Politechnika Krakowska

Wydział Informatyki i Telekomunikacji

Studia Stacjonarne

Sprawozdanie z przedmiotu:

Obliczenia ewaluacyjne

Temat Projektu:

Implementacja klasycznego algorytmu genetycznego

Wykonali:

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1. Technologie

Do wykonania projektu wykorzystaliśmy język Python i biblioteki tj.:

- tkinter
- matplotlib
- numpy
- time
- benchmark_functions
- opfunu.cec_based.cec2014

2. Wymagania środowiska do uruchomienia aplikacji

Do uruchomienia aplikacji należy mieć zainstalowanego pythona i biblioteki:

- tkinter
- matplotlib
- numpy
- time
- benchmark_functions
- opfunu.cec_based.cec2014

Proces instalacji:

git clone https://github.com/Zubbek/Classic_Genetic_Algorithm.git

cd Classic_Genetic_Algorithm
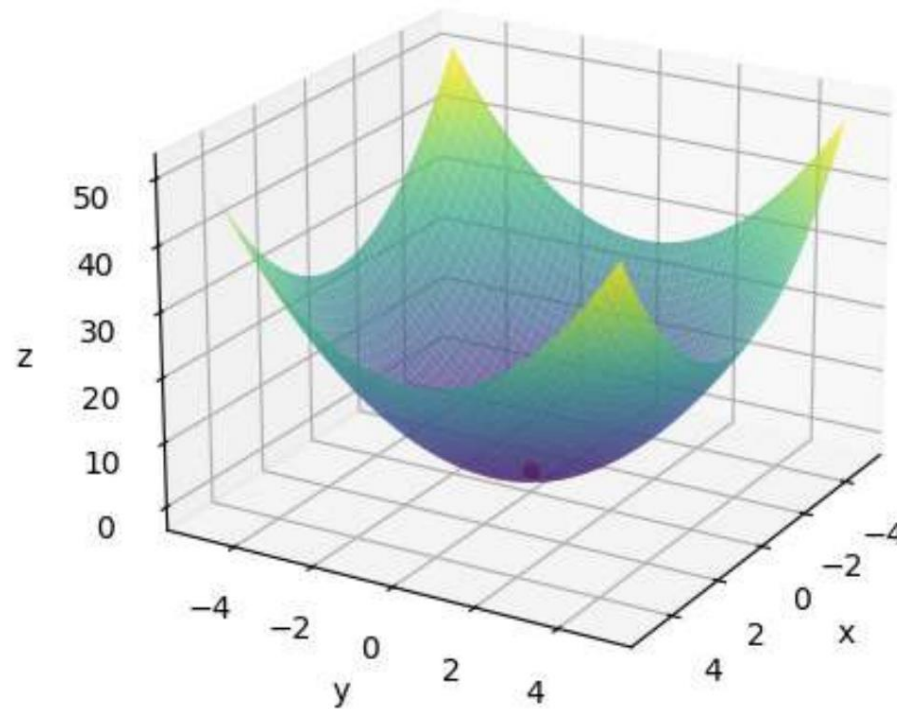
pip install -r requirements.txt

Uruchomienie:

python ./Gui.py

3. Wybrane funkcje
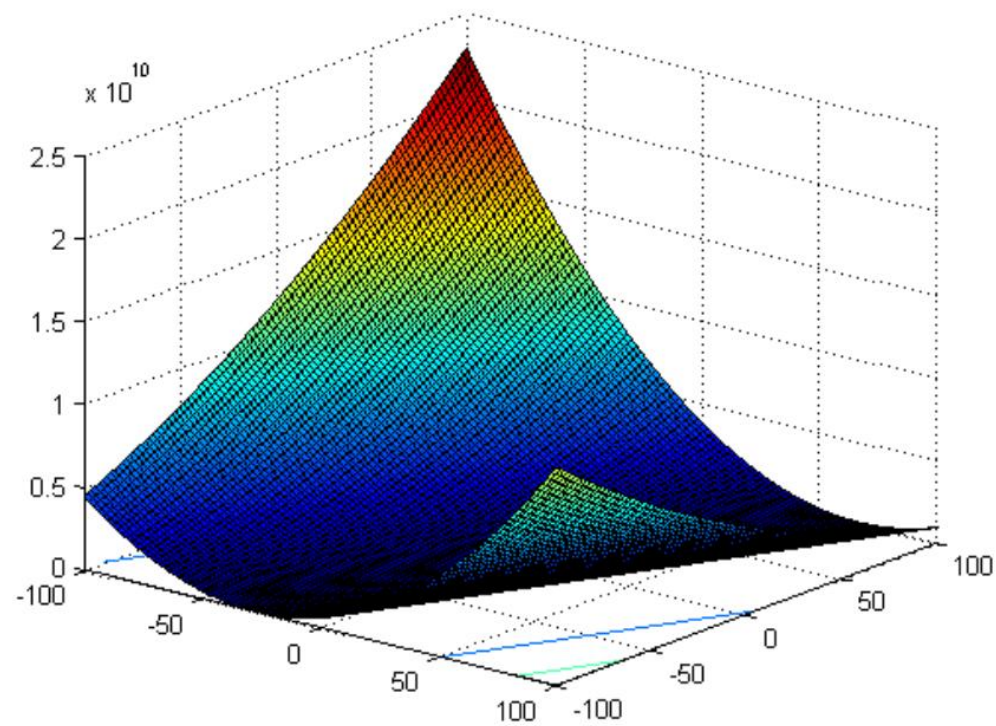
3.1.Hypersphere
   a.Zakres poszukiwań [-5, 5]
   b.Wykres

   c.Globalne minimum równe 0.0 w punkcie [0.0, 0.0]
   d.Maksimum globalne w punktach [-5.0, -5.0], [5.0,5.0], [-5.0, 5.0], [5.0,-5.0] dla 10 zmiennych to 250

