Student handout

- Brainstorm several different ways in which you might visualize a scalar field in three dimensions, using graphs. You might want to use the electrostatic potential V due to some simple configurations like a quadrupole of charges as examples.
- After you have brainstormed ideas of your own, open this Sage code or this Mathematica worksheet and explore some of the ways implemented there. If you have a different visualization, please bring it to the attention of the teaching team and we may incorporate it next year!

1 Instructor's Guide

1.1 Prerequisites

We find it valuable to use this activity AFTER students have done the activity `https://paradigms.oregonstate.edu/act/2070`. This pair of activities bolster students' geometric sensemaking of potentials. We have successfully used this pair of activities both before and after `https://paradigms.oregonstate.edu/act/2076`.

1.2 Introduction

This activity starts with prompting the students to brainstorm different ways to represent a three dimensional scalar field on a 2-D surface (like their paper or a whiteboard). ($\approx$ 5 minutes, can be done as a whole class discussion or in small groups.)

1.3 Student Conversations

It is a good idea to put the *least* computationally confident member of each group at the keyboard. This helps to ensure that everyone is comfortable with the technology. Do not hesitate to encourage a group to change its typist if the current one is typing too quickly.

This activity can be used very effectively in a context where students are asked to brainstorm about ways in which they might graphically represent the electrostatic potential. They should be reminded to think about the fact that the electrostatic potential is a scalar field, i.e. it is a number (with appropriate units) at every point in THREE dimensional space. In a whole class setting, as the students generate ideas, the instructor projects each choice from the Sage code or Mathematica worksheet for the students to examine/discuss.

A pedagogically useful representation is for each number at a point to be represented by a color. Then the students can imagine how they would try to show this "sea" of colors on a two-dimensional graph.

If students are new to using Mathematica, it is well worth showing them how to create a new line so they can enter new mathematical input. This requires moving the mouse between existing blocks; the pointer should change to a horizontal line.

1.4 Wrap-up

Consider adding the Surfaces activity `https://paradigms.oregonstate.edu/act/2363`.