



Piet Mondrian  
Farmstead and Irrigation Ditch with Prow of Rowboat, 1898



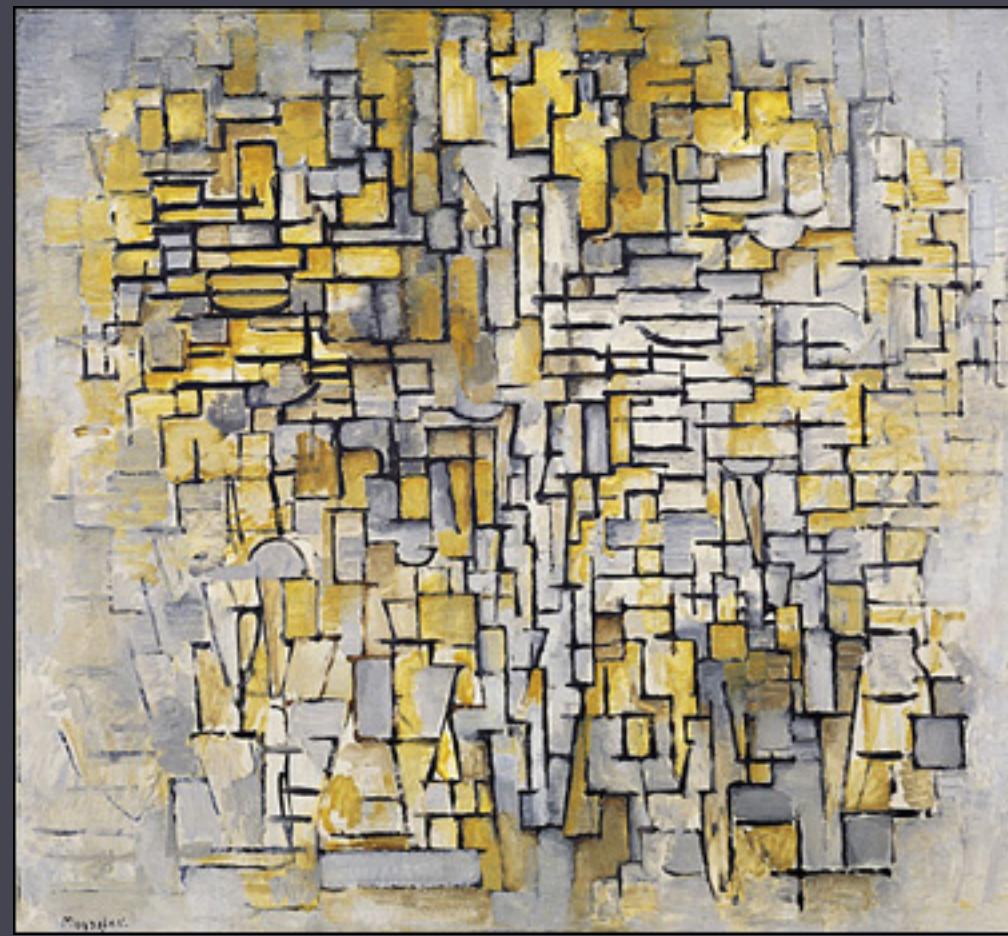
Piet Mondrian  
Evening: Red Tree, 1908-1910

