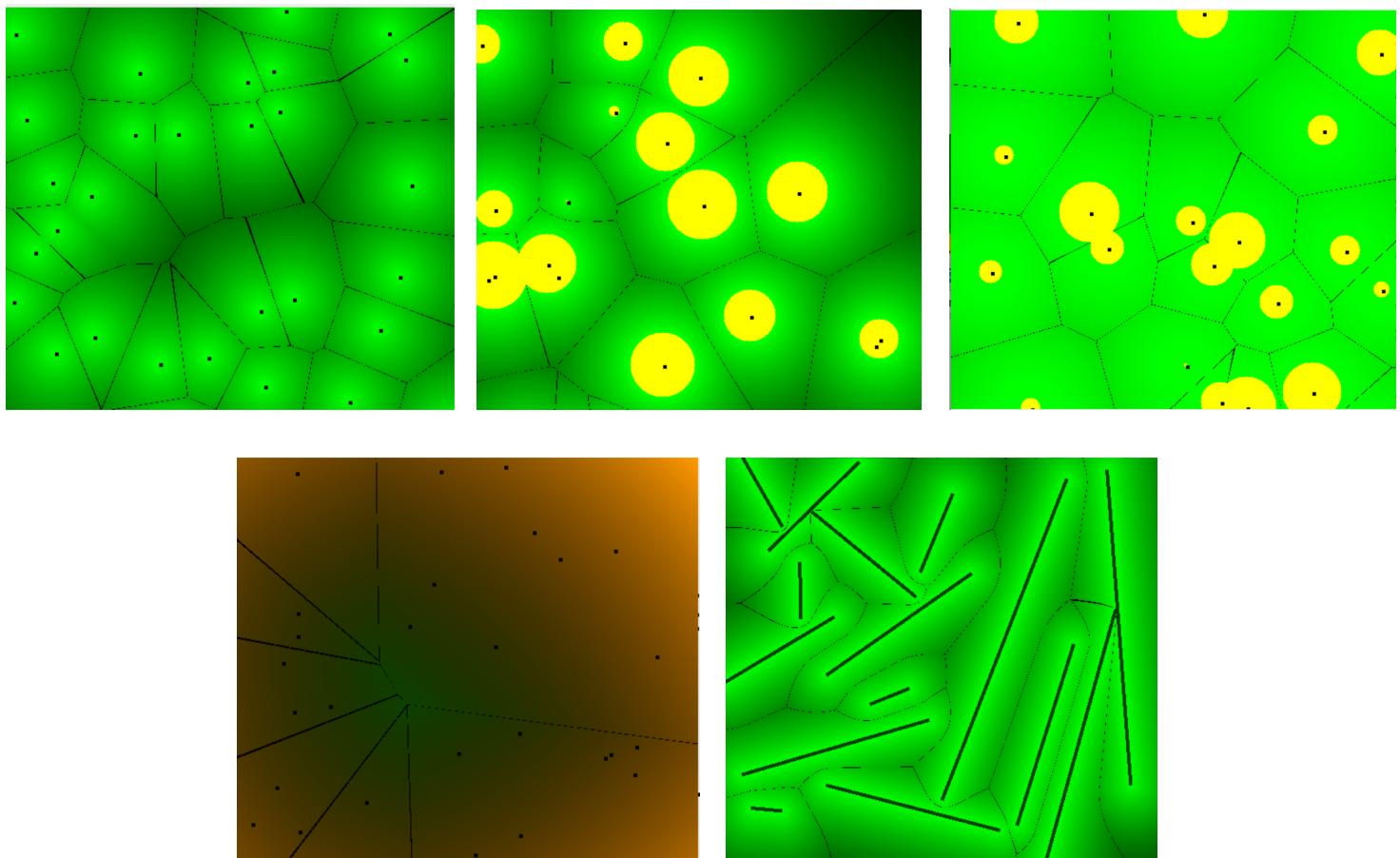

Drawing Various Voronoi Diagram By Simulation and Approximation

An Applet Designed for Lecture 15 of CSE 546

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1st Row: Voronoi diagram, Weighted Voronoi Diagram, Power Voronoi Diagram.

2nd Row: Furthest Voronoi Diagram, Segment Voronoi Diagram.

