

Министерство науки и высшего образования Российской Федерации Федеральное государственное бюджетное образовательное учреждение высшего образования

«Московский государственный технический университет имени Н.Э. Баумана

(национальный исследовательский университет)» (МГТУ им. Н.Э. Баумана)

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

Выполнил: Митрофанов Д.А., студент группы ИУ8-33

Проверил: Коннова Н. С., доцент каф. ИУ8

г. Москва, 2019 г.

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. B качестве потомков следует выбирать результат скрещивания лучшего решения со вторым и третьим в порядке убывания значений функции приспособленности с последующей случайной мутацией обоих генов. B качестве критерия остановки эволюционного процесса задаться номером конечной популяции ($N\sim10^1...10^2$). Визуализировать результаты расчетов.

1.3. Условие варианта

Вид функции f(x,y)	${f O}$ бласть 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 p 0 p	0.4018 0.9958 1.445 1.283	5 1.223 0.9934	0.1317 0.2019 0.2416 0.3465	 0.3465	 0.2304	-
1	1.283 1.283 0.9955 0.9955	-0.0001607 -0.08465	0.3465 0.3474 0.3523 0.3536	 0.3536	 0.3499	-
1 ig	1.283 1.283 1.283 1.283 1.283 1.283 0.995 0.995 0.995 0.995	-0.08465 -0.08465 -0.0001607 -0.0001607 -0.0001607 5 -0.08465 5 -0.08465 5 -0.08465 5 -0.0001607 5 -0.0001607	0.3465 0.3465 0.3465 0.3474 0.3474 0.3474 0.3523 0.3523 0.3523 0.3523 0.3536	 	 0.3499	-
2	0.995 0.995 0.995	5 -0.0001607 5 -0.0001607	0.3536 0.3536 0.3536 0.3536	 0.3536		-

2		 0.9955	-0.0001607			
2	ig ig	0.9955	-0.0001607	•	I I	I I
	_		· ·			
2	ig	0.9955	-0.0001607		I	1
2	ig	0.9955	-0.0001607	•	Į.	
2	ig	0.9955	-0.0001607		Į.	
2	ig	0.9955	-0.0001607	•	I	I .
2	ig	0.9955	-0.0001607		Į.	Į.
2	ig	0.9955	-0.0001607	•	1	
2	ig	0.9955	1 0.000 = 007	0.3536	1	
2	ig	0.9955	-0.0001607	•		
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	l p	0.9955	-0.0001607			
3	l 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			
3	ig	0.9955	-0.0001607	•	1	
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	1	
3	ig	0.9955	-0.0001607	0.3536		
3	ig	0.9955	-0.0001607	0.3536	1	
3				. 0 2526	1	I
3	ig	0.9955	-0.0001607	0.3536	Į.	I
3	ig ig 	0.9955 0.9955	-0.0001607	0.3536	0.3536	0.3536
	ig p p p	0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536	 	
3 	ig p p	0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536	0.3536	0.3536
3 4 4 4 4 4	ig	0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536	 	
3 	ig	0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536 0.3536	 	
3 	ig p p p p p	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536 0.3536	 	
3 	ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536	 	
3 	ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536	 	
3 	ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607 -0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536 0.3536	 	
3 	ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	 	
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	 	
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	 	
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	 	
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	 	
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	 	
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536
3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 5 5 5 5 5 5	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536 0.3536 0.3536
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536 0.3536 0.3536
3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 5 5 5 5 5	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536 0.3536 0.3536
3	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536 0.3536 0.3536
3 	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536 0.3536 0.3536
3 4 4 4 4 4 4 4 4 4 4 4 4 4	ig	0.9955 0.9955	-0.0001607 -0.0001607	0.3536 0.3536	0.3536	 0.3536 0.3536 0.3536

5 5 5 5 5 5	ig ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536	 0.3536	
6 6 6 6	l p	0.9955 0.9955 0.9955 0.9955	-0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536	 0.3536	 0.3536
6 6 6 6 6 6 6 6 6	ig ig ig ig ig ig ig ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 0.3536 -0.0001607 0.3536	 0.3536	
7 7 7 7	p	0.9955 0.9955 0.9955 0.9955	-0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536	 0.3536	
7 7 7 7 7 7 7 7 7	ig ig ig ig ig ig ig ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 0.3536 -0.0001607 0.3536	 0.3536	
8 8 8 8	p	0.9955 0.9955 0.9955 0.9955	-0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536 -0.0001607 0.3536	 0.3536	
8 8 8 8 8 8 8 8 8	ig ig ig ig ig ig ig ig	0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955 0.9955	-0.0001607 0.3536 -0.0001607 0.3536	 	

9 9 9 9	p	9955 -0 9955 -0	0.0001607	0.3536 0.3536 0.3536 0.3536	 0.3536	 		
9 9 9 9 9 9	ig	9955 -0 9955 -0 9955 -0 9955 -0 9955 -0	0.0001607 0.0001607 0.0001607 0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536 0.3536	 			
9 9 9 9 9	ig	9955 -0 9955 -0 9955 -0 9955 -0	0.0001607 0.0001607 0.0001607	0.3536 0.3536 0.3536 0.3536 0.3536 0.3536	0.3536	0.3536		
10 10 10 10	result 0 result 0 result 0 result 0	.9955 -	0.0001607 0.0001607 0.0001607 0.0001607	0.3536 0.3536 0.3536 0.3536	 0.3536	 0.3536		
	100 generations:							
genereatio	on prefix X	Y	1	FIT	max element	average		
0 0 0 0	p	51 -1 9145 -0	.732 .321	0.05218 0.1983 0.2953 0.3276	0.3276	0.2183		
0 0	p	51 -1 9145 -0 384 0. 51 0.	732 321 5381 178 5381 178 5381	0.05218 0.1983 0.2953 0.3276 	0.3276	 		
0 0 0 0 1 1 1	p	51	178 178	0.05218 0.1983 0.2953 0.3276 	0.3276	0.2183		

2 2 2 2 2 2 2 2 2	ig ig ig ig ig ig ig	1.384 0.9145 0.9145 0.9145 0.9145 0.9145 0.9145 0.9145 0.9145	0.178 0.178 0.178 0.178 0.178 0.178 0.178 0.178 0.178 0.178	0.3276 0.336 0.336 0.336 0.336 0.336 0.336 0.336 0.336	 0.336	0.3339	
3 3 3 3	p p p	0.9145 0.9145 0.9145 0.9145	0.178 0.178 0.178 0.178	0.336 0.336 0.336 0.336	 0.336	 0.336	
3 3 3 3 3 3 3 3 3 3	ig ig ig ig ig ig ig ig	0.9145 0.9145	0.178 0.178	0.336 0.336	 		
4 4 4 4	p p p	0.9145 0.9145 0.9145 0.9145	0.178 0.178 0.178 0.178	0.336 0.336 0.336 0.336	 0.336	 0.336	
4 4 4 4 4 4 4 4 4 4	ig ig ig ig ig ig ig ig	0.9145 0.9145	0.178 0.178	0.336 0.336 0.336 0.336 0.336 0.336 0.336 0.336 0.336 0.336	 0.336	0.336	
5 5 5 5	p p p	0.9145 0.9145 0.9145 0.9145	0.178 0.178 0.178 0.178	0.336 0.336 0.336 0.336	 0.336	 0.336	
5 5 5 5 5 5 5	ig ig ig ig ig ig ig	0.9145 0.9145 0.9145 0.9145 0.9145 0.9145 0.9145 0.9145 0.9145	0.178 0.178 0.178 0.178 0.178 0.178 0.178 0.178 0.178	0.336 0.336 0.336 0.336 0.336 0.336 0.336 0.336			

5	ig	0.9145	0.178	0.336		
5	ig	0.9145	0.178	0.336	1 0 226	1 0 226
5	ig	0.9145	0.178	0.336	0.336	0.336
6	l p	0.9145	0.178	0.336		
6	l p	0.9145	0.178	0.336		l .
6	l p	0.9145	0.178	0.336		
6	l p	0.9145	0.178	0.336	0.336	0.336
6	ig	0.9145	0.178	0.336	1	
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		1
6	ig	0.9145	0.178	0.336		1
6	ig	0.9145	0.178	0.336	i	i
6	l ig	0.9145	0.178	0.336	i	i
6	ig	0.9145	0.178	0.336	i	i
6	ig	0.9145	0.178	0.336	0.336	0.336
7	·					
7	l p	0.9145	0.178	0.336	!	I .
7	l p	0.9145	0.178	0.336		l
7	l p	0.9145	0.178	0.336		
7	l 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	İ	i
7	ig	0.9145	0.178	0.336	i	i
7	ig	0.9145	0.178	0.336	i	i
7	ig	0.9145	0.178	0.336		i
7	ig	0.9145	0.178	0.336		i
7	ig	0.9145	0.178	0.336		i
7	ig	0.9145	0.178	0.336		i I
7	ig	0.9145	0.178	0.336	1	! I
7			0.178	0.336	1	I I
	ig	0.9145	•			I I
7	ig	0.9145	0.178	0.336	1 0 226	1 0 226
7	ig 	0.9145	0.178	0.336	0.336	0.336
8	l p	0.9145	0.178	0.336		1
8	l p	0.9145	0.178	0.336		
8	l p	0.9145	0.178	0.336		
8	р 	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	l ig	0.9145	0.178	0.336		
8	ig	0.9145	0.178	0.336	i	·
8	ig	0.9145	0.178	0.336	i	i
8	ig	0.9145	0.178	0.336	i	
8	ig	0.9145	0.178	0.336	İ	
8	ig	0.9145	0.178	0.336	I I	I
8	ig				I I	1
		0.9145	0.178	0.336	I	
8	ig	0.9145	0.178	0.336		1
8	ig	0.9145	0.178	0.336	1	1
8	ig 	0.9145	0.178	0.336 	0.336	0.336
-					·	-
9	l p	0.9145	0.178	0.336	I	I