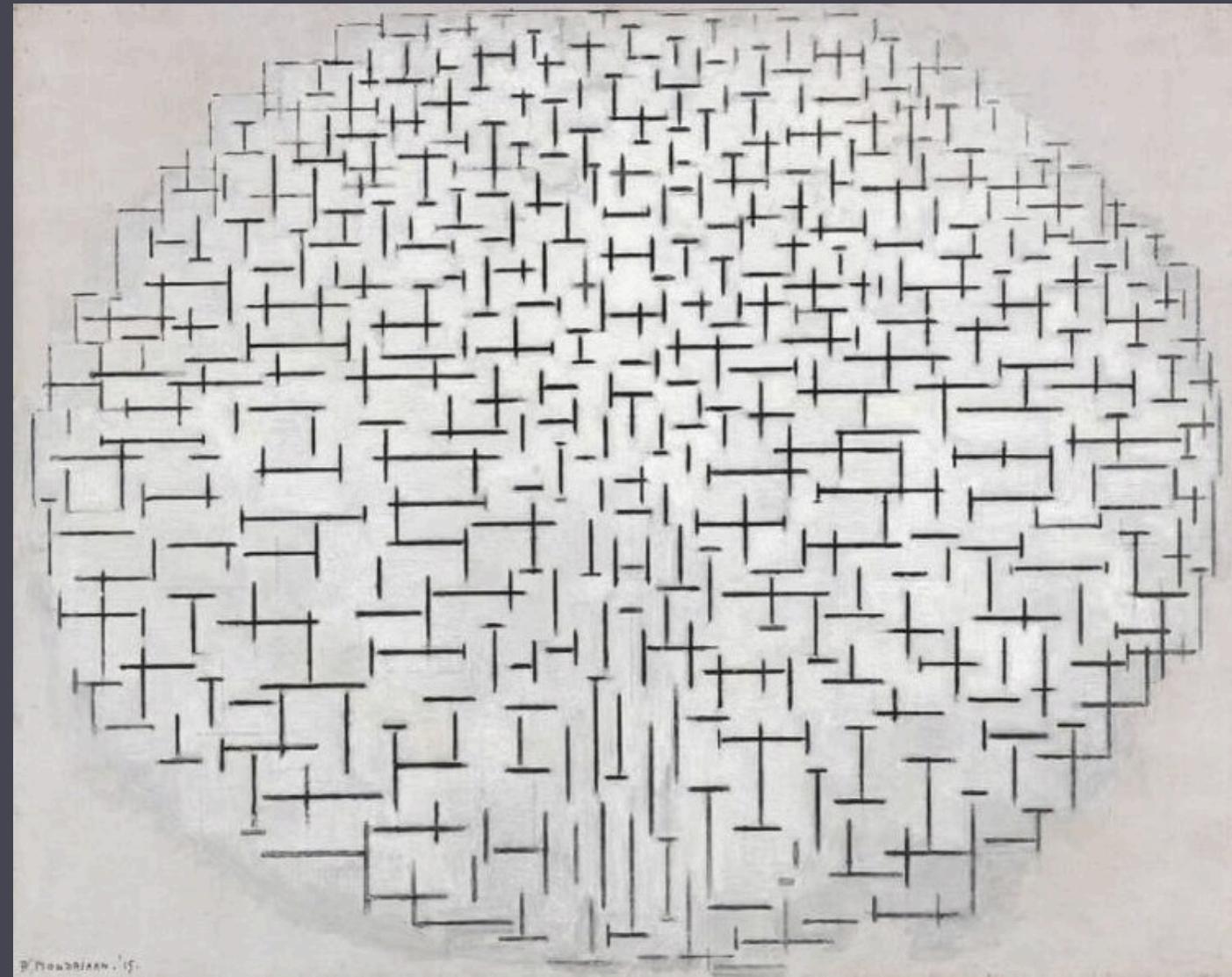


Piet Mondrian  
The Flowering Apple Tree, 1912



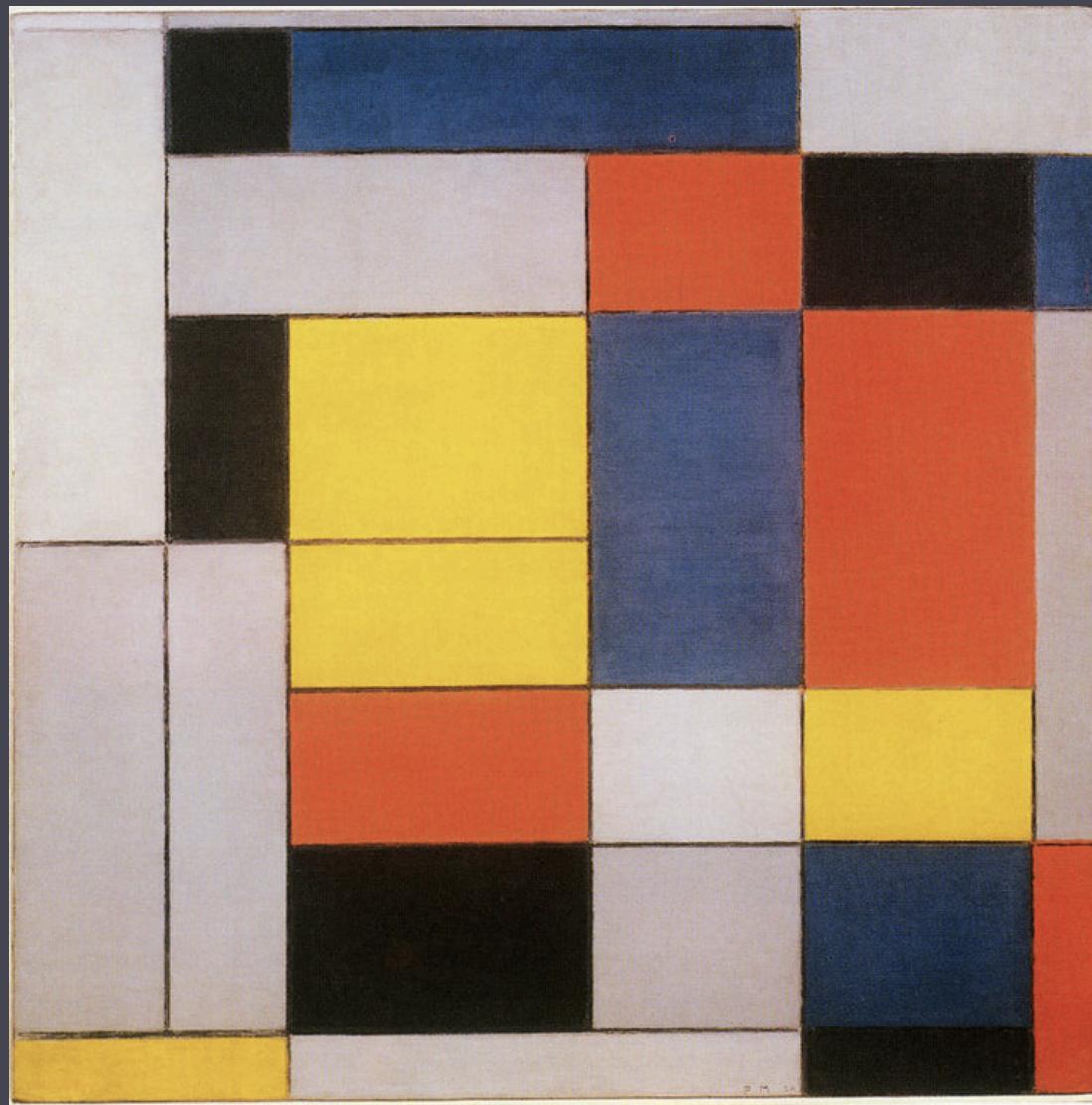
Piet Mondrian  
The Grey Tree, 1911



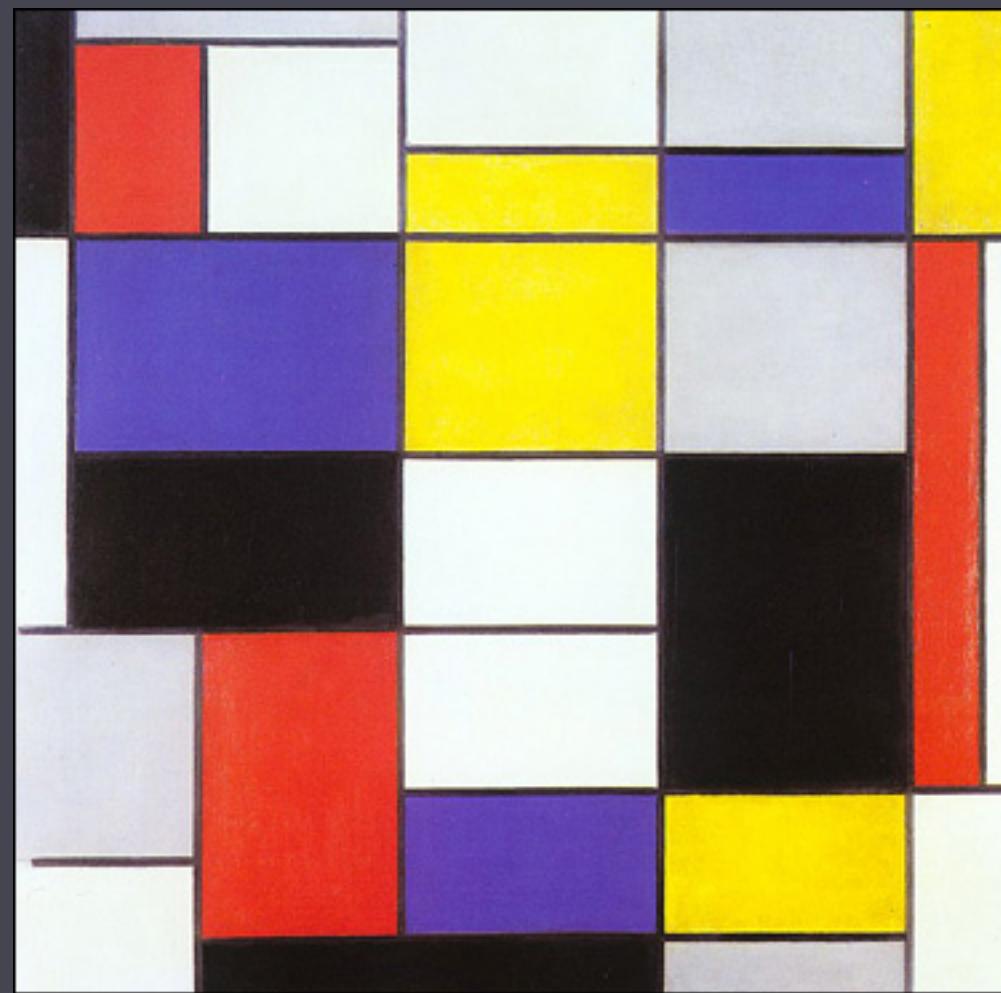


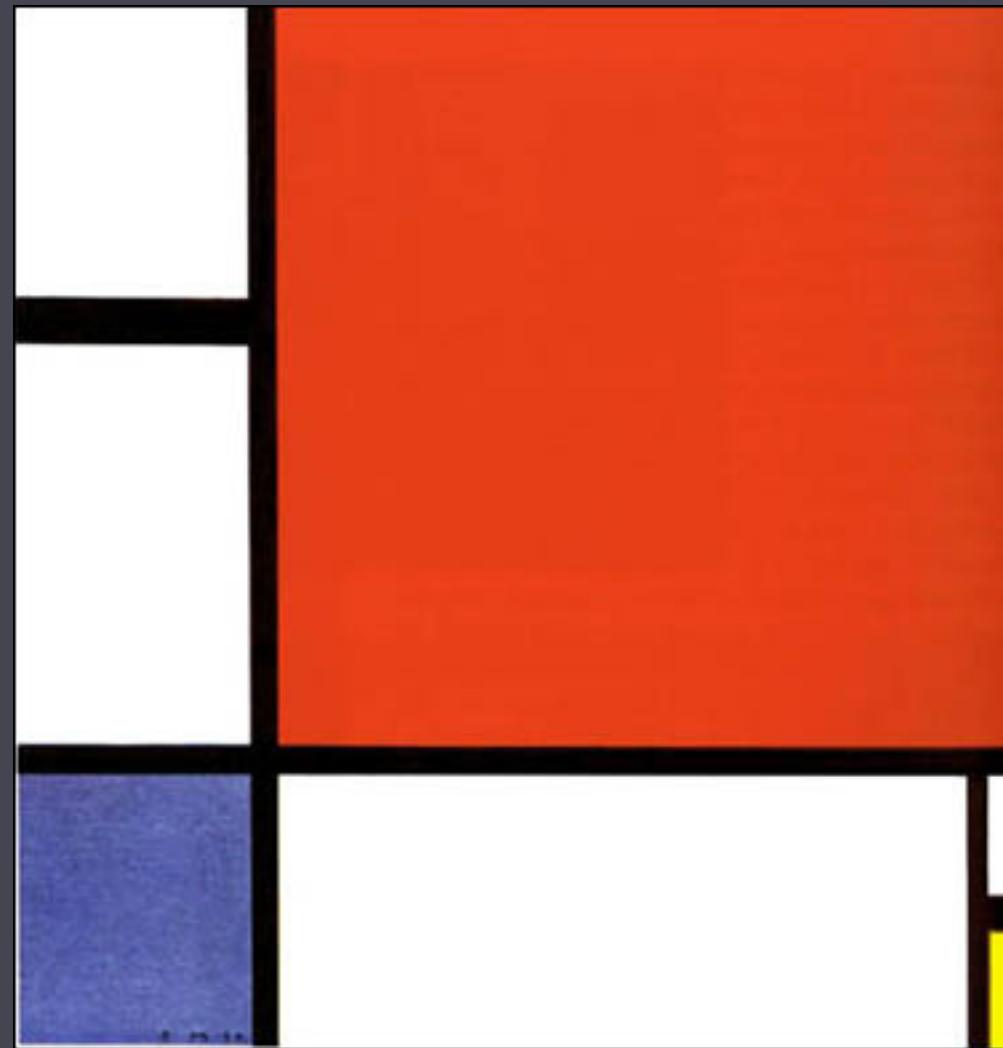
Piet Mondrian  
Composite 10 in Zwart Wit (Composition 10 in Black and White), 1915

