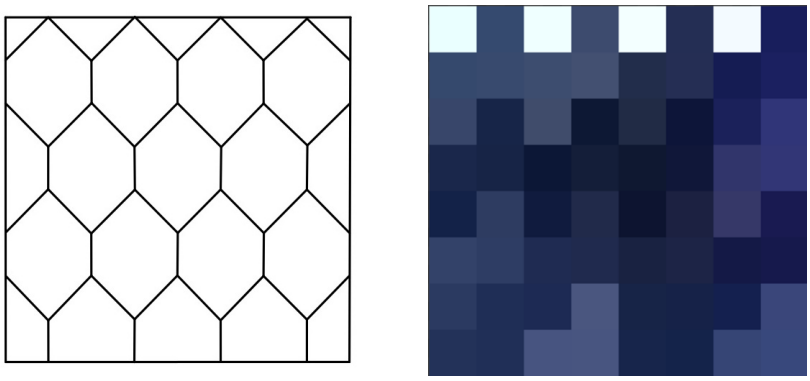
Introduction to AI. Assignment 2. Report.

Lada Morozova

Description of algorithm

The main idea behind transformation of image is that the converted image will be split into hexagons. To improve performance of algorithm (e.g. execution time) the image has been divided into the size of the segment 8 by 8 pixels as shown on Figure 1(a). Due to the fact that pixel cannot be colored on half, so colors overlap there, and the hexagons degenerate to the shape shown in Figure 1(b). The blank is divided into such segments and a genetic algorithm is applied for each of them.[1] Algorithm tries to reproduce segment close to the segment of goal image.



(a) Grid of 8x8 segment (b) Example of colored 8x8 segment

Figure 1: Segment of produced image

Chromosome representation

The chromosome is an ordered set of colors for the segment hexagons. Each color is represented as an RGB tuple. Colors from the input image were used to create the chromosome. For each hexagon, a random color was selected from a set of colors from the input image.

Population size and selection technique

Population size is the constant in the program which user can determine by him/herself. For creating images represented in the section "Example images" population size is 8.
Since the population size is relatively small, to create the next generation, the algorithm will cross all individuals within the population and select the population size best ones. Such technique will also allow to improve convergence of algorithm to goal. Such selection technique is based on classic elitism selection applied in the genetics algorithms.

Fitness function

Fitness function is based upon structural similarity between produced segment and segment from input image.[2] The user can also set the percentage up to which the segments should be similar. Result of fitness function is a number $\in (0; 1)$. However, it should be borne in mind that the coincidence of two segments only occasionally can exceed 0.3 due to the shape of pattern for covering segment(e.g. hexagons).

Crossover

This algorithm implements a single point crossover. A random gene is selected on the chromosome, which is considered a point, and an exchange takes place between the two parents. The result of this crossover is two children.

Mutation

In this algorithm, a mutation is implemented as a change in the color of a gene to a random color. Rate of mutation in the generation determines by mutation probability, which also can be change by user.

Example images

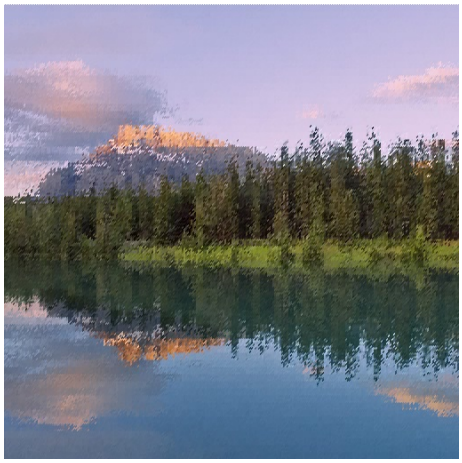
Image 1. Banff National Park.

Parameters used in production:

- Maximum fitness for segment = 0.15
- Maximum number of iterations per segment = 500
- Mutation probability = 0.001
- Size of population = 8

Execution time: 1291.2224748134613 seconds. Approximately 20 minutes.

(a) Goal image



(b) Image produced by the algorithm

Image 2. Vincent van Gogh "The Starry Night".

Parameters used in production:

- Maximum fitness for segment = 0.1
- Maximum number of iterations per segment = 200
- Mutation probability = 0.001
- Size of population = 8

Execution time: 3203.187178850174 seconds. Approximately 50 minutes.