9 9 9	p p	0.9145 0.9145 0.9145	0.178 0.178 0.178	0.336 0.336 0.336	 0.336	 0.336
9 9 9	ig ig	0.9145	0.178	0.336 0.336	 	
9 9	ig ig ig	0.9145 0.9145 0.9145	0.178 0.178 0.178	0.336 0.336 0.336		
9 9 9	ig ig ig	0.9145 0.9145 0.9145	0.178 0.178 0.178	0.336 0.336 0.336	 	
9 9 9	ig ig ig	0.9145 0.9145 0.9145	0.178 0.178 0.178	0.336 0.336 0.336		
9	i ig	0.9145	0.178	0.336	0.336	0.336
10 10	 p p	0.9145 0.9145	0.178 0.178	0.336 0.336	 	
10	p	0.9145	0.178	0.336	0.336	0.336
	·					
10 10	 ig ig	0.9145 0.9145	0.178 0.178	0.336 0.336		
10	ig	0.9145	0.178	0.336		
10	ig ig	0.9145 0.9145	0.178	0.336		
10 10	ig ig	0.9145 0.9145	0.178 0.178	0.336 0.336		
10 10	ig ig	0.9145 0.9145	0.178 0.178	0.336 0.336		
10	ig ig	0.9145	0.178	0.336		
1 10	ig	0.9145	0.178	0.336	0.336	0.336
11 11	p	0.9145 0.9145	0.178 0.178	0.336		
11	b	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 ig	0.9145 0.9145	0.178 0.178	0.336 0.336		
11 11	ig ig	0.9145 0.9145	0.178 0.178	0.336		
11	ig	0.9145	0.178	0.336		
11 11	ig ig	0.9145 0.9145	0.178 0.178	0.336		
11	ig ig	0.9145 0.9145	0.178 0.178	0.336 0.336		
11 11	ig ig	0.9145 0.9145	0.178 0.178	0.336	 0.336	 0.336
	· — ɔ					
12	p	0.8731	0.3743	0.3087	 	
12	p	0.8499	0.2147	0.3191		
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	1	

	ig	0.8682		•	ļ	!!!!
12 12		1.015	·		l I	
	ig	0.9327	0.3364 -0.01976	0.3449	l I	
12	l ia	0.942	-0.05961			
12	iq	0.9686	0.00882	0.3504	i	i
	l ia	I 1 201	1 0 1403	0.3531	i	i
12	ig ig	1.14	0.1633	0.3549	1	1
	ig	1.1	0.1489		1	
12 	ig 	1.146	0.02796 	0.3587 	0.3587	0.3312
13		1.201		0.3531	1	1
			0.1633			
			0.1489	0.3558		
13 		1.146	0.02796 	0.358 <i>1</i> 		0.3556
13	 ig	1.201	0.1633	 0.3521		
		1.201	·	0.3527	i	i
13	ig		0.1633	1 0.3548	İ	i
13	ig	1.1	0.1633	0.3551		İ
13	l ia	1.146	0.1489	0.3554	1	1
			0.1489		!	<u> </u>
13	ig	1.201	0.02796	0.3558		
13	ig ig	1.146 1.14	0.1403 0.1403	0.3558	I	
13 13	1 id	±•±4 1 1	0.1403	0.330 0.3562	I I	
13	l ia	1 1.14	0.1403	1 0.3589	! 	
13	ig	1.1	0.02796	0.3593	0.3593	0.3556
	. , 	· 		.		
			0.1403		I	
			0.02796	U.358/ N.3580	l I	
	p	1.14 1.1	0.02796 0.02796	0.3593	0.3593	0.3583
			•	0.3558	1	1
	_	1.14		0.356	1	1
	ig	1.1	0.1403	0.3562	!	<u> </u>
	ig	1.146	0.02796	0.3587	<u> </u>	<u> </u>
	ig	1.146	0.02796	0.3587		
	_	1.14	0.02796 0.02796	0.3589 0.3589	I	
	ig ig	1.14 1.1	0.02796	0.3593	1	
	_	1.1	0.02796	0.3593		i
		1.1	0.02796	0.3593	i	
		1.1	0.02796	0.3593	j	j
	ig 	1.1	0.02796	0.3593	0.3593	0.3583
15	 р	1.1	0.02796	0.3593		
15	p	1.1	0.02796	0.3593		l
		1.1		0.3593	1	
15 	p	1.1	0.02796 	0.3593 	0.3593	0.3593
 15	 ig	1.1	 0.02796	 0.3593		
	ig	1.1	0.02796	0.3593		
15		1.1	0.02796	0.3593	i	
	ig	1.1		0.3593	i	i
15	1 -4		0.02796	0.3593	i	i
15 15		1.1				
15 15 15 15	ig ig	1.1	0.02796	0.3593		
15 15 15 15 15	ig ig ig	1.1	0.02796	0.3593		
15 15 15 15 15 15	ig ig ig	1.1	0.02796			

15 15	lig		0.02796 0.02796	0.3593		
15 	ig 	1.1	0.02796	0.3593	0.3593	0.3593
16	p	1.1		0.3593	 !	 !
16 16	q q	1.1	0.02796 0.02796			
16 		1.1	0.02796	0.3593	0.3593	0.3593
16	 ig	1.1	0.02796	0.3593	 	
16 16		1.1	0.02796 0.02796	0.3593		
		1.1		0.3593		
16	ig	1.1	·	0.3593	İ	İ
16 16	ig ig	1.1	•	0.3593 0.3593		
16	_	1 1.1		0.3593		i I
16		1.1		0.3593	!	1
16 16		1.1	0.02796 0.02796		l	l I
16	ig	1.1	0.02796	0.3593	0.3593	0.3593
17	 p	1.1	0.02796	0.3593	 	
17		1.1	0.02796		!	1
17 17	p p	1.1	0.02796 0.02796		0.3593	 0.3593
17	_	1.1		0.3593	I	I
17 17	_	1.1	0.02796 0.02796	0.3593		
17	ig	1.1	·	0.3593		İ
17	ig	1.1	·	0.3593	1	ļ
17 17	ig ig	1.1	·	0.3593 0.3593	l	1
17	ig	1.1	0.02796	0.3593	İ	İ
17 17		1.1	0.02796 0.02796	0.3593 0.3593		
17	ig ig	1.1	•	0.3593		
17 	ig	1.1		0.3593	0.3593	0.3593
18	l p	1.1	0.02796	0.3593	1	1
18 18	l p	1.1	0.02796 0.02796	0.3593 0.3593		
18	p	1.1	0.02796		0.3593	 0.3593
10						
18 18	ig ig	1.1	0.02796 0.02796	0.3593 0.3593	 	l I
18	ig	1.1	0.02796	0.3593	i	i
18	ig	1.1	0.02796	0.3593		
18 18	ig ig	1.1	0.02796 0.02796	0.3593 0.3593		
18	ig	1.1	0.02796	0.3593	i	İ
18	ig	1.1	0.02796	0.3593		
18 18	ig ig	1.1	0.02796 0.02796	0.3593 0.3593		
18	ig	1.1	0.02796	0.3593	i	i
18 	ig 	1.1	0.02796	0.3593	0.3593	0.3593
19	l p	1.1	0.02796	0.3593		I

19	l p	1.1	0.02796	0.3593		
19 19	p	1.1	0.02796 0.02796	0.3593 0.3593	 0.3593	0.3593
19	ig	1.1	0.02796	0.3593	1	1
19	ig	1.1	0.02796	0.3593	ļ]
19 19	ig ig	1.1	0.02796 0.02796	0.3593 0.3593		
19	ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593	i	i
19	ig	1.1	0.02796	0.3593		
19 19	ig	1.1	0.02796 0.02796	0.3593 0.3593		
1 19	ig ig	1.1	0.02796	0.3593		
19	ig	1.1	0.02796	0.3593	i	i
19	ig	1.1	0.02796	0.3593	0.3593	0.3593
20	 p	 1.1	 0.02796	0.3593	 	 I
20	p	1.1	0.02796	0.3593	i	İ
20	p	1.1	0.02796	0.3593	I	1
20	p	1.1	0.02796 	0.3593	0.3593	0.3593
20	ig	1.1	0.02796	0.3593	Į.	
20 20	ig ig	1.1	0.02796 0.02796	0.3593 0.3593	Į Į	
20	ig	1.1	0.02796	0.3593		
20	ig	1.1	0.02796	0.3593	i	İ
20	ig	1.1	0.02796	0.3593		1
20 20	ig	1.1	0.02796	0.3593 0.3593		
20	ig ig	1.1	0.02796 0.02796	0.3593	l I	
20	ig	1.1	0.02796	0.3593	İ	İ
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	1	1
21	l p	1.1	0.02796	0.3593]
21	p p	1.1	0.02796 0.02796	0.3593	 0.3593	 0.3593
21	 ig	 1.1	 0.02796	0.3593		
21	ig	1.1	0.02796	0.3593	ĺ	
21	ig	1.1	0.02796	0.3593	I	1
21	ig	1.1	0.02796	0.3593	Į.	
21	ig ig	1.1	0.02796 0.02796	0.3593 0.3593	I I	
21	ig	1.1	0.02796	0.3593	i	
21	ig	1.1	0.02796	0.3593	I	1
21	ig	1.1	0.02796	0.3593	Į.	
21	ig ig	1.1	0.02796 0.02796	0.3593 0.3593	I I	
21	ig	1 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	i	İ
22	p	0.9305	0.1513	0.3405	1	1
22	p	1.203	0.09021	0.3546	0.3546	0.3393
22 22	ig ig	0.817 1.37	-0.2483 0.3149	0.3074 0.3227		
					•	