Introduction:

In Lecture 15, we studied the basic definition of Voronoi diagram.

Voronoi Diagram:

- A finite set of point sites p
 - Euclidean distance d :
- $$d(x, p_i) = |x - p_i|$$
- Voronoi diagram is the set of x with multiple nearest sites.

Therefore, we know that the edge of Voronoi diagram is just a point set that every point in the set have more than one nearest distance to the sites.

By changing the condition, we can create various special version of Voronoi diagrams, for example, the weighted Voronoi diagram, which changes the sites from points to circles.

However, the basic idea is still a collection of points that have more than one nearest distance to the sites, which can be point, circle, or even line segment.

According to this fundamental property, we made an applet to generate the Voronoi diagram by using the approach of approximation and simulation.

Approach:

The approach we use is to first randomly generate several sites, then for every pixel point on the plane, we find the nearest distance between the sites and this pixel point, which is D1, then we find the secondary nearest distance between the sites to the pixel point, which is D2.

If we have $|D2-D1| \leq \delta$, where δ is a very small value, which we define here as the “resolution”, then we can approximately say D1 is equal to D2. In this case, we know

that this pixel point is on the edge of the Voronoi Diagram, and draw a black dot on this pixel.

If the difference of D1 and D2 is larger than delta, we draw a dot with a color dependent on D1, if D1 is small, which means it is close to one of the sites, we fill it with a color that's more closer to green, which is Color(0, 255, 0). On the other hand, if the distance between this pixel point to the nearest site D1 is large, we use a color that's more orange (Color(255, 153, 0)) to draw a dot on this pixel point.

The color on the pixel can be expressed by:

```
farColor = {255,153,0};  
closeColor ={0, 255 , 0};  
p = minDistOnThisPixel/maxDistForAllPixels  
colorOnThisPixel[l] =(1-p)closeColor[l]+p*farColor[l];  
(p is the normalized factor for coloring)
```

As we can see from the graph below:

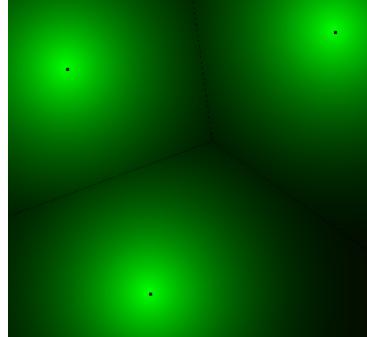


Figure 1

Using the two different coloring strategy when $|D2-D1| \leq \text{delta}$ and $|D2-D1| \geq \text{delta}$, we can generate the below Voronoi diagram as Figure 2.

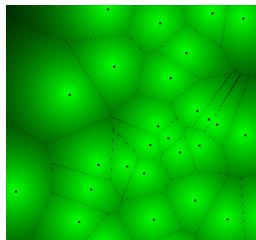


Figure 2:

A regular Voronoi Diagram with 30 sites and $\text{delta} = 0.15$

By using this basic idea, we can also apply it on the construction of other various Voronoi diagram, which includes all different various Voronoi diagram covered in lecture 15.

Instruction for Playing Applet:

First: We choose **how many sites we want to generate**, **the value of delta**, and **the upper limit of radius** if we want to generate weighted/power diagram.

Second: **Click** on the button of the diagram you want to generate.

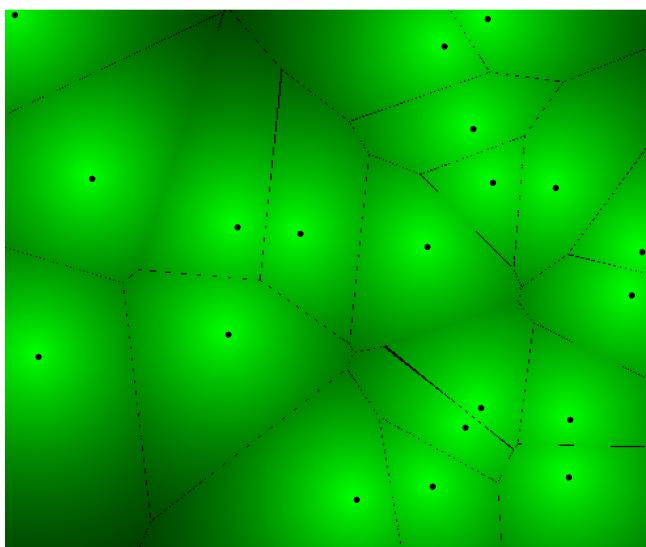
Then you will be able to see a nice diagram !

