Radial Basis Functions (RBF) kernel

Polynomial kernels are not the only tool that we have to split data. In this section, we will learn about the RBF kernel.
This process has us pull points off of the line and plot them on a "mountain range," split the points on the range, and then translate them back to their original position with multiple cut points.

The technique

Build a "mountain" on top of every point. The technical term for these mountains is radial basis functions. How could we combine these functions in a way that helps us separate the blue and the red points?

We can multiply the mountain over the red point by -1, which flips it, and then add the functions together. At every point, *just add the three heights*. Next, move the points to the corresponding sum. After we do this we can easily draw a line that splits the points in two. This line will intersect the mountain range at two points. When we project down to the line, we get two cuts that match where the line intersected our mountain range.

`Notice that these cuts separate the blue points from the red points as we wanted.`
We are not limited by addition, we can actually reach each mountain by any constant that we want.

How do we find this weight?

- Place one mountain/function on top of each point. Under each point, record the value of each function, or how tall the mountain is at that point.
- Continue doing this for each point and each function.
- Each point will have one value of 1 in their vector of heights, since the height of the mountain corresponding to that point is one by construction. In general, the other values will be small.

How do we find the right linear combination of functions which will be able to separate the blue and the red points?

Take the three height vectors and plot them in a three-dimensional space. Since we have as many dimensions as points, we'll be able to separate our points well. Using the application of our known SVM algorithm, we should be able to separate these red and blue points with a plane with the equation, $2x-4y+1z=-1$. If we take the constants of the equation off the plane, they become the constants of our model. The first mountain has a weight of 2, the second -4, and the third has a weight of 1. The line that separates these points is the line at height -1.

Quiz Question

When drawing a graph using radial basic functions, the 'mountain peaks' should be located where?

a. Directly over the points
b. Between the points