

Automating Evolutionary Art in the Style of Mondrian

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1 Introduction

Many recent systems for computer artwork generation with evolutionary algorithms have been interactive, relegating the task of evaluating new genotypes to their users. In contrast, we are interested in fully automating the entire evolutionary cycle applied to art work generation. We set out to produce a program that would generate artwork in the style of the Dutch painter Piet Mondrian, who was active mainly in the first half of the 20th century. He developed his own distinctive and abstract style (called simply *de stijl*, which is Dutch for “the style”). Paintings in Mondrian’s style typically include vertical and horizontal black lines over a white background, with some or all of the primary colors (blue, red, and yellow), plus black, filling in some of the square or rectangular regions (or parts of the regions) separated out from the background by the black lines. It is this style that our system tries to emulate. Fig. 1 shows a typical Mondrian painting in his distinctive style.

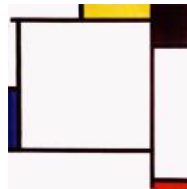


Fig. 1. A typical Mondrian painting

We decided to use an evolutionary algorithm in order to generate different paintings. After being generated by the evolutionary operators of crossover and mutation, paintings are evaluated to determine how much they “make sense.” In the context of our research, “making sense” would imply being as close as possible to the style of Mondrian. The evaluation subroutine of the evolutionary algorithm, therefore, is of critical importance to the success of the approach. It consists of the following eight rules (each of which has the same weight), which capture and recognize the stylistic characteristics of Mondrian’s paintings:

1. EvaluateColor: Each colored region that is contained in a genotype must have one of the five valid colors.
2. EvaluateCoordinates: The height, width, x-coordinate, and y-coordinate of each colored region in a genotype must all fall between 0 and 3.9999.

3. EvaluateLineThickness: Up to two black colored regions are allowed in a genotype that are not thin, but all other black regions must be either vertically or horizontally thin (and thus represent a line rather than a rectangular region).
4. EvaluateNumberOfVerticalLines: A minimum of two and a maximum of ten vertical lines must be present in a genotype.
5. EvaluateNumberOfHorizontalLines: A minimum of two and a maximum of ten horizontal lines must be present in a genotype.
6. EvaluateLimits: Each colored region in a genotype must be adjacent either vertically (both above and below) or horizontally (both to the left and to the right), or both, to another colored region or to the edge of the “frame” (with some small tolerance).
7. EvaluateFrame: All other colored regions in a genotype must fall within the coordinates of the “frame,” whose color is white by definition and whose coordinates are represented just as any other colored region’s are.
8. EvaluateNumberOfColoredRegions: There must be at least one colored region represented in a genotype, and at most 13, not counting lines. At most one of them can be white (and represents the “frame”).

2 Discussion and Results

The implementation of this work has resulted in a system named MONICA (Mondrian-Imitating Computer Artist). Neither the relationship between evolutionary algorithms and Mondrian, nor the attempt to capture and automate the generation of new creations in the style of given artists or designers, is new. However, the approach we followed in implementing MONICA is different from those that have been used in other projects that have explored these issues. Fig. 2 shows three Mondrian-like paintings which were created by our system (which assigned a fitness value of 1 to them) at different times. The fact that MONICA has shown the capacity to create Mondrian-like paintings on several occasions validates the set of evaluation rules we programmed into the system and also confirms the capacity to create artwork by computer autonomously, without the need for user feedback or intervention.

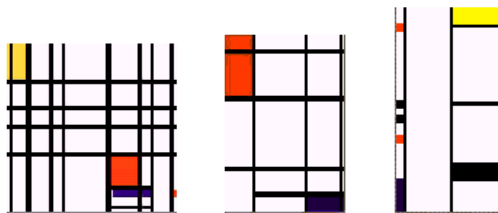


Fig. 2. Three Mondrian-like paintings generated by MONICA