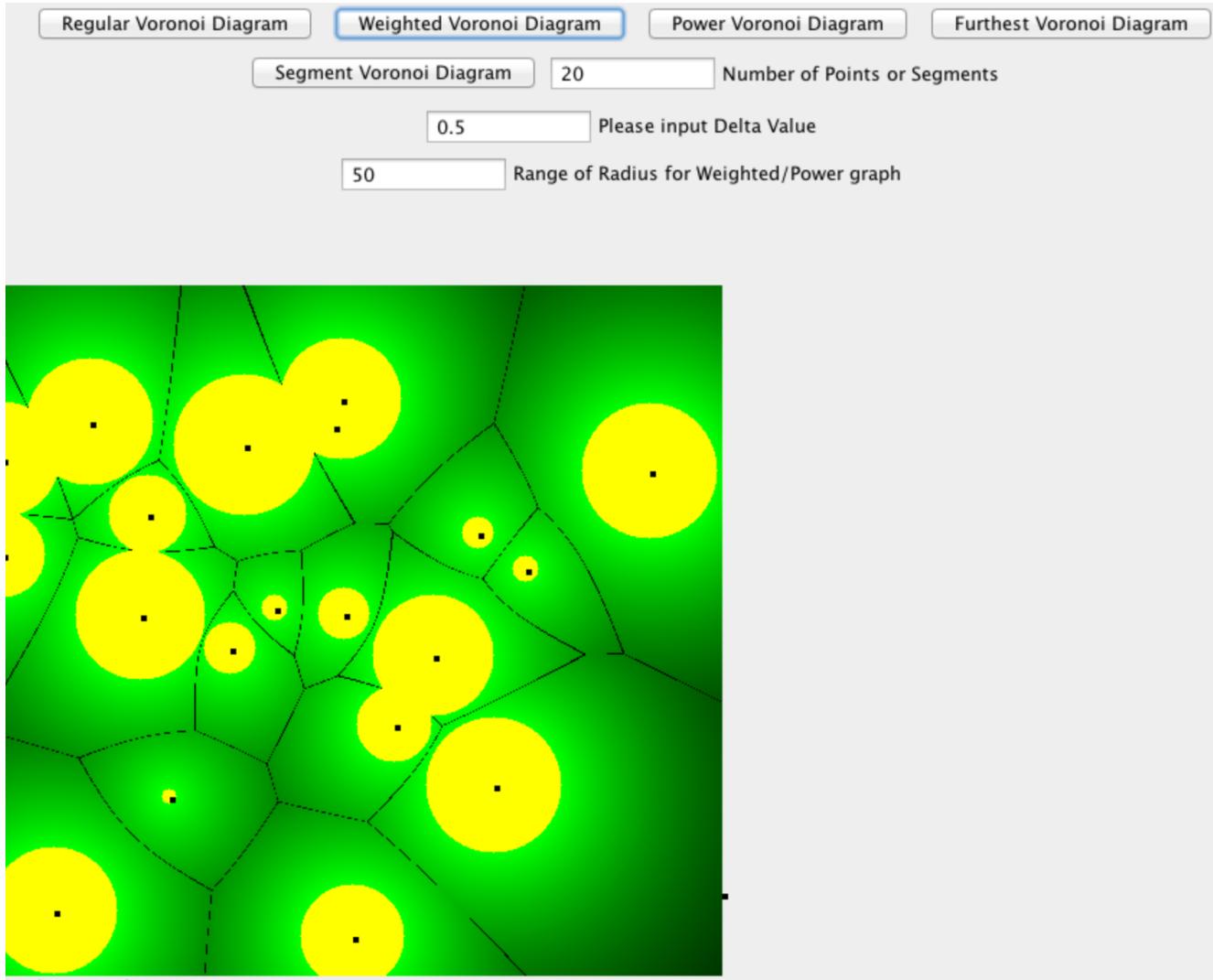
NOTE:

