Assignment 2 Report

Introduction to Artificial Intelligence

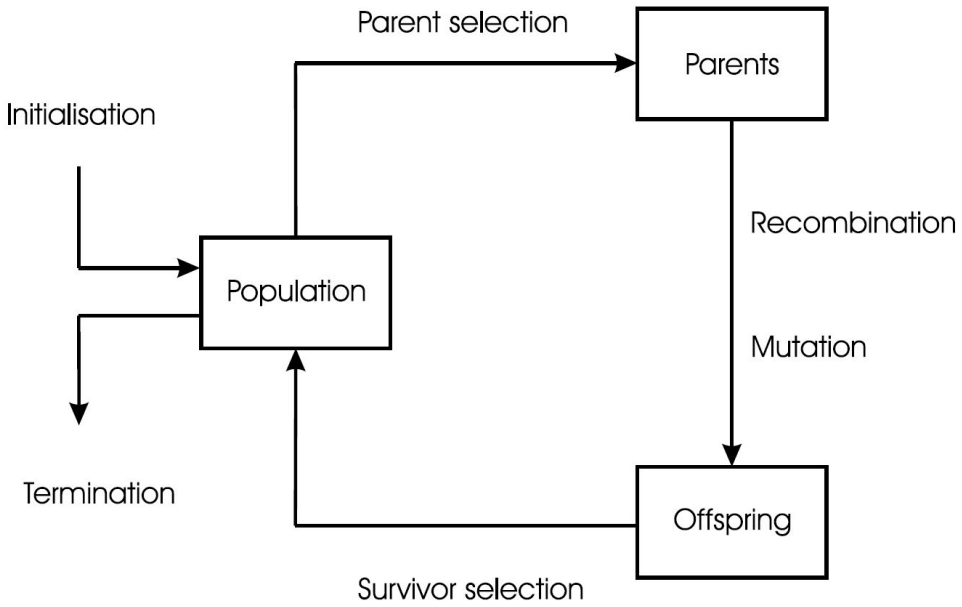
Made by: Zhuchkov Alexey

Outline:

- Description of the algorithm used in the program
- Examples of inputs and outputs of the program
- Why can the program's output be considered to be an art?

Description of the algorithm

Book A. Eiben Jim Smith "Introduction To Evolutionary Computing" has been used as reference to create genetic algorithm in program.



The algorithm tries to construct an image that is the most similar to the input image with a finite number of triangles using a genetic algorithm. The main concept of the algorithm is displayed on the scheme Genetic algorithm has been used for this assignment with the selection process in which the least fit members of the population set are eliminated on the survivor selection step, whereas the fit members are allowed to survive and continue until better solutions are determined. Over time, the successful members evolve at the

recombination (crossover) and mutation steps to present the optimized solution to the problem. The combined application of variation and selection generally leads to improving fitness values in consecutive populations.

The most important components of the algorithm:

1. **Representation (definition of individuals)**

   Class Species has been created to work with individuals. DNA field of the class is a list of floats R(0..1) that has been used to represent an individual. Every 10 floats represent one triangle: 4 - RGBA, 6 - 3*(X, Y) coordinate of a triangle's vertex (Gene). So, each individual is a set of triangles with a defined color and coordinates. In order to calculate fitness, individual's genes should be drawn on the canvas (a matrix that can be considered as a picture).

2. **Fitness function**

   *1 - (((original_img - canvas) ** 2).sum() / (pic_size * pic_size * 3 * 256 * 256))*

   It takes two pictures in matrix representation and sums the squared difference between each component. Then this difference is divided on the maximum loss that can be. Next, this fraction is subtracted from one. So, in this case, the fittest picture has score 1. The overall range of fitness function is R(0..1)

3. **Population**

   Class Population has been created to work with the population. Its size is constant throughout the entire program life.

4. **Parent selection mechanism**

   Parent selection is partially probabilistic. However, one of the parents always taken from the best individuals (num_to_select) and the second one randomly from the entire population. So, high-quality individuals get a higher chance to become a parent than those with low quality. Nevertheless, low-quality individuals are often given a small, but positive chance, otherwise the whole search can get stuck in a local optimum.

