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ФАКУЛЬТЕТ «Информатика и системы управления» (ИУ)

КАФЕДРА «Информационная безопасность» (ИУ8)

Отчёт

по рубежному контролю № 3
по дисциплине «Методы оптимизации»

Тема: « Исследование генетических алгоритмов в задачах поиска экстремумов »

Вариант 10

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1.1. Цель работы

Изучить основные принципы действия генетических алгоритмов на примере решения задач оптимизации функций двух переменных.

1.2. Постановка задачи

Найти максимум функции f(x,y) в области D с помощью простого (классического) генетического алгоритма. За исходную популяцию принять 4 случайных точки. Хромосома каждой особи состоит из двух генов: значений координат x, y. В качестве потомков следует выбирать результат скрещивания лучшего решения со вторым и третьим в порядке убывания значений функции приспособленности с последующей случайной мутацией обоих генов. В качестве критерия остановки эволюционного процесса задаться номером конечной популяции ($N \sim 10^1 ... 10^2$). Визуализировать результаты расчетов.

1.3. Условие варианта

Вид функции *f(x,y)*	**Область допустимых значений** *D*
$\frac{sin^2(x)}{1+x^2+y^2}$	$(0,2) \times (-2,2)$

2. Расчёт с помощью программы

10 generations:

genereation	prefix	X	Y	FIT	max element	average
0	p	0.4018	-0.0001607	0.1317		
0	p	0.9955	1.223	0.2019		
0	p	1.445	0.9934	0.2416		
0	p	1.283	-0.08465	0.3465	0.3465	0.2304
1	p	1.283	-0.08465	0.3465		
1	p	1.283	-0.0001607	0.3474		
1	p	0.9955	-0.08465	0.3523		
1	p	0.9955	-0.0001607	0.3536	0.3536	0.3499
1	ig	1.283	-0.08465	0.3465		
1	ig	1.283	-0.08465	0.3465		
1	ig	1.283	-0.08465	0.3465		
1	ig	1.283	-0.0001607	0.3474		
1	ig	1.283	-0.0001607	0.3474		
1	ig	1.283	-0.0001607	0.3474		
1	ig	0.9955	-0.08465	0.3523		
1	ig	0.9955	-0.08465	0.3523		
1	ig	0.9955	-0.08465	0.3523		
1	ig	0.9955	-0.0001607	0.3536		
1	ig	0.9955	-0.0001607	0.3536		
1	ig	0.9955	-0.0001607	0.3536	0.3536	0.3499
2	p	0.9955	-0.0001607	0.3536		
2	p	0.9955	-0.0001607	0.3536		
2	p	0.9955	-0.0001607	0.3536		
2	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536		
2	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

3	p	0.9955	-0.0001607	0.3536		
3	p	0.9955	-0.0001607	0.3536		
3	p	0.9955	-0.0001607	0.3536		
3	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

4	p	0.9955	-0.0001607	0.3536		
4	p	0.9955	-0.0001607	0.3536		
4	p	0.9955	-0.0001607	0.3536		
4	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536		
4	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

5	p	0.9955	-0.0001607	0.3536		
5	p	0.9955	-0.0001607	0.3536		
5	p	0.9955	-0.0001607	0.3536		
5	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		

5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536		
5	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

6	p	0.9955	-0.0001607	0.3536		
6	p	0.9955	-0.0001607	0.3536		
6	p	0.9955	-0.0001607	0.3536		
6	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536		
6	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

7	p	0.9955	-0.0001607	0.3536		
7	p	0.9955	-0.0001607	0.3536		
7	p	0.9955	-0.0001607	0.3536		
7	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536		
7	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

8	p	0.9955	-0.0001607	0.3536		
8	p	0.9955	-0.0001607	0.3536		
8	p	0.9955	-0.0001607	0.3536		
8	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536		
8	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

9	p	0.9955	-0.0001607	0.3536		
9	p	0.9955	-0.0001607	0.3536		
9	p	0.9955	-0.0001607	0.3536		
9	p	0.9955	-0.0001607	0.3536	0.3536	0.3536

9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536		
9	ig	0.9955	-0.0001607	0.3536	0.3536	0.3536

10	result	0.9955	-0.0001607	0.3536		
10	result	0.9955	-0.0001607	0.3536		
10	result	0.9955	-0.0001607	0.3536		
10	result	0.9955	-0.0001607	0.3536	0.3536	0.3536

100 generations:

genereation	prefix	X	Y	FIT	max element	average
0	p	0.4897	-1.732	0.05218		
0	p	1.51	-1.321	0.1983		
0	p	0.9145	-0.5381	0.2953		
0	p	1.384	0.178	0.3276	0.3276	0.2183

1	p	1.51	0.178	0.3009		
1	p	1.384	-0.5381	0.3013		
1	p	1.384	0.178	0.3276		
1	p	0.9145	0.178	0.336	0.336	0.3165

1	ig	1.51	-0.5381	0.2792		
1	ig	0.9145	-0.5381	0.2953		
1	ig	1.51	0.178	0.3009		
1	ig	1.51	0.178	0.3009		
1	ig	1.384	-0.5381	0.3013		
1	ig	1.384	0.178	0.3276		
1	ig	1.384	0.178	0.3276		
1	ig	1.384	0.178	0.3276		
1	ig	1.384	0.178	0.3276		
1	ig	1.384	0.178	0.3276		
1	ig	0.9145	0.178	0.336		
1	ig	0.9145	0.178	0.336	0.336	0.3156

2	p	1.384	0.178	0.3276		
2	p	0.9145	0.178	0.336		
2	p	0.9145	0.178	0.336		
2	p	0.9145	0.178	0.336	0.336	0.3339

2	ig	1.384	0.178	0.3276		
2	ig	1.384	0.178	0.3276		

2	ig	1.384	0.178	0.3276		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336		
2	ig	0.9145	0.178	0.336	0.336	0.3339

3	p	0.9145	0.178	0.336		
3	p	0.9145	0.178	0.336		
3	p	0.9145	0.178	0.336		
3	p	0.9145	0.178	0.336	0.336	0.336

3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336		
3	ig	0.9145	0.178	0.336	0.336	0.336

4	p	0.9145	0.178	0.336		
4	p	0.9145	0.178	0.336		
4	p	0.9145	0.178	0.336		
4	p	0.9145	0.178	0.336	0.336	0.336

4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336		
4	ig	0.9145	0.178	0.336	0.336	0.336

5	p	0.9145	0.178	0.336		
5	p	0.9145	0.178	0.336		
5	p	0.9145	0.178	0.336		
5	p	0.9145	0.178	0.336	0.336	0.336

5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		

5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336	0.336	0.336

6	p	0.9145	0.178	0.336		
6	p	0.9145	0.178	0.336		
6	p	0.9145	0.178	0.336		
6	p	0.9145	0.178	0.336	0.336	0.336

6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336		
6	ig	0.9145	0.178	0.336	0.336	0.336

7	p	0.9145	0.178	0.336		
7	p	0.9145	0.178	0.336		
7	p	0.9145	0.178	0.336		
7	p	0.9145	0.178	0.336	0.336	0.336

7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336		
7	ig	0.9145	0.178	0.336	0.336	0.336

8	p	0.9145	0.178	0.336		
8	p	0.9145	0.178	0.336		
8	p	0.9145	0.178	0.336		
8	p	0.9145	0.178	0.336	0.336	0.336

8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336	0.336	0.336

9	p	0.9145	0.178	0.336		

9	p	0.9145	0.178	0.336		
9	p	0.9145	0.178	0.336		
9	p	0.9145	0.178	0.336	0.336	0.336

9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336		
9	ig	0.9145	0.178	0.336	0.336	0.336

10	p	0.9145	0.178	0.336		
10	p	0.9145	0.178	0.336		
10	p	0.9145	0.178	0.336		
10	p	0.9145	0.178	0.336	0.336	0.336

10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336		
10	ig	0.9145	0.178	0.336	0.336	0.336

11	p	0.9145	0.178	0.336		
11	p	0.9145	0.178	0.336		
11	p	0.9145	0.178	0.336		
11	p	0.9145	0.178	0.336	0.336	0.336

11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336		
11	ig	0.9145	0.178	0.336	0.336	0.336

12	p	0.8731	0.3743	0.3087		
12	p	0.8499	0.2147	0.3191		
12	p	0.9721	0.2458	0.3403		
12	p	1.085	0.2404	0.3499	0.3499	0.3295

12	ig	0.6459	0.08588	0.2543		
12	ig	0.6916	0.3437	0.2548		

12	ig	0.8682	0.1139	0.3297		
12	ig	1.015	0.377	0.3322		
12	ig	1.199	0.3364	0.3403		
12	ig	0.9327	-0.01976	0.3449		
12	ig	0.942	-0.05961	0.3459		
12	ig	0.9686	0.00882	0.3504		
12	ig	1.201	0.1403	0.3531		
12	ig	1.14	0.1633	0.3549		
12	ig	1.1	0.1489	0.3558		
12	ig	1.146	0.02796	0.3587	0.3587	0.3312

13	p	1.201	0.1403	0.3531		
13	p	1.14	0.1633	0.3549		
13	p	1.1	0.1489	0.3558		
13	p	1.146	0.02796	0.3587	0.3587	0.3556

13	ig	1.201	0.1633	0.3521		
13	ig	1.201	0.1489	0.3527		
13	ig	1.146	0.1633	0.3548		
13	ig	1.1	0.1633	0.3551		
13	ig	1.146	0.1489	0.3554		
13	ig	1.14	0.1489	0.3556		
13	ig	1.201	0.02796	0.3558		
13	ig	1.146	0.1403	0.3558		
13	ig	1.14	0.1403	0.356		
13	ig	1.1	0.1403	0.3562		
13	ig	1.14	0.02796	0.3589		
13	ig	1.1	0.02796	0.3593	0.3593	0.3556

14	p	1.1	0.1403	0.3562		
14	p	1.146	0.02796	0.3587		
14	p	1.14	0.02796	0.3589		
14	p	1.1	0.02796	0.3593	0.3593	0.3583

14	ig	1.146	0.1403	0.3558		
14	ig	1.14	0.1403	0.356		
14	ig	1.1	0.1403	0.3562		
14	ig	1.146	0.02796	0.3587		
14	ig	1.146	0.02796	0.3587		
14	ig	1.14	0.02796	0.3589		
14	ig	1.14	0.02796	0.3589		
14	ig	1.1	0.02796	0.3593		
14	ig	1.1	0.02796	0.3593		
14	ig	1.1	0.02796	0.3593		
14	ig	1.1	0.02796	0.3593		
14	ig	1.1	0.02796	0.3593	0.3593	0.3583

15	p	1.1	0.02796	0.3593		
15	p	1.1	0.02796	0.3593		
15	p	1.1	0.02796	0.3593		
15	p	1.1	0.02796	0.3593	0.3593	0.3593

15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		

15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593		
15	ig	1.1	0.02796	0.3593	0.3593	0.3593

16	p	1.1	0.02796	0.3593		
16	p	1.1	0.02796	0.3593		
16	p	1.1	0.02796	0.3593		
16	p	1.1	0.02796	0.3593	0.3593	0.3593

16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593		
16	ig	1.1	0.02796	0.3593	0.3593	0.3593

17	p	1.1	0.02796	0.3593		
17	p	1.1	0.02796	0.3593		
17	p	1.1	0.02796	0.3593		
17	p	1.1	0.02796	0.3593	0.3593	0.3593

17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593		
17	ig	1.1	0.02796	0.3593	0.3593	0.3593

