CS480/580 Introduction to Artificial Intelligence

## Assignment 2

Total Points: 100

Due Date: 10/13/2020

**Genetic Algorithm: Mimic an image with triangles**

The design of this assignment is inspired by the following blog.

<https://rogerjohansson.blog/2008/12/07/genetic-programming-evolution-of-mona-lisa/>

In this assignment, you are asked to implement your own genetic algorithm to use a set of semi-transparent triangles (say 100) to mimic an arbitrary image. Each triangle is represented by 3 points in 2D space, (x0, y0), (x1, y1), (x2, y2) and a color of (r, g, b). An individual can be represented as a fixed-length array of the triangles.

To implement the genetic algorithm, you need to design the following components:

1. Fitness function: You are required to implement a fitness function to measure how well your individual is matching with the target image. You can simply sum the RGB value differences of each pixel in your generated pixel with respect to the pixel in the target image.
2. Selection: You are required to implement selection method to select individuals for reproduction.
3. Genetic operation: You need to implement crossover of two individual and mutation of a single individuals.

Then, you can assemble the above components into genetic algorithm iterations.

**Analysis**

The parameters (population size, crossover rate, mutation rate, etc.), the implementation of fitness function, the genetic operators can have significant impact to the performance of the genetic algorithm. You are required to submit a written report showing analysis on how different parameters have impact on the convergence.

**Hints**

Always start from the simplest setup. Attempt a small image at first. Genetic algorithm on a large image takes time.

Good data structure is important.

**What to Hand in**

1. Well documented codes implementing the genetic algorithm. A README file should provide instructions on how to compile and execute the code. If you use codes available in the internet, you need to specify and give credit to the authors. Provide detailed description of the implementation of your genetic algorithm.
2. For your best implementation, provide the initial image, the final image, and two in-between images for four target images you select to show the evolution process.
3. Analyze the results using different parameters in the genetic algorithm and how they impact the performance of the genetic algorithm.

Please turn in the program and the analysis before the assignment due date.

Bonus: (10 pts)

Bonus will be given for students who exhibit novel implementations, for examples, fitness function, representations, crossover and mutation, etc.