Kandinsky’s Art through the Computational Lens
Venecia Xu, Class of 2016

Abstract
We used computational tools and techniques to analyze geometric objects, particularly straight lines, in Wassily Kandinsky’s paintings. Kandinsky was an abstract Russian artist unique for laying out rules and correlations about abstract composition in his writings. Our goal is to investigate if patterns can be identified in his work and whether these patterns correlate with his rules. We wrote a computer program to process and extract all the straight lines from his paintings, and then generated the distribution of the slopes and the lengths of the straight lines within the four quadrants of each image. While we have completed the computer vision part of our study, the data analysis part is our next step.

Introduction
Wassily Kandinsky was a Russian artist in the early 20th century instrumental in developing abstract painting. From 1922 – 1933 he taught at the Bauhaus, a famous German design school, by which time he had written several books on art theory and had fully developed his abstract style. Kandinsky associated shapes, lines and angles with specific colors, and declared that lines had different tensions based on their angle and location in the painting. Divided into four quadrants, the canvas became associated with different weights, which affected line tension and determined whether a line was harmonious or disharmonious. Although Kandinsky wrote prolifically about his theories of abstract composition, especially in Point and Line to Plane (1923), he avoided the question of how such compositions were created, perhaps leaving it to artistic intuition. The ultimate goal of our research is to characterize the complex function that maps artistic intuition to a final composition. The first step is to understand the geometric properties of basic objects like straight lines.

Line Extraction
To optimize the extraction, the paintings had to be processed. First, the images were blurred to minimize noise. Then, the light areas of the image were dilated and expanded to skeletonize the lines. An edge detector isolated the outlines of all shapes on the canvas. Another method identified all the straight lines. However, duplicate lines, broken lines, and lines along curves produced undesirable output. What should have been a single line was broken up as tens of smaller lines. To solve this problem, we wrote a procedure to identify the segments that were part of the same line and merge them. This involved extending the lines if they overlapped with other lines, or connecting disjointed lines. This procedure required a lot of computational efforts.

After the paintings were processed to isolate all straight lines, each line was assigned to quadrant(s) based on its start and end points. The slopes and lengths of all the lines in each quadrant were grouped together. If a line was part of multiple quadrants, then it was classified as either a harmonic or a disharmonic line.

Conclusion
While we completed the computer vision part, our next step would be to analyze the data with the goal of discovering repeatedly occurring patterns in Kandinsky’s works. Possible extensions of our work would be to analyze more complex shapes and interaction among shapes, and to investigate the correlation between shapes and colors. Another direction could be looking at how Kandinsky’s paintings vary based on chronological order.

Faculty Mentor: Mohammad Irfan (Dept. of Computer Science), and Sarah Montross (Museum of Art)
Funded by the Gibbons Summer Research Program