18	p	1.1	0.02796	0.3593		
18	p	1.1	0.02796	0.3593		
18	p	1.1	0.02796	0.3593		
18	p	1.1	0.02796	0.3593	0.3593	0.3593

18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593		
18	ig	1.1	0.02796	0.3593	0.3593	0.3593

19	p	1.1	0.02796	0.3593		

19	p	1.1	0.02796	0.3593		
19	p	1.1	0.02796	0.3593		
19	p	1.1	0.02796	0.3593	0.3593	0.3593

19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593	0.3593	0.3593

20	p	1.1	0.02796	0.3593		
20	p	1.1	0.02796	0.3593		
20	p	1.1	0.02796	0.3593		
20	p	1.1	0.02796	0.3593	0.3593	0.3593

20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593	0.3593	0.3593

21	p	1.1	0.02796	0.3593		
21	p	1.1	0.02796	0.3593		
21	p	1.1	0.02796	0.3593		
21	p	1.1	0.02796	0.3593	0.3593	0.3593

21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593		
21	ig	1.1	0.02796	0.3593	0.3593	0.3593

22	p	0.9433	0.3001	0.331		
22	p	0.8888	-0.1718	0.3312		
22	p	0.9305	0.1513	0.3405		
22	p	1.203	0.09021	0.3546	0.3546	0.3393

22	ig	0.817	-0.2483	0.3074		
22	ig	1.37	0.3149	0.3227		

22	ig	0.8956	-0.2085	0.3301		
22	ig	1.301	0.2975	0.3341		
22	ig	0.9813	0.3238	0.3341		
22	ig	1.159	0.3108	0.3442		
22	ig	1.283	0.153	0.3444		
22	ig	1.047	-0.2175	0.3498		
22	ig	1.073	-0.1934	0.3527		
22	ig	1.169	0.1587	0.3541		
22	ig	1.11	0.1109	0.3575		
22	ig	1.153	-0.03746	0.3584	0.3584	0.3408

23	p	1.169	0.1587	0.3541		
23	p	1.203	0.09021	0.3546		
23	p	1.11	0.1109	0.3575		
23	p	1.153	-0.03746	0.3584	0.3584	0.3562

23	ig	1.203	0.1587	0.3522		
23	ig	1.203	0.1109	0.354		
23	ig	1.153	0.1587	0.3548		
23	ig	1.11	0.1587	0.3554		
23	ig	1.203	-0.03746	0.3556		
23	ig	1.169	0.1109	0.3561		
23	ig	1.169	0.09021	0.3567		
23	ig	1.153	0.1109	0.3567		
23	ig	1.153	0.09021	0.3574		
23	ig	1.169	-0.03746	0.3577		
23	ig	1.11	0.09021	0.3581		
23	ig	1.11	-0.03746	0.3592	0.3592	0.3562

24	p	1.169	-0.03746	0.3577		
24	p	1.11	0.09021	0.3581		
24	p	1.153	-0.03746	0.3584		
24	p	1.11	-0.03746	0.3592	0.3592	0.3584

24	ig	1.169	0.09021	0.3567		
24	ig	1.153	0.09021	0.3574		
24	ig	1.169	-0.03746	0.3577		
24	ig	1.169	-0.03746	0.3577		
24	ig	1.11	0.09021	0.3581		
24	ig	1.153	-0.03746	0.3584		
24	ig	1.153	-0.03746	0.3584		
24	ig	1.11	-0.03746	0.3592		
24	ig	1.11	-0.03746	0.3592		
24	ig	1.11	-0.03746	0.3592		
24	ig	1.11	-0.03746	0.3592		
24	ig	1.11	-0.03746	0.3592	0.3592	0.3584

25	p	1.11	-0.03746	0.3592		
25	p	1.11	-0.03746	0.3592		
25	p	1.11	-0.03746	0.3592		
25	p	1.11	-0.03746	0.3592	0.3592	0.3592

25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		

25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592		
25	ig	1.11	-0.03746	0.3592	0.3592	0.3592

26	p	1.11	-0.03746	0.3592		
26	p	1.11	-0.03746	0.3592		
26	p	1.11	-0.03746	0.3592		
26	p	1.11	-0.03746	0.3592	0.3592	0.3592

26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592		
26	ig	1.11	-0.03746	0.3592	0.3592	0.3592

27	p	1.11	-0.03746	0.3592		
27	p	1.11	-0.03746	0.3592		
27	p	1.11	-0.03746	0.3592		
27	p	1.11	-0.03746	0.3592	0.3592	0.3592

27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592	0.3592	0.3592

28	p	1.11	-0.03746	0.3592		
28	p	1.11	-0.03746	0.3592		
28	p	1.11	-0.03746	0.3592		
28	p	1.11	-0.03746	0.3592	0.3592	0.3592

28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592		
28	ig	1.11	-0.03746	0.3592	0.3592	0.3592

29	p	1.11	-0.03746	0.3592		

29	p	1.11	-0.03746	0.3592		
29	p	1.11	-0.03746	0.3592		
29	p	1.11	-0.03746	0.3592	0.3592	0.3592

29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592		
29	ig	1.11	-0.03746	0.3592	0.3592	0.3592

30	p	0.8837	-0.2737	0.322		
30	p	0.8537	0.09882	0.3268		
30	p	1.253	-0.08731	0.3501		
30	p	1.206	-0.1019	0.3541	0.3541	0.3382

30	ig	0.8248	-0.07941	0.3198		
30	ig	0.8459	0.07566	0.3256		
30	ig	0.8962	0.2599	0.326		
30	ig	1.401	-0.03646	0.3277		
30	ig	0.9161	0.2483	0.331		
30	ig	1.362	0.1316	0.3332		
30	ig	1.328	-0.2447	0.3337		
30	ig	1.19	-0.2904	0.3447		
30	ig	1.29	-0.004256	0.3466		
30	ig	1.257	0.1736	0.3466		
30	ig	1.157	0.1034	0.3568		
30	ig	1.174	-0.01883	0.3576	0.3576	0.3374

31	p	1.253	-0.08731	0.3501		
31	p	1.206	-0.1019	0.3541		
31	p	1.157	0.1034	0.3568		
31	p	1.174	-0.01883	0.3576	0.3576	0.3547

31	ig	1.253	0.1034	0.3497		
31	ig	1.253	-0.1019	0.3497		
31	ig	1.253	-0.01883	0.3511		
31	ig	1.206	0.1034	0.3541		
31	ig	1.206	-0.08731	0.3545		
31	ig	1.206	-0.01883	0.3556		
31	ig	1.174	0.1034	0.3561		
31	ig	1.174	-0.1019	0.3561		
31	ig	1.174	-0.08731	0.3565		
31	ig	1.157	-0.1019	0.3569		
31	ig	1.157	-0.08731	0.3573		
31	ig	1.157	-0.01883	0.3584	0.3584	0.3547

32	p	1.157	-0.1019	0.3569		
32	p	1.157	-0.08731	0.3573		
32	p	1.174	-0.01883	0.3576		
32	p	1.157	-0.01883	0.3584	0.3584	0.3576

32	ig	1.174	-0.1019	0.3561		
32	ig	1.174	-0.08731	0.3565		

32	ig	1.157	-0.1019	0.3569		
32	ig	1.157	-0.1019	0.3569		
32	ig	1.157	-0.08731	0.3573		
32	ig	1.157	-0.08731	0.3573		
32	ig	1.174	-0.01883	0.3576		
32	ig	1.157	-0.01883	0.3584		
32	ig	1.157	-0.01883	0.3584		
32	ig	1.157	-0.01883	0.3584		
32	ig	1.157	-0.01883	0.3584		
32	ig	1.157	-0.01883	0.3584	0.3584	0.3576

33	p	1.157	-0.01883	0.3584		
33	p	1.157	-0.01883	0.3584		
33	p	1.157	-0.01883	0.3584		
33	p	1.157	-0.01883	0.3584	0.3584	0.3584

33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584		
33	ig	1.157	-0.01883	0.3584	0.3584	0.3584

34	p	1.157	-0.01883	0.3584		
34	p	1.157	-0.01883	0.3584		
34	p	1.157	-0.01883	0.3584		
34	p	1.157	-0.01883	0.3584	0.3584	0.3584

34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584		
34	ig	1.157	-0.01883	0.3584	0.3584	0.3584

35	p	1.157	-0.01883	0.3584		
35	p	1.157	-0.01883	0.3584		
35	p	1.157	-0.01883	0.3584		
35	p	1.157	-0.01883	0.3584	0.3584	0.3584

35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		

35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584		
35	ig	1.157	-0.01883	0.3584	0.3584	0.3584

36	p	1.157	-0.01883	0.3584		
36	p	1.157	-0.01883	0.3584		
36	p	1.157	-0.01883	0.3584		
36	p	1.157	-0.01883	0.3584	0.3584	0.3584

36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584		
36	ig	1.157	-0.01883	0.3584	0.3584	0.3584

37	p	1.157	-0.01883	0.3584		
37	p	1.157	-0.01883	0.3584		
37	p	1.157	-0.01883	0.3584		
37	p	1.157	-0.01883	0.3584	0.3584	0.3584

37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584		
37	ig	1.157	-0.01883	0.3584	0.3584	0.3584

38	p	1.157	-0.01883	0.3584		
38	p	1.157	-0.01883	0.3584		
38	p	1.157	-0.01883	0.3584		
38	p	1.157	-0.01883	0.3584	0.3584	0.3584

38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584	0.3584	0.3584

39	p	1.157	-0.01883	0.3584		

39	p	1.157	-0.01883	0.3584			
39	p	1.157	-0.01883	0.3584			
39	p	1.157	-0.01883	0.3584	0.3584	0.3584	

39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584			
39	ig	1.157	-0.01883	0.3584	0.3584	0.3584	

40	p	1.327	-0.115	0.3394			
40	p	1.23	0.1582	0.35			
40	p	1.121	0.2042	0.3528			
40	p	1.191	-0.04289	0.3564	0.3564	0.3497	

40	ig	1.402	-0.2806	0.3191			
40	ig	1.41	0.08513	0.3252			
40	ig	0.8953	0.2481	0.3269			
40	ig	0.8597	0.03431	0.3299			
40	ig	1.357	-0.08288	0.3354			
40	ig	0.9937	0.2356	0.3438			
40	ig	0.9722	0.06636	0.3501			
40	ig	1.134	-0.2435	0.3501			
40	ig	0.9857	0.1141	0.3502			
40	ig	1.247	-0.1055	0.3502			
40	ig	1.003	0.01384	0.3543			
40	ig	1.207	-0.03463	0.3553	0.3553	0.3409	

41	p	1.121	0.2042	0.3528			
41	p	1.003	0.01384	0.3543			
41	p	1.207	-0.03463	0.3553			
41	p	1.191	-0.04289	0.3564	0.3564	0.3547	

41	ig	1.003	0.2042	0.3471			
41	ig	1.207	0.2042	0.3495			
41	ig	1.191	0.2042	0.3506			
41	ig	1.003	-0.04289	0.354			
41	ig	1.003	-0.03463	0.3541			
41	ig	1.207	-0.04289	0.3552			
41	ig	1.207	0.01384	0.3554			
41	ig	1.191	-0.03463	0.3565			
41	ig	1.191	0.01384	0.3566			
41	ig	1.121	-0.04289	0.3591			
41	ig	1.121	-0.03463	0.3592			
41	ig	1.121	0.01384	0.3593	0.3593	0.3547	