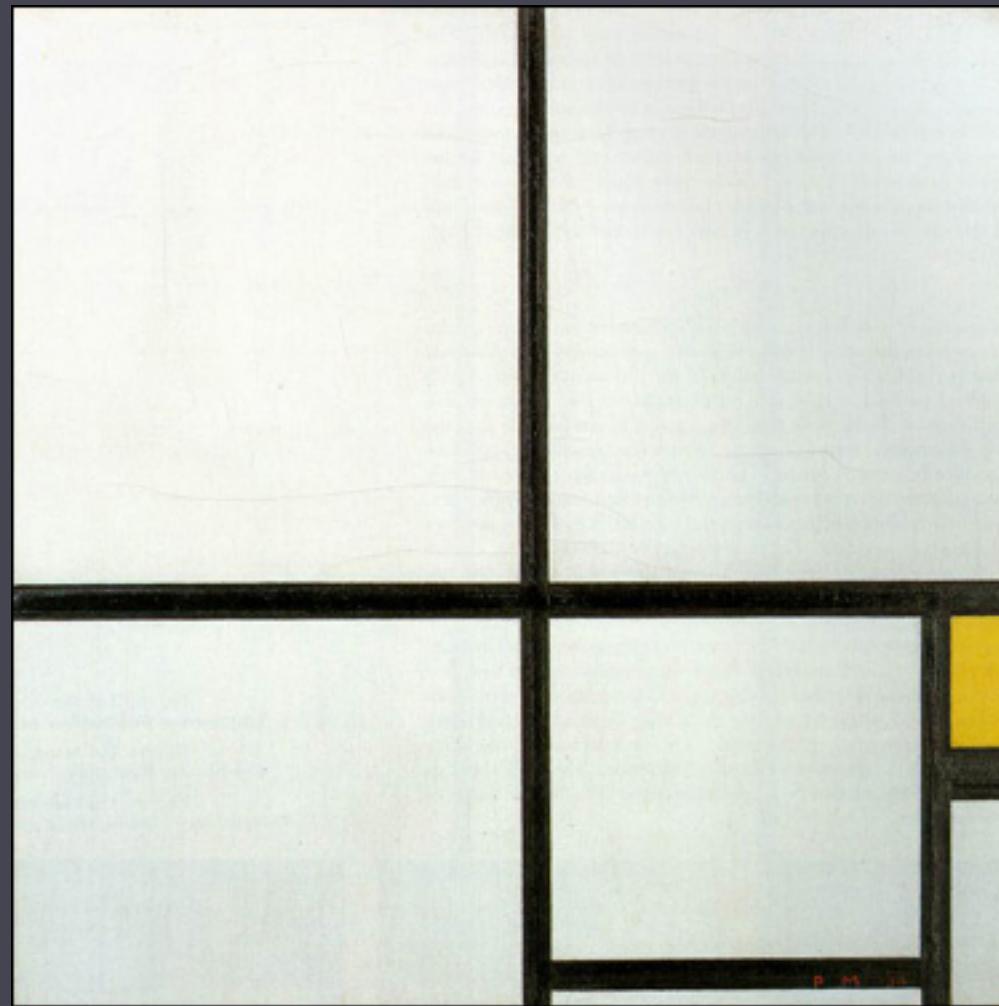


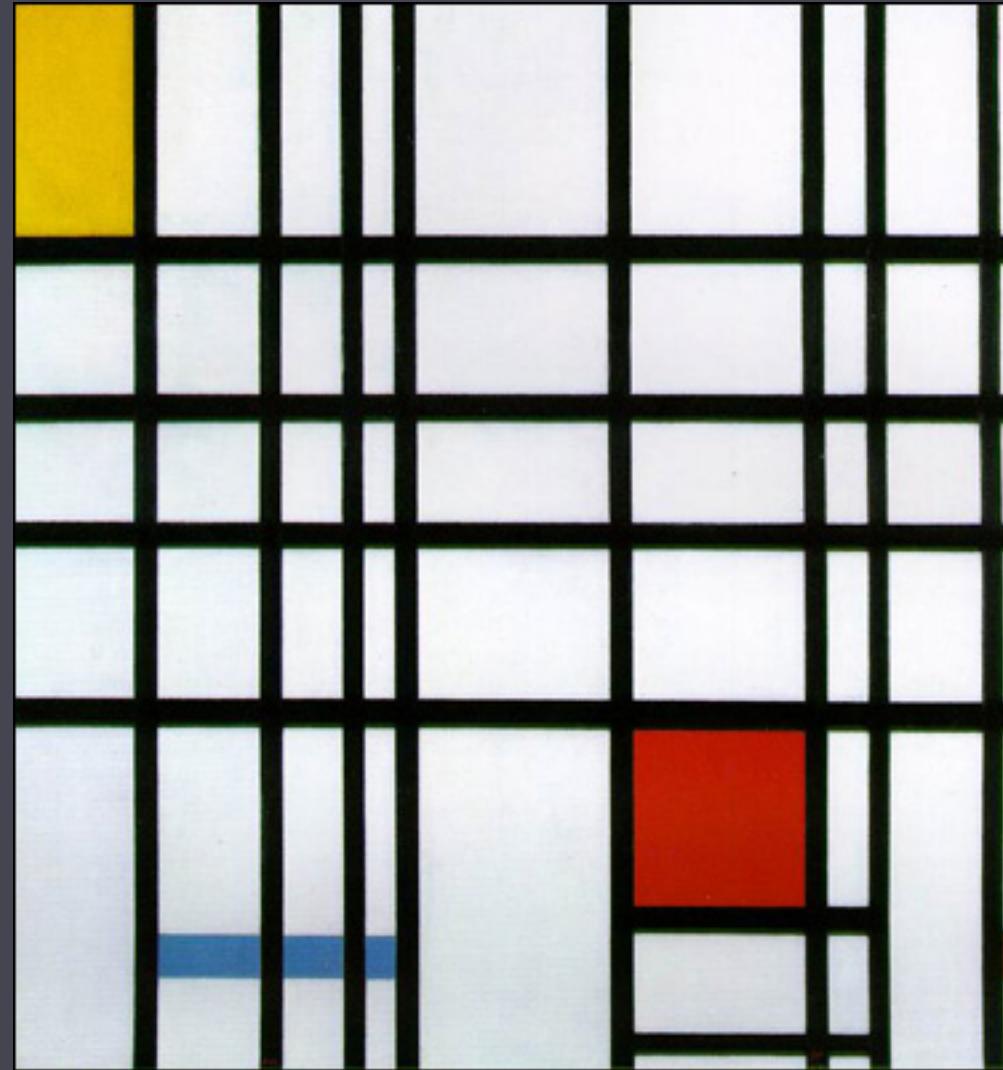


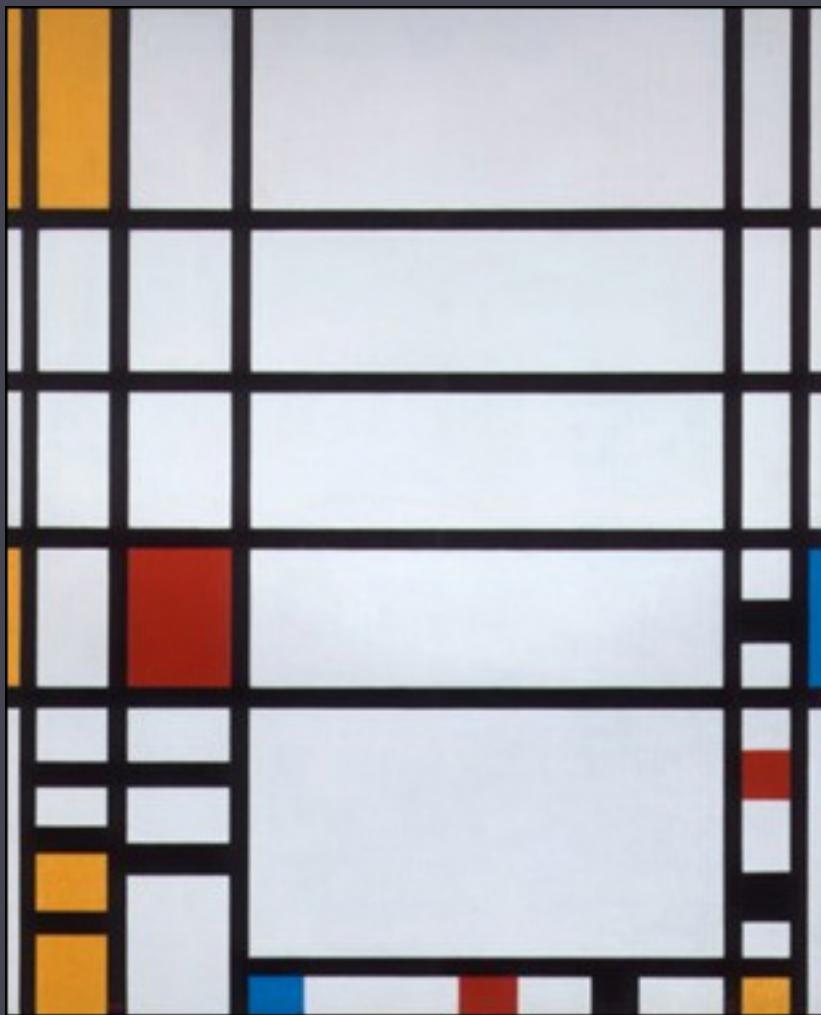
Piet Mondrian  
No. VI /COMPOSITION No.II, 1920