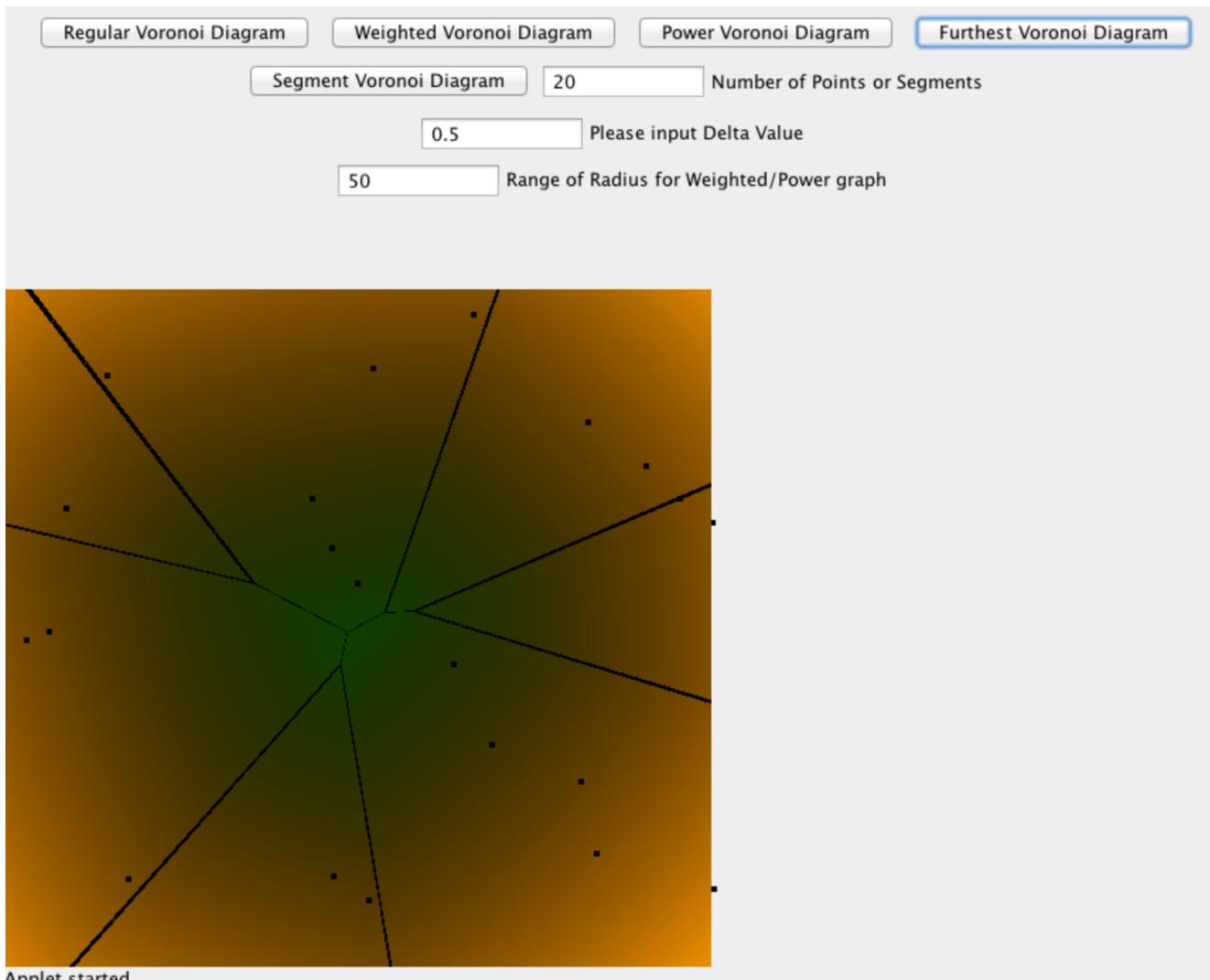
The appropriate delta can be from 0.2 to 0.8 in order to generate nice diagram.