42	p	1.191	0.01384	0.3566			
42	p	1.121	-0.04289	0.3591			
42	p	1.121	-0.03463	0.3592			
42	p	1.121	0.01384	0.3593	0.3593	0.3586	

42	ig	1.191	-0.04289	0.3564			
42	ig	1.191	-0.03463	0.3565			

42	ig	1.191	0.01384	0.3566		
42	ig	1.121	-0.04289	0.3591		
42	ig	1.121	-0.04289	0.3591		
42	ig	1.121	-0.03463	0.3592		
42	ig	1.121	-0.03463	0.3592		
42	ig	1.121	0.01384	0.3593		
42	ig	1.121	0.01384	0.3593		
42	ig	1.121	0.01384	0.3593		
42	ig	1.121	0.01384	0.3593		
42	ig	1.121	0.01384	0.3593	0.3593	0.3586

43	p	1.121	0.01384	0.3593		
43	p	1.121	0.01384	0.3593		
43	p	1.121	0.01384	0.3593		
43	p	1.121	0.01384	0.3593	0.3593	0.3593

43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593		
43	ig	1.121	0.01384	0.3593	0.3593	0.3593

44	p	1.121	0.01384	0.3593		
44	p	1.121	0.01384	0.3593		
44	p	1.121	0.01384	0.3593		
44	p	1.121	0.01384	0.3593	0.3593	0.3593

44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593		
44	ig	1.121	0.01384	0.3593	0.3593	0.3593

45	p	1.121	0.01384	0.3593		
45	p	1.121	0.01384	0.3593		
45	p	1.121	0.01384	0.3593		
45	p	1.121	0.01384	0.3593	0.3593	0.3593

45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		

45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593		
45	ig	1.121	0.01384	0.3593	0.3593	0.3593

46	p	1.121	0.01384	0.3593		
46	p	1.121	0.01384	0.3593		
46	p	1.121	0.01384	0.3593		
46	p	1.121	0.01384	0.3593	0.3593	0.3593

46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593		
46	ig	1.121	0.01384	0.3593	0.3593	0.3593

47	p	1.121	0.01384	0.3593		
47	p	1.121	0.01384	0.3593		
47	p	1.121	0.01384	0.3593		
47	p	1.121	0.01384	0.3593	0.3593	0.3593

47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593		
47	ig	1.121	0.01384	0.3593	0.3593	0.3593

48	p	1.121	0.01384	0.3593		
48	p	1.121	0.01384	0.3593		
48	p	1.121	0.01384	0.3593		
48	p	1.121	0.01384	0.3593	0.3593	0.3593

48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593		
48	ig	1.121	0.01384	0.3593	0.3593	0.3593

49	p	1.121	0.01384	0.3593		

49	p	1.121	0.01384	0.3593		
49	p	1.121	0.01384	0.3593		
49	p	1.121	0.01384	0.3593	0.3593	0.3593

49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593		
49	ig	1.121	0.01384	0.3593	0.3593	0.3593

50	p	1.121	0.01384	0.3593		
50	p	1.121	0.01384	0.3593		
50	p	1.121	0.01384	0.3593		
50	p	1.121	0.01384	0.3593	0.3593	0.3593

50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593		
50	ig	1.121	0.01384	0.3593	0.3593	0.3593

51	p	0.8859	0.2745	0.3225		
51	p	1.348	-0.1815	0.3338		
51	p	0.8975	-0.126	0.3356		
51	p	1.17	0.07722	0.357	0.357	0.3372

51	ig	1.378	0.2998	0.3223		
51	ig	1.395	-0.137	0.327		
51	ig	0.9798	0.2878	0.3375		
51	ig	1.22	-0.2815	0.3435		
51	ig	1.306	-0.03513	0.3441		
51	ig	1.296	0.08919	0.3446		
51	ig	1.242	0.2213	0.3456		
51	ig	1.01	-0.2201	0.3466		
51	ig	1.24	0.1364	0.35		
51	ig	1.212	-0.04924	0.3548		
51	ig	1.049	-0.1271	0.3551		
51	ig	1.094	-0.124	0.3568	0.3568	0.344

52	p	1.212	-0.04924	0.3548		
52	p	1.049	-0.1271	0.3551		
52	p	1.094	-0.124	0.3568		
52	p	1.17	0.07722	0.357	0.357	0.3559

52	ig	1.212	-0.1271	0.3528		
52	ig	1.212	-0.124	0.3529		

52	ig	1.212	0.07722	0.3543		
52	ig	1.049	-0.124	0.3552		
52	ig	1.17	-0.1271	0.3554		
52	ig	1.17	-0.124	0.3556		
52	ig	1.094	-0.1271	0.3567		
52	ig	1.049	0.07722	0.3568		
52	ig	1.049	-0.04924	0.3574		
52	ig	1.17	-0.04924	0.3575		
52	ig	1.094	0.07722	0.3584		
52	ig	1.094	-0.04924	0.3589	0.3589	0.356

53	p	1.049	-0.04924	0.3574		
53	p	1.17	-0.04924	0.3575		
53	p	1.094	0.07722	0.3584		
53	p	1.094	-0.04924	0.3589	0.3589	0.358

53	ig	1.049	0.07722	0.3568		
53	ig	1.17	0.07722	0.357		
53	ig	1.049	-0.04924	0.3574		
53	ig	1.049	-0.04924	0.3574		
53	ig	1.17	-0.04924	0.3575		
53	ig	1.17	-0.04924	0.3575		
53	ig	1.094	0.07722	0.3584		
53	ig	1.094	-0.04924	0.3589		
53	ig	1.094	-0.04924	0.3589		
53	ig	1.094	-0.04924	0.3589		
53	ig	1.094	-0.04924	0.3589		
53	ig	1.094	-0.04924	0.3589	0.3589	0.358

54	p	1.094	-0.04924	0.3589		
54	p	1.094	-0.04924	0.3589		
54	p	1.094	-0.04924	0.3589		
54	p	1.094	-0.04924	0.3589	0.3589	0.3589

54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589		
54	ig	1.094	-0.04924	0.3589	0.3589	0.3589

55	p	1.094	-0.04924	0.3589		
55	p	1.094	-0.04924	0.3589		
55	p	1.094	-0.04924	0.3589		
55	p	1.094	-0.04924	0.3589	0.3589	0.3589

55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		

55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589		
55	ig	1.094	-0.04924	0.3589	0.3589	0.3589

56	p	1.094	-0.04924	0.3589		
56	p	1.094	-0.04924	0.3589		
56	p	1.094	-0.04924	0.3589		
56	p	1.094	-0.04924	0.3589	0.3589	0.3589

56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589		
56	ig	1.094	-0.04924	0.3589	0.3589	0.3589

57	p	1.094	-0.04924	0.3589		
57	p	1.094	-0.04924	0.3589		
57	p	1.094	-0.04924	0.3589		
57	p	1.094	-0.04924	0.3589	0.3589	0.3589

57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589		
57	ig	1.094	-0.04924	0.3589	0.3589	0.3589

58	p	1.094	-0.04924	0.3589		
58	p	1.094	-0.04924	0.3589		
58	p	1.094	-0.04924	0.3589		
58	p	1.094	-0.04924	0.3589	0.3589	0.3589

58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589		
58	ig	1.094	-0.04924	0.3589	0.3589	0.3589

59	p	1.094	-0.04924	0.3589		

59	p	1.094	-0.04924	0.3589		
59	p	1.094	-0.04924	0.3589		
59	p	1.094	-0.04924	0.3589	0.3589	0.3589

59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589	0.3589	0.3589

60	p	1.094	-0.04924	0.3589		
60	p	1.094	-0.04924	0.3589		
60	p	1.094	-0.04924	0.3589		
60	p	1.094	-0.04924	0.3589	0.3589	0.3589

60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589		
60	ig	1.094	-0.04924	0.3589	0.3589	0.3589

61	p	1.094	-0.04924	0.3589		
61	p	1.094	-0.04924	0.3589		
61	p	1.094	-0.04924	0.3589		
61	p	1.094	-0.04924	0.3589	0.3589	0.3589

61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589	0.3589	0.3589

62	p	1.094	-0.04924	0.3589		
62	p	1.094	-0.04924	0.3589		
62	p	1.094	-0.04924	0.3589		
62	p	1.094	-0.04924	0.3589	0.3589	0.3589

62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		

62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589		
62	ig	1.094	-0.04924	0.3589	0.3589	0.3589

63	p	0.8117	-0.1273	0.3142		
63	p	0.8567	-0.0657	0.3285		
63	p	1.014	-0.3378	0.3365		
63	p	1.045	-0.268	0.3457	0.3457	0.3312

63	ig	0.8726	-0.2805	0.3189		
63	ig	1.381	-0.2719	0.3235		
63	ig	0.8909	-0.1626	0.3322		
63	ig	1.282	-0.3409	0.3329		
63	ig	1.285	-0.2988	0.3359		
63	ig	0.9557	-0.1749	0.3431		
63	ig	1.244	0.164	0.3484		
63	ig	1.258	-0.04802	0.3502		
63	ig	1.236	0.07917	0.352		
63	ig	1.061	-0.1902	0.3524		
63	ig	1.207	-0.1033	0.3539		
63	ig	1.125	0.08361	0.3582	0.3582	0.3418

64	p	1.236	0.07917	0.352		
64	p	1.061	-0.1902	0.3524		
64	p	1.207	-0.1033	0.3539		
64	p	1.125	0.08361	0.3582	0.3582	0.3541

64	ig	1.236	-0.1902	0.3479		
64	ig	1.207	-0.1902	0.3503		
64	ig	1.236	-0.1033	0.3514		
64	ig	1.236	0.08361	0.3519		
64	ig	1.125	-0.1902	0.3537		
64	ig	1.207	0.08361	0.3545		
64	ig	1.207	0.07917	0.3546		
64	ig	1.061	-0.1033	0.3566		
64	ig	1.061	0.08361	0.3572		
64	ig	1.061	0.07917	0.3574		
64	ig	1.125	-0.1033	0.3576		
64	ig	1.125	0.07917	0.3583	0.3583	0.3543

65	p	1.061	0.07917	0.3574		
65	p	1.125	-0.1033	0.3576		
65	p	1.125	0.08361	0.3582		
65	p	1.125	0.07917	0.3583	0.3583	0.3579

65	ig	1.061	-0.1033	0.3566		
65	ig	1.061	0.08361	0.3572		
65	ig	1.061	0.07917	0.3574		
65	ig	1.125	-0.1033	0.3576		
65	ig	1.125	-0.1033	0.3576		
65	ig	1.125	0.08361	0.3582		
65	ig	1.125	0.08361	0.3582		
65	ig	1.125	0.07917	0.3583		
65	ig	1.125	0.07917	0.3583		

65	ig	1.125	0.07917	0.3583		
65	ig	1.125	0.07917	0.3583		
65	ig	1.125	0.07917	0.3583	0.3583	0.3579
66	p	1.125	0.07917	0.3583		
66	p	1.125	0.07917	0.3583		
66	p	1.125	0.07917	0.3583		
66	p	1.125	0.07917	0.3583	0.3583	0.3583
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583		
66	ig	1.125	0.07917	0.3583	0.3583	0.3583
67	p	1.125	0.07917	0.3583		
67	p	1.125	0.07917	0.3583		
67	p	1.125	0.07917	0.3583		
67	p	1.125	0.07917	0.3583	0.3583	0.3583
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583		
67	ig	1.125	0.07917	0.3583	0.3583	0.3583
68	p	1.125	0.07917	0.3583		
68	p	1.125	0.07917	0.3583		
68	p	1.125	0.07917	0.3583		
68	p	1.125	0.07917	0.3583	0.3583	0.3583
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583		
68	ig	1.125	0.07917	0.3583	0.3583	0.3583
69	p	1.125	0.07917	0.3583		