22 22 22 22 22 22 22 22	ig ig ig ig ig ig ig	0.8956 1.301 0.9813 1.159 1.283 1.047 1.073 1.169 1.11	-0.2085 0.2975 0.3238 0.3108 0.153 -0.2175 -0.1934 0.1587 0.1109 -0.03746	0.3301 0.3341 0.3341 0.3442 0.3444 0.3498 0.3527 0.3541 0.3575 0.3584	0.3584	0.3408
23 23 23 23 23	p p	1.169 1.203 1.11 1.153	0.1587 0.09021 0.1109 -0.03746	0.3541 0.3546 0.3575 0.3584	 0.3584	
23 23 23 23 23 23 23 23	ig ig ig ig ig ig ig ig	1.203 1.203 1.153 1.11 1.203 1.169 1.169 1.153 1.153 1.169 1.11	0.1587 0.1109 0.1587 0.1587 -0.03746 0.1109 0.09021 0.1109 0.09021 -0.03746 0.09021 -0.03746	0.3522 0.354 0.3548 0.3554 0.3556 0.3561 0.3567 0.3567 0.3574 0.3577 0.3581 0.3592	0.3592	0.3562
24 24 24 24	p p p	1.169 1.11 1.153 1.11	-0.03746 0.09021 -0.03746 -0.03746	0.3577 0.3581 0.3584 0.3592	 0.3592	
24 24 24 24 24 24 24 24	ig ig ig ig ig ig ig ig	1.169 1.153 1.169 1.169 1.11 1.153 1.153 1.11 1.11 1.11	0.09021 0.09021 -0.03746 -0.03746 0.09021 -0.03746 -0.03746 -0.03746 -0.03746 -0.03746 -0.03746	0.3567 0.3574 0.3577 0.3577 0.3581 0.3584 0.3584 0.3592 0.3592 0.3592 0.3592 0.3592	0.3592	0.3584
25 25 25 25 25	p p p	1.11 1.11 1.11 1.11	-0.03746 -0.03746 -0.03746 -0.03746	0.3592 0.3592 0.3592 0.3592	 0.3592	
25 25 25 25 25 25 25 25 	ig ig ig ig ig ig ig	1.11 1.11 1.11 1.11 1.11 1.11 1.11 1.11 1.11	-0.03746 -0.03746 -0.03746 -0.03746 -0.03746 -0.03746 -0.03746 -0.03746 -0.03746	0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592		

25	ig	1.11	-0.03746	0.3592	1	1 1
25	ig	1.11	-0.03746		i	i
25	ig	1.11	-0.03746	0.3592	0.3592	0.3592
26		. 1 11	-0.03746	 0.3592		
26 26	p	1.11	-0.03746	0.3592	I I	
26	q q	1.11	·	0.3592	I I	
26	_	1.11	-0.03746	0.3592	0.3592	0.3592
	p					
26	ig	1.11	-0.03746	0.3592 0.3592	I	
26	ig		-0.03746	•		!
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	·	0.3592		
26	ig	1.11		0.3592		
26	ig	1.11		0.3592		
26	ig	1.11		0.3592		
26	ig	1.11		0.3592		
26 	ig 	1.11	-0.03746	0.3592	0.3592	0.3592
27	l p	1.11	-0.03746	0.3592		
27	p	1.11		0.3592		
27	l þ	1.11	-0.03746			
27 	p	1.11	-0.03746	0.3592	0.3592	0.3592
27	ig	1.11	-0.03746	0.3592	1	
27	ig	1.11	-0.03746	0.3592		
27	ig	1.11	-0.03746	0.3592	1	
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	1	
27	ig	1.11	-0.03746	0.3592	1	
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
20	·		1 -0 02746			
28	p	1.11	-0.03746	0.3592	1	
28	p	1.11	-0.03746		1	
28	l p	1.11	-0.03746	•		
28 	p	1.11	-0.03746	U.3592 	0.3592	0.3592
	1 2 2					
28	ig	1.11	-0.03746	0.3592	I	
28	ig	1.11	-0.03746	0.3592	I .	
28	ig	1.11	-0.03746	0.3592	1	
28	ig	1.11		0.3592	ļ	<u> </u>
28	ig	1.11	-0.03746	0.3592	ļ	<u> </u>
28	ig	1.11	-0.03746	0.3592	1	
28	ig	1.11	·	0.3592	I	
28	ig	1.11	-0.03746	0.3592	1	
28	ig	1.11	-0.03746	0.3592	1	
28	ig	1.11		0.3592	1	
28	ig	1.11	-0.03746	0.3592		1
28	ig	1.11	-0.03746	0.3592	0.3592	0.3592
		_				_
 29		1.11	-0.03746	 		
۵ کا	l p	1 + • + +	1 0.03/40	1 0.3334	I	ı
				10		

29 29	p	1.11	-0.03746 -0.03746	0.3592	 	
29	p	1.11	-0.03746	0.3592	0.3592	0.3592
	·					
29 29	ig ig	1.11 1.11	-0.03746 -0.03746	0.3592 0.3592		
29	ig	1.11		0.3592	İ	i
29	ig	1.11		0.3592	1	1
29	ig	1.11		0.3592 0.3592		
29 29		1.11		0.3592	1	ļ
29	ig	1.11	·	0.3592	i	i
29		1.11		0.3592	Į.	Į.
29 29		1.11		0.3592	l I	l I
29	ig	1.11	-0.03746	0.3592	0.3592	0.3592
30	 q	0.8837	 -0.2737	0.322	 	 I
30	p	0.8537	0.09882	0.3268	İ	İ
30	l b	1.253	· ·	0.3501		
30	p 	1.206	-0.1019 	0.3541	0.3541	0.3382
30 30	ig ig	0.8248 0.8459	-0.07941 0.07566	0.3198 0.3256	l I	l I
30	ig	0.8962	0.2599	0.326		İ
30	ig	1.401	-0.03646	0.3277	1	1
30	ig ig	0.9161 1.362	0.2483 0.1316	0.331 0.3332		
30		1.328		0.3337	l I	
30	ig	1.19		0.3447	i	i
30	ig	1.29		0.3466	Į.	ļ
30	ig ig	1.257 1.157	0.1736 0.1034	0.3466 0.3568	l I	l I
30	ig	1.174	-0.01883	0.3576	0.3576	0.3374
31	 р	1.253	-0.08731	0.3501	 	
31	l p	1.206	-0.1019	0.3541	1	1
31	p	1.157	0.1034 -0.01883	0.3568	 0.3576	 0.3547
	p 					
31	ig	1.253		0.3497	 	
31	ig	1.253		0.3497	İ	i
31	ig	1.253	-0.01883	0.3511	ļ	!
31 31	ig ig	1.206 1.206	0.1034 -0.08731	0.3541 0.3545		I
31	ig	1.206	· ·	0.3556		
31	ig	1.174	0.1034	0.3561	1	1
31		1.174	-0.1019	0.3561		1
31 31	ig ig	1.174 1.157	-0.08731 -0.1019	0.3565 0.3569	I I	I I
31	ig	1.157	-0.08731	0.3573	i	i
31	ig	1.157	-0.01883	0.3584	0.3584	0.3547
=	=					
32	p	1.157	· ·	0.3569	1	1
32	l b	1.157		0.3573	Į.	Į.
32	p p	1.174 1.157	-0.01883 -0.01883	0.3576 0.3584	 0.3584	 0.3576
	·					
32	 ig	1.174	-0.1019	0.3561		
32	ig	1.174	-0.08731	0.3565	1	1

32 32 32 32 32 32 32 32	ig ig ig ig ig ig ig ig	1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157	-0.1019 -0.08731 -0.08731 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883	0.3569 0.3573 0.3573 0.3576 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584	0.3584	0.3576
33 33 33 33 33 33 33	ig ig ig ig ig ig ig	1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157	-0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883	0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584	 0.3584	 0.3584
34 34 34 34	p p p	1.157 1.157 1.157 1.157	-0.01883 -0.01883 -0.01883 -0.01883	0.3584 0.3584 0.3584 0.3584	 0.3584	 0.3584
34 34 34 34 34 34 34 34	ig ig ig ig ig ig ig ig	1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157	-0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883	0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584	0.3584	
35 35 35 35	p p p	1.157 1.157 1.157 1.157	-0.01883 -0.01883 -0.01883 -0.01883	0.3584 0.3584 0.3584 0.3584	 0.3584	 0.3584
35 35 35 35 35 35 35 35	ig ig ig ig ig ig ig ig	1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157 1.157	-0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883 -0.01883	0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584 0.3584		

35	ig	1.157	-0.01883	0.3584		1
35	ig	1.157	-0.01883	0.3584	1	
35 	ig 	1.157	-0.01883	0.3584	0.3584	0.3584
36	p	1.157	-0.01883	0.3584		
36	l p	1.157	-0.01883	0.3584	1	
36	l 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	1	
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	1	
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	i I	
37	p	1.157	-0.01883	0.3584	i I	
37	q q	1.157	-0.01883	0.3584	0.3584	0.3584
37	 ig	1.157		 0.3584		
37	ig	1.157	-0.01883	0.3584	i I	
37	ig	1.157	-0.01883	0.3584	l I	!
37	ig	1.157	-0.01883	0.3584	I I	
37	ig	1.157	-0.01883	0.3584	!	
37	ig	1.157	-0.01883	0.3584	!	
37	_	1.157	-0.01883	0.3584		
	ig					
37	ig	1.157	-0.01883	0.3584 0.3584		
37 37	ig	1.157	-0.01883		ļ	
	ig	1.157	-0.01883	0.3584		
37 37	ig	1.157 1.157	-0.01883 -0.01883		0.3584	0.3584
	ig 					
38	Ιp	1.157	-0.01883	0.3584	1	1
38	l p	1.157	-0.01883	0.3584		
38	l p	1.157	-0.01883	0.3584		l
38	p	1.157	-0.01883	0.3584	0.3584	0.3584
		- -				
38	ig	1.157	-0.01883	0.3584	Į.	
38	ig	1.157	-0.01883	0.3584	Į.	
38	ig	1.157	-0.01883	0.3584	1	
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	-0.01883	0.3584	<u> </u>	1
38	ig	1.157	-0.01883	0.3584		
38	ig	1.157	· ·	0.3584	1	
38	ig	1.157	-0.01883	0.3584	1	
38	ig	1.157	-0.01883	0.3584	1	
38	lig	1.157	-0.01883	0.3584	1	İ
38	ig	1.157	-0.01883	0.3584		ļ
38	l ig	1.157	-0.01883	0.3584	0.3584	0.3584
						 _
 39	 p	1.157	-0.01883	 0.3584		
<u> </u>	· P	1 - • - • /	, 0.01000	, 0.0001	1	ı
				4 -		