3.2.Rotated High Conditioned Elliptic Function
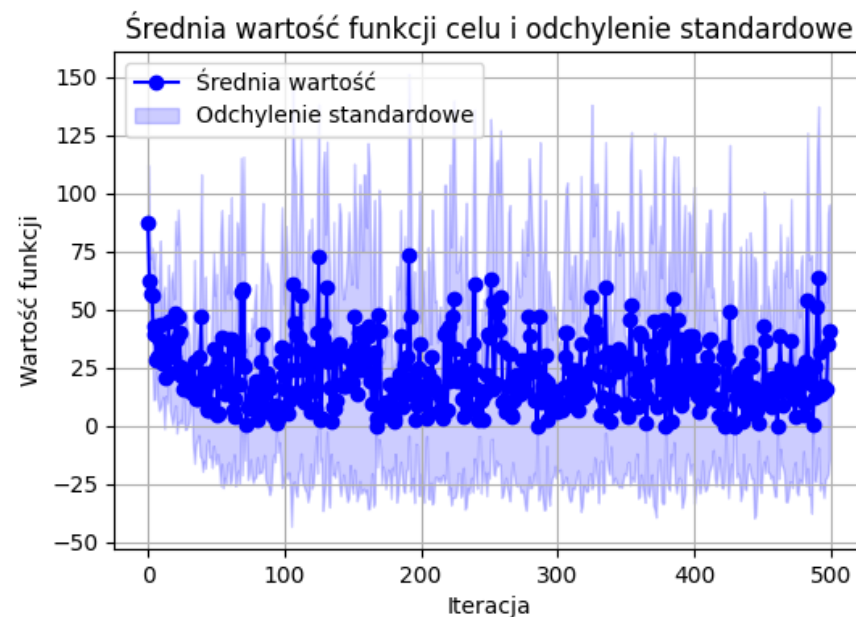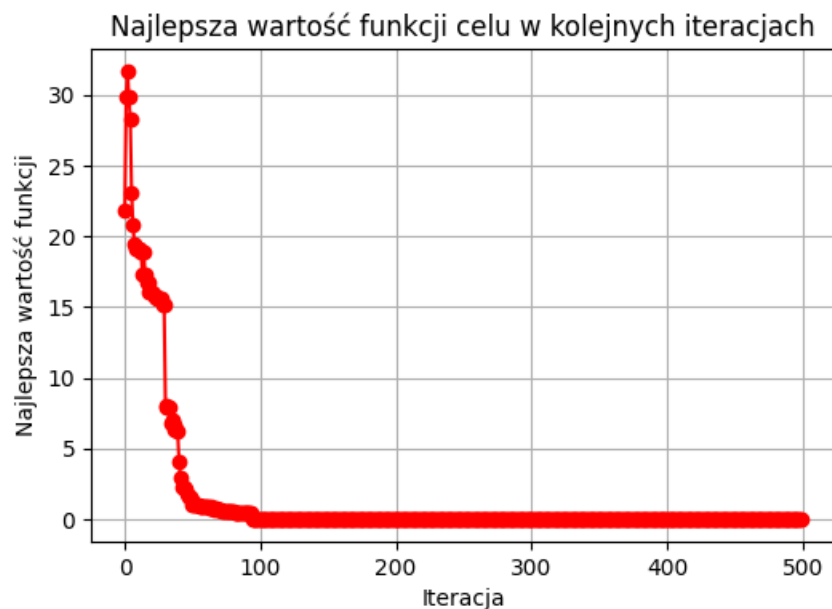   a.Zakres poszukiwań [-50, 100]
   b.Wykres

4. Testy – Hypersphere

Podstawowa konfiguracja uruchamiania. W testach będzie zmianiane tylko selection method, cross method, i mutation method.