69	p	1.125	0.07917	0.3583		
69	p	1.125	0.07917	0.3583		
69	p	1.125	0.07917	0.3583	0.3583	0.3583

69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583		
69	ig	1.125	0.07917	0.3583	0.3583	0.3583

70	p	1.125	0.07917	0.3583		
70	p	1.125	0.07917	0.3583		
70	p	1.125	0.07917	0.3583		
70	p	1.125	0.07917	0.3583	0.3583	0.3583

70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583		
70	ig	1.125	0.07917	0.3583	0.3583	0.3583

71	p	1.125	0.07917	0.3583		
71	p	1.125	0.07917	0.3583		
71	p	1.125	0.07917	0.3583		
71	p	1.125	0.07917	0.3583	0.3583	0.3583

71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583		
71	ig	1.125	0.07917	0.3583	0.3583	0.3583

72	p	0.8414	0.267	0.3124		
72	p	0.9691	-0.08189	0.3493		
72	p	1.229	-0.08949	0.3524		
72	p	1.181	-0.118	0.3552	0.3552	0.3423

72	ig	0.833	-0.1129	0.3208		
72	ig	0.8533	-0.04678	0.3281		

72	ig	1.375	-0.159	0.33		
72	ig	1.334	-0.1768	0.3362		
72	ig	0.9594	0.183	0.3432		
72	ig	0.9897	-0.2185	0.3446		
72	ig	0.9549	-0.1358	0.3452		
72	ig	1.129	0.2178	0.3519		
72	ig	1.023	0.09588	0.3545		
72	ig	1.181	-0.135	0.3546		
72	ig	1.026	-0.03101	0.3561		
72	ig	1.114	-0.01244	0.3594	0.3594	0.3437

73	p	1.181	-0.135	0.3546		
73	p	1.181	-0.118	0.3552		
73	p	1.026	-0.03101	0.3561		
73	p	1.114	-0.01244	0.3594	0.3594	0.3563

73	ig	1.026	-0.135	0.3532		
73	ig	1.026	-0.118	0.3539		
73	ig	1.181	-0.135	0.3546		
73	ig	1.181	-0.118	0.3552		
73	ig	1.026	-0.01244	0.3563		
73	ig	1.114	-0.135	0.3565		
73	ig	1.181	-0.03101	0.3571		
73	ig	1.181	-0.03101	0.3571		
73	ig	1.114	-0.118	0.3572		
73	ig	1.181	-0.01244	0.3572		
73	ig	1.181	-0.01244	0.3572		
73	ig	1.114	-0.03101	0.3593	0.3593	0.3562

74	p	1.181	-0.01244	0.3572		
74	p	1.181	-0.01244	0.3572		
74	p	1.114	-0.03101	0.3593		
74	p	1.114	-0.01244	0.3594	0.3594	0.3583

74	ig	1.181	-0.03101	0.3571		
74	ig	1.181	-0.03101	0.3571		
74	ig	1.181	-0.01244	0.3572		
74	ig	1.181	-0.01244	0.3572		
74	ig	1.181	-0.01244	0.3572		
74	ig	1.181	-0.01244	0.3572		
74	ig	1.114	-0.03101	0.3593		
74	ig	1.114	-0.01244	0.3594		
74	ig	1.114	-0.01244	0.3594		
74	ig	1.114	-0.01244	0.3594		
74	ig	1.114	-0.01244	0.3594		
74	ig	1.114	-0.01244	0.3594	0.3594	0.3583

75	p	1.114	-0.01244	0.3594		
75	p	1.114	-0.01244	0.3594		
75	p	1.114	-0.01244	0.3594		
75	p	1.114	-0.01244	0.3594	0.3594	0.3594

75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		

75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594		
75	ig	1.114	-0.01244	0.3594	0.3594	0.3594

76	p	1.114	-0.01244	0.3594		
76	p	1.114	-0.01244	0.3594		
76	p	1.114	-0.01244	0.3594		
76	p	1.114	-0.01244	0.3594	0.3594	0.3594

76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594		
76	ig	1.114	-0.01244	0.3594	0.3594	0.3594

77	p	1.114	-0.01244	0.3594		
77	p	1.114	-0.01244	0.3594		
77	p	1.114	-0.01244	0.3594		
77	p	1.114	-0.01244	0.3594	0.3594	0.3594

77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594		
77	ig	1.114	-0.01244	0.3594	0.3594	0.3594

78	p	1.114	-0.01244	0.3594		
78	p	1.114	-0.01244	0.3594		
78	p	1.114	-0.01244	0.3594		
78	p	1.114	-0.01244	0.3594	0.3594	0.3594

78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594		
78	ig	1.114	-0.01244	0.3594	0.3594	0.3594

79	p	1.114	-0.01244	0.3594		

79	p	1.114	-0.01244	0.3594		
79	p	1.114	-0.01244	0.3594		
79	p	1.114	-0.01244	0.3594	0.3594	0.3594

79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594		
79	ig	1.114	-0.01244	0.3594	0.3594	0.3594

80	p	1.114	-0.01244	0.3594		
80	p	1.114	-0.01244	0.3594		
80	p	1.114	-0.01244	0.3594		
80	p	1.114	-0.01244	0.3594	0.3594	0.3594

80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594		
80	ig	1.114	-0.01244	0.3594	0.3594	0.3594

81	p	1.329	-0.2285	0.3345		
81	p	0.9956	-0.2684	0.3412		
81	p	1.296	0.01628	0.3457		
81	p	1.016	0.147	0.3518	0.3518	0.3433

81	ig	0.8289	0.1804	0.316		
81	ig	0.8173	0.06417	0.3181		
81	ig	0.9072	0.09116	0.3389		
81	ig	0.9131	0.05738	0.3409		
81	ig	0.9269	0.107	0.3419		
81	ig	1.208	0.2332	0.3477		
81	ig	1.261	-0.1137	0.3485		
81	ig	0.9701	-0.03846	0.3503		
81	ig	0.9886	-0.08807	0.3514		
81	ig	1.198	-0.1319	0.3537		
81	ig	1.124	0.09032	0.358		
81	ig	1.094	-0.003841	0.3593	0.3593	0.3437

82	p	1.016	0.147	0.3518		
82	p	1.198	-0.1319	0.3537		
82	p	1.124	0.09032	0.358		
82	p	1.094	-0.003841	0.3593	0.3593	0.3557

82	ig	1.016	-0.1319	0.3525		
82	ig	1.198	0.147	0.3531		

82	ig	1.016	0.09032	0.3541			
82	ig	1.198	0.09032	0.355			
82	ig	1.016	-0.003841	0.3555			
82	ig	1.094	0.147	0.3558			
82	ig	1.124	0.147	0.3559			
82	ig	1.198	-0.003841	0.3562			
82	ig	1.094	-0.1319	0.3565			
82	ig	1.124	-0.1319	0.3566			
82	ig	1.094	0.09032	0.358			
82	ig	1.124	-0.003841	0.3593	0.3593	0.3557	

83	p	1.094	0.09032	0.358			
83	p	1.124	0.09032	0.358			
83	p	1.094	-0.003841	0.3593			
83	p	1.124	-0.003841	0.3593	0.3593	0.3587	

83	ig	1.094	0.09032	0.358			
83	ig	1.094	0.09032	0.358			
83	ig	1.094	0.09032	0.358			
83	ig	1.124	0.09032	0.358			
83	ig	1.124	0.09032	0.358			
83	ig	1.124	0.09032	0.358			
83	ig	1.094	-0.003841	0.3593			
83	ig	1.094	-0.003841	0.3593			
83	ig	1.094	-0.003841	0.3593			
83	ig	1.124	-0.003841	0.3593			
83	ig	1.124	-0.003841	0.3593			
83	ig	1.124	-0.003841	0.3593	0.3593	0.3587	

84	p	1.124	-0.003841	0.3593			
84	p	1.124	-0.003841	0.3593			
84	p	1.124	-0.003841	0.3593			
84	p	1.124	-0.003841	0.3593	0.3593	0.3593	

84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593			
84	ig	1.124	-0.003841	0.3593	0.3593	0.3593	

85	p	1.124	-0.003841	0.3593			
85	p	1.124	-0.003841	0.3593			
85	p	1.124	-0.003841	0.3593			
85	p	1.124	-0.003841	0.3593	0.3593	0.3593	

85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			
85	ig	1.124	-0.003841	0.3593			

85	ig	1.124	-0.003841	0.3593		
85	ig	1.124	-0.003841	0.3593		
85	ig	1.124	-0.003841	0.3593	0.3593	0.3593

86	p	1.124	-0.003841	0.3593		
86	p	1.124	-0.003841	0.3593		
86	p	1.124	-0.003841	0.3593		
86	p	1.124	-0.003841	0.3593	0.3593	0.3593

86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593		
86	ig	1.124	-0.003841	0.3593	0.3593	0.3593

87	p	1.124	-0.003841	0.3593		
87	p	1.124	-0.003841	0.3593		
87	p	1.124	-0.003841	0.3593		
87	p	1.124	-0.003841	0.3593	0.3593	0.3593

87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593		
87	ig	1.124	-0.003841	0.3593	0.3593	0.3593

88	p	1.124	-0.003841	0.3593		
88	p	1.124	-0.003841	0.3593		
88	p	1.124	-0.003841	0.3593		
88	p	1.124	-0.003841	0.3593	0.3593	0.3593

88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593		
88	ig	1.124	-0.003841	0.3593	0.3593	0.3593

89	p	1.124	-0.003841	0.3593		

89	p	1.124	-0.003841	0.3593		
89	p	1.124	-0.003841	0.3593		
89	p	1.124	-0.003841	0.3593	0.3593	0.3593

89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593	0.3593	0.3593

90	p	1.124	-0.003841	0.3593		
90	p	1.124	-0.003841	0.3593		
90	p	1.124	-0.003841	0.3593		
90	p	1.124	-0.003841	0.3593	0.3593	0.3593

90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593	0.3593	0.3593

91	p	1.124	-0.003841	0.3593		
91	p	1.124	-0.003841	0.3593		
91	p	1.124	-0.003841	0.3593		
91	p	1.124	-0.003841	0.3593	0.3593	0.3593

91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593	0.3593	0.3593

92	p	1.397	0.1751	0.3254		
92	p	1.383	0.06953	0.3307		
92	p	1.179	-0.2905	0.3452		
92	p	0.9736	-0.03464	0.3508	0.3508	0.338

92	ig	1.416	-0.08996	0.3241		
92	ig	1.385	-0.2114	0.326		

92	ig	0.8539	0.06848	0.3278		
92	ig	1.34	0.2622	0.3308		
92	ig	1.328	-0.2039	0.3359		
92	ig	1.296	0.1955	0.3408		
92	ig	0.9441	-0.107	0.3448		
92	ig	1.236	-0.223	0.3461		
92	ig	0.9681	0.1196	0.3478		
92	ig	1.262	-0.07811	0.3492		
92	ig	1.105	-0.1809	0.3542		
92	ig	1.181	-0.09039	0.3561	0.3561	0.3403

93	p	1.262	-0.07811	0.3492		
93	p	0.9736	-0.03464	0.3508		
93	p	1.105	-0.1809	0.3542		
93	p	1.181	-0.09039	0.3561	0.3561	0.3526