39 39	p	1.157 1.157	-0.01883 -0.01883	0.3584		
39	p	1.157	-0.01883	0.3584	0.3584	0.3584
39	ig	1.157	-0.01883 -0.01883	0.3584	1	1
39 39	ig ig	1.157 1.157	-0.01883 -0.01883	0.3584 0.3584	l	l
39	ig	1.157	-0.01883	0.3584	i	i
39	ig	1.157	-0.01883	0.3584		
39 39	ig ig	1.157 1.157	-0.01883 -0.01883	0.3584 0.3584	I I	l I
39	ig	1.157	-0.01883	0.3584	i	i
39 39	ig ig	1.157 1.157	-0.01883 -0.01883	0.3584 0.3584		
39	ig	1.157	-0.01883	0.3584		I I
39	ig	1.157	-0.01883	0.3584	0.3584	0.3584
40	р	1.327	-0.115	0.3394	 	
1 40	p	1.23	0.1582	0.35	į.	ļ.
40 40	q q	1.121 1.191	0.2042 -0.04289	0.3528 0.3564	 0.3564	 0.3497
40	 ig	1.402	 -0.2806	 0.3191		
40	ig	1.41	0.08513	0.3252	İ	İ
40	ig	0.8953	0.2481	0.3269		
40	ig ig	0.8597 1.357	0.03431 -0.08288	0.3299 0.3354	l	l I
1 40	ig	0.9937	0.2356	0.3438	İ	İ
40		0.9722	0.06636	0.3501	l	1
40 40	ig ig	1.134 0.9857	-0.2435 0.1141	0.3501 0.3502	l	l
1 40	ig	1.247	-0.1055	0.3502	i	i
40 40	ig ig	1.003	0.01384 -0.03463	0.3543 0.3553	 0.3553	 0.3409
41	l p	1.121	0.2042	0.3528		
41 41	p p	1.003 1.207	0.01384 -0.03463	0.3543 0.3553	l	l I
41	p	1.191	-0.04289	0.3564	0.3564	0.3547
41 41	ig	1.003 1.207	0.2042	0.3471 0.3495	I I	ļ
41	ig ig	1.191	0.2042	0.3506		
41	ig	1.003	-0.04289	0.354	i	i
41 41	ig ig	1.003 1.207	-0.03463 -0.04289	0.3541 0.3552	ļ.	ļ
41	ig	1.207	0.01384	0.3554		
41	ig	1.191	-0.03463	0.3565	İ	İ
41 41	ig ig	1.191 1.121	0.01384 -0.04289	0.3566 0.3591		
41	ig	1.121	-0.04289	0.3591		
41	ig	1.121	0.01384	0.3593	0.3593	0.3547
						
42	p	1.191	0.01384	0.3566		
42	l p	1.121	-0.04289	0.3591	1	1
42 42	p p	1.121 1.121	-0.03463 0.01384	0.3592 0.3593	0.3593	 0.3586
· -						
42	 ig	1.191	-0.04289	0.3564		
42	ig	1.191	-0.03463	0.3565	1	

42 42 42 42 42 42 42 42	ig ig ig ig ig ig ig ig	1.191 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121	0.01384 -0.04289 -0.04289 -0.03463 -0.03463 0.01384 0.01384 0.01384 0.01384	0.3566 0.3591 0.3591 0.3592 0.3592 0.3593 0.3593 0.3593 0.3593	0.3593	
43 43 43 43	p p p	1.121 1.121 1.121 1.121	0.01384 0.01384 0.01384 0.01384	0.3593 0.3593 0.3593 0.3593	 0.3593	
43 43 43 43 43 43 43 43	ig ig ig ig ig ig ig ig	1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121	0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384	0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593	0.3593	0.3593
44 44 44 44	p p p	1.121 1.121 1.121 1.121	0.01384 0.01384 0.01384 0.01384	0.3593 0.3593 0.3593 0.3593	 0.3593	
44 44 44 44 44 44 44 44	ig ig ig ig ig ig ig ig	1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121	0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384	0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593	0.3593	
45 45 45 45	p p	1.121 1.121 1.121 1.121	0.01384 0.01384 0.01384 0.01384	0.3593 0.3593 0.3593 0.3593	 0.3593	
45 45 45 45 45 45 45 45 	ig ig ig ig ig ig ig ig	1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121 1.121	0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384 0.01384	0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593		

45 45	ig	1.121 1.121	0.01384 0.01384	0.3593	1	
45	ig ig	1.121		0.3593	1 0.3593	1 0.3593
46	 р	1.121	0.01384	0.3593		
46	Ιp	1.121	0.01384	0.3593	1	
46	l p	1.121	0.01384	0.3593		
46	p	1.121	0.01384		0.3593	0.3593
46	ig	1.121	0.01384	0.3593	I	1
46	ig	1.121		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	1	
46	ig	1.121	0.01384	0.3593	1	
46	ig	1.121	0.01384	0.3593	1	
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	l p	1.121	0.01384	0.3593	!	
47	l p	1.121	0.01384			
47	p	1.121	·	0.3593		
47 	q 	1.121	0.01384	0.3593	0.3593	0.3593
47	ig	1.121	0.01384	0.3593	1	
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	1	
47	ig	1.121	0.01384	0.3593	1	
47	ig	1.121	0.01384	0.3593	1	
47	ig	1.121	0.01384	0.3593	1	
47	ig	1.121	0.01384	0.3593	1	
47	ig	1.121	0.01384	0.3593	0.3593	0.3593
 48			 0.01384	0.3593		
48	p	1.121 1.121	0.01384	0.3593	I I	I
48	l p	1.121	0.01384	0.3593	1 1	I
48	p p	1.121	0.01384		0.3593	0.3593
48	 ig	1.121	0.01384	0.3593	 I	
48	ig	1.121	0.01384	0.3593	1	
48	ig	1.121	0.01384	0.3593	1 	I I
48	ig	1.121	0.01384	0.3593	1 	I I
48	ig	1.121	0.01384	0.3593	1	I I
48	ig	1.121	0.01384	0.3593	1 	I I
48	ig	1.121	0.01384	0.3593	1 1	I I
48	19 ig	1.121	0.01384	0.3593	I I	I
	_		·		I I	I
48	ig	1.121	0.01384	0.3593	1	I
48	ig	1.121	0.01384	0.3593	1	
48	ig	1.121	0.01384	0.3593 0.3593	0.3593	 0.3593
48 	ig 	1.121	0.01384	1 0.3393		
49	 р	1.121	0.01384	0.3593	 _	
	-					

49 49 49	p		0.01384 0.01384 0.01384	0.3593 0.3593 0.3593	 0.3593	 0.3593
	p 					
 49 49		1.121 1.121	0.01384 0.01384	0.3593 0.3593	 	
49	ig		0.01384	0.3593 0.3593	 	
49	ig		0.01384	0.3593		
49	ig	1.121	0.01384	0.3593 0.3593 0.3593		
49	ig	1.121	0.01384	0.3593		
			0.01384	0.3593	0.3593	0.3593
		1.121 1.121		0.3593 0.3593	 	
50	p	1.121		0.3593	0.3593	0.3593
	ig	1.121	0.01384	0.3593	 	
50	ig		0.01384	0.3593	 	!
50 50	ig		0.01384 0.01384	0.3593		
50	ig			0.3593 0.3593		
			0.01384 0.01384	0.3593 0.3593		
50 50		1.121 1.121	0.01384 0.01384	0.3593 0.3593	1	
50			0.01384	0.3593	0.3593	0.3593
51 51	p	0.8859 1.348	0.2745 -0.1815	0.3225 0.3338	1	
51	p p	0.8975	-0.126 0.07722	0.3356	0.357	0.3372
51 51		1.378 1.395	0.2998 -0.137	0.3223 0.327	 	
51	ig	0.9798	0.2878	0.3375		
51	ig	1.306	-0.03513	0.3435	 	
51	ig	1.242	0.2213	0.3446		
				0.3466 0.35		
		1.212 1.049		0.3548 0.3551		
			-0.124 	0.3568	0.3568 	0.344
				0.3548 0.3551	1	
52	p	1.094	-0.124	0.3568	0.357	0.3559
	· ·		 			
	ig ig		-0.1271 -0.124	0.3528 0.3529		1

52 52 52 52 52 52 52 52	ig ig ig ig ig ig ig ig	1.212 1.049 1.17 1.17 1.094 1.049 1.049 1.17 1.094 1.094	0.07722 -0.124 -0.1271 -0.124 -0.1271 0.07722 -0.04924 -0.04924 0.07722 -0.04924	0.3543 0.3552 0.3554 0.3556 0.3567 0.3568 0.3574 0.3575 0.3584 0.3589	 0.3589	
53 53 53 53	p p p	1.049 1.17 1.094 1.094	-0.04924 -0.04924 0.07722 -0.04924	0.3574 0.3575 0.3584 0.3589	 0.3589	 0.358
53 53 53 53 53 53 53 53	lig lig lig lig lig lig lig	1.049 1.17 1.049 1.049 1.17 1.17 1.094 1.094 1.094 1.094 1.094	-0.04924 -0.04924 -0.04924 0.07722 -0.04924 -0.04924	0.3568 0.357 0.3574 0.3574 0.3575 0.3575 0.3584 0.3589 0.3589 0.3589 0.3589	 	
54 54 54 54	p p p	1.094 1.094 1.094 1.094	-0.04924	0.3589 0.3589 0.3589 0.3589	 0.3589	
54 54 54 54 54 54 54 54	ig ig ig ig ig	1.094 1.094 1.094 1.094 1.094 1.094 1.094 1.094 1.094 1.094	-0.04924 -0.04924 -0.04924 -0.04924 -0.04924 -0.04924 -0.04924 -0.04924 -0.04924 -0.04924	0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589		
55 55 55 55	l p	1.094 1.094 1.094 1.094	·	0.3589 0.3589 0.3589 0.3589	 0.3589	 0.3589
55 55 55 55 55 55 55 55	ig ig ig ig ig ig	1.094 1.094 1.094 1.094 1.094 1.094 1.094 1.094	-0.04924 -0.04924	0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589		