5. **Variation operators, recombination (crossover) and mutation**

   All individuals have the same number of the genes (triangles) in their DNA. Each of the genes (triangles) is the child's DNA is the result of a random choice of the parent that gives this gene (triangle) and mutation on the attributes of this gene (triangle). Mutations help to fill the gene pool with "fresh blood". Crossover mates two individuals with different but desirable features and produces a child which combines both of the features (R, G, B, A, (X, Y) coordinates).

6. **Survivor selection mechanism (replacement)**

   Some (defined percentage) of the fittest individuals from the previous population and new individuals which appeared after crossover and mutation survive so that the population size remains the same

7. **Method of using the input image**

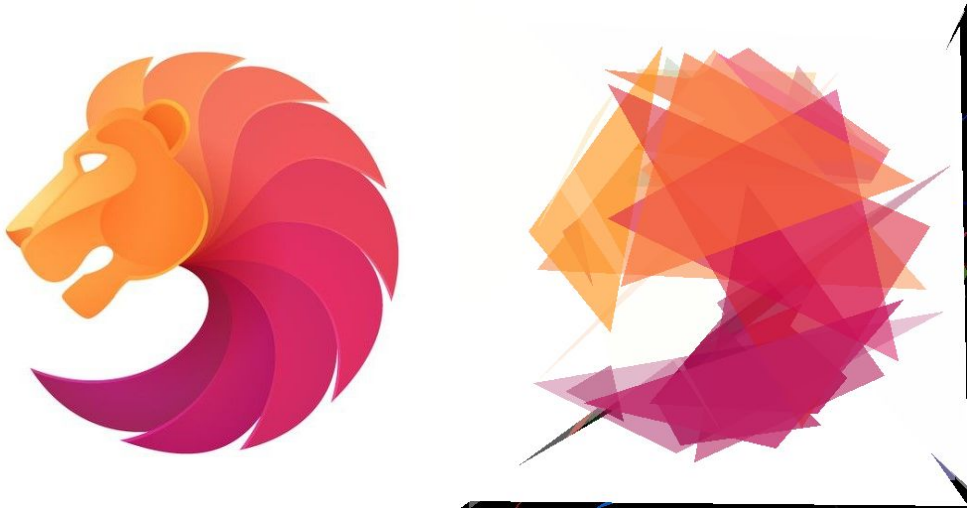
   The input message is resized to internal picture size which is usually smaller than 512*512 (for computational optimizations) and uses as a standard to which individuals aspire.

Examples of inputs and outputs

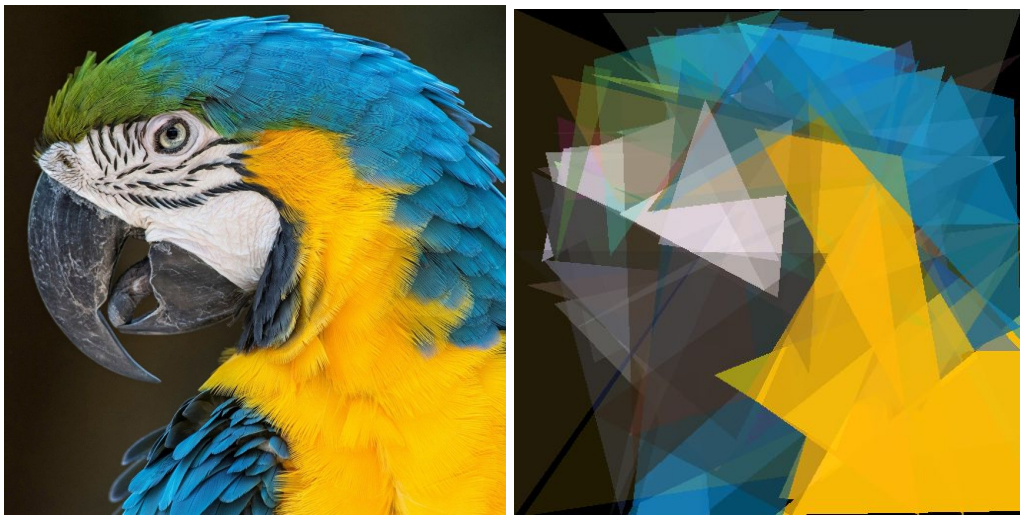
Parameter	Pic 1	Pic 2	Pic 3	Pic 4	Pic 5	Pic 6
Internal picture size	128*128	96*96	64*64	96*96	128*128	128*128
Population size	45	30	30	40	50	50
Number of polygons	100	65	50	75	100	80
Number of iterations (changes of populations)	1500	4000	4000	4000	1500	1500
Chance of mutation	1%	1%	1%	1%	1%	1%
Amount of mutation	10%	10%	10%	10%	10%	10%