(a) Goal image

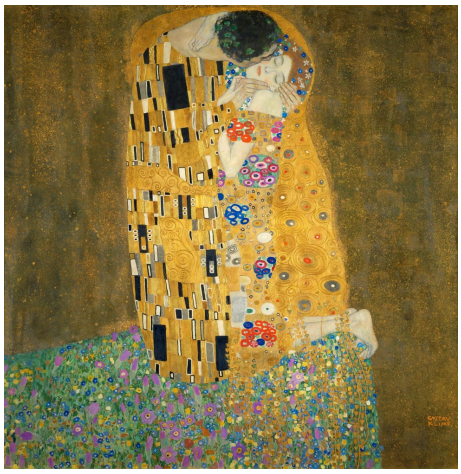
(b) Image produced by the algorithm

Image 3. Gustav Klimt "The Kiss"

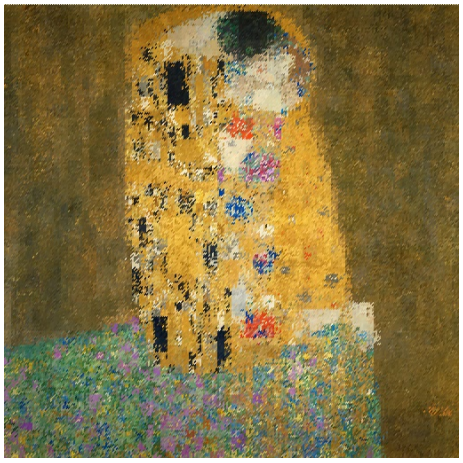
Parameters used in production:

- Maximum fitness for segment = 0.1
- Maximum number of iterations per segment = 200
- Mutation probability = 0.001
- Size of population = 8

Execution time: 1036.9940204620361 seconds. Approximately 18 minutes.



(a) Goal image



(b) Image produced by the algorithm

Image 4. Rene Magritte "Cat in a Hat"

Parameters used in production:

- Maximum fitness for segment = 0.1
- Maximum number of iterations per segment = 200
- Mutation probability = 0.001
- Size of population = 8

Execution time: 404.1551311016083 seconds. Approximately 7 minutes.

(a) Goal image

(b) Image produced by the algorithm

Image 5. Johannes Vermeer "Girl with a Pearl Earring"

Parameters used in production:

- Maximum fitness for segment = 0.1
- Maximum number of iterations per segment = 200
- Mutation probability = 0.001
- Size of population = 8

Execution time: 269.5357449054718 seconds. Approximately 5 minutes.

(a) Goal image

(b) Image produced by the algorithm

What is art?

What does humanity mean when it talks about works of art and artists? How many people are in this world and there will be so many opinions on this matter. According to the Oxford dictionary, art is "the use of the imagination to express ideas or feelings, particularly in painting, drawing or sculpture".[3] This definition quite fully covers everything that humanity calls art. Art is one of the opportunities to express emotions and convey them to society. Besides, art can be defined as the ability to create objects that someone in the world will find beautiful and will admire.

Can society consider the work of algorithm to transform pictures as art? One example of the claim that society accepts such art is the sale of a painting created by AI at auction. In 2018 Christie's auctioned "Portrait of Edmond Belamy" for a record $432,500, while Andy Warhol's works were sold at the same auction for $780,000.[4] This situation shows that objects created by algorithms can be defined as a kind of art. The sold portrait was nothing but the result of applying the algorithm to a specific set of data. The algorithm used in this assignment for the task is no different from the Obvious algorithm.

In conclusion, nowadays society increasingly recognizes objects created with the help of algorithms and machines as art. Thus, the works produced by this algorithm can be considered art.

References:

[1]. V. Mallawaarachchi, "Introduction to genetic algorithms" 01-Mar-2020. [Online]. Available: `https://towardsdatascience.com/introduction-to-genetic-algorithms-including-example-code-e396e98d8bf3`. [Accessed: 08-Apr-2021].

[2]. P. Datta, "All about Structural Similarity Index (SSIM): Theory + Code in PyTorch," Medium, 04-Mar-2021. [Online]. Available: `https://medium.com/srm-mic/all-about-structural-similarity-index-ssim-theory-code-in-pyto` [Accessed: 08-Apr-2021].

[3]. "Art," art noun - Definition, pictures, pronunciation and usage notes — Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.com. [Online]. Available: `https://www.oxfordlearnersdictionaries.com/definition/english/art_1`. [Accessed: 11-Apr-2021].

[4]. "Is artificial intelligence set to become art's next medium?: Christie's," The first piece of AI-generated art to come to auction — Christie's, 12-Dec-2018. [Online]. Available: `https://www.christies.com/features/A-collaboration-between-two-artists-one-human-one-a-machine-9332-1.aspx`. [Accessed: 11-Apr-2021].