55	_	1.094			1	
55 55		1.094 1.094		0.3589	1 0.3589	I I 0.3589
 56	 q	1.094	-0.04924	 0.3589		
56	p	1.094	-0.04924		i	į
56	p	1.094		0.3589		
56 	p	1.094	-0.04924	0.3589 	0.3589 	0.3589
 56	 ig	1.094	-0.04924	 0.3589	 	
56	_	1.094	-0.04924	0.3589	i	j
56	ig	1.094	-0.04924	0.3589		1
56		1.094	·	0.3589		1
56	ig	1.094	-0.04924	0.3589		[
56	ig	1.094	·	0.3589		
56 56	ig ig	1.094 1.094		0.3589 0.3589	l I	I I
56	ig	1.094	-0.04924	0.3589	l I	!
56	_	1.094	·	0.3589	i	i I
56		1.094		0.3589	i	i
56	ig	1.094	-0.04924	0.3589	0.3589	0.3589
		. 1 004		1 0 3500		
57 57	q q	1.094 1.094	-0.04924 -0.04924		I I	I I
57	1 p	1.094	-0.04924			l I
57	p	1.094	-0.04924	0.3589	0.3589	0.3589
57	 ig	1.094	-0.04924	0.3589		
57	ig	1.094		0.3589		
57	ig	1.094	·	0.3589	!	1
57 57	ig	1.094	-0.04924 -0.04924	0.3589 0.3589	l I	
57	ig ig	1.094 1.094		0.3589	I I	I I
57	ig	1.094	·	0.3589	i	i I
57	ig	1.094	-0.04924	0.3589		i
57	ig	1.094		0.3589	İ	j
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	1	
58	p	1.094	-0.04924	0.3589	1	
58	l p	1.094	-0.04924	0.3589	1	
58 	p	1.094	-0.04924	0.3589	0.3589	0.3589
 58	 ig	1.094	-0.04924	 0.3589		
58	ig	1.094	1 -0.04924	0.3589		!
58	ig	1.094	-0.04924	0.3589	i	
58	ig	1.094	-0.04924	0.3589	İ	
58	ig	1.094	-0.04924	0.3589	1	
58	ig	1.094	-0.04924	0.3589	1	1
58	ig	1.094	-0.04924	0.3589	!	
58	ig	1.094	-0.04924	0.3589		
58 58	ig	1.094	-0.04924	0.3589 0.3589	l	
58 58	ig ig	1.094 1.094	-0.04924 -0.04924	0.3589	I I	I I
58	ig	1.094	-0.04924	0.3589	0.3589	0.3589
 59	 p	1.094	-0.04924	 0.3589	 I	

59 59	p	1.094 1.094	-0.04924 -0.04924	0.3589 0.3589		
59	p	1.094	1 -0.04924	0.3589	0.3589	0.3589
	·					
59	ig	1.094	-0.04924	0.3589	I	
59 59	ig ig	1.094 1.094	-0.04924 -0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589	I I	
59	ig	1.094	-0.04924	0.3589	į	
59		1.094	-0.04924	0.3589	1	
59 59		1.094 1.094	-0.04924 -0.04924	0.3589 0.3589		
59		1.094	-0.04924	0.3589		
59	ig	1.094	-0.04924	0.3589	i	
59	_	1.094	-0.04924	0.3589		0 3500
59 	ig 	1.094	-0.04924	0.3589	0.3589 	0.3589
60	p	1.094	-0.04924	0.3589		
60	l p	1.094	-0.04924	0.3589		
60 60	q q	1.094 1.094	-0.04924 -0.04924	0.3589 0.3589	 0.3589	 0.3589
	тр 					
 I 60	 ig	1.094	 -0.04924	0.3589		
1 60	ig	1.094	-0.04924	0.3589	l I	
60	ig	1.094	-0.04924	0.3589	į	
60	ig	1.094	-0.04924	0.3589	1	
60 60		1.094 1.094	-0.04924 -0.04924	0.3589 0.3589		
60		1.094	-0.04924	1 0.3589	I I	
60	ig	1.094	-0.04924	0.3589	į	
60		1.094	-0.04924	0.3589	1	
60 60	ig ig	1.094 1.094	-0.04924 -0.04924	0.3589 0.3589		
60	ig	1.094	-0.04924	0.3589	0.3589	0.3589
		1.094	 -0.04924			
61 61	p p	1.094	-0.04924	0.3589	I I	l
61	p	1.094	-0.04924	0.3589		
61	l p	1.094	-0.04924	0.3589	0.3589	0.3589
						
61	ig	1.094	-0.04924	0.3589		
61 61	ig ig	1.094 1.094	-0.04924 -0.04924	0.3589 0.3589	I I	I
61		1.094	-0.04924	0.3589		
61	ig	1.094	-0.04924	0.3589	!	!
61 61	_	1.094 1.094	-0.04924 -0.04924	0.3589		
61	ig ig	1.094	-0.04924 -0.04924	0.3589	I I	
61	ig	1.094	-0.04924	0.3589	i	İ
61	ig	1.094	-0.04924	0.3589	ļ	
61 61	ig ig	1.094 1.094	-0.04924 -0.04924	0.3589 0.3589	 0.3589	 0.3589
62	l p	1.094	-0.04924	0.3589	1	
62 62	q q	1.094	-0.04924 -0.04924	0.3589	I I	I
62	p	1.094	-0.04924	0.3589	0.3589	0.3589
62	ig	1.094	-0.04924	0.3589	1	
62	ig	1.094	-0.04924	0.3589	1	

62	ig ig ig ig ig ig ig ig	1.094 1.094 1.094 1.094 1.094 1.094 1.094	-0.04924 -0.04924 -0.04924	0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589 0.3589	 0.3589	0.3589
63 63	p p	0.8567 1.014	-0.1273 -0.0657 -0.3378 -0.268	0.3142 0.3285 0.3365 0.3457	 0.3457	0.3312
63	ig ig ig ig ig ig ig ig ig ig ig	1.381 0.8909 1.282 1.285 0.9557 1.244 1.258 1.236 1.061	0.07917 -0.1902	0.3189 0.3235 0.3322 0.3329 0.3359 0.3431 0.3484 0.3502 0.352 0.3524 0.3539 0.3582	 	
64 64	p	1.061 1.207		0.352 0.3524 0.3539 0.3582	 0.3582	
64	ig ig ig ig ig ig ig ig ig ig ig	1.207 1.236 1.236 1.125 1.207 1.207 1.061 1.061 1.061		0.3479 0.3503 0.3514 0.3519 0.3537 0.3545 0.3546 0.3566 0.3572 0.3574 0.3576 0.3583	 	
65 65	p p	1.125 1.125	0.08361	0.3574 0.3576 0.3582 0.3583	 0.3583	 0.3579
65 65 65 65 65 65	ig ig ig ig ig ig ig	1.061	-0.1033 0.08361 0.07917 -0.1033 -0.1033 0.08361 0.08361 0.07917	0.3566 0.3572 0.3574 0.3576 0.3576 0.3582 0.3582 0.3583 0.3583		

		. 1 105					
65	ig	1.125	0.07917	0.3583			- !
65 65	ig	1.125	0.07917 0.07917	0.3583	0.3583	0.3579	
65	ig 	1.125		0.3583	0.3363		
66	l p	1.125	0.07917	0.3583			- 1
66	l p	1.125	0.07917	0.3583			
66	l p	1.125	0.07917	0.3583			
66	l p	1.125	0.07917	0.3583	0.3583	0.3583	
I 66	ig	1.125	0.07917	0.3583	1		
1 66	ig	1.125	0.07917	0.3583	i		i
66	ig	1.125	0.07917	0.3583	i		i
66	ig	1.125	0.07917	0.3583	i	İ	i
66	ig	1.125	0.07917	0.3583	i	i	i
66	ig	1.125	0.07917	0.3583	i	i	i
66	ig	1.125	0.07917	0.3583	i	i	i
66	ig	1.125	0.07917	0.3583	i	i	i
66	ig	1.125	0.07917	0.3583	i	i	i
66	ig	1.125	0.07917	0.3583	i	i	i
66	ig	1.125	0.07917	0.3583	i	i	i
66	ig	1.125	0.07917	0.3583	0.3583	0.3583	i
 67		1.125	0.07917	0.3583			
67	p	1.125	0.07917	0.3583			
67	p		·	0.3583	I I		- 1
1 67	p	1.125 1.125	0.07917 0.07917	0.3583	0.3583	0.3583	
	p 	1.123					'
67	ig	1.125	0.07917	0.3583			- 1
67	ig	1.125	0.07917	0.3583			- 1
67	ig	1.125	0.07917	0.3583			- 1
67	ig	1.125	0.07917	0.3583			- 1
67	ig	1.125	0.07917	0.3583			- 1
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			
1 67	ig	1.125	0.07917	0.3583	0.3583	0.3583	
68	l p	1.125	0.07917	0.3583	1		1
68	l p	1.125	0.07917	0.3583	1		i
68	l p	1.125	0.07917	0.3583	İ	İ	i
68	p	1.125	0.07917	0.3583	0.3583	0.3583	i
	1 4 ~	I 1 10F		1 0 2502			
68	ig	1.125	0.07917	0.3583	1	l I	I
68	ig	1.125	0.07917	0.3583	I		
68	ig	1.125	0.07917	0.3583	I	I	
68	ig	1.125	0.07917	0.3583		I	
68	ig	1.125	0.07917	0.3583	I	I	
68	ig	1.125	0.07917	0.3583	I	I	
68	ig	1.125	0.07917	0.3583	I		
68	ig	1.125	0.07917	0.3583	I	I	
68	ig	1.125	0.07917	0.3583	I	I	
68	ig	1.125	0.07917	0.3583	1	l I	I
68 68	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583	0.3583	0.3583	
	ı ±9	1 1.123	U.U/91/	U.JJOJ	1 0.3303	1 0.3363	'
69	l p	1.125	0.07917	0.3583	1	1	