4.1. Minimum

Wykresy dla wartości: [Solution method: Bestsolution, Cross method: Granular crossover, Mutation method: Boundary]

Selection Method	Cross Method	Mutation Method	Średni czas	Średni Fitness	Najlepszy Fitness	Najgorszy Fitness	Najlepszy czas	Najgorszy czas	Błąd
Roulette Wheel	One-Point	Boundary	2,4554	0,001322006	1,51E-05	0,006084328	2,4142	2,541	1,51E-05
Roulette Wheel	One-Point	One-Point	2,9497	0,001253527	9,13E-06	0,006073896	2,6863	3,216	9,13E-06
Roulette Wheel	One-Point	Two-Point	3,7723	0,000245713	6,15E-06	0,000855617	2,8895	5,3441	6,15E-06
Roulette Wheel	Two-Point	Boundary	3,4515	2,22E-05	2,42E-06	5,61E-05	3,025	4,034	2,42E-06
Roulette Wheel	Two-Point	One-Point	3,346	9,80E-05	6,15E-06	0,000412254	3,1371	3,6644	6,15E-06
Roulette Wheel	Two-Point	Two-Point	4,2901	0,000185281	2,42E-06	0,001509113	3,1756	5,6345	2,42E-06
Roulette Wheel	Uniform crossover	Boundary	5,2178	0,000148993	2,42E-06	0,00084146	4,1744	6,1172	2,42E-06
Roulette Wheel	Uniform crossover	One-Point	5,463	8,81E-05	3,91E-06	0,000373506	4,6333	6,69	3,91E-06

Roulette Wheel	Uniform crossover	Two-Point	5,3651	7,11E-05	1,68E-06	0,000298246	4,299	7,2318	1,68E-06
Roulette Wheel	Granular crossover	Boundary	5,5049	0,00017932	1,68E-06	0,001503152	3,1001	12,0036	1,68E-06
Roulette Wheel	Granular crossover	One-Point	3,3968	2,72E-05	2,42E-06	0,000111959	3,0094	4,8579	2,42E-06
Roulette Wheel	Granular crossover	Two-Point	3,6959	0,000709121	3,17E-06	0,006060483	2,9825	6,114	3,17E-06
Best solution	One-Point	Boundary	3,7253	0,000118814	1,51E-05	0,000483788	2,9526	4,8966	1,51E-05
Best solution	One-Point	One-Point	5,1316	0,04280095	2,48E-05	0,396821844	3,6117	6,9385	2,48E-05
Best solution	One-Point	Two-Point	4,7303	0,003565501	9,13E-06	0,026227941	3,6108	5,8502	9,13E-06
Best solution	Two-Point	Boundary	3,5471	0,0057008	5,40E-06	0,056401261	3,0876	5,0281	5,40E-06
Best solution	Two-Point	One-Point	3,9803	0,000230363	1,66E-05	0,000874991	3,3062	5,0472	1,66E-05
Best solution	Two-Point	Two-Point	4,026	0,001370962	4,94E-05	0,012281732	2,9536	5,295	4,94E-05
Best solution	Uniform crossover	Boundary	3,4149	0,000283715	9,31E-07	0,001505387	3,0518	4,2396	9,31E-07
Best solution	Uniform crossover	One-Point	3,6787	0,000741982	1,06E-05	0,003009843	2,958	4,9696	1,06E-05
Best solution	Uniform crossover	Two-Point	4,1845	0,000679688	2,92E-05	0,001965144	2,9803	6,712	2,92E-05
Best solution	Granular crossover	Boundary	3,2443	0,004327267	3,91E-06	0,036869415	2,9136	3,9695	3,91E-06
Best solution	Granular crossover	One-Point	3,2241	0,000716125	1,14E-05	0,006079857	3,0091	3,7947	1,14E-05
Best solution	Granular crossover	Two-Point	3,4826	0,005306318	1,81E-05	0,025852386	3,1182	4,0194	1,81E-05
Tournament	One-Point	Boundary	3,5986	0,000854574	8,81E-05	0,004972566	2,5622	4,4341	8,81E-05
Tournament	One-Point	One-Point	3,7642	0,014753913	4,71E-05	0,105072904	2,6356	4,9934	4,71E-05
Tournament	One-Point	Two-Point	3,4946	0,017172443	0,000107488	0,097695184	2,922	5,2937	0,000107488
Tournament	Two-Point	Boundary	3,762	0,001360828	2,25E-05	0,006187159	3,1769	4,3953	2,25E-05
Tournament	Two-Point	One-Point	3,8861	0,009943231	0,000274401	0,054824525	2,6018	5,2857	0,000274401
Tournament	Two-Point	Two-Point	3,5449	0,001027672	0,000107488	0,003518035	2,6319	4,576	0,000107488
Tournament	Uniform crossover	Boundary	4,404	0,001043842	1,88E-05	0,003816094	3,0376	5,3293	1,88E-05
Tournament	Uniform crossover	One-Point	5,0917	0,001588471	7,54E-05	0,007602197	4,474	6,4069	7,54E-05
Tournament	Uniform crossover	Two-Point	5,4887	0,002129897	2,11E-05	0,014178882	4,6002	7,0292	2,11E-05
Tournament	Granular crossover	Boundary	4,709	0,000709196	1,66E-05	0,003932338	3,6041	9,4138	1,66E-05

	Granular crossover	One-Point	3,6443	0,001919914	0,000102272	0,014212413	3,0978	3,9492	0,000102272
Tournament									
Tournament	Granular crossover	Two-Point	3,8386	0,001801062	6,20E-05	0,006085073	3,3882	4,2964	6,20E-05