93	ig	0.9736	-0.1809	0.3452		
93	ig	1.262	-0.1809	0.3457		
93	ig	1.262	-0.09039	0.3489		
93	ig	0.9736	-0.09039	0.3496		
93	ig	1.262	-0.03464	0.3499		
93	ig	0.9736	-0.07811	0.3499		
93	ig	1.181	-0.1809	0.3525		
93	ig	1.181	-0.07811	0.3564		
93	ig	1.181	-0.03464	0.3571		
93	ig	1.105	-0.09039	0.3581		
93	ig	1.105	-0.07811	0.3584		
93	ig	1.105	-0.03464	0.3592	0.3592	0.3526

94	p	1.181	-0.03464	0.3571		
94	p	1.105	-0.09039	0.3581		
94	p	1.105	-0.07811	0.3584		
94	p	1.105	-0.03464	0.3592	0.3592	0.3582

94	ig	1.181	-0.09039	0.3561		
94	ig	1.181	-0.07811	0.3564		
94	ig	1.181	-0.03464	0.3571		
94	ig	1.105	-0.09039	0.3581		
94	ig	1.105	-0.09039	0.3581		
94	ig	1.105	-0.07811	0.3584		
94	ig	1.105	-0.07811	0.3584		
94	ig	1.105	-0.03464	0.3592		
94	ig	1.105	-0.03464	0.3592		
94	ig	1.105	-0.03464	0.3592		
94	ig	1.105	-0.03464	0.3592		
94	ig	1.105	-0.03464	0.3592	0.3592	0.3582

95	p	1.105	-0.03464	0.3592		
95	p	1.105	-0.03464	0.3592		
95	p	1.105	-0.03464	0.3592		
95	p	1.105	-0.03464	0.3592	0.3592	0.3592

95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		

95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592		
95	ig	1.105	-0.03464	0.3592	0.3592	0.3592

96	p	1.105	-0.03464	0.3592		
96	p	1.105	-0.03464	0.3592		
96	p	1.105	-0.03464	0.3592		
96	p	1.105	-0.03464	0.3592	0.3592	0.3592

96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592		
96	ig	1.105	-0.03464	0.3592	0.3592	0.3592

97	p	1.105	-0.03464	0.3592		
97	p	1.105	-0.03464	0.3592		
97	p	1.105	-0.03464	0.3592		
97	p	1.105	-0.03464	0.3592	0.3592	0.3592

97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592	0.3592	0.3592

98	p	1.105	-0.03464	0.3592		
98	p	1.105	-0.03464	0.3592		
98	p	1.105	-0.03464	0.3592		
98	p	1.105	-0.03464	0.3592	0.3592	0.3592

98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592	0.3592	0.3592

99	p	1.105	-0.03464	0.3592		

```
|  99        | p      | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | p      | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | p      | 1.105        | -0.03464    | 0.3592       | 0.3592       | 0.3592       |
 -----------------------------------------------------------------------------------------
 -----------------------------------------------------------------------------------------
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       |              |              |
|  99        | ig     | 1.105        | -0.03464    | 0.3592       | 0.3592       | 0.3592       |
 -----------------------------------------------------------------------------------------

 -----------------------------------------------------------------------------------------
|  100       | result | 1.105        | -0.03464    | 0.3592       |              |              |
|  100       | result | 1.105        | -0.03464    | 0.3592       |              |              |
|  100       | result | 1.105        | -0.03464    | 0.3592       |              |              |
|  100       | result | 1.105        | -0.03464    | 0.3592       | 0.3592       | 0.3592       |
 -----------------------------------------------------------------------------------------
Значение префиксов:
        1) p – parent
        2) ig – intermediate generation
        3) result – результат
```

Код программы приведён в Приложении.