69 69 69	p p p	1.125 1.125 1.125	0.07917 0.07917 0.07917	0.3583 0.3583 0.3583	 0.3583	 0.3583
	·					
 69 69	 ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583	 	
69 69	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583		1
69 69		1.125 1.125	0.07917 0.07917	0.3583 0.3583		
69 69	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583		
69 69	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583		
69 69	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583	 0.3583	 0.3583
70	p	1.125	0.07917	0.3583	 	
70 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 70	ig ig	1.125 1.125	0.07917 0.07917	0.3583		
70 70	ig ig	1.125 1.125	0.07917 0.07917	0.3583		
70 70	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583		
70 70	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583		
70 70	ig ig	1.125 1.125	0.07917	0.3583		l I
70	ig	1.125	0.07917	0.3583	0.3583	0.3583
71 71	p p	1.125 1.125	0.07917 0.07917	0.3583 0.3583		
71 71	p p	1.125 1.125	0.07917 0.07917	0.3583 0.3583	 0.3583	 0.3583
71 71	ig ig	1.125 1.125	0.07917 0.07917	0.3583 0.3583		I
71 71	ig ig	1.125 1.125	0.07917	0.3583		l I
71	ig ig	1.125	0.07917	0.3583		i
71 71	ig ig	1.125 1.125	0.07917	0.3583		
71 71 71		1.125 1.125 1.125	0.07917	0.3583		
71 71 71	ig ig ig	1.125 1.125 1.125	0.07917	0.3583	 0.3583	 0.3583
	· -9					
 72	 р	0.8414	0.267	0.3124	 	
72 72	p p	0.9691 1.229	-0.08189 -0.08949	0.3493 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		1

72 72 72 72 72 72 72 72	ig ig ig ig ig ig	1.375 1.334 0.9594 0.9897 0.9549 1.129 1.023 1.181 1.026 1.114	-0.159 -0.1768 0.183 -0.2185 -0.1358 0.2178 0.09588 -0.135 -0.03101 -0.01244	0.3561	 0.3594	
73 73	p	1.181 1.181 1.026 1.114	-0.118	0.3546 0.3552 0.3561 0.3594	 0.3594	
73 73 73 73 73 73 73 73	ig ig ig ig ig ig ig ig	1.026 1.026 1.181 1.181 1.026 1.114 1.181 1.181 1.181 1.181 1.181	-0.118 -0.01244 -0.135 -0.03101 -0.03101	0.3572	 	
74		1.181 1.181 1.114 1.114	-0.01244 -0.01244 -0.03101 -0.01244	0.3593	 0.3594	
74 74 74 74 74 74 74 74	ig ig ig ig ig ig ig ig	1.181 1.181 1.181 1.181 1.181 1.181 1.114 1.114 1.114 1.114 1.114	-0.03101 -0.01244	0.3571 0.3572 0.3572 0.3572 0.3572 0.3593 0.3594 0.3594 0.3594 0.3594	0.3594	0.3583
75	p	1.114 1.114 1.114 1.114	-0.01244 -0.01244 -0.01244 -0.01244	0.3594	 0.3594	
75 75 75 75 75 75	ig ig ig ig ig ig	1.114 1.114 1.114 1.114 1.114 1.114 1.114 1.114	-0.01244 -0.01244 -0.01244	0.3594 0.3594 0.3594		

75 75	ig ig		-0.01244 -0.01244	0.3594		
75 	ig 	1.114	-0.01244	0.3594	0.3594	0.3594
 76	p	1.114		0.3594	 	
76	l p	1.114	-0.01244			! !
76 76	q q	1.114 1.114	-0.01244 -0.01244		 0.3594	
76	ig	1.114	-0.01244	0.3594	 	! ! !
76 76	ig ig	1.114 1.114	-0.01244 -0.01244		l I	
76	ig	1.114		0.3594		
76	ig	1.114	-0.01244	0.3594	i	i i
76	ig	1.114	•	0.3594	Į.	! !
76 76	ig	1.114 1.114		0.3594		
76 76	ig ig	1.114	-0.01244 -0.01244	0.3594 0.3594	I I	
76		1.114	-0.01244		i	
76	_	1.114	-0.01244	0.3594	i	i i
76 	ig 	1.114	-0.01244	0.3594	0.3594	0.3594
77	l p	1.114	-0.01244	0.3594	1	
77	l p	1.114	-0.01244	0.3594	İ	i
77	q l	1.114	-0.01244		1	
77 	p 	1.114	-0.01244	0.3594	0.3594	0.3594
77	 ig	1.114	-0.01244	0.3594	 	
77	ig	1.114		0.3594		1
77	l ig	1.114		0.3594		! !
77 77	ig ig	1.114 1.114		0.3594 0.3594	l I	
77	ig	1.114		0.3594		
77	l ig	1.114	•	0.3594	i	i i
77	ig	1.114	·	0.3594	1	1
77	ig	1.114	·	0.3594		! !
77 77	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594		
77	ig	1.114	-0.01244		0.3594	0.3594
 78	p	1.114	-0.01244	0.3594		
78	p	1.114	-0.01244	0.3594	i	
78	l p	1.114	-0.01244	0.3594	1	ı i
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	1	
78	ig	1.114	-0.01244	0.3594	Ţ	
78 78	ig	1.114	-0.01244	0.3594		
78 78	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594 0.3594	1	
78	ig	1.114	-0.01244	0.3594	i	
78	ig	1.114	-0.01244	0.3594	İ	·
78	ig	1.114	-0.01244	0.3594	Ţ	
78 78	ig	1.114	-0.01244	0.3594		
78 78	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594	0.3594	0.3594
 79	 р	1.114	-0.01244	0.3594	 	
	-					'

79	p	1.114	-0.01244	0.3594	Ţ	
79 79	p	1.114 1.114	-0.01244 -0.01244	0.3594	0.3594	0.3594
79 79	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594 0.3594		
1 79	ig	1.114		0.3594	1	1
79	ig	1.114	-0.01244	0.3594	i	İ
79	ig	1.114	-0.01244	0.3594	1	1
79 79	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594 0.3594		
79		1.114		0.3594	l I	
79	ig	1.114	-0.01244	0.3594	İ	i
79	ig	1.114		0.3594	Į.	!
79 79	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594 0.3594	 0.3594	 0.3594
80	l p	1.114	-0.01244	0.3594	I	ļ
80	p	1.114		0.3594		1
80 80	q q	1.114 1.114	-0.01244 -0.01244	0.3594 0.3594	 0.3594	 0.3594
	·					
 I 80	ig	 1.114	 -0.01244	0.3594	 	·
80	ig	1.114	-0.01244	0.3594	İ	İ
80	ig	1.114	-0.01244	0.3594	1	1
80	ig	1.114	-0.01244	0.3594	Į.	1
80 80	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594 0.3594	l I	1
80		1.114		0.3594	İ	İ
80	ig	1.114		0.3594	1	1
80	ig	1.114		0.3594		
80 80	ig ig	1.114 1.114	-0.01244 -0.01244	0.3594 0.3594	I I	1
80	ig	1.114	-0.01244	0.3594	0.3594	0.3594
81	 р	1.329	-0. 2285	0.3345	 	
81	p	0.9956	-0.2684	0.3412	İ	i
81	p	1.296	0.01628	0.3457		
81	р 	1.016	0.147	0.3518	0.3518	0.3433
81	 ig	 0.8289	0.1804	0.316	 	
81	ig	0.8173		0.3181	İ	İ
81	ig	0.9072	0.09116	0.3389	1	1
81		0.9131	0.05738	0.3409		1
81 81	ig ig	0.9269 1.208	0.107 0.2332	0.3419 0.3477	l I	
81	ig	1.261	-0.1137	0.3485	i	İ
81	ig	0.9701		0.3503	Į.	1
81		0.9886	-0.08807 -0.1319	0.3514		1
81 81	ig ig	1.198 1.124	0.09032	0.3537 0.358	I I	1
81	ig	1.094	-0.003841	0.3593	0.3593	0.3437
82	 р	1.016	0.147	0.3518		
82	l p	1.198	-0.1319	0.3537	1	1
82 82	p p	1.124 1.094	0.09032 -0.003841	0.358 0.3593	 0.3593	 0.3557
	·				1 0.3333	
82	ig	1.016	-0.1319	0.3525	 	
82	ig	1.198	0.147	0.3531	1	1

82 82 82 82 82 82 82 82	ig ig ig ig ig ig ig ig	1.016 1.198 1.016 1.094 1.124 1.198 1.094 1.124 1.094 1.124	0.09032 0.09032 -0.003841 0.147 0.147 -0.003841 -0.1319 -0.1319 0.09032 -0.003841	0.3541 0.355 0.3555 0.3558 0.3559 0.3562 0.3565 0.3566 0.358 0.3593	 0.3593	
83 83 83 83	p p p	1.094 1.124 1.094 1.124	·	0.358 0.358 0.3593 0.3593	 0.3593	 0.3587
83 83 83 83 83 83 83 83	ig ig	1.094 1.094 1.094 1.124 1.124 1.124 1.094 1.094 1.094 1.124 1.124 1.124	-0.003841 -0.003841	0.358 0.358 0.358 0.358 0.358 0.358 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593	0.3593	0.3587
84 84 84 84	p p p	1.124 1.124 1.124 1.124	-0.003841 -0.003841 -0.003841 -0.003841	0.3593 0.3593 0.3593 0.3593	 0.3593	
84 84 84 84 84 84 84 84	ig ig ig ig ig ig ig ig	1.124 1.124 1.124 1.124 1.124 1.124 1.124 1.124 1.124 1.124 1.124	-0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841	0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593	0.3593	0.3593
85 85 85 85	p p p	1.124 1.124 1.124 1.124	-0.003841 -0.003841 -0.003841 -0.003841	0.3593 0.3593 0.3593 0.3593	 0.3593	
85 85 85 85 85 85 85 85	ig ig ig ig ig ig ig ig	1.124 1.124 1.124 1.124 1.124 1.124 1.124 1.124 1.124 1.124	-0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841 -0.003841	0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593 0.3593		