Picture 1

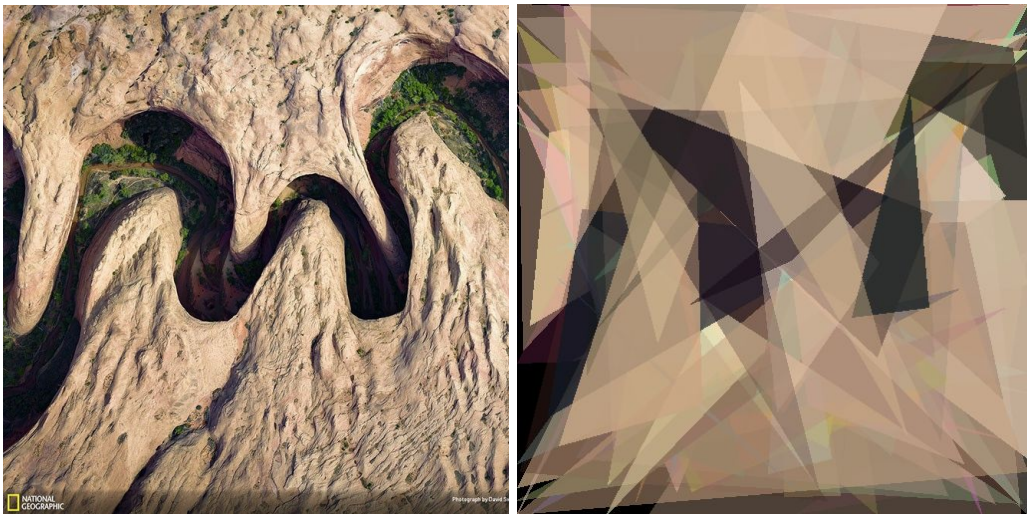
Picture 2



Picture 3



Picture 4



Picture 5

Picture 6

Why can the program's output be considered to be art?

Let's start from the question: "What is art?" I think art is the expression of imagination in a visual form such as painting or sculpture, producing works to be appreciated primarily for their beauty or emotional power. Though a lot of people are irritated by modern advertisement, it is considered to be a driving force of any commerce, and, as a consequence, the country economy. The task of an advertisement is to capture people's attention without putting in beauty. However, in our hectic world full of the uncontrolled flow of information people receive an enormous amount of data daily, and it becomes challenging to get them involved, evaluate it's emotional power because we learn to ignore most of the information we perceive to prioritize properly. What is the best way to draw people's attention? From my point of view, it is to create something brand new, but first, make it from something real to convey a feeling and impression and second, to keep it simple in order to save our minds from being overloaded by details.

If we look back at the history of humankind creativity, we can notice that people have always been seeking for something extraordinary, something they had no idea about before and tried to reproduce it or save it somehow. For example, rock-painting in ancient ages or impressionists in the 19th century. People seem to have tried plenty of imaginative approaches to creating paintings delightful to the eyes. Realism, impressionism, and abstractionism have had their heydays. Chasing novice and boldness in the expression of thoughts, we followed the way towards visual art simplification: from Mona Lisa to Black Square. Artists tried to simplify the original picture and convey emotions, feelings, and mood from seen at that moment via color and form. At the current moment, we can meet all different styles and approaches, as well as their mixture just walking down the street or turning on a TV, but how long time ago have you met a work of art that caught your eye and you thought: "This indeed conveys his/her mood from seen. It is so impressive"?

I think these are computer algorithms and especially the evolutionary ones, that can help us with this issue. While fitting the image with random triangles, the algorithm tries to produce a picture similar to the input image but not the same one, keeping individuality. Through a limited number of triangles, the effect of color mood transfer is achieved. The algorithm can convey color throughout the aggregation a bunch of pixels into one triangle. Through a limited number of iterations, the effect of simplicity and indifference to detail is achieved. The algorithm does not have time to adjust the shape to the true ones, but it has enough time to convey the main objects and the overall idea of the picture. So, the algorithm did as an artist, it tried to convey the mood on the canvas, to transfer the color impression to the viewer.

We have always thought about computers as machines inferior to us in creativity. Maybe it is time to give them a chance to try?