4.2. Maximum

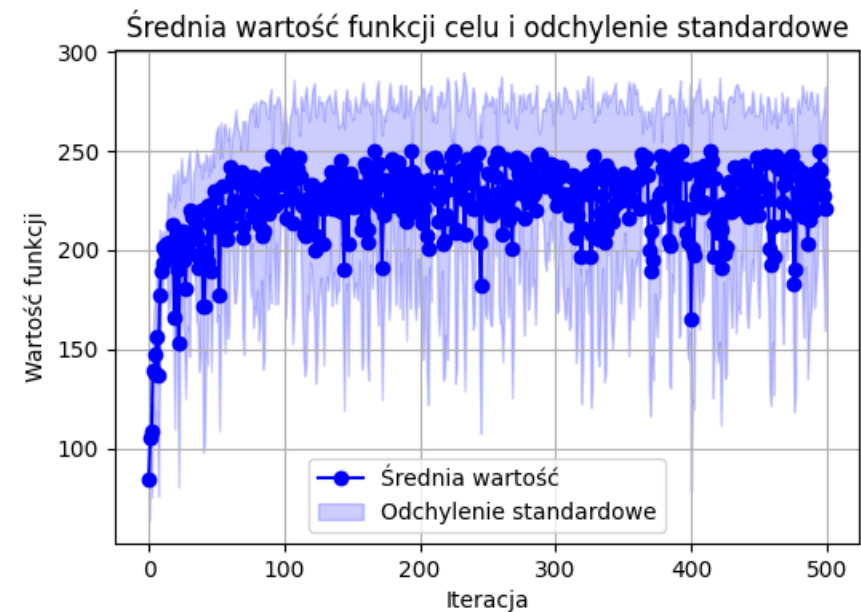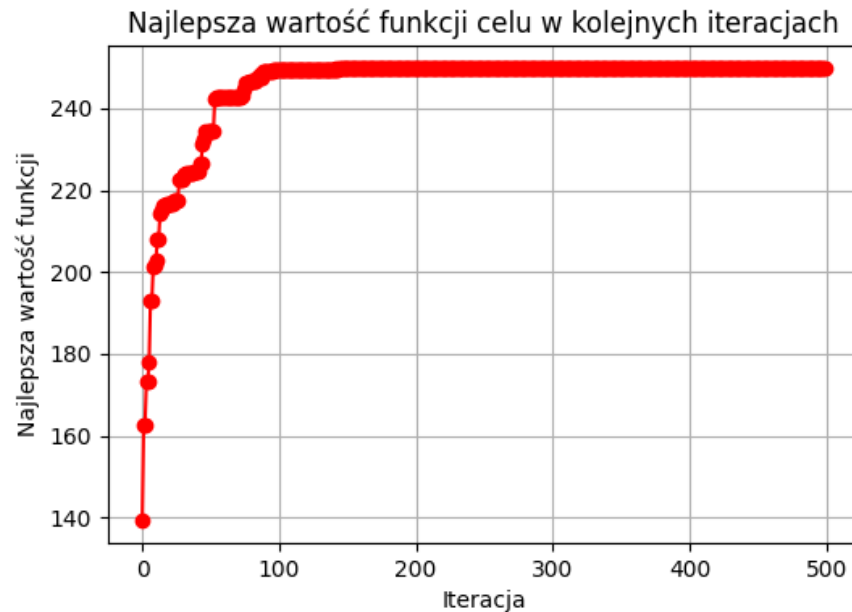Wykresy dla wartości: [Solution method: Bestsolution, Cross method: Granular crossover, Mutation method: Boundary]

Selection Method	Cross Method	Mutation Method	Średni czas	Średni Fitness	Najgorszy Fitness	Najlepszy Fitness	Najlepszy czas	Najgorszy czas	Błąd
Roulette Wheel	One-Point	Boundary	2,6755	249,9927	249,9878	250	2,349	3,6227	0
Roulette Wheel	One-Point	One-Point	3,3531	249,9957	249,9878	250	2,5824	4,1684	0
Roulette Wheel	One-Point	Two-Point	3,897	249,9872	249,9512	250	2,8249	5,2224	0
Roulette Wheel	Two-Point	Boundary	5,0476	249,9945	249,9756	250	3,8867	7,0265	0
Roulette Wheel	Two-Point	One-Point	5,8745	249,9963	249,9878	250	4,3506	12,4403	0
Roulette Wheel	Two-Point	Two-Point	5,5104	249,9951	249,9756	250	3,8408	7,4499	0
Roulette Wheel	Uniform crossover	Boundary	4,7475	249,9902	249,9634	250	3,7975	6,9417	0