85 85	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	 		
85 	ig 	1.124	-0.003841	0.3593	0.3593 	0.3593	
86	p	1.124	-0.003841	0.3593		!	 !
86 86	p p	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	l I	l I	
86	p	1.124	-0.003841	0.3593	0.3593	0.3593	
86 86	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	I		
86	ig	1.124	-0.003841	0.3593	l I	l I	
86	ig	1.124		0.3593	i	İ	i
86	ig	1.124	·	0.3593	i		i
86	ig	1.124	-0.003841	0.3593	İ		i
86	ig	1.124	-0.003841	0.3593			
86	ig	1.124		0.3593			- 1
86	ig	1.124		0.3593			
86	ig	1.124		0.3593			!
86 86	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	0.3593	1 0.3593	l I
			·				
87	l p	1.124	-0.003841	0.3593	!		!
87	p	1.124	-0.003841	0.3593			
87 87	p	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	0.3593	1 0.3593	1
	q 	1.124					
 87	ig	1.124	-0.003841	0.3593			 I
87	ig	1.124	-0.003841	0.3593	į	İ	i
87	ig	1.124		0.3593			- 1
87	ig	1.124	-0.003841	0.3593			- 1
87	ig	1.124	-0.003841	0.3593			- 1
87	ig	1.124	-0.003841	0.3593			- 1
87	ig	1.124		0.3593			- !
87 87	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593		l	
87	ig	1.124	-0.003841	0.3593			
87	ig	1.124	-0.003841		İ		i
87	ig	1.124		0.3593	0.3593	0.3593	İ
88	 I р	1.124	 -0.003841	0.3593	 		 I
88	p	1.124		0.3593	i	i	i
88	l 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 88	ig ig	1.124 1.124		0.3593 0.3593	l I	l I	1
88	ig	1.124	•	0.3593	 	 	1
88	ig	1.124		0.3593	i		
88	ig	1.124	-0.003841		i	i	i
88	ig	1.124	-0.003841	0.3593	1		İ
88	ig	1.124		0.3593			1
88	ig	1.124		0.3593	1		- 1
88	ig	1.124		0.3593		ļ	1
88	ig	1.124		0.3593			!
88 	ig 	1.124 	-0.003841 	0.3593 	0.3593 	0.3593	
89	l p	1.124	-0.003841	0.3593	1	1	1

89 89	p p	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	 	
89	p	1.124	-0.003841	0.3593	0.3593	0.3593
89	ig	1.124 1.124	-0.003841	0.3593		1
89 89	ig ig	1.124	-0.003841 -0.003841	0.3593		l I
89	ig	1.124	-0.003841	0.3593	i	i
89 89	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593		
89	ig	1.124	-0.003841	0.3593	I I	
89	ig	1.124	-0.003841	0.3593	Ì	Ì
89 89	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 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	l p	1.124	-0.003841	0.3593		Į.
90 90	q q	1.124 1.124	-0.003841 -0.003841	0.3593	0.3593	 0.3593
90	 ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593	Ì	Ì
90 90	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593		
90	ig	1.124	-0.003841	0.3593	1	1
90 90	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593		
1 90	ig	1.124	-0.003841	0.3593		l
90	ig	1.124	-0.003841	0.3593	1	1
90 90	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	 0.3593	0.3593
91	 p	 1.124	-0.003841	0.3593		
91	p	1.124	-0.003841	0.3593		
91	l p	1.124	-0.003841	0.3593	1	1
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	!	ļ.
91 91	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593		
91	ig	1.124	-0.003841	0.3593		
91	ig	1.124	-0.003841	0.3593	1	Į.
91 91	ig ig	1.124 1.124	-0.003841 -0.003841	0.3593 0.3593	I	I I
91	ig	1.124	-0.003841	0.3593		İ
91	ig	1.124	-0.003841	0.3593		
91	ig 	1.124	-0.003841	0.3593	0.3593 	0.3593
92	l p	1.397	0.1751	0.3254		ļ.
92	q q	1.383 1.179	0.06953 -0.2905	0.3307	I	I I
92	l p	0.9736	-0.03464	0.3508	0.3508	0.338
92	ig ig	1.416 1.385	-0.08996 -0.2114	0.3241 0.326	I	I I
					· ·	· ·

92 92 92 92 92 92 92 92	ig ig ig ig ig ig ig ig	0.8539 1.34 1.328 1.296 0.9441 1.236 0.9681 1.262 1.105 1.181	0.06848 0.2622 -0.2039 0.1955 -0.107 -0.223 0.1196 -0.07811 -0.1809 -0.09039	0.3278 0.3308 0.3359 0.3408 0.3448 0.3461 0.3478 0.3492 0.3542 0.3561	 0.3561	
93 93 93 93 93	p p p	1.262 0.9736 1.105 1.181	-0.07811 -0.03464 -0.1809 -0.09039	0.3492 0.3508 0.3542 0.3561	 0.3561	
93 93 93 93 93 93 93 93		0.9736 1.262 1.262 0.9736 1.262 0.9736 1.181 1.181 1.181 1.181 1.105 1.105	-0.1809 -0.1809 -0.09039 -0.09039 -0.03464 -0.07811 -0.1809 -0.07811 -0.03464 -0.09039 -0.07811 -0.03464		 	
94 94 94 94	p p p	1.181 1.105 1.105 1.105	-0.03464 -0.09039 -0.07811 -0.03464		 0.3592	
94 94 94 94 94 94 94 94	ig ig ig ig ig ig ig ig	1.181 1.181 1.181 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105	-0.09039 -0.07811 -0.03464 -0.09039 -0.07811 -0.07811 -0.03464 -0.03464 -0.03464 -0.03464	0.3561 0.3564 0.3571 0.3581 0.3581 0.3584 0.3592 0.3592 0.3592 0.3592 0.3592	0.3592	0.3582
95 95 95 95 95	p p p	1.105 1.105 1.105 1.105	-0.03464 -0.03464 -0.03464 -0.03464	0.3592 0.3592 0.3592 0.3592	 0.3592	
95 95 95 95 95 95 95 95		1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105	-0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464	0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592		

95	ig	1.105	-0.03464	0.3592	ļ	!!!!
95 95	ig ig	1.105 1.105	-0.03464 -0.03464	0.3592 0.3592	 0.3592	0.3592
96	 р	1.105	-0.03464	0.3592		
96	l p	1.105	-0.03464	0.3592	<u> </u>	<u> </u>
96	l 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		1
96	ig	1.105	-0.03464	0.3592		
96	l ig	1.105	-0.03464	0.3592	ļ.	! !
96	ig	1.105	-0.03464	0.3592		
96 96	ig ig	1.105 1.105	-0.03464 -0.03464	0.3592 0.3592	l I	1
96	ig	1.105	-0.03464	0.3592	i	
96	ig	1.105	-0.03464	0.3592	i	i
96	ig	1.105	-0.03464	0.3592	İ	i i
96	ig	1.105	-0.03464	0.3592		1
96 	ig 	1.105	-0.03464	0.3592 	0.3592	0.3592
97	l p	1.105	-0.03464	0.3592	1	1
97	l p	1.105	-0.03464	0.3592	i	i i
97	l p	1.105	-0.03464	0.3592		1
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	i	i
97	l ig	1.105	-0.03464	0.3592	i	i i
97	ig	1.105	-0.03464	0.3592		1
97	ig	1.105	-0.03464	0.3592	1	<u> </u>
97	ig	1.105	-0.03464	0.3592		
97 97	ig	1.105 1.105	-0.03464 -0.03464	0.3592 0.3592	l	
97	ig ig	1.105	-0.03464	0.3592	l I	I I
97	ig	1.105	-0.03464	0.3592		
97	ig	1.105	-0.03464	0.3592	i	i i
97 	ig 	1.105	-0.03464	0.3592	0.3592	0.3592
98	 р	1.105	-0.03464	0.3592	1	
98	l p	1.105	-0.03464		1	1
98	l p	1.105	-0.03464	0.3592		1
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	i	i
98	ig	1.105	-0.03464	0.3592	1	i i
98	ig	1.105	-0.03464	0.3592	1	<u> </u>
98	ig	1.105	-0.03464	0.3592		
98	ig	1.105	-0.03464	0.3592	1	
98 98	ig ig	1.105 1.105	-0.03464 -0.03464	0.3592 0.3592	I	
98	ig	1.105	-0.03464	0.3592	1	
98	ig	1.105	-0.03464	0.3592	i	
98	ig	1.105	-0.03464	0.3592	i	; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;
98	ig	1.105	-0.03464	0.3592	0.3592	0.3592
99	p	1.105	-0.03464	0.3592	1	

	99 99 99	p	1.105 1.105 1.105	-0.03464 -0.03464 -0.03464	0.3592 0.3592 0.3592	 0.3592	 0.3592 	
	99 99 99 99 99 99 99 99 99	ig	1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105	-0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464 -0.03464	0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592 0.3592	 	 	
	100 100 100 100	result result result result	1.105 1.105 1.105 1.105	-0.03464 -0.03464 -0.03464 -0.03464	0.3592 0.3592 0.3592 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 penoзиторий github: https://github.com/DarthBarada/TSISA RK3