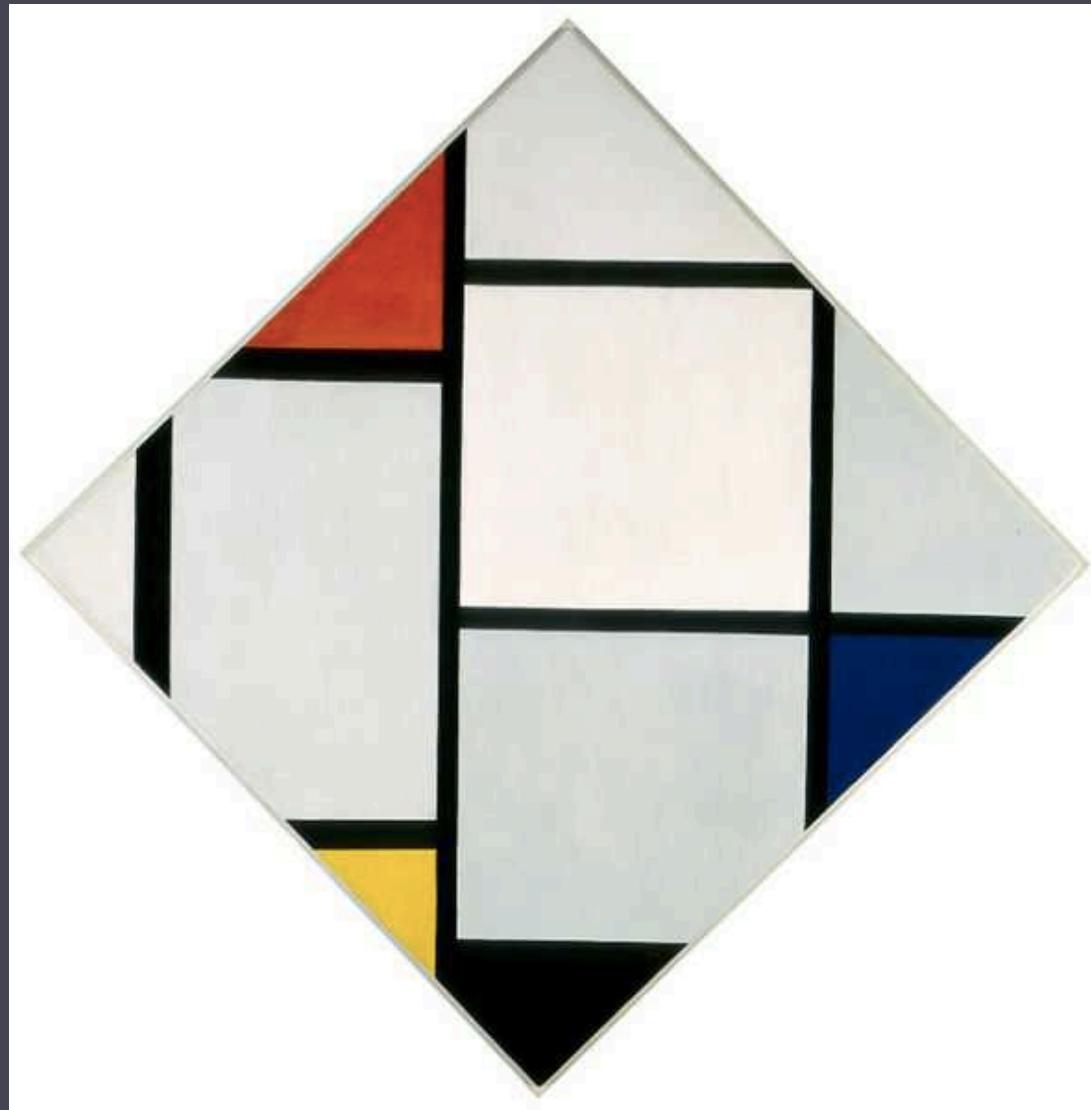




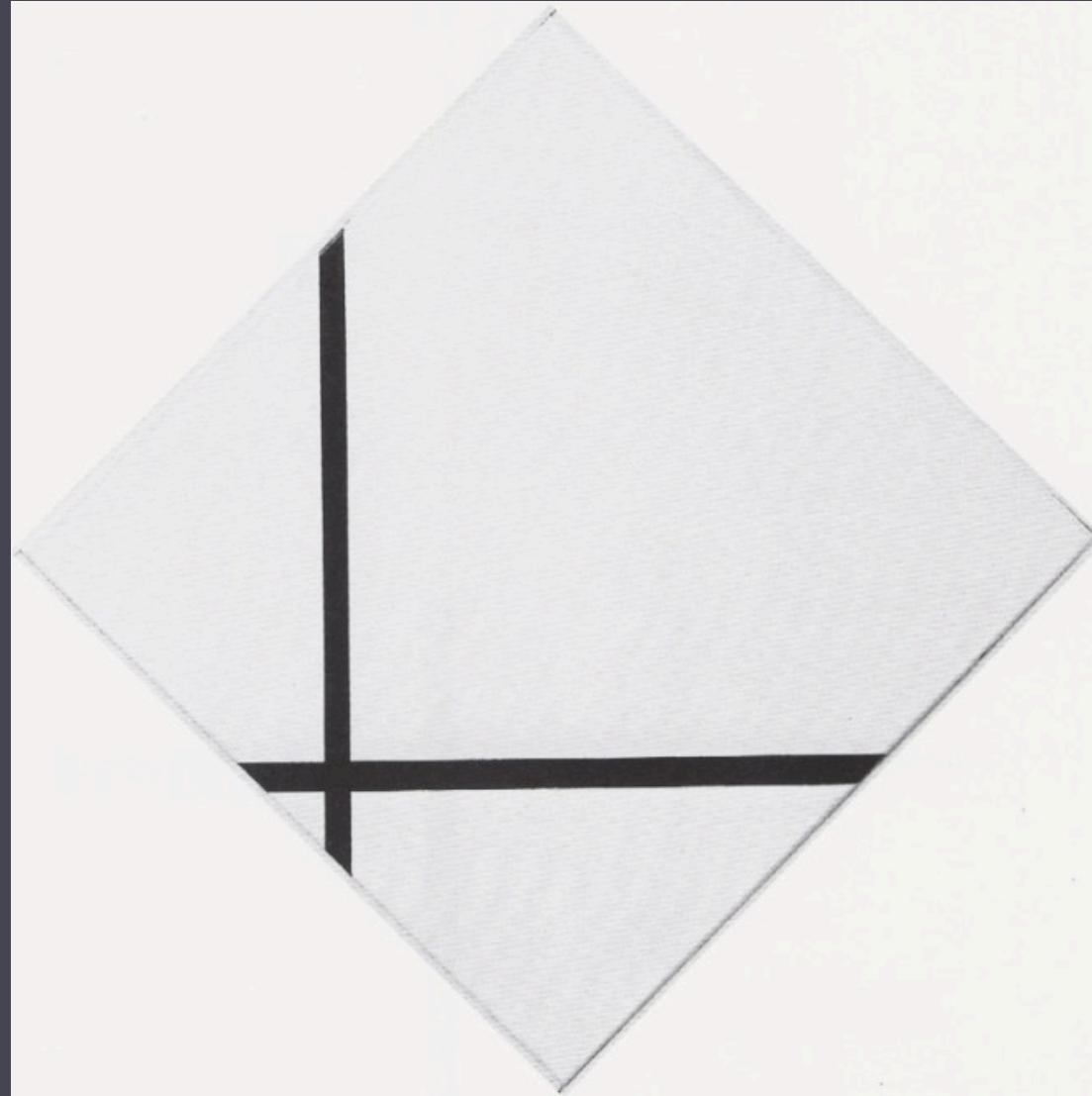




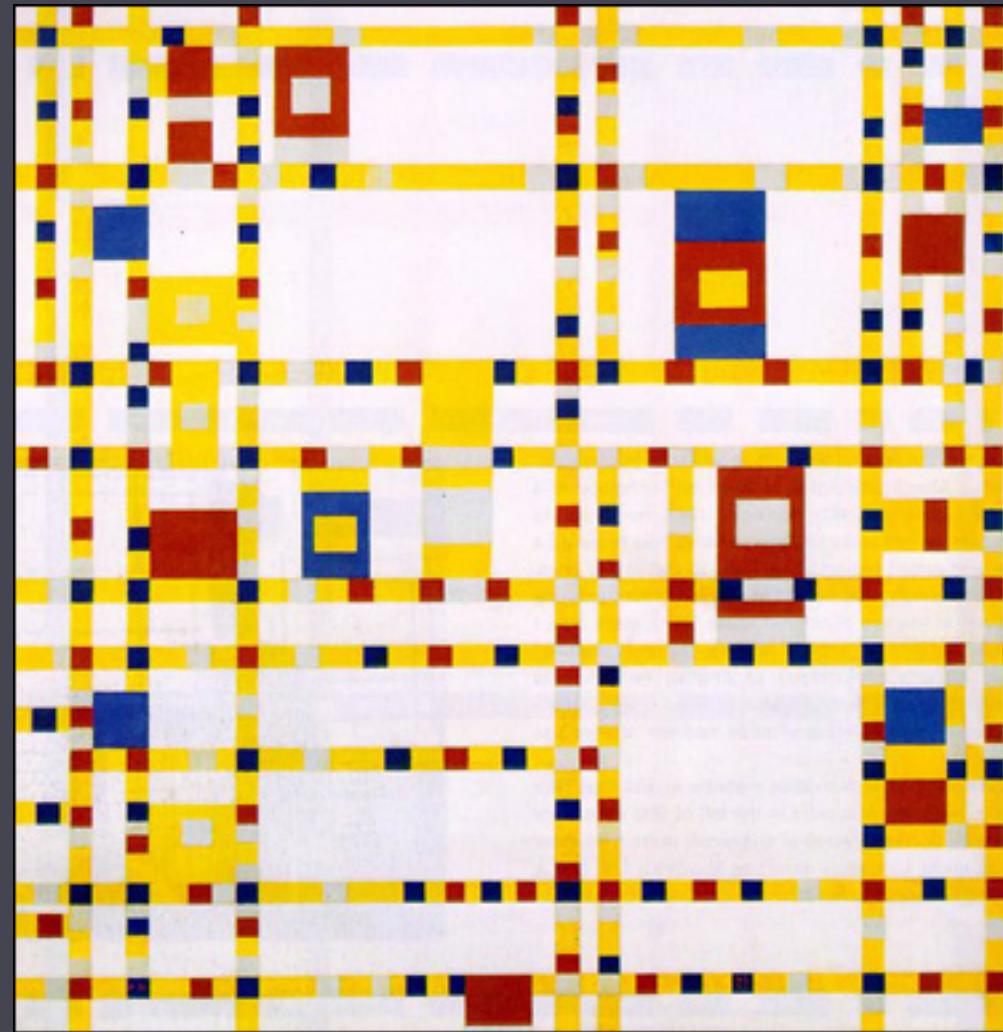




Piet Mondrian  
*Composition II in Red, Blue, and Yellow*, 1930



Piet Mondrian  
*Lozenge Composition with Two Lines*, 1931



Piet Mondrian  
Broadway Boogie Woogie, 1943

## Data Science and the Arts: Quantitative Measures of Artistic Style

How can we use computational tools and data science to meaningfully interpret works of art?

# Data Science and the Arts: Quantitative Measures of Artistic Style

How can we use computational tools and data science to meaningfully interpret works of art?

Artists' work is often described in terms of distinct phases clustering thematic and aesthetic approaches (for instance Picasso's Blue Period), and art historians narrate the evolution of individual style (for instance Mondrian's passage from representational landscapes to pure abstraction) to describe conceptual advancement in the field.

Additionally, contemporary image processing and computer vision techniques provide a wealth of newly-available features describing the content of images. Taking art as data, how can we use these feature extraction and analytic techniques to meaningfully describe, quantify, and draw conclusions about the content of art works?

This project starts with the analysis of historical works of fine art, with potential extension to broad categories of contemporary cultural image production.

Tags: cultural analytics, artistic style, visual culture, quantifying culture

Data: works of art! for instance, the complete works (catalogue raisonne), digital images, bibliographic data

Methods: image analysis, feature extraction, clustering, visualization

# Data Science and the Arts: Quantitative Measures of Artistic Style

How can we use computational tools and data science to meaningfully interpret works of art?