Roulette Wheel	Uniform crossover	One-Point	3,5741	249,9939	249,9817	250	3,1242	4,2255	0
Roulette Wheel	Uniform crossover	Two-Point	3,5183	249,9927	249,9695	250	3,1407	4,0098	0
Roulette Wheel	Granular crossover	Boundary	3,381	249,964	249,7683	250	3,0659	3,8401	0
Roulette Wheel	Granular crossover	One-Point	3,2064	249,9921	249,9756	250	2,872	3,7407	0
Roulette Wheel	Granular crossover	Two-Point	3,2725	249,9829	249,9451	250	2,9419	3,6902	0
Best solution	One-Point	Boundary	3,2026	249,7488	249,2876	249,9268	2,8943	3,5812	0,0732
Best solution	One-Point	One-Point	3,4663	249,6812	249,4766	249,8719	3,1479	3,7965	0,1281
Best solution	One-Point	Two-Point	3,9615	249,5443	248,4591	249,8657	3,2593	4,7395	0,1343
Best solution	Two-Point	Boundary	3,1357	249,8165	249,5986	249,9268	2,8989	3,4936	0,0732
Best solution	Two-Point	One-Point	3,6466	249,7817	249,5857	249,8597	3,269	4,0782	0,1403
Best solution	Two-Point	Two-Point	4,9902	249,7958	249,5681	249,9756	3,6015	6,1337	0,0244
Best solution	Uniform crossover	Boundary	5,0762	249,8671	249,555	249,9817	3,5156	8,638	0,0183
Best solution	Uniform crossover	One-Point	3,8426	249,7707	249,4515	249,9695	3,3126	5,1236	0,0305
Best solution	Uniform crossover	Two-Point	3,2589	249,7818	249,4278	249,939	3,0467	3,4536	0,061
Best solution	Granular crossover	Boundary	3,1515	249,858	249,4218	249,9695	2,9438	3,3931	0,0305
Best solution	Granular crossover	One-Point	3,1973	249,6228	249,1698	249,9329	2,8557	3,4867	0,0671
Best solution	Granular crossover	Two-Point	3,3487	249,7353	249,1027	249,9268	3,0861	3,6223	0,0732
Tournament	One-Point	Boundary	3,6878	249,4943	248,6556	249,8657	3,1947	7,0085	0,1343
Tournament	One-Point	One-Point	4,4725	249,4597	248,9114	249,8109	3,2505	7,5456	0,1891
Tournament	One-Point	Two-Point	3,8676	249,3425	248,6789	249,7255	3,1673	4,2611	0,2745
Tournament	Two-Point	Boundary	3,622	249,487	248,6647	249,9329	2,6116	4,8175	0,0671
Tournament	Two-Point	One-Point	3,5625	249,4765	248,7007	249,8414	3,2519	3,812	0,1586
Tournament	Two-Point	Two-Point	3,5895	249,5163	248,7677	249,8658	3,2723	4,123	0,1342
Tournament	Uniform crossover	Boundary	3,962	249,7795	249,2089	249,939	3,4554	5,7174	0,061
Tournament	Uniform crossover	One-Point	4,2915	249,4751	248,5613	249,9451	3,3353	5,8563	0,0549

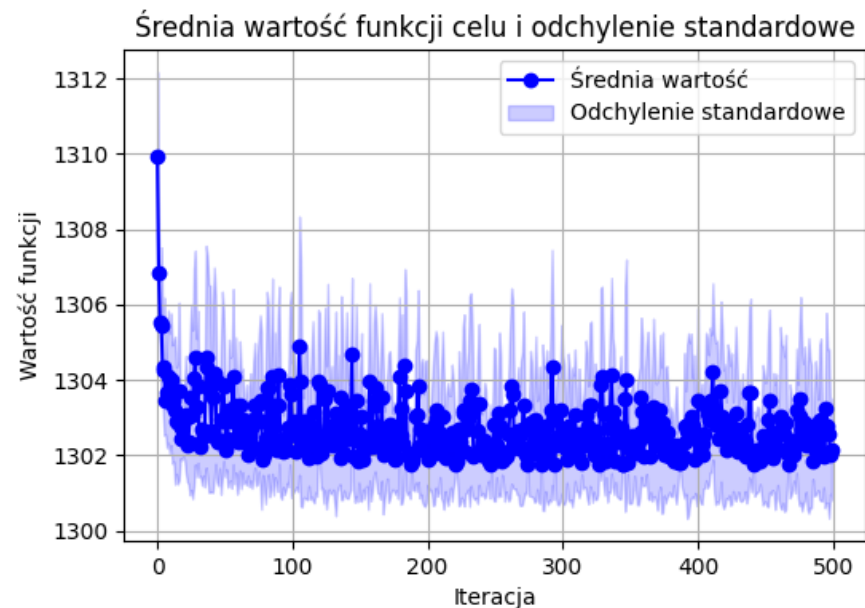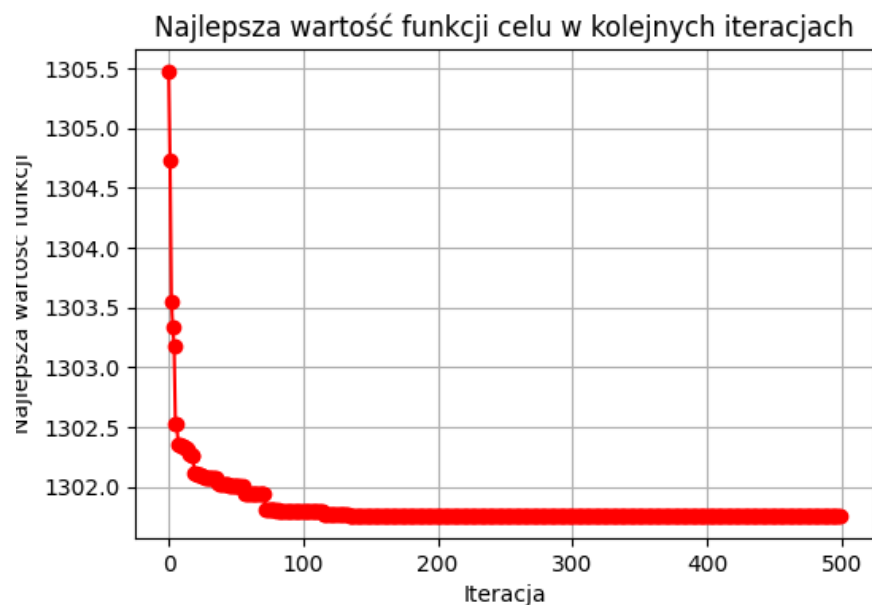|									
Tournament	Uniform crossover	Two-Point	3,715	249,6457	249,0844	249,9024	3,2993	5,1525	0,0976
Tournament	Granular crossover	Boundary	3,6738	249,7281	249,4638	249,8963	3,0254	4,978	0,1037
Tournament	Granular crossover	One-Point	4,2596	249,667	249,4574	249,8719	3,1973	5,7794	0,1281
Tournament	Granular crossover	Two-Point	3,6042	249,4417	248,7013	249,8658	3,253	4,1657	0,1342