3. Графическая часть

1) Для 10 поколений

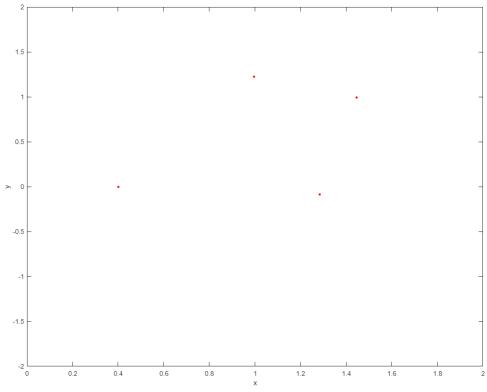


Рисунок 1 – поколение 0

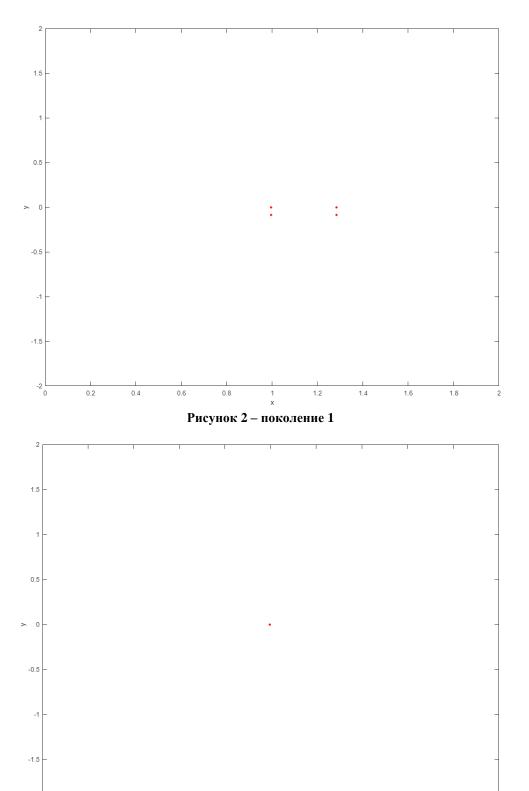


Рисунок 3 - поколения 2-10

2) Для 100 поколений

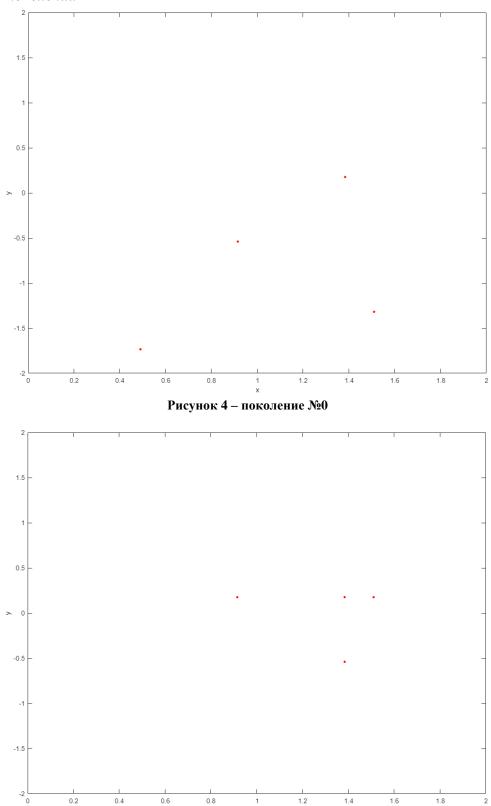


Рисунок 5 - поколение №1

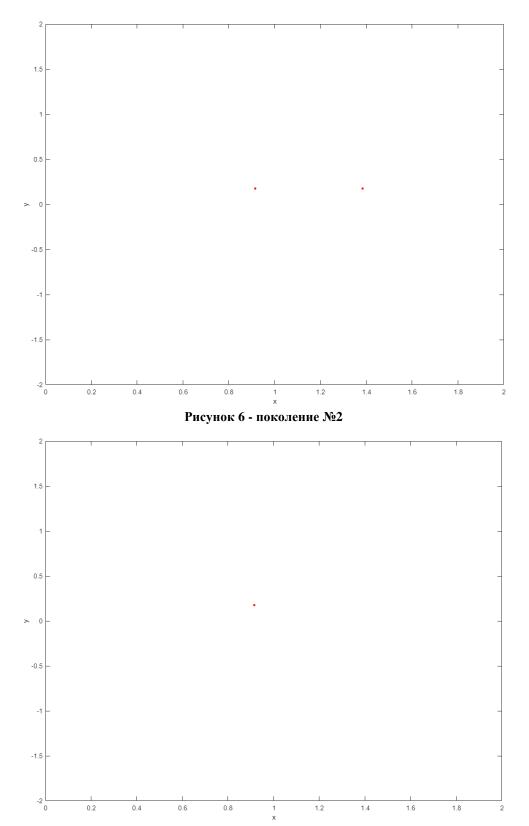


Рисунок 7 поколения №3-11

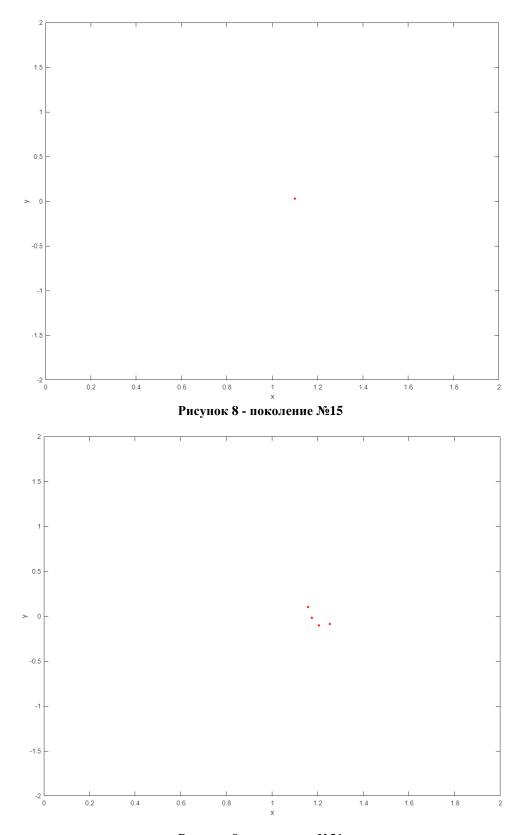


Рисунок 9 - поколение №31

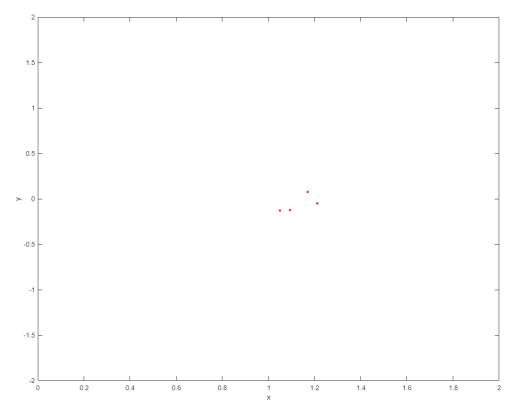


Рисунок 10 - поколение №52

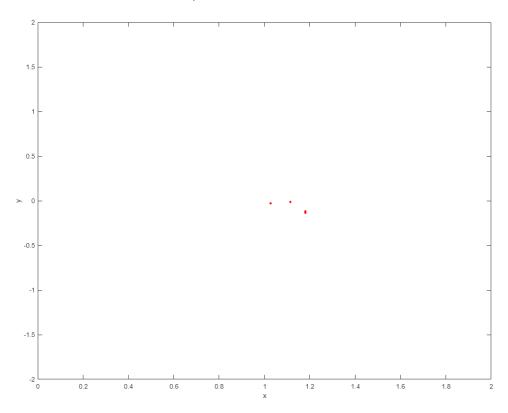


Рисунок 11 - поколение №73

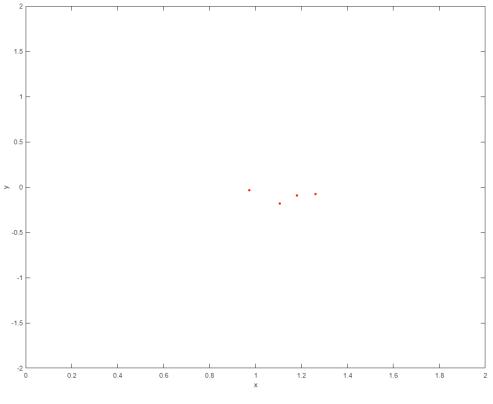


Рисунок 12 - поколение №93

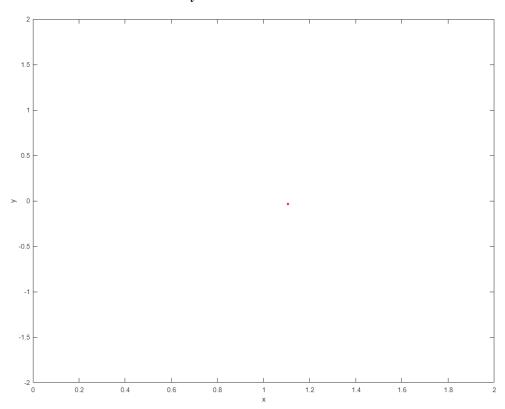


Рисунок 13 - поколение №100

4. Выводы

B процессе выполнения рубежного контроля я изучил метод поиска экстремума функции с помощью генетического алгоритма. B 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

Файл GeneticAlg.h

```
#pragma once
#include <map>
#include <random>
#include <iostream>
#include <iomanip>
#include <string>
struct point
       {
              double x; // Координата х
              double y; // Координата у
              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 х и у
              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</pre>
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)</pre>
                     {
                            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 (х1,у1) - координаты 1 родителя, (х2,у2) - 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)</pre>
                            parents.erase(parents.begin());
                     }
              std::cout<<"";</pre>
       }
void GeneticAlgorithm::mutation()
       {
                     Заметка:
                     Мутация в данной реализации генного алгоритма выглядит следующим
образом:
```

```
берется координата точки х и рандомно сдвигается и также с у
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)</pre>
                                          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)</pre>
                                          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)</pre>
                                   {
                                          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)</pre>
                                          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";</pre>
              for (size t iteration = 1u;iteration <= max generations - 1u ;++iteration)</pre>
                             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";</pre>
              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<<" ";</pre>
                             for (int index = 1;index < 85;++index)</pre>
                                            std::cout<<"-";</pre>
                             std::cout<<"\n";</pre>
                      }
              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;</pre>
                                                                                         }
              );
              for (auto tochka = multimap.begin();tochka != multimap.end();++tochka)
                     {
                             std::cout<<std::left<<std::setprecision(4)<<"</pre>
"<<std::setw(9)<<genereation<<"|"<<std::setw(6)<<' '+prefix<<" | "<<std::setw(10)<<tochka-
>second.x<<"\int "<<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-</pre>
>first<<" | "<<std::setw(10)<<average<<" |";</pre>
                                      {
                                              std::cout<<" | "<<std::setw(10)<<"
                                                                                              "<<"
"<<std::setw(10)<<"
                                      }
                               std::cout<<"\n";</pre>
                       }
               if (border)
                       {
                               std::cout<<" ";</pre>
                               for (int index = 1;index < 85;++index)</pre>
                                              std::cout<<"-";</pre>
                               std::cout<<"\n";</pre>
                       }
         }
```