Some Implementation Details in GA.cpp

1 Necessary Parameters

The appropriate population size should be in [*20*, *200*]. I choose *100*.
The appropriate probability of crossover should be in [*0.4*, *0.99*]. I choose *0.7*.
The appropriate probability of mutation should be in [*0.005*, *0.01*]. I choose *0.07*.
The appropriate maximum number of generations (one of the stopping criterions) should be in [*100*, *1000*]. I choose *500*.

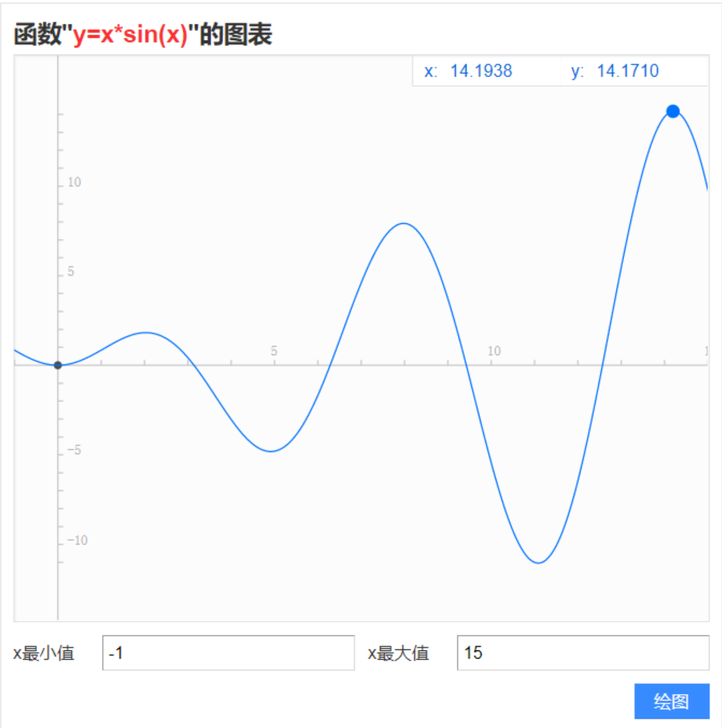
2 Encoding Method

To turn each x into a 16-bit binary digit, namely turn [*-1*, *15*] into [0, *1111 1111 1111 1111*],
I do

$$xdna = BIN\,(2^{(x+1)} - 1).$$

3 Fitness Score

Firstly, we need to obtain the x which can make $f(x)$ smallest.
Firstly, we hope that the fitness score is the highest when the x is optimal.
Secondly, because we need to use fitness scores to calculate the select-rates, we have to make the fitness scores all positive.
Then I use *baidu* to draw the image of $f(x) = x*sin(x)$.



We can see the max value of *f(x)* is smaller than 15.
Above all, I do

$$fitness = -x*sin(x) + 15$$

to get legal fitness scores.

4 Selection Method

I choose a roulette-like way to select offspring.
Get the probability through

$$P(x_i) = \frac{fitness(x_i)}{\sum_{i=0}^{n} fitness(x_i)}.$$

The **x** which has higher fitness score will be selected more probably.