Ссылка на репозиторий github: https://github.com/DarthBarada/TSISA_RK3

3. Графическая часть

1) *Для 10 поколений*

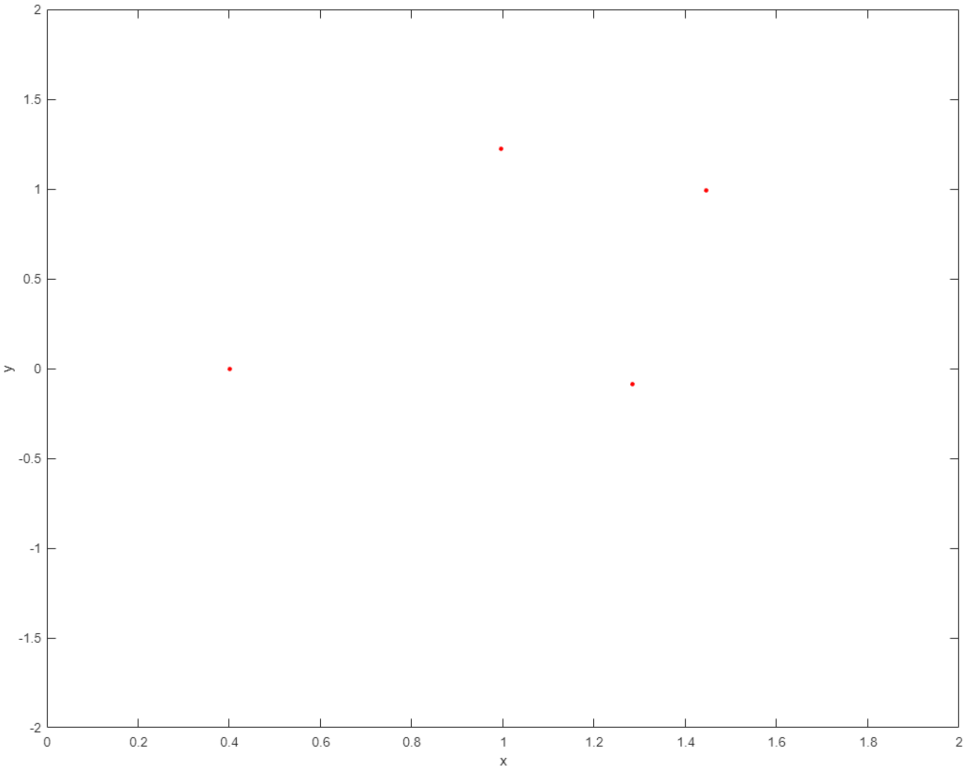

Рисунок 1 – поколение 0

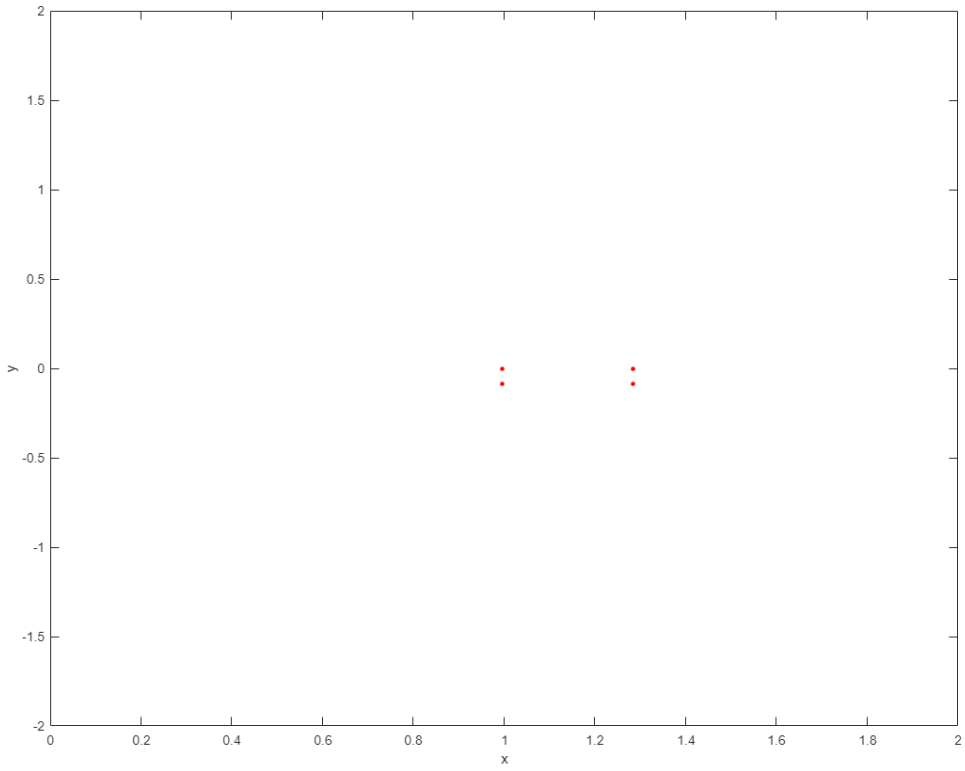

Рисунок 2 – поколение 1

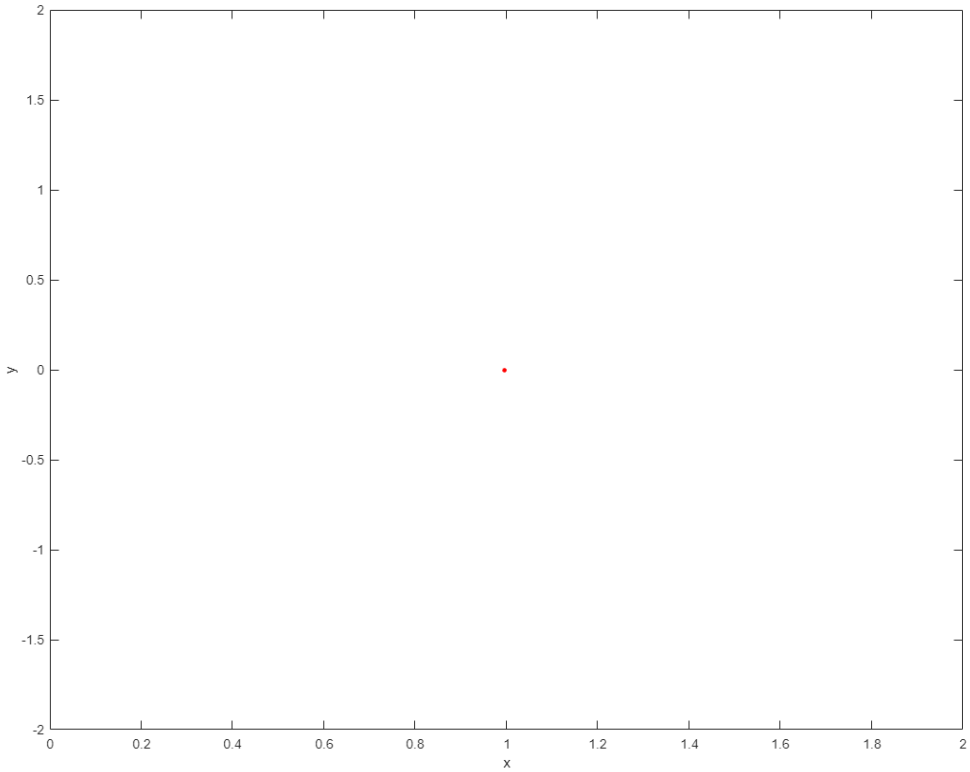

Рисунок 3 - поколения 2-10

2) Для 100 поколений

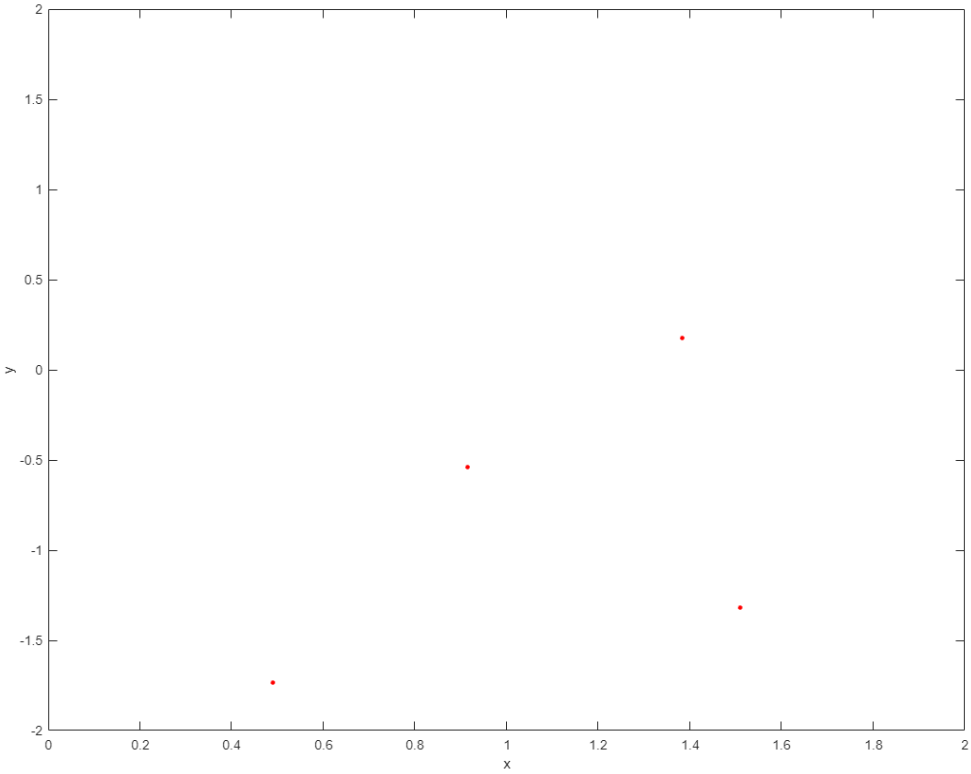

Рисунок 4 – поколение №0

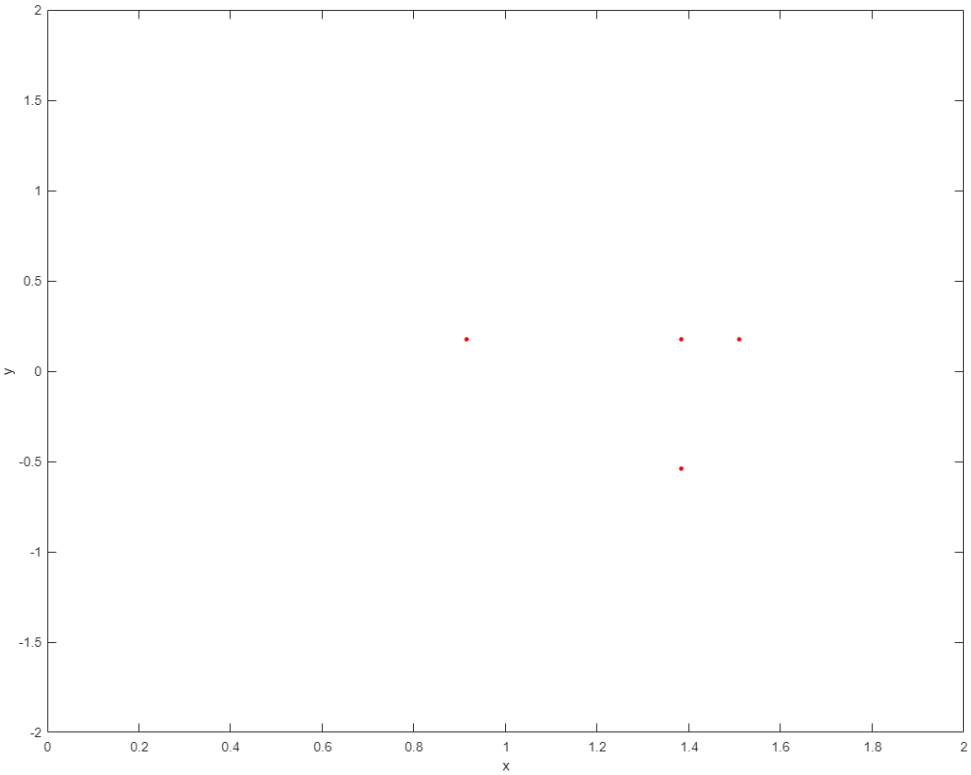

Рисунок 5 - поколение №1

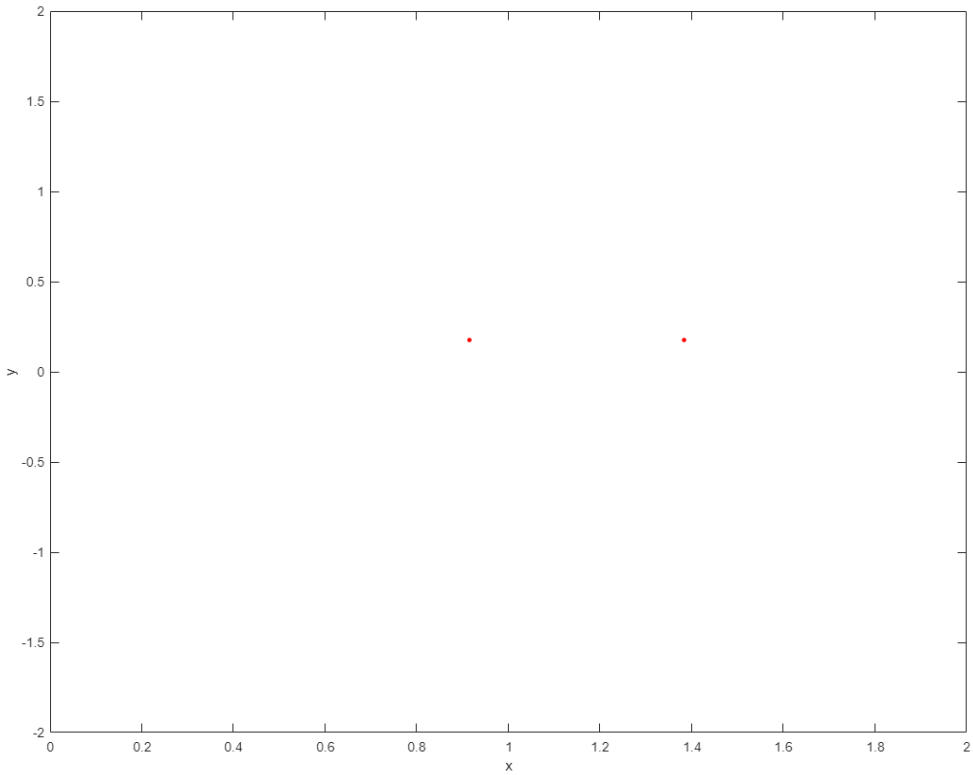

Рисунок 6 - поколение №2

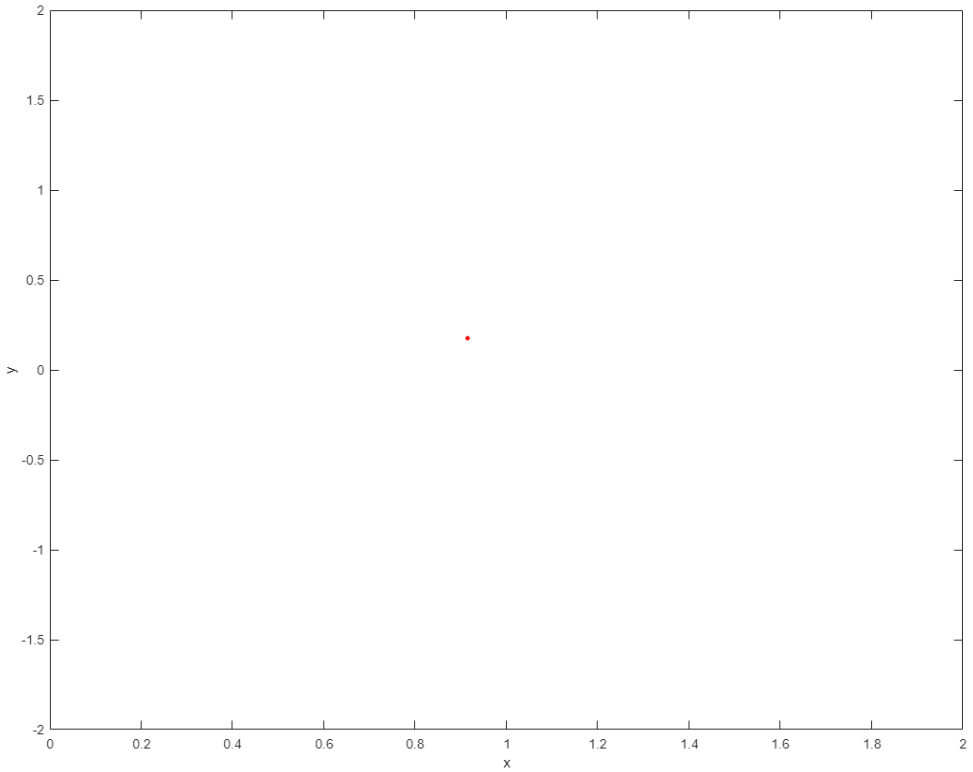

Рисунок 7 поколения №3-11

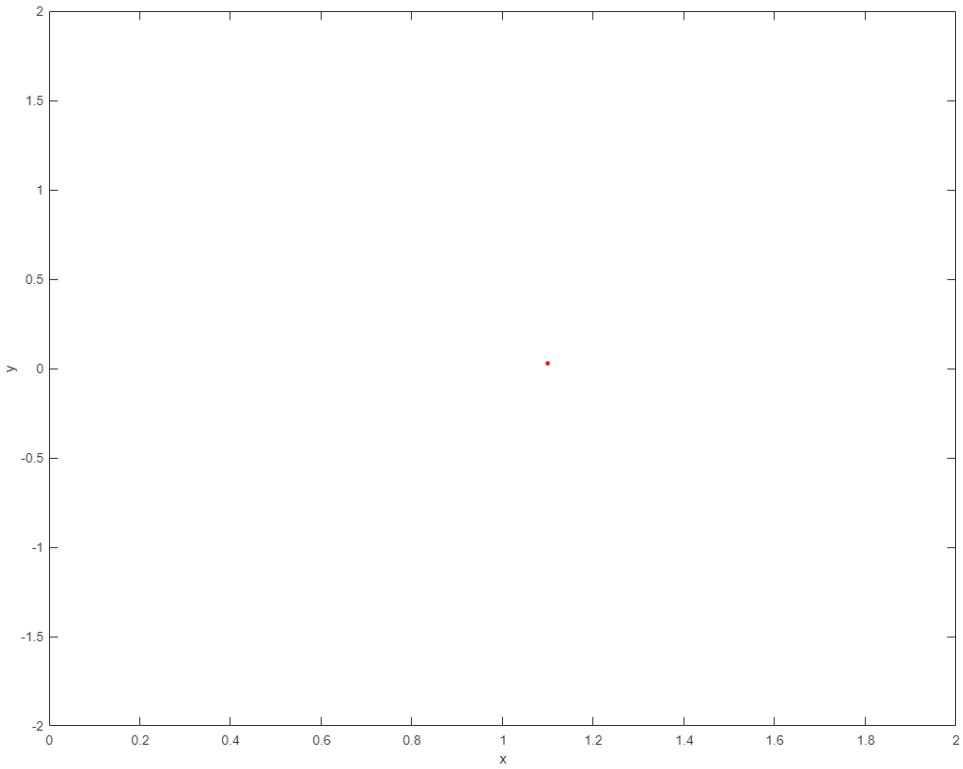

Рисунок 8 - поколение №15

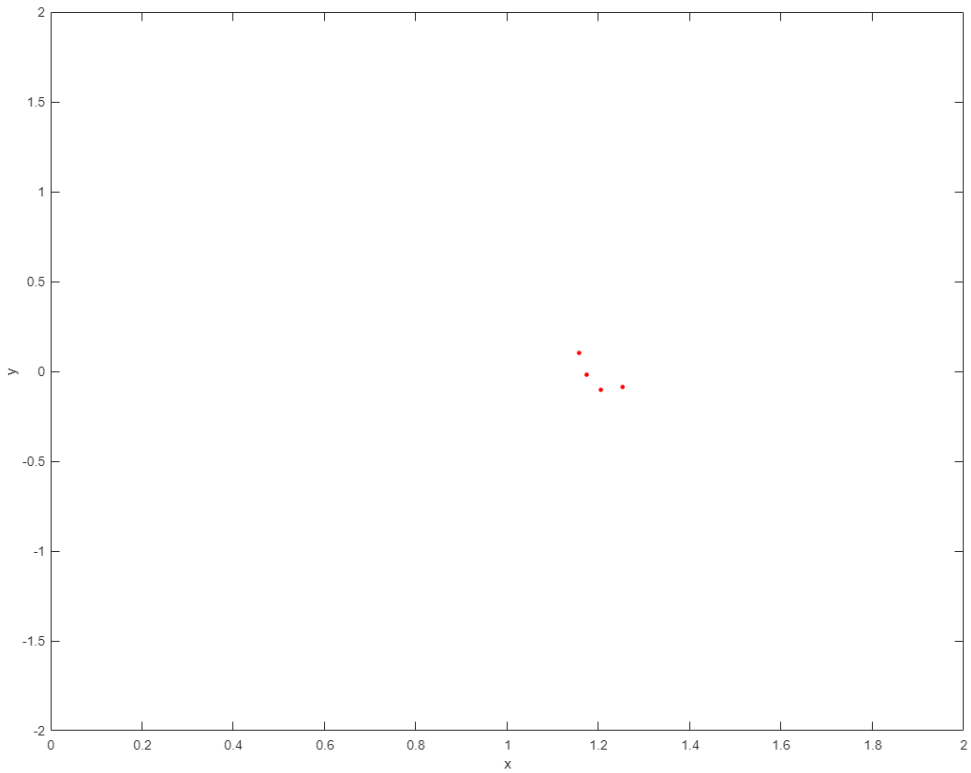