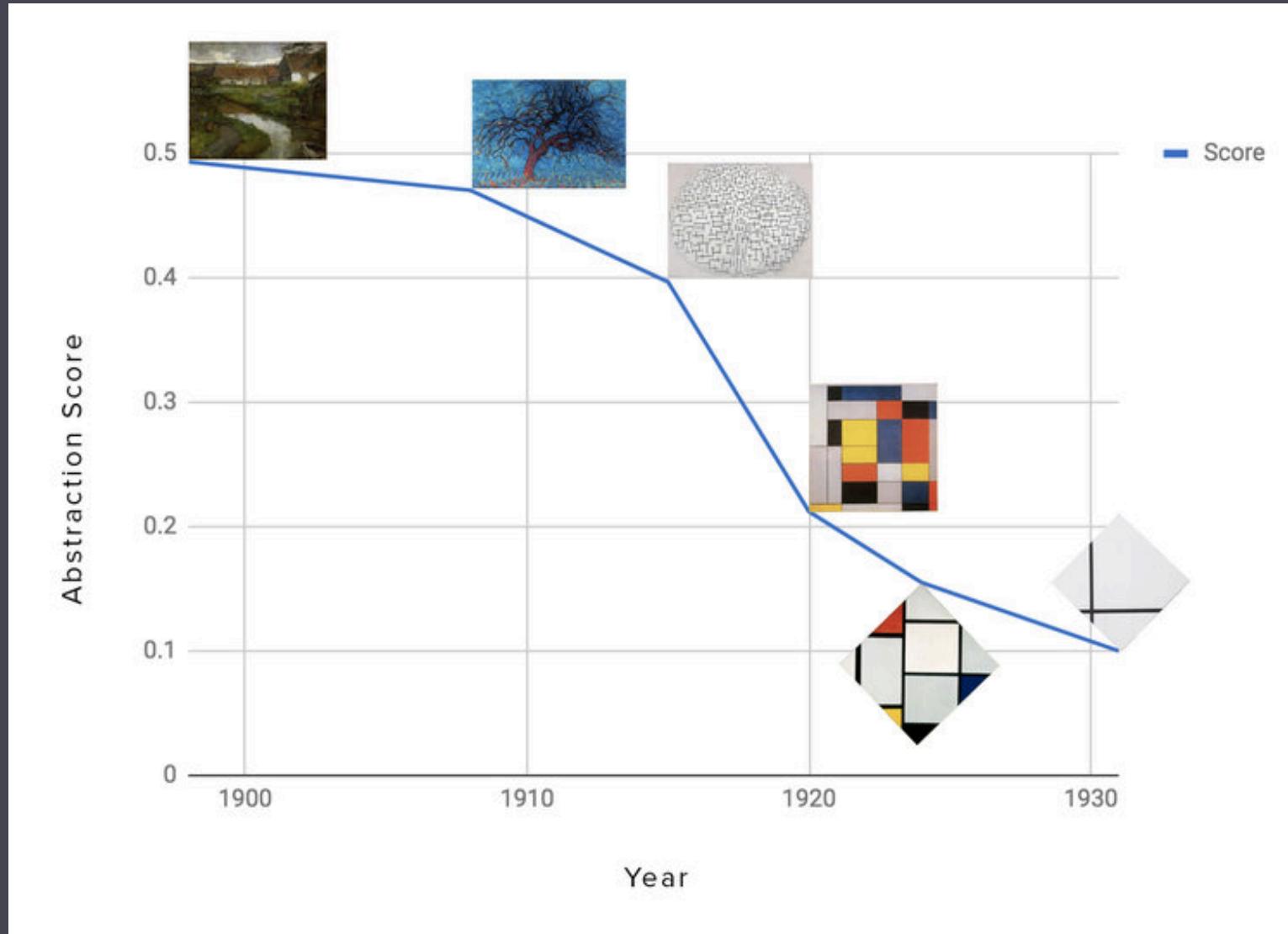
This project will combine:

- learning about the arts as a domain for datascience
  - Cultural Analytics, Digital Humanities, etc.
- collection of visual datasets from online material
- image analysis and feature extraction
- clustering
- visualization

## Overview of the quarter / what to expect:

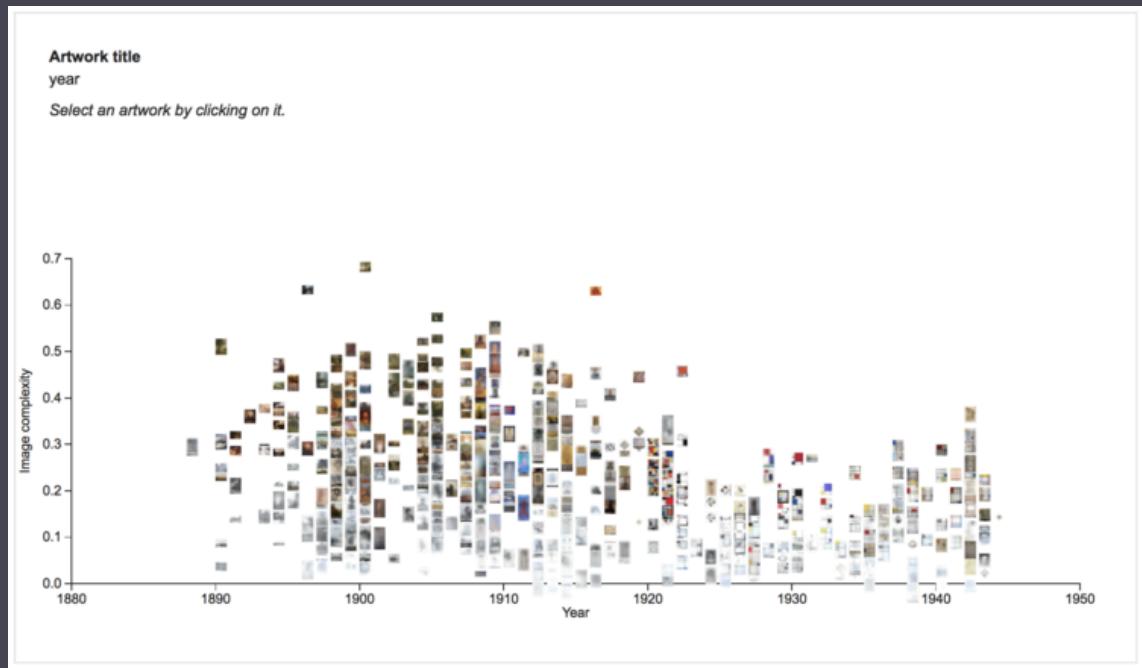
- What is artistic style: What are the visual qualities that lend artworks their distinctive, recognizable style?
- What does style mean: how do artists, art historians, cultural produces, and cultural consumers (the public) understand visual style?
- Quantifying images: what feature extraction and image analysis techniques best capture significant traits of visual style? How can we meaningfully represent style with quantitative measures?
- Evolution of style: Explore the progression towards abstraction in the work of painter Piet Mondrian (1872-1944) as a case study of a dramatic evolution in visual style over a compressed time period. Exemplar for the development of abstraction in 20th century art.
- Extensions: How can we use these quantitative cultural analyses to address diverse questions and domains, understanding how art is created and perceived?

# Primary Study - Evolution of Artistic Style: Mondrian



Jason Bailey, Quantifying Abstraction In Art: Mondrian (2018)  
<https://www.artnome.com/news/2018/4/11/quantifying-modrian-journey-to-abstraction>

# Primary Study - Evolution of Artistic Style: Mondrian



*Mondrian's evolution into abstraction, through paintings and drawings, is incredible - watching this slow stylistic transition encouraged us to ask ourselves: how do we define an artwork as "abstract"?*

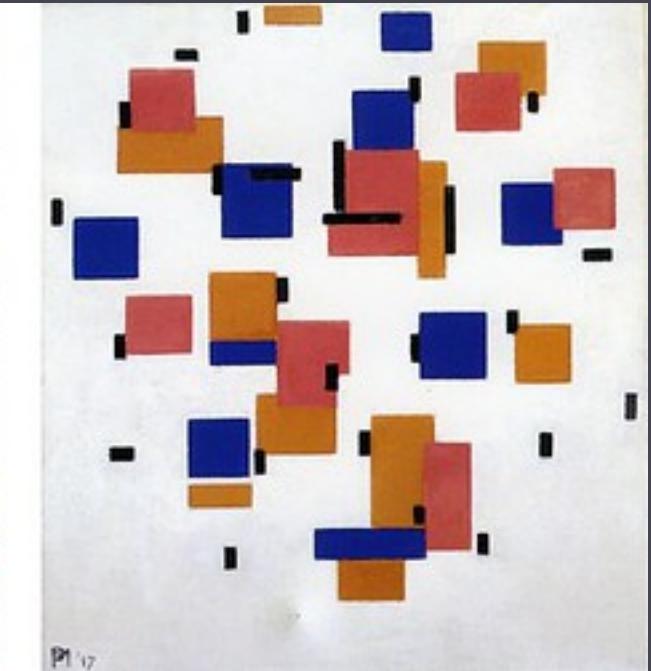
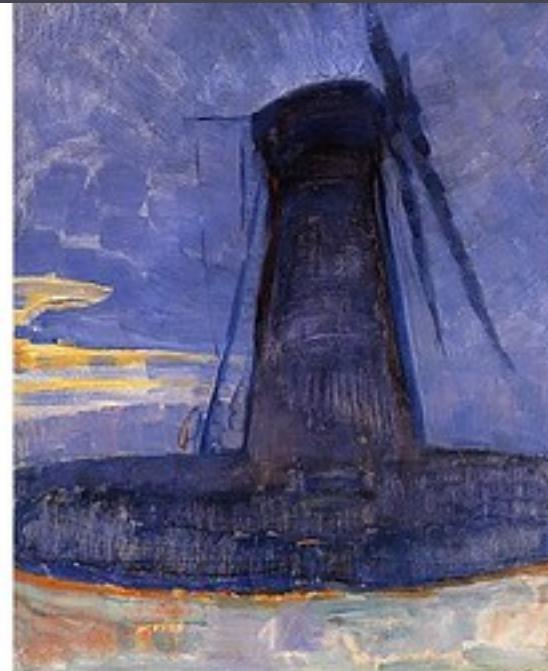
Data: artnome database of Piet Mondrian Paintings <https://knownwork.knack.com/artnome#artworks-piet-mondrian/>, including both images and metadata.

