MATH/CPT_S 453 Graph Theory

Final Project Write-Up

A Graph Theorist’s Sketchpad: Features and Implementation

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Source Code: https://gitlab.com/nate-gibson/graph-sketchpad

Live version: http://natesgibson.com/graph

Features

1. Graph Information

   In the upper left-hand corner of the window, graph information will be displayed and automatically updated. This includes the current number of vertices and the current number of edges in the graph.

2. Drawing Vertices

   Vertices may be drawn anywhere on the canvas by pressing down the ‘v’ key, provided the cursor is over the canvas and nothing is currently selected. The vertex will be drawn at the position of the cursor.

3. Vertex information

   Information about the vertex will be displayed and automatically updated. The unique id of the vertex will appear just below the vertex and to the left. The degree of the vertex will appear just bellow and to the right.

4. Selecting Objects

   One or more objects may be selected by either dragging the blue-purple selection window over the desired object(s), or by holding the shift key and left-clicking on each object the user would like to select. Additionally, selected objects may be un-selected using the shift key method. Once selected, objects will have a light-blue rectangle surrounding them, which is automatically removed should an object become unselected. Selecting objects allows the user to perform actions on the selected objects as a group. Selectable objects include vertices and edges.

5. Moving Selection

   Once selected, objects may be moved by left-clicking and dragging the outer selection rectangle on the canvas. If an object is movable, the cursor will appear as “four arrows” when hovered above the object. If an object is selectable but not movable, the cursor will appear as a “pointer”. Note: drag objects outside of the canvas at your own peril.

6. Changing the Color of Selected Vertices

   If a selection includes one or more vertices, the color of these vertices may be changed by pressing down the 1-6 keys, with each key corresponding to a different color. The 1-6 numpad keys are supported as well.

7. Drawing Edges

   Edges may be drawn when exactly one or two vertices are selected. If more objects are selected, an edge will not be drawn. If two vertices are selected, a straight edge connecting them will be drawn. If one vertex is selected, an elliptical loop will be added to the vertex. Loops add 2 to the degree of their adjacent vertex.

8. Deleting Selection

   A selection may be deleted by pressing down the delete or backspace buttons. Edges adjacent to deleted vertices will be automatically deleted. Deletable objects include vertices and edges.

9. Directed Edges

10. A
11. A

Implementation

Overview:

I implemented this project as a web application, coding it in HTML/CSS and JavaScript. I chose this approach because web apps coded in JavaScript are highly accessible – they will run on pretty much any machine with a sufficiently modern web browser.

Graphics:

The native JavaScript canvas has very limited functionality, which would have required me to code at a very low-level to implement this application's requirements. Instead, I used the JavaScript HTML5 canvas library Fabric.js (http://fabricjs.com).

Fabric.js allowed me to interact with shapes such as lines and circles as objects. These objects allow me to define various properties of a shape such as position, size, and color. Once instantiated with properties, adding these objects to the canvas is as simple as "canvas.add(object);". This greatly streamlined my ability to code the graphics.

Graph, Vertex, Edge:

I implemented Graph, Vertex, and Edge as JavaScript classes. Classes in JavaScript can be… difficult. One of the major drawbacks of my JavaScript approach is that JavaScript was not originally designed as an object-oriented language. However, JavaScript classes are a thing, and I did use them, albeit with some difficulty.

Events:

Events are function pointers which allow you to call functions automatically when some "event" has happened.