Рисунок 9 - поколение №31

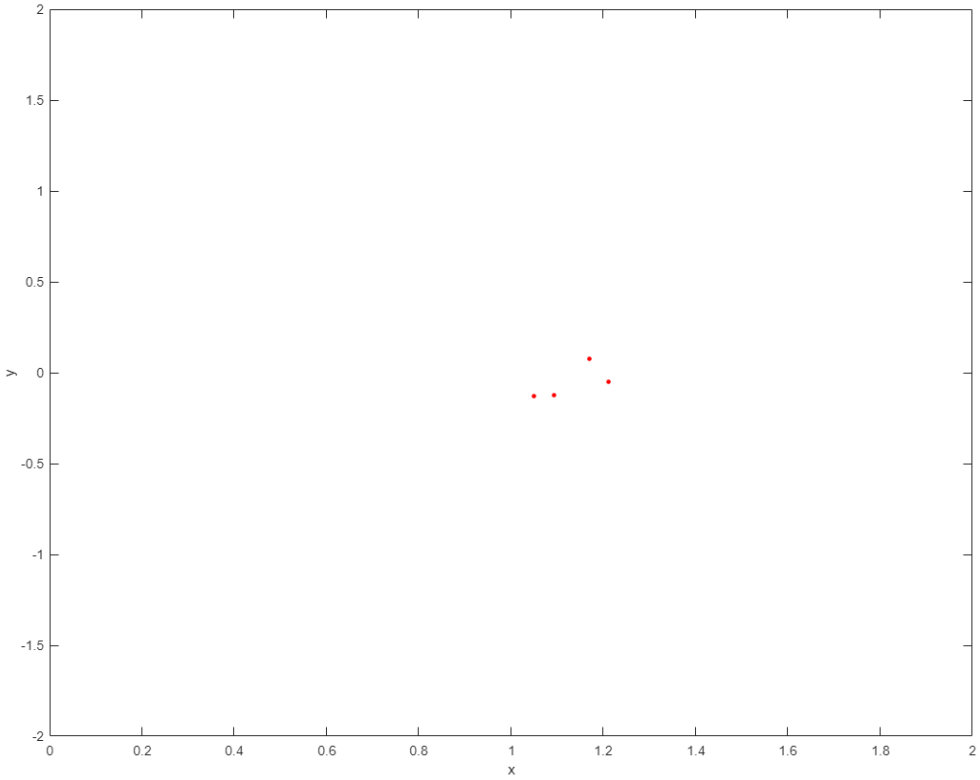

Рисунок 10 - поколение №52

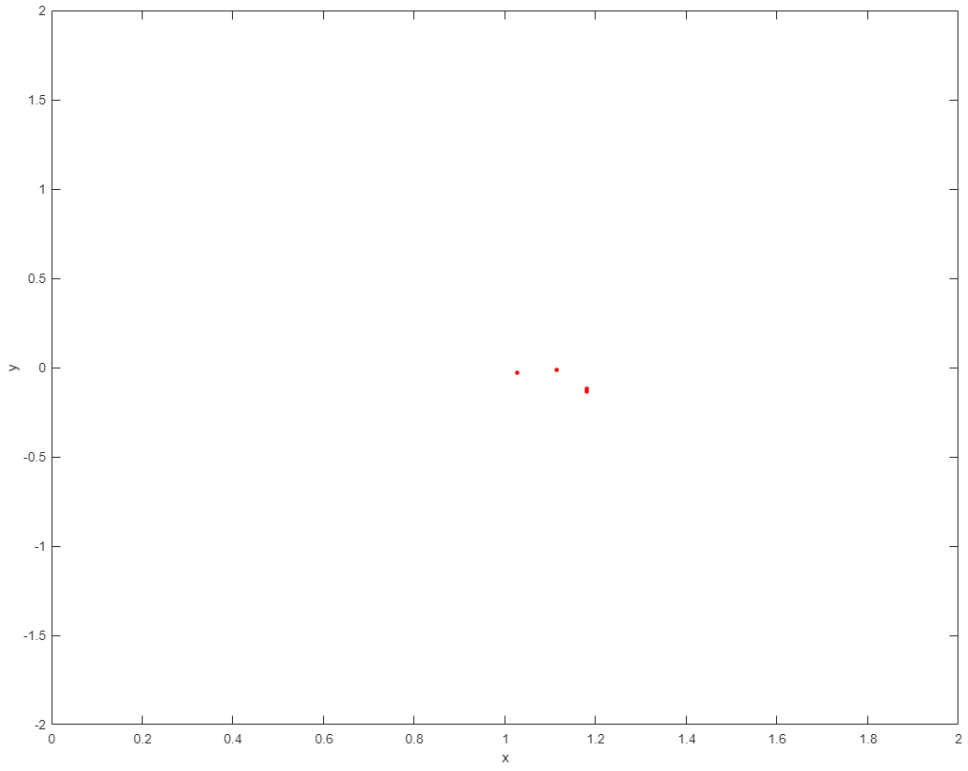

Рисунок 11 - поколение №73

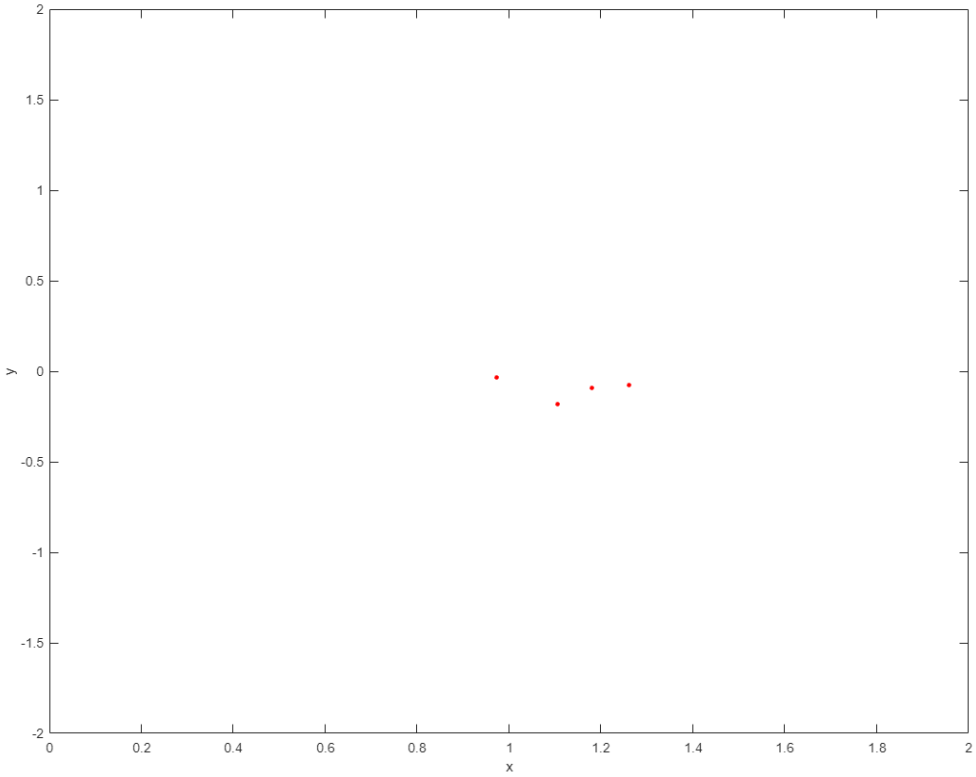

Рисунок 12 - поколение №93

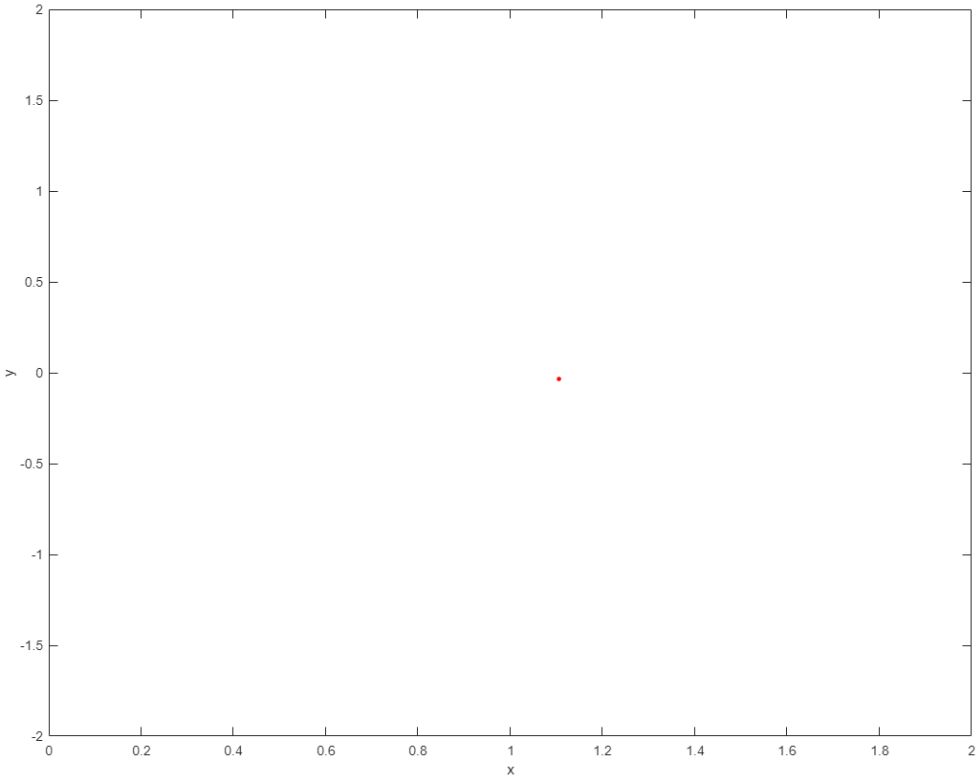

Рисунок 13 - поколение №100

4. Выводы

В процессе выполнения рубежного контроля я изучил метод поиска экстремума функции с помощью генетического алгоритма. В ходе работы мною был использован

алгоритм генерации промежуточной популяции, опирающийся на генетику, рулеточной селекции и мутации, в основе которой лежит случайное изменение генов. Значения полученные в ходе выполнения программы совпадают с графическими, что говорит о корректном ходе её работы.