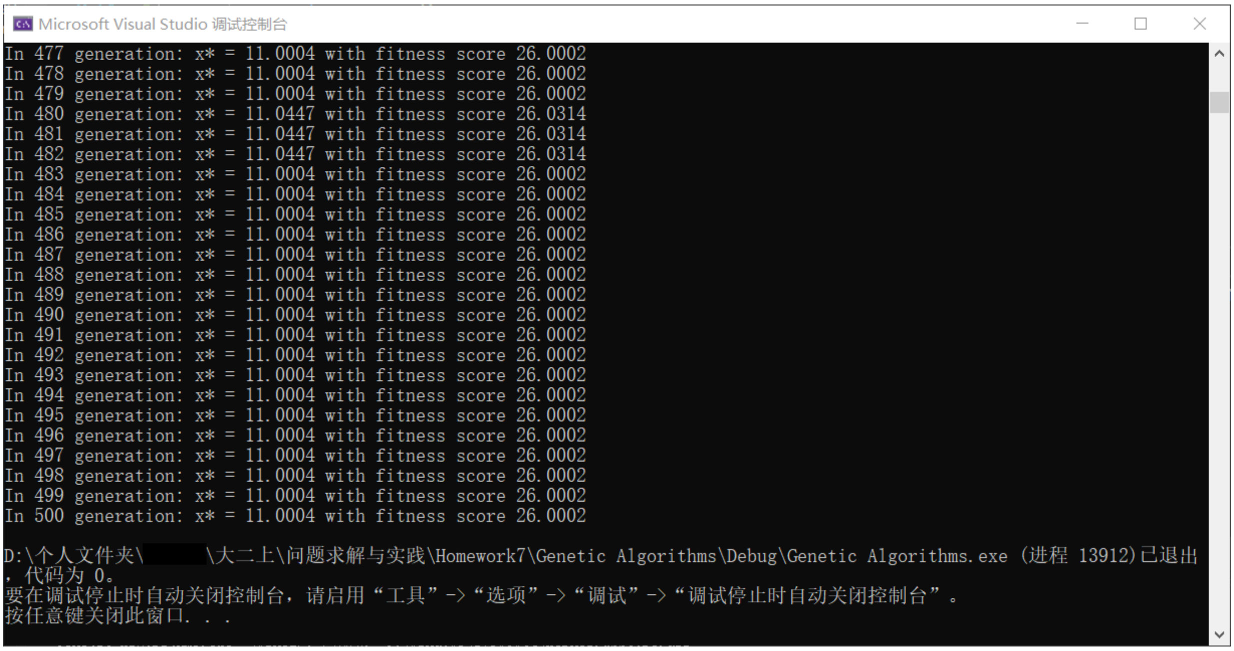
5 Crossover Method

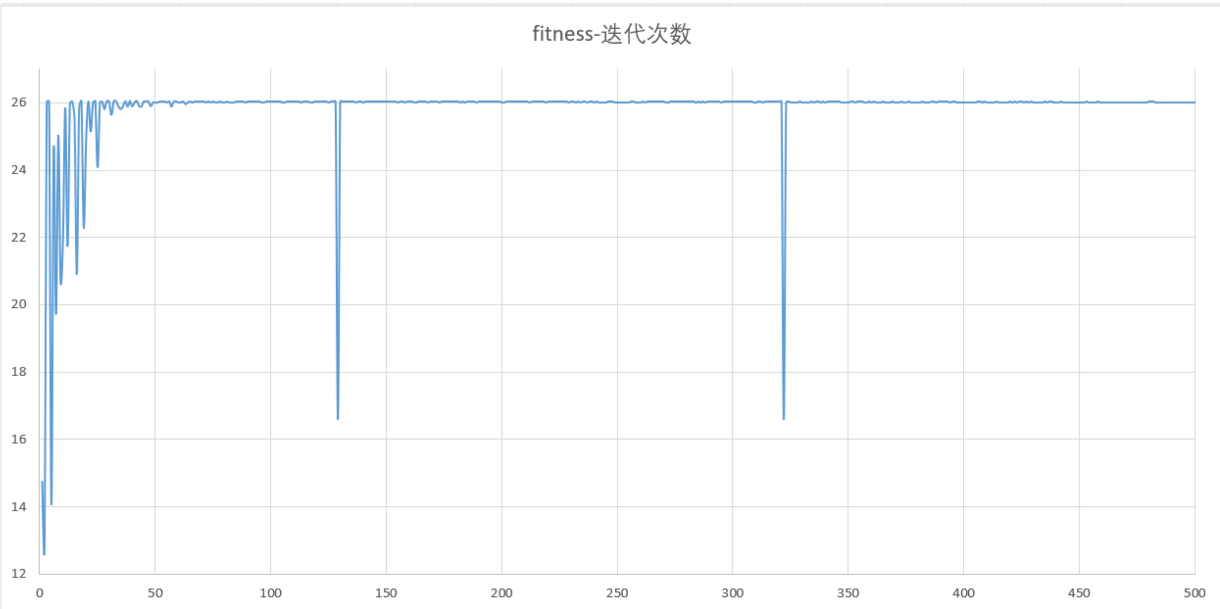
I choose single-point crossover method.
Between each pair of parents in population, crossover will happen at a probability of *70%*. If the crossover happens, we randomly choose a position **i**, then exchange the front i digits of DNA of $\mathbf{x_{2i}}$ and $\mathbf{x_{2i+1}}$.

6 Mutation Method

I choose bit mutation method.
Every bit in DNA of each x will mutate at a probability of *7%*. If the mutation happens, original ***0*** will change to ***1***, original ***1*** will change to ***0***.

7 Experimental Result





The result I obtained through GA.cpp is

$$x^* = 11.0004$$

The relative error is

$$\eta = (11.0857 - 11.0004)/11.0857 * 100\% = 0.77\%$$