5. Testy – Shifted and Rotated HappyCat Function

Podstawowa konfiguracja uruchamiania. W testach będzie zmieniane tylko selection method, cross method, i mutation method.

5.1. Minimum

Wykresy dla wartości: [Solution method: Bestsolution, Cross method: Granular crossover, Mutation method: Boundary]

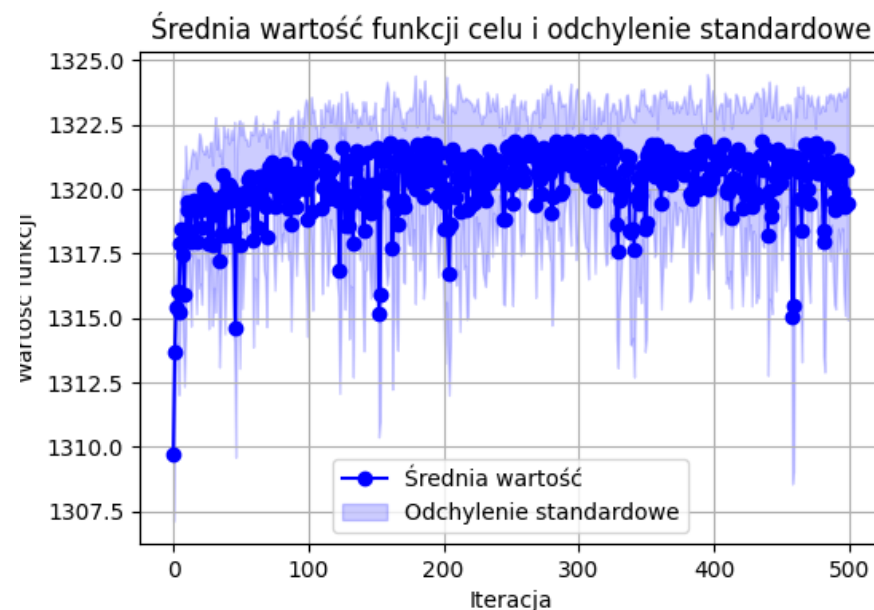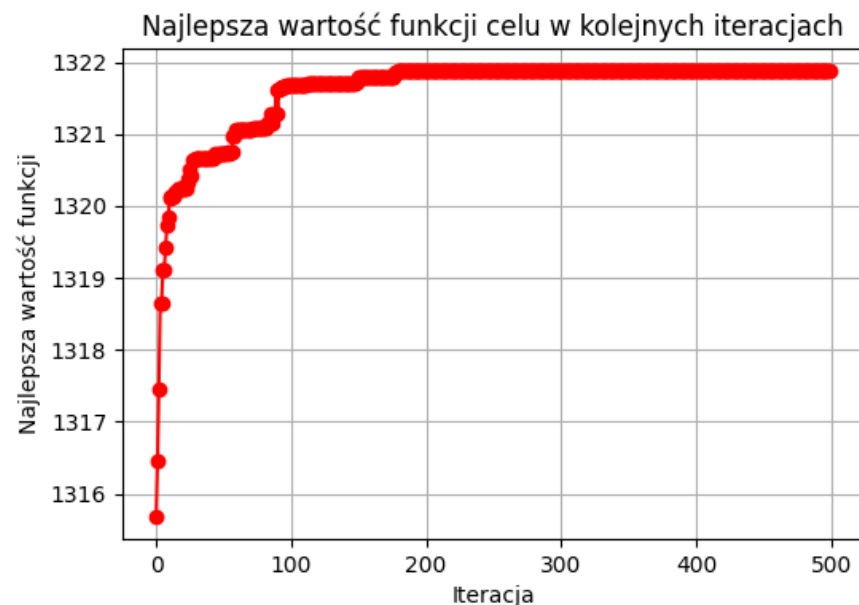Najlepsza wartość funkcji celu w kolejnych iteracjach

