game of life

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1. **Introduction**

**1.1 Genetic Algorithm:**

Genetic algorithm is a computational model that simulates the natural selection and genetic mechanism of Darwin's theory of biological evolution. It is a method of searching the optimal solution by simulating natural evolution. A genetic algorithm starts with a population that represents a potential set of solutions to a problem, and a population consists of a certain number of individuals that are encoded by genes.

After the generation of the first-generation population, according to the principles of survival of the fittest and survival of the fittest, evolution from generation to generation yields better and better solutions. In each generation, selection is based on the fitness of the individual in the problem domain Individuals, with the help of genetic operators of natural genetics, perform crossover and mutation to produce a population representing a new solution set. This process will cause the population in the offspring generation to be more adaptive to the environment than the previous generation. The optimal individual in the last generation population is decoded and can be used as the optimal solution to the problem.

**1.2 Approach:**

In building the game of life, we used genetic algorithms to build offspring, genotypes, and environments. We have designed related algorithms such as fitness algorithm for our own genetic algorithm. To simulate the distribution of each generation of individuals in the game of life.

1. **Overview**

**2.1 Description**

"Game of Life" is a non-operational game. Players observe the changes in the individual distribution of each generation. The individual changes of the game are determined only by the distribution of the first generation of individuals. After the first generation of individuals is generated, the program will automatically run and iterate, continuously generating the next generation until the end (or infinite). During this period, all operations of the game are performed automatically, and no player action is required.

**2.2 Definition in Problem:**

1. **Genotype**

Each gene is an array of ten random integers

1. **chromosome**

According to the definition of genetic algorithms, chromosomes are constructed by genes. Each chromosome contains two genes (x gene, y gene). Each generation of chromosomes will pass genes to the next generation, and the x, y genes of each chromosome represent the coordinates of an individual.

1. **Phenotype**

Phenotype contains two important attributes. The first is the generation. This attribute represents the generation that a chromosome can survive in the game of life. The second reason is that this attribute represents the next behavior of a chromosome. 0 represents death, 1 represents repetition of previous records, and 2 represents maximum number of generations reached.

1. **Fitness**

Fitness represents the generation of chromosomes under the rules of the game of life.

1. **Design**

**3.1 Parameter Setting**

1. **Group Size**

500 individuals

1. **Gene**

Each gene is an array of ten random integers

1. **Chromosome Length**

Chromosome has two genes

1. **Mutation Probability**

P = 0.05+Random (0~0.3) -- 5%~8%

1. **Generation**

The max number of generations is 1000

1. **Rules**

Based on game of life, only the fitness lives.

**3.2 Algorithm Design**

1. **Evolution Algorithm**

For evolution, the best chromosomal genes were used to create the next generation of genes. In evolutionary function, genes will change. The rule is if its value is <0, it is added as a random number between 0 and 10; if its value is> 0, it is reduced to a random number between 0 and 10. We designed it to make genes interact more and for the results, giving them a chance to reproduce.

1. **Mutation Algorithm**

During evolution, 5% to 8% of chromosomes are likely to be mutated, which means it will add a random number to the gene. It will then proceed with what we described earlier.

1. **Data Analysis**

We have tested some data in 40\*40 grid. We can find that with the growth of gene length, the chance to find the best pattern is less than before.

1. **Testing**

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1. **Conclusion**

The key to find the best pattern is to find the right gene length in certain population. In order to get the results quickly, we have shortened the entire process, but we find that it is difficult to find the best pattern in the initial stage. As the process continues, more and more individuals interact each other and grow rapidly. Under a certain amount of conditions, with the growth of gene length, the chance to find the best pattern is less than before. So the proper gene denseness is important.