Приложение

Файл main.cpp

```
#include "GeneticAlg.h"

using namespace std;

int main()
	{
		std::cout<<"\t\t\t\t10 generations:\n\n";
		GeneticAlgorithm A(10);
		A.pass();
		std::cout<<"\n\t\t\t\t100 generations:\n\n";
		GeneticAlgorithm B(100);
		B.pass();
		system("pause");
		return 0;
	}
```

Файл GeneticAlg.h

```
#pragma once
#include <map>
#include <random>
#include <iostream>
#include <iomanip>
#include <string>

struct point
	{
		double x; // Координата x
		double y; // Координата y
		double z; // Координата z

		point()
			{
				x = 0.0;
				y = 0.0;
				z = 0.0;
			}
		point(double xval,double yval,double zval = 0.0)
			{
				x = xval;y = yval;z=zval;
			}
		bool operator!=( point point_2 )
			{
				if ((x != point_2.x) && (y != point_2.y))
					{
						return true;
					}
				return false;
			}
		bool operator==( point point_2 )
			{
				if ((x == point_2.x) && (y == point_2.y))
					{
						return true;
```

```
                                }
                        return false;
                }
        };

struct borders
        {
                double a;       // Нижняя граница
                double b;       // Верхняя граница

                borders()
                        {
                                a = 0.0;
                                b = 0.0;
                        }
                borders(double a2,double b2)
                        {
                                a=a2;
                                b=b2;
                        }
        };

class GeneticAlgorithm
        {
                protected:
                /**
                *       Область поиска для координат x и y
                */
                std::pair<borders,borders> border{{0.0,2.0},{-2.0,2.0}};
                /**
                *       Родители
                */
                std::multimap<double,point> parents;
                /**
                *       Промежуточная популяция
                */
                std::multimap<double,point> intermidiate_generation;
                /**
                *       Максимальное количество поколений
                */
                size_t max_generations;

                public:

                GeneticAlgorithm(size_t generations = 100u,std::pair<borders,borders>
input_border = {{0.0,2.0},{-2.0,2.0}})
                        {
                                max_generations = generations;
                                border = input_border;
                        }
                /**
                * @brief Функция используется для полного прохождения генетического алгоритма
                *
                */
                void pass();
                /**
                * @brief Функция используется для создания 0 генерации
                *
                * @param[in] count_of_parents Количество родителей
                *
                */
                void init_gen(size_t count_of_parents = 4u);
                /**
                * @brief Функция, описывающая селекцию
```

```
		*
		*/
		void selection();

		/**
		* @brief Функция, описывающая мутацию
		*
		*/
		void mutation();

		/**
		* @brief Функция, описывающая селекцию
		*
		*/
		void reduction();

		/**
		* @brief Функция для печати multimap
		*
		* @param[in] multimap Контейнер std::multimap<double,point>
		* @param[in] prefix Префикс перед строкой
		* @param[in] up_border Рисует границу сверху и снизу, если значение true
		*
		*/
		void print(size_t genereation, std::multimap<double,point> multimap,
std::string prefix = "", bool border = true);
	};
```

Файл GeneticAlg.cpp

```
	#include"GeneticAlg.h"
#include "Function.h"
#include <iterator>
#include <algorithm>

std::random_device rd;
std::mt19937 gen(rd());

void draw_hat()
	{

	std::cout<<std::left<<std::setprecision(4)<<"|"<<std::setw(9)<<"genereation"<<"|"<<st
d::setw(6)<<"prefix"<<" | "<<std::setw(10)<<"X"<<" | "<<std::setw(10)<<"Y"<<" |
"<<std::setw(10)<<"FIT"<<" |"<<std::setw(10)<<"max element"<<" |
"<<std::setw(9)<<"average"<<" |\n";
	}

void GeneticAlgorithm::init_gen(size_t count_of_parents)
	{
		std::uniform_real_distribution<double> x_border
(border.first.a,border.first.b);
		std::uniform_real_distribution<double> y_border
(border.second.a,border.second.b);

		parents.clear();

		point temp_point;

		for (size_t count = 0u;count < count_of_parents;++count)
			{
				temp_point.x = x_border(gen);
				temp_point.y = y_border(gen);
				temp_point.z = F(temp_point.x,temp_point.y);
```

```
                        parents.insert({temp_point.z,temp_point});
                }
        }

void GeneticAlgorithm::selection()
        {
                intermidiate_generation.clear();

                point temp_point;

                for(auto index = parents.begin();index != parents.end();++index)
                        {
                                /*
                                        Так как потомок может иметь что-то от каждого из
радителей, то я сделал следующее:
                                        у 2 родителей могут быть 2 потомка с координитами
(x1,y2,f(x1,y2)) и (x2,y1,f(x2,y1)),
                                        где (x1,y1) - координаты 1 родителя, (x2,y2) - координаты
2 родителя.
                                */
                                for(auto index_2 = std::next(index);index_2 !=
parents.end();++index_2)
                                        {
                                                // 1)
                                                temp_point.x = index->second.x;
                                                temp_point.y = index_2->second.y;
                                                temp_point.z = F(temp_point.x,temp_point.y);


        intermidiate_generation.insert({temp_point.z,temp_point});
                                                // 2)
                                                temp_point.x = index_2->second.x;
                                                temp_point.y = index->second.y;
                                                temp_point.z = F(temp_point.x,temp_point.y);


        intermidiate_generation.insert({temp_point.z,temp_point});
                                        }
                        }
        }

void GeneticAlgorithm::reduction()
        {
                for (auto temp : intermidiate_generation)
                        {
                                parents.insert(temp);
                        }
                intermidiate_generation.clear();

                size_t temp = parents.size() - 4;
                for (size_t index = 0u;index < temp;++index)
                        {
                                parents.erase(parents.begin());
                        }
                std::cout<<"";
        }

void GeneticAlgorithm::mutation()
        {
                /*
                        Заметка:
                        Мутация в данной реализации генного алгоритма выглядит следующим
образом:
```

```
                берется координата точки x и рандомно сдвигается и также с y
координатой.
                */
                std::uniform_real_distribution<double> delta(-0.3,0.3);

                std::multimap<double, point> temp_multimap;

                for (auto parent = parents.begin();parent != parents.end();++parent)
                        {
                                parent->second.x += delta(gen);
                                parent->second.y += delta(gen);

                                if (parent->second.x < border.first.a)
                                        {
                                                parent->second.x = border.first.a;
                                        }
                                else if (parent->second.x > border.first.b)
                                        {
                                                parent->second.x = border.first.b;
                                        }
                                if (parent->second.y < border.second.a)
                                        {
                                                parent->second.y = border.second.a;
                                        }
                                else if (parent->second.y > border.second.b)
                                        {
                                                parent->second.y = border.second.b;
                                        }
                                parent->second.z = F(parent->second.x,parent->second.y);
                                temp_multimap.insert({parent->second.z,parent->second});
                        }
                parents = temp_multimap;
                temp_multimap.clear();

                for (auto child = intermidiate_generation.begin();child !=
intermidiate_generation.end();++child)
                        {
                                child->second.x += delta(gen);
                                child->second.y += delta(gen);
                                if (child->second.x < border.first.a)
                                        {
                                                child->second.x = border.first.a;
                                        }
                                else if (child->second.x > border.first.b)
                                        {
                                                child->second.x = border.first.b;
                                        }
                                if (child->second.y < border.second.a)
                                        {
                                                child->second.y = border.second.a;
                                        }
                                else if (child->second.y > border.second.b)
                                        {
                                                child->second.y = border.second.b;
                                        }
                                child->second.z = F(child->second.x,child->second.y);
                                temp_multimap.insert({child->second.z,child->second});
                        }
                intermidiate_generation = temp_multimap;
                temp_multimap.clear();
        }

void GeneticAlgorithm::pass()
        {
```

```
		double P = 0.0;
		std::uniform_real_distribution<double> Probability(0.0,0.1);

		draw_hat();
		init_gen();
		print(0u,parents,"p");
		selection();
		reduction();
		std::cout<<"\n";

		for (size_t iteration = 1u;iteration <= max_generations - 1u ;++iteration)
			{
				P += Probability(gen);
				// std::cout<<P<<"\n"; // Debug
				selection();
				if (P > 0.5)
					{
						mutation();
						P = 0.0;
					}
				print(iteration, parents,"p");
				print(iteration, intermidiate_generation, "ig",true);
				reduction();
				std::cout<<"\n";
			}
		print(max_generations,parents,"result");
	}

void GeneticAlgorithm::print(size_t genereation,std::multimap<double,point> multimap,
std::string prefix,bool border)
	{
		if (border)
			{
				std::cout<<" ";
				for (int index = 1;index < 85;++index)
					{
						std::cout<<"-";
					}
				std::cout<<"\n";
			}

		double average = 0.0;

		for (auto tochka: multimap)
			{
				average +=tochka.second.z;
			}

		average=average/multimap.size();

		auto max_element = std::max_element(multimap.begin(),multimap.end(),

[](std::pair<double,point> var1,std::pair<double,point> var2)
{

	return var1.first < var2.first;
}
		);

		for (auto tochka = multimap.begin();tochka != multimap.end();++tochka)
			{
				std::cout<<std::left<<std::setprecision(4)<<"|
"<<std::setw(9)<<genereation<<"|"<<std::setw(6)<<' '+prefix<<" | "<<std::setw(10)<<tochka-
>second.x<<" | "<<std::setw(10)<<tochka->second.y<<" | "<<std::setw(10)<<tochka->second.z;
```

```
                        if (tochka == std::prev(multimap.end()))
                                {
                                        std::cout<<" | "<<std::setw(10)<<max_element-
>first<<" | "<<std::setw(10)<<average<<" |";
                                }
                        else
                                {
                                        std::cout<<" | "<<std::setw(10)<<"          "<<" |
"<<std::setw(10)<<"          "<<" |";
                                }
                        std::cout<<"\n";
                }

            if (border)
                {
                        std::cout<<" ";
                        for (int index = 1;index < 85;++index)
                                {
                                        std::cout<<"-";
                                }
                        std::cout<<"\n";
                }
        }
```