Analysis: global image features (calculated across the whole image)

Complexity Score:

$$\text{complexity\_score} = (\text{color\_score} + \text{variance\_score} + \text{edge\_score})/3$$

## Evolution of Artistic Style: Mondrian



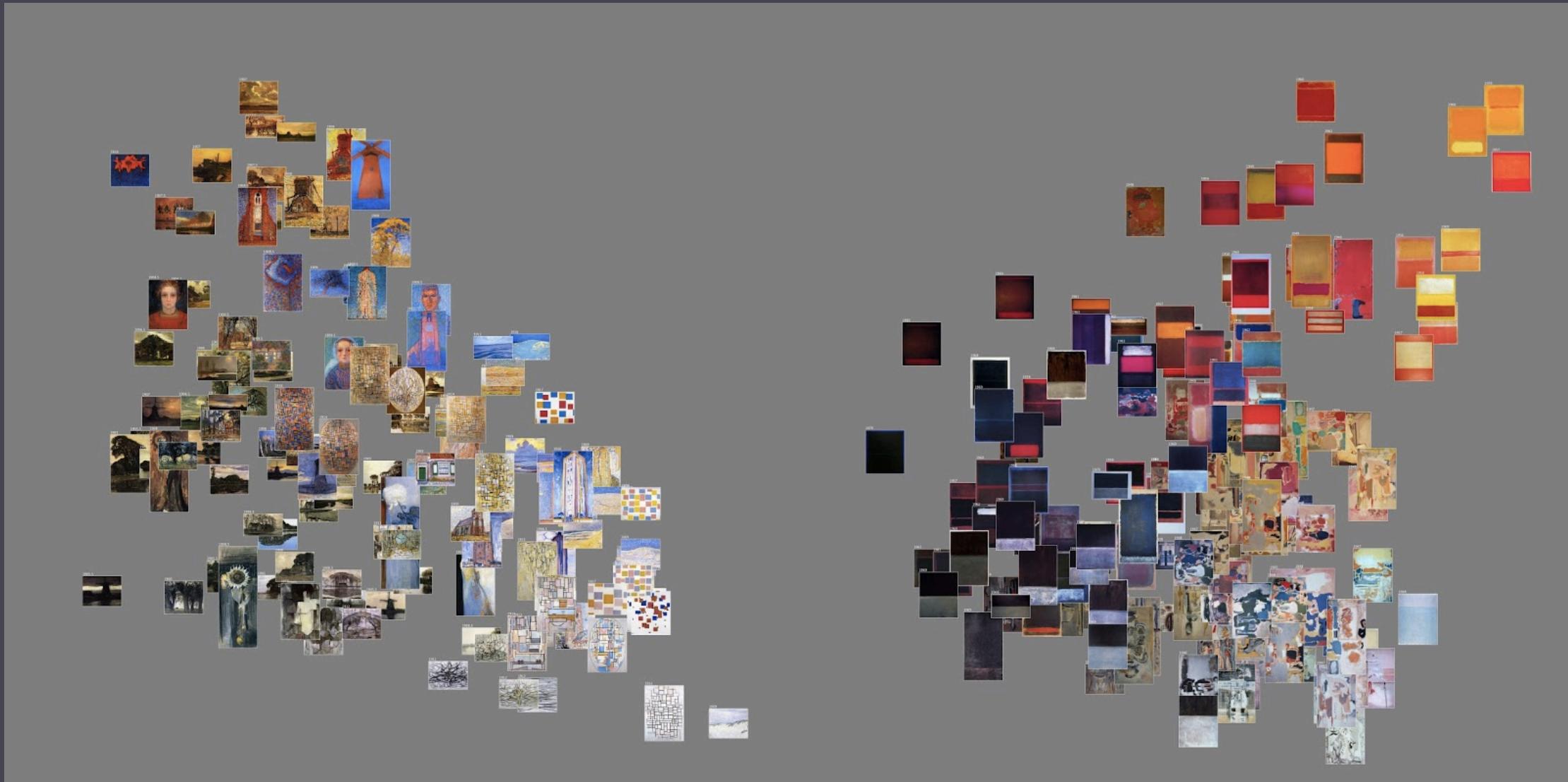
Mondrian's paintings illustrating the changes in his art during selected period.  
Left: 1905; middle: 1909; right: 1917.

## Evolution of Artistic Style: Rothko



Mark Rothko's paintings illustrating the changes in his art during selected period.  
Left: 1944; middle: 1948; right: 1957

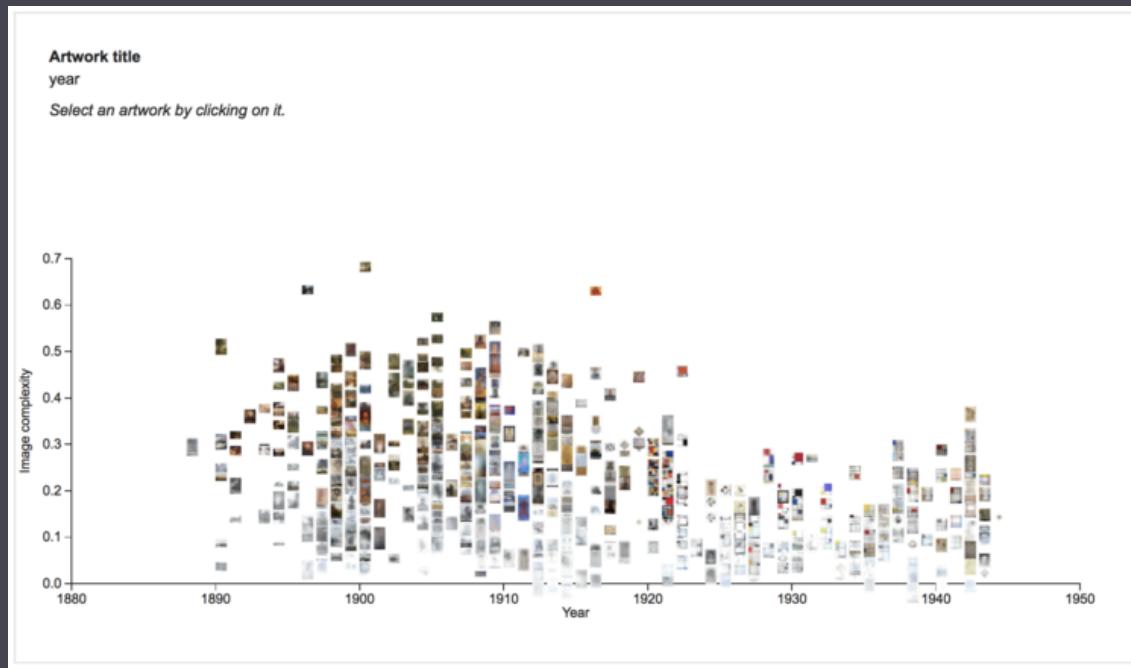
## Secondary Study - Evolution of Artistic Style: Mondrian v. Rothko



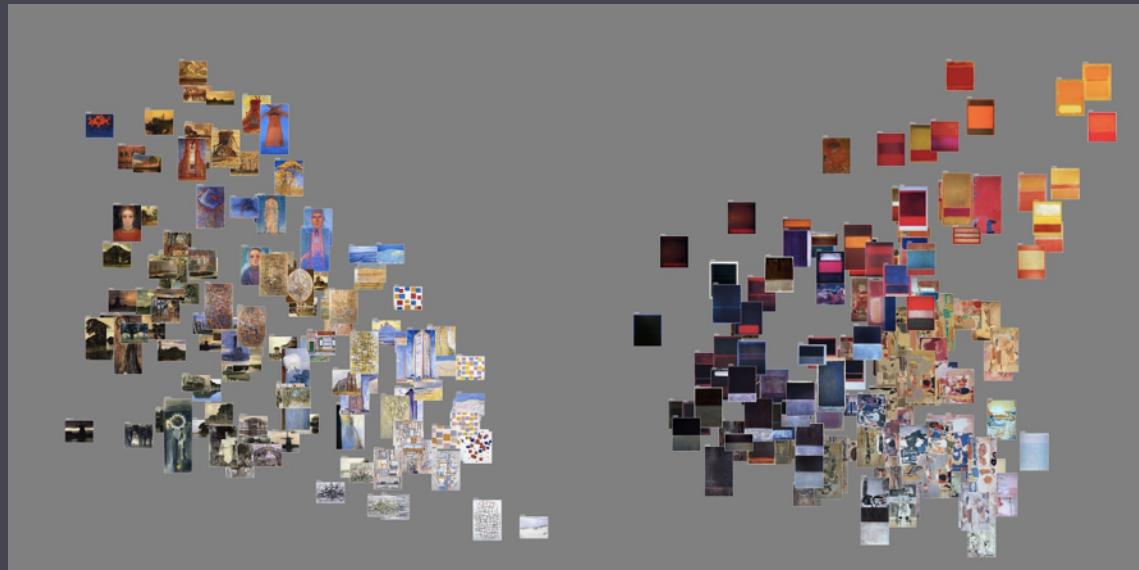
128 paintings by Piet Mondrian (1905-1917); 123 paintings by Mark Rothko (1938-1953)  
X-axis: brightness mean; Y-axis: saturation mean.

## Outputs: Abstraction Plot by Date

Interactive graph of Piet Mondrian's complete works sorted by date and level of abstraction. Created by [Alexander Koch](#).