Średnia wartość funkcji celu i odchylenie standardowe

Selection Method	Cross Method	Mutation Method	Średni czas	Średni Fitness	Najlepszy Fitness	Najgorszy Fitness	Najlepszy czas	Najgorszy czas
Roulette Wheel	One-Point	Boundary	5,0493	1301,7959	1301,7586	1301,9291	4,8123	5,5757
Roulette Wheel	One-Point	One-Point	5,9589	1301,7781	1301,7601	1301,902	4,9333	8,1777
Roulette Wheel	One-Point	Two-Point	5,0446	1301,785	1301,7594	1301,9148	4,8777	5,2896
Roulette Wheel	Two-Point	Boundary	5,0558	1301,7674	1301,7589	1301,7927	5,0219	5,1064
Roulette Wheel	Two-Point	One-Point	5,0662	1301,7666	1301,7585	1301,7812	5,0272	5,1348
Roulette Wheel	Two-Point	Two-Point	5,0957	1301,8122	1301,7639	1301,9531	5,0169	5,1703
Roulette Wheel	Uniform crossover	Boundary	5,3743	1301,8628	1301,7728	1302,1392	5,2028	5,5564
Roulette Wheel	Uniform crossover	One-Point	5,8216	1301,7688	1301,7584	1301,788	5,3101	6,9685
Roulette Wheel	Uniform crossover	Two-Point	5,4924	1301,7864	1301,7584	1301,9537	5,2997	5,6807
Roulette Wheel	Granular crossover	Boundary	5,5087	1302,5013	1301,9124	1303,9844	5,226	6,9401
Roulette Wheel	Granular crossover	One-Point	5,3319	1301,7812	1301,7593	1301,8987	5,2536	5,4286
Roulette Wheel	Granular crossover	Two-Point	5,2666	1301,8042	1301,7592	1301,8958	5,1693	5,3944
Best solution	One-Point	Boundary	4,9177	1301,7611	1301,7583	1301,772	4,8167	5,0639

Best solution	One-Point	One-Point	5,0587	1301,7769	1301,7584	1301,8934	4,9343	5,4264
Best solution	One-Point	Two-Point	4,9834	1301,764	1301,7587	1301,7789	4,8835	5,1943
Best solution	Two-Point	Boundary	5,6341	1301,7787	1301,7583	1301,8977	5,0625	7,9235
Best solution	Two-Point	One-Point	5,206	1301,7789	1301,7583	1301,9095	5,1226	5,3772
Best solution	Two-Point	Two-Point	5,2584	1301,7955	1301,7583	1301,9536	5,0041	5,9267
Best solution	Uniform crossover	Boundary	5,3255	1301,7629	1301,7583	1301,7861	5,1701	5,5436
Best solution	Uniform crossover	One-Point	5,2743	1301,7632	1301,7583	1301,7789	5,1876	5,3681
Best solution	Uniform crossover	Two-Point	5,2986	1301,7635	1301,7583	1301,7762	5,2069	5,4632
Best solution	Granular crossover	Boundary	5,3256	1301,7673	1301,7588	1301,7877	5,1021	5,8877
Best solution	Granular crossover	One-Point	5,3264	1301,7613	1301,7584	1301,7651	5,2442	5,4119
Best solution	Granular crossover	Two-Point	5,2977	1301,7653	1301,7585	1301,7791	5,2118	5,5775
Tournament	One-Point	Boundary	5,2352	1301,7634	1301,7584	1301,7761	5,1508	5,3024
Tournament	One-Point	One-Point	5,2147	1301,7622	1301,7584	1301,7699	5,1523	5,2672
Tournament	One-Point	Two-Point	5,2645	1301,7635	1301,7583	1301,7799	5,1566	5,5139
Tournament	Two-Point	Boundary	5,309	1301,7931	1301,7584	1301,8974	5,2663	5,4041
Tournament	Two-Point	One-Point	5,3379	1301,7765	1301,7583	1301,9067	5,2268	5,597
Tournament	Two-Point	Two-Point	5,2967	1301,7651	1301,7583	1301,7789	5,1809	5,6238
Tournament	Uniform crossover	Boundary	5,5658	1301,7634	1301,7583	1301,7826	5,5123	5,6514
Tournament	Uniform crossover	One-Point	5,611	1301,7755	1301,7583	1301,8968	5,5358	5,709
Tournament	Uniform crossover	Two-Point	5,5519	1301,7687	1301,7583	1301,7791	5,4771	5,6348
Tournament	Granular crossover	Boundary	5,5568	1301,7694	1301,7584	1301,8274	5,4042	5,9423
Tournament	Granular crossover	One-Point	5,5927	1301,7753	1301,7583	1301,8756	5,5004	5,8384
Tournament	Granular crossover	Two-Point	5,573	1301,7607	1301,7583	1301,7766	5,513	5,6821

5.2. Maximum

Wykresy dla wartości: [Solution method: Bestsolution, Cross method: Granular crossover, Mutation method: Boundary]