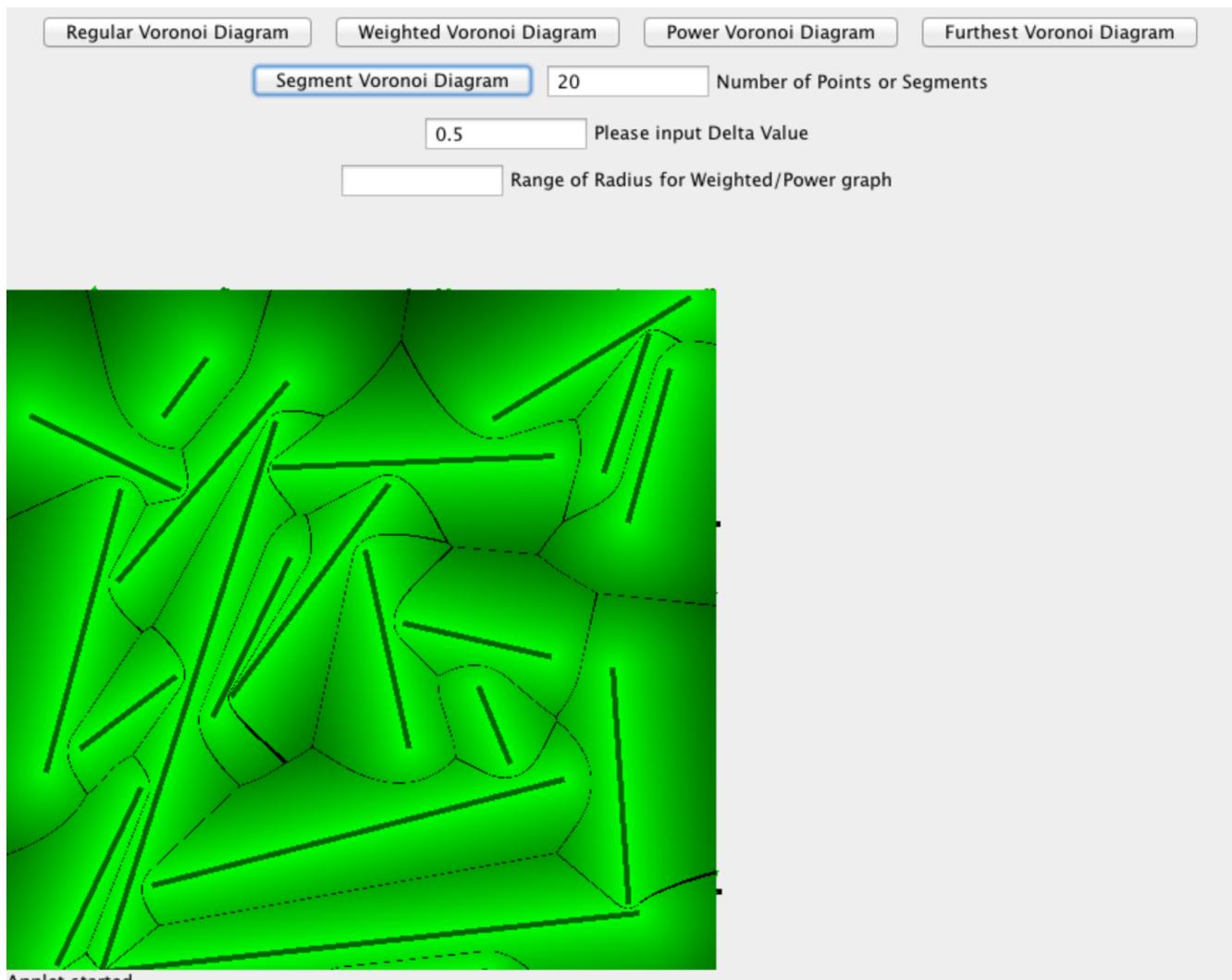
The appropriate maximum radius for radius in weighted/power diagram can be 30 to 50

<input type="button" value="Regular Voronoi Diagram"/>	<input type="button" value="Weighted Voronoi Diagram"/>	<input type="button" value="Power Voronoi Diagram"/>	<input type="button" value="Furthest Voronoi Diagram"/>
<input type="button" value="Segment Voronoi Diagram"/>	<input type="text" value="20"/> Number of Points or Segments		
<input type="text" value="0.25"/> Please input Delta Value			
<input type="text"/> Range of Radius for Weighted/Power graph			









Thank you !!