## Outputs: Style Space

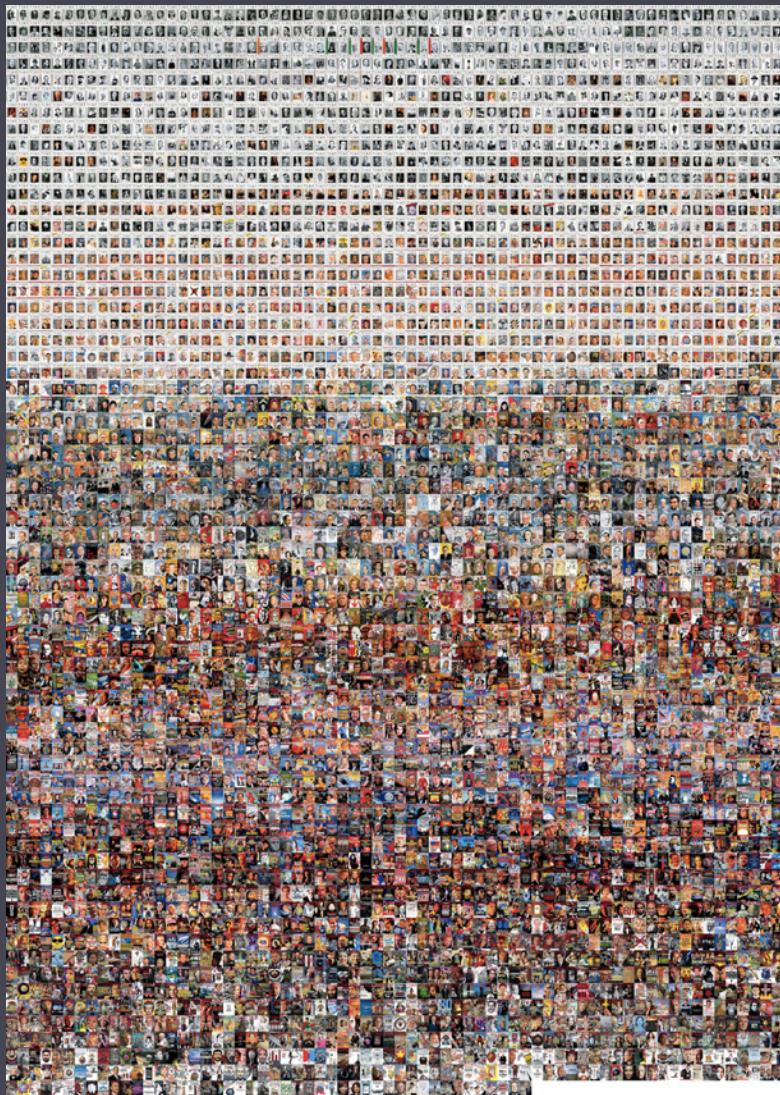


*This visualization demonstrates how image plots can be used to compare multiple data sets. In this case, the goal is to compare similar number of paintings by Piet Mondrian and Mark Rothko (produced over comparable time periods of 13 years) along particular visual dimensions.*

Data: 128 paintings by Piet Mondrian (1905 - 1917) and 151 paintings by Mark Rothko (1944 - 1957).

Mapping: X-axis: brightness mean, Y-axis: saturation mean.

## Related Work: Time Covers



Data: The covers of every issue of Time magazine published from 1923 to summer 2009. (n=4535)

The large percentage of the covers included red borders. We cropped these borders and scaled all images to the same size to allow a user see more clearly the temporal patterns across all covers.

Timescale: 1923-2009

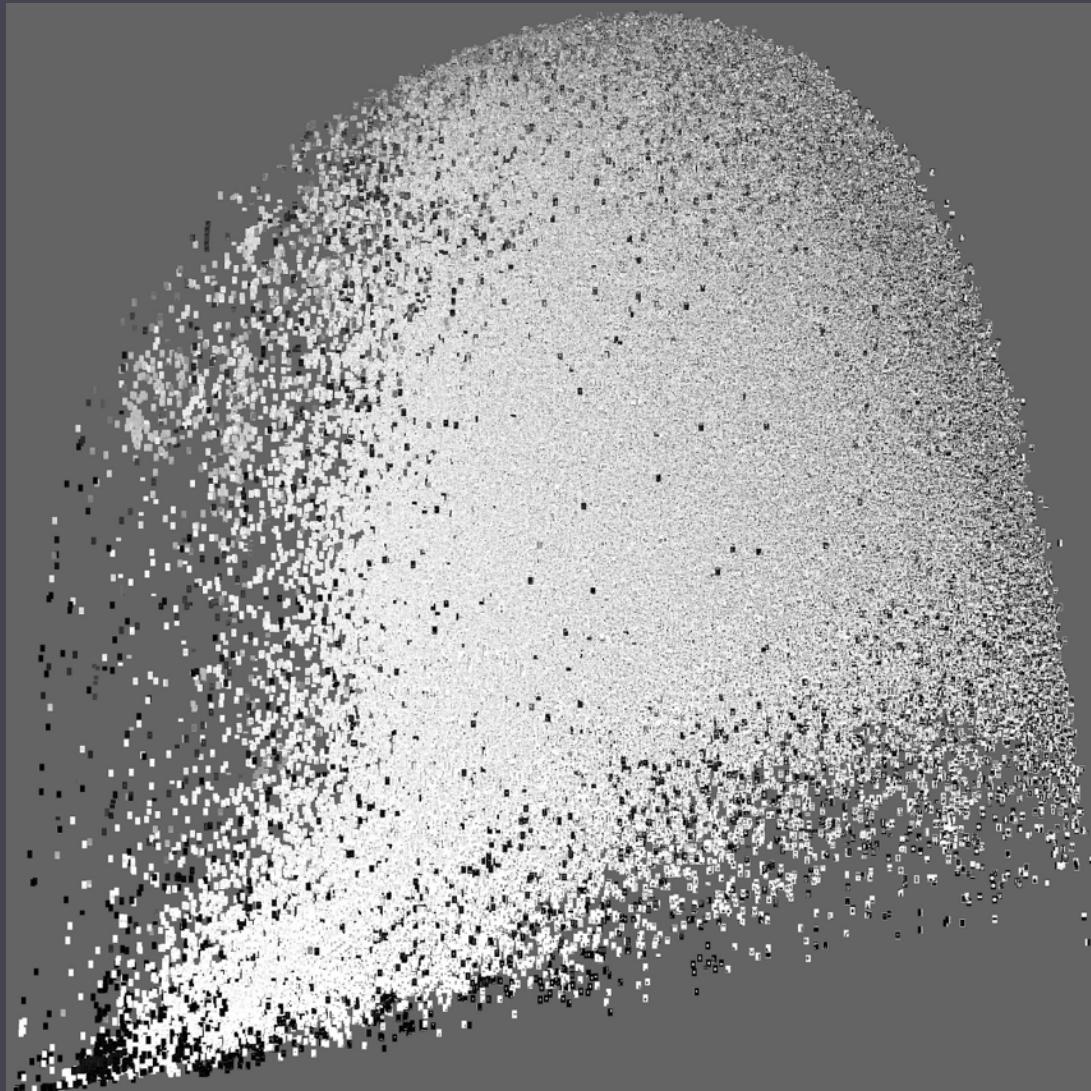
Mapping: Time covers appear in order of publication (i.e., from 1923 to 2009), arranged in a grid layout (left to right and top to bottom).

## Related Work: Time Covers



Cultural Analytics Lab, Timeline: 4535 Time Magazine Covers, 1923-2009  
<http://lab.culturalanalytics.info/2016/04/timeline-4535-time-magazine-covers-1923.html>

## Related Work: 1M Manga Pages

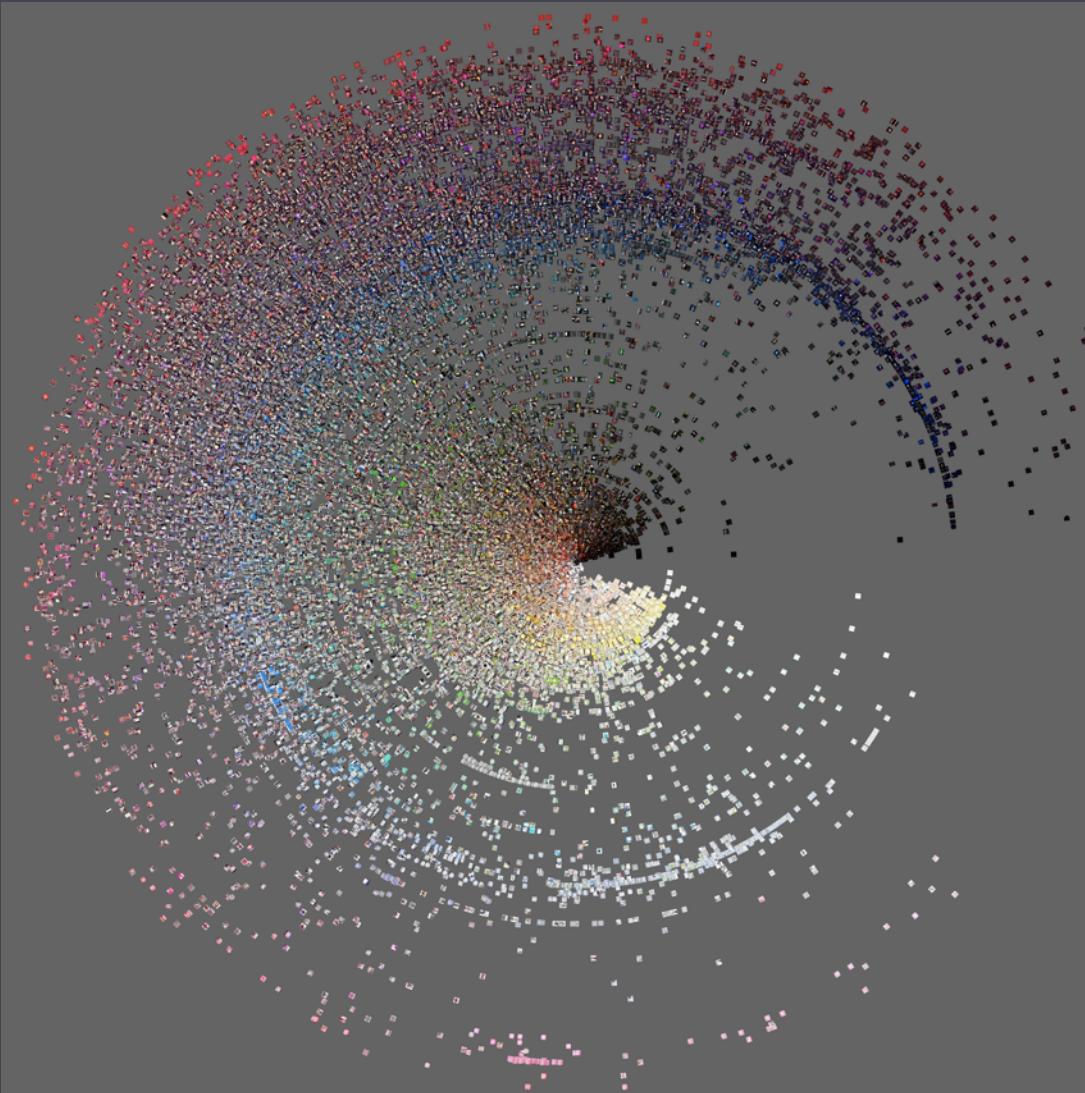


*This visualization shows 1,074,790 unique pages from 883 distinct manga series from Japan, Korea and China. The series include both very popular long-running titles such as *Naruto* and *One Piece* and also many short-lived titles. The visualization maps the pages according to some of their visual characteristics that were measured automatically on supercomputers at the U.S. National Department of Energy Research Center using custom software developed by Software Studies Initiative.*

