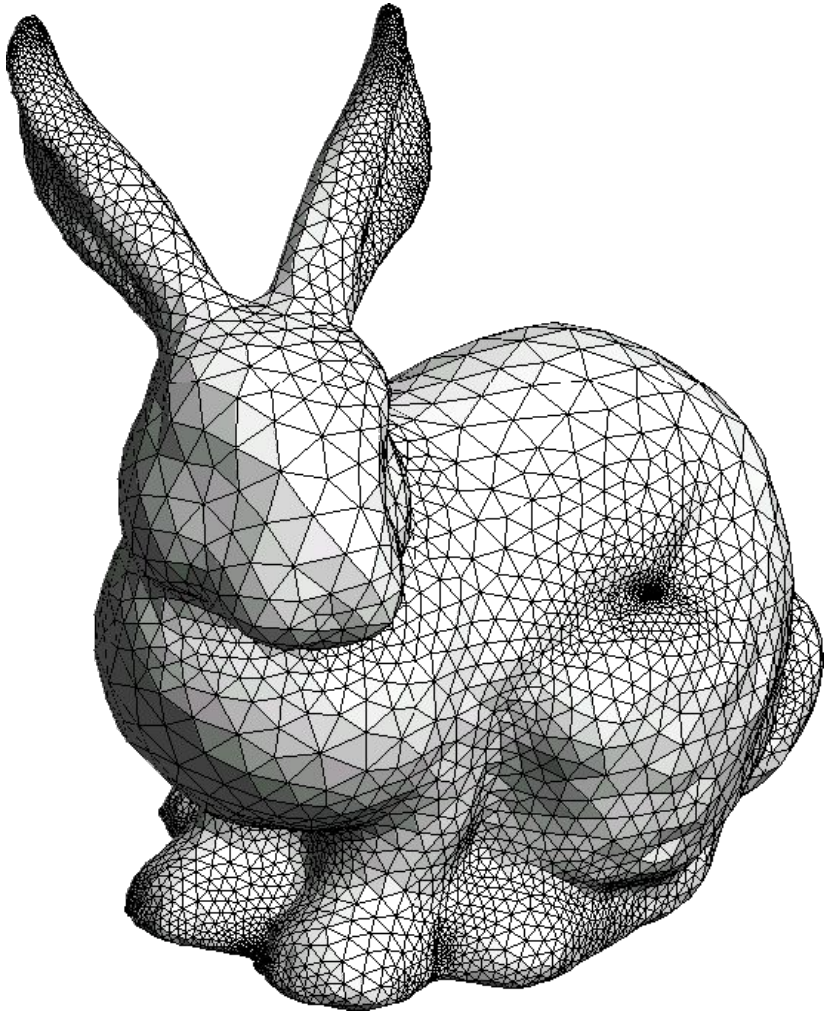

ThinkFun



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



POTD #18 Tue

https://github.students.cs.ubc.ca/cpsc203-2019w-t1/potd18

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://en.wikipedia.org/wiki/Voronoi_diagram