Metoda Selekcji	Metoda Krzyżowania	Metoda Mutacji	Średni czas	Średni Fitness	Najgorszy Fitness	Najlepszy Fitness	Najlepszy czas	Najgorszy czas
Roulette Wheel	One-Point	Boundary	5,9352	1321,6675	1321,2691	1321,8765	4,9944	8,0372
Roulette Wheel	One-Point	One-Point	5,6837	1321,6897	1321,2032	1321,9057	4,8623	8,331
Roulette Wheel	One-Point	Two-Point	5,8659	1321,8216	1321,2964	1321,907	5,3772	7,935
Roulette Wheel	Two-Point	Boundary	8,1555	1321,6547	1321,1913	1321,9061	5,545	8,7346
Roulette Wheel	Two-Point	One-Point	9,0727	1321,615	1320,9584	1321,9116	8,4996	9,6193
Roulette Wheel	Two-Point	Two-Point	6,3416	1321,7815	1321,4961	1321,9085	5,1073	9,2312
Roulette Wheel	Uniform crossover	Boundary	8,2513	1321,4366	1319,7204	1321,8769	7,7591	9,0588
Roulette Wheel	Uniform crossover	One-Point	8,064	1321,7458	1320,9164	1321,911	7,6849	8,5104

Roulette Wheel	Uniform crossover	Two-Point	8,1251	1321,7905	1321,5807	1321,9078	7,8168	9,0332
Roulette Wheel	Granular crossover	Boundary	7,9059	1320,7692	1319,9573	1321,4254	7,7395	8,1263
Roulette Wheel	Granular crossover	One-Point	7,7623	1321,769	1321,3937	1321,9036	7,1062	8,1
Roulette Wheel	Granular crossover	Two-Point	7,7988	1321,7163	1321,4876	1321,9099	7,374	8,4878
Best solution	One-Point	Boundary	7,4261	1321,7659	1321,2679	1321,9121	6,975	7,7285
Best solution	One-Point	One-Point	7,1298	1321,8619	1321,6137	1321,9121	4,9669	8,0564
Best solution	One-Point	Two-Point	5,5916	1321,7664	1321,5807	1321,912	4,8927	7,4831
Best solution	Two-Point	Boundary	7,6197	1321,7782	1321,0474	1321,9121	7,3943	7,8452
Best solution	Two-Point	One-Point	7,7628	1321,7	1321,172	1321,9121	7,3695	8,7607
Best solution	Two-Point	Two-Point	6,2316	1321,5235	1321,0136	1321,8658	4,9684	8,5786
Best solution	Uniform crossover	Boundary	7,5022	1321,8111	1321,4643	1321,9121	5,1943	8,5036
Best solution	Uniform crossover	One-Point	8,1674	1321,8224	1321,6275	1321,9121	7,7274	9,0956
Best solution	Uniform crossover	Two-Point	7,6288	1321,8388	1321,6139	1321,8809	5,1046	9,1351
Best solution	Granular crossover	Boundary	5,2917	1321,8232	1321,2867	1321,9121	4,9855	6,3006
Best solution	Granular crossover	One-Point	7,5927	1321,8512	1321,6604	1321,9121	6,2326	8,1473
Best solution	Granular crossover	Two-Point	8,1336	1321,8259	1321,5809	1321,9121	7,6634	9,0211
Tournament	One-Point	Boundary	7,5178	1321,8738	1321,8334	1321,9121	5,2492	9,5259
Tournament	One-Point	One-Point	7,7727	1321,8611	1321,5827	1321,9113	6,4175	8,1519
Tournament	One-Point	Two-Point	6,7361	1321,8344	1321,6268	1321,9119	4,9122	8,5882
Tournament	Two-Point	Boundary	5,1903	1321,6886	1321,172	1321,9113	5,0814	5,3891
Tournament	Two-Point	One-Point	5,4019	1321,7775	1321,1636	1321,9121	5,2692	5,5534
Tournament	Two-Point	Two-Point	7,1158	1321,8034	1321,221	1321,9121	5,3458	8,8029
Tournament	Uniform crossover	Boundary	5,8853	1321,7678	1321,6139	1321,912	5,2764	8,4877
Tournament	Uniform crossover	One-Point	5,6157	1321,8276	1321,5808	1321,9121	5,3409	5,8815
Tournament	Uniform crossover	Two-Point	5,6252	1321,7662	1321,2212	1321,9121	5,5061	5,7178
Tournament	Granular crossover	Boundary	5,7046	1321,7281	1321,2213	1321,9121	5,6106	6,1617

Tournament	Granular crossover	One-Point	5,8054	1321,8584	1321,5805	1321,9121	5,4922	6,3697
Tournament	Granular crossover	Two-Point	5,8065	1321,8164	1321,5808	1321,9121	5,6746	6,0852

6. Podsumowanie

W zrealizowanym projekcie wszystkie wyniki obliczane wyniki są bardzo zbliżone do właściwych. Różnice pomiędzy poszczególnymi konfiguracjami metod mutacji, selekcji i krosowania występują, ale nie są one duże w przewidywanych wynikach.