X-axis: standard deviation. Y-axis: entropy

Visual Stats: Brightness mean, Std Dev, Entropy, Sobel (the amount of edges found), Contrast, Correlation, Energy, Homogeneity

## Related Work: Instagram Cities

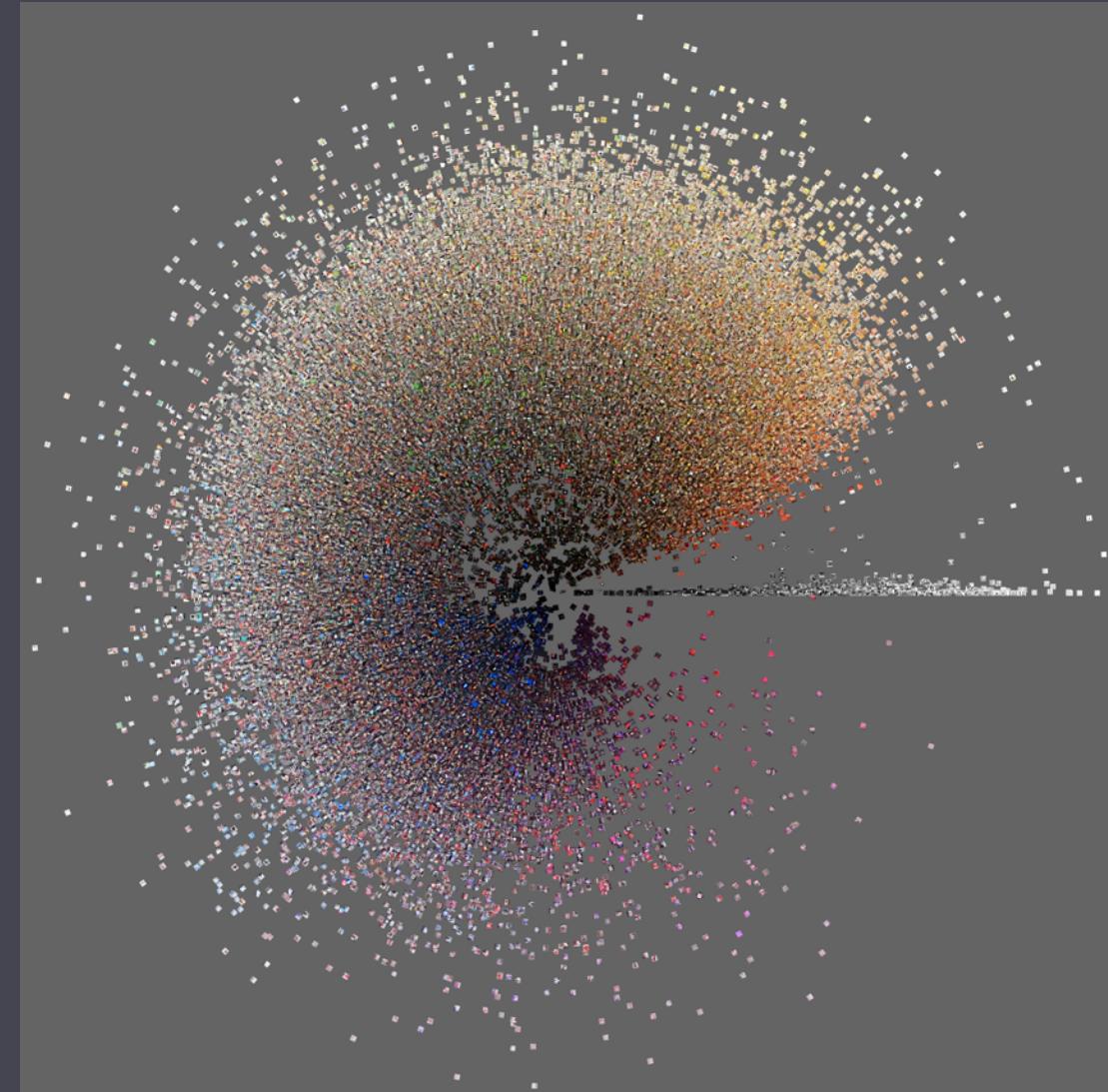
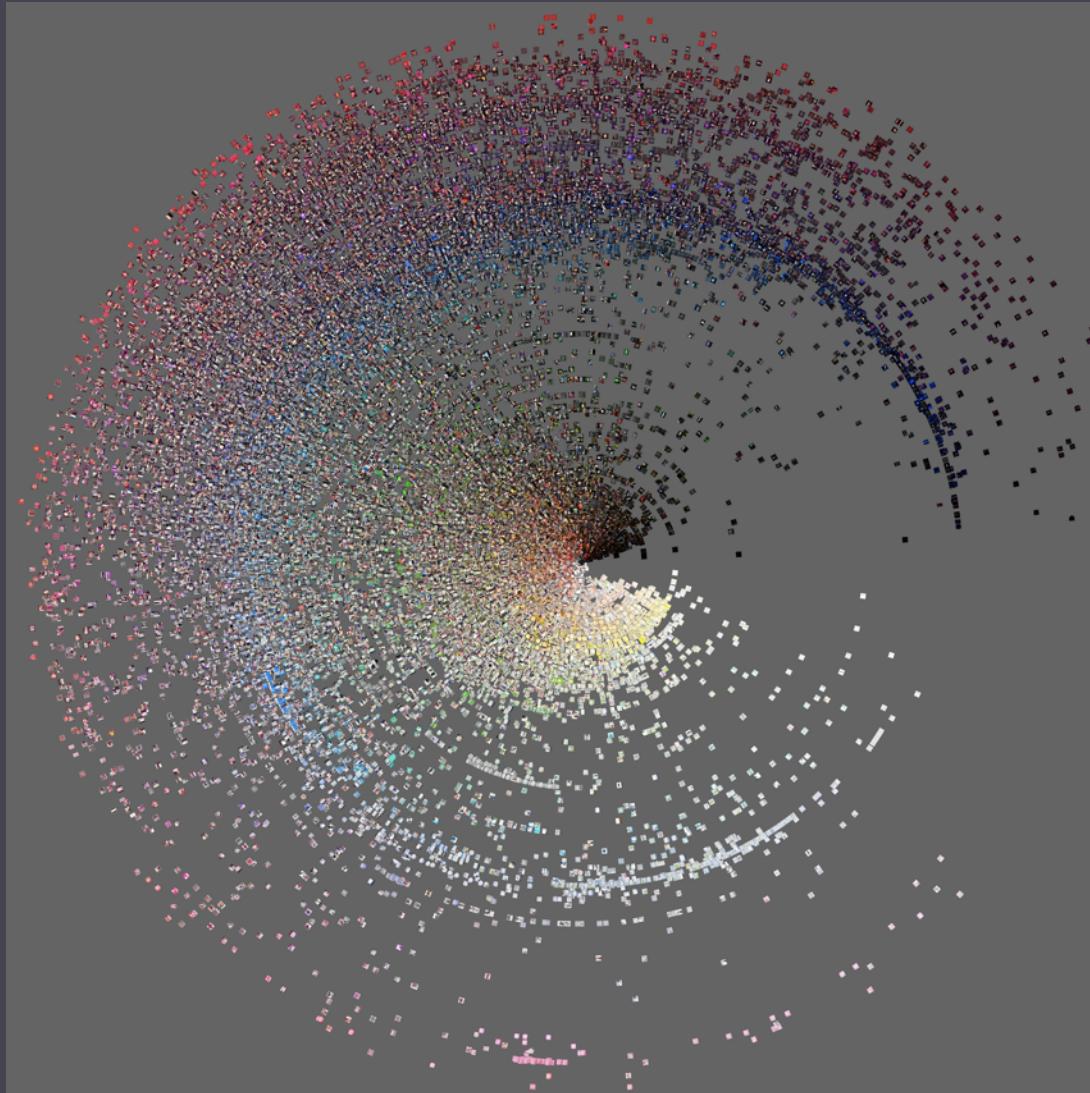


*How can we visualize millions of photos taken in New York, Bangkok or Tel Aviv in such a way that cultural differences between these cities can be revealed?*

*How can we read the “stories” made up by the users’ sequences of photos? Visualizing and analyzing 2.353M publicly shared Instagram photos from around the world, we explore these photos on multiple scales.*

At left: 50,000 Instagram photos from NYC, organized by hue mean (radius) and brightness mean (perimeter).

## Related Work: Instagram Cities



Phototrails: Instagram Cities: New York and Tokyo  
Lev Manovich + The Cultural Analytics Lab <http://phototrails.info/instagram-cities/>

## Outputs: Visualizations

How to view large collections of images?

How to browse/interact with them?

- (javascript / browser)
- VROOM tiled display



Cultural Analytics software running on HiPerSpace display  
Calit2-San Diego, May 2009

## Outputs: Visualizations



Cultural Analytics software running on HiPerSpace display  
Calit2-San Diego, May 2009

## Outputs: Visualizations



Cultural Analytics software running on HiPerSpace display  
Calit2-San Diego, May 2009

## Outputs: Visualizations



Future Patient V2, VROOM  
QI/Calit2-San Diego, October 2019

## Culture (Art) as Data:

- Are these image statistics meaningful descriptions of the works of art?
- What do computational/quantitative approaches to art analysis provide that traditional approaches to art history and criticism do not? What do they lack?
- What other visual/cultural data sets would be interested to analyze this way?

## Culture (Art) as Data:

- Paintings
  - Mondrian Catalogue raisonné: <http://pietmondrian.rkdmonographs.nl/>
- Instagram Posts
- Manga
- Magazine Covers
- ... what else?

## Links

- Explore phototrails in browser: <http://phototrails.info/instagram-cities/>
- Explore other Cultural Analytics Lab projects: <http://lab.culturalanalytics.info/p/projects.html>
- Familiarize yourself with Mondrian's paintings through his catalogue raisonné:  
<http://pietmondrian.rkdmonographs.nl/>