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# Výběr funkcí

Pro výběr funkcí jsem se poradil s Chat GPT. Kladl jsem důraz na zadané požadavky:

* Multimodální
* Spojitá na celém rozsahu
* Ohodnotitelná v reálném čase
* Nemá fraktální charakter, či jiné „patologie“

I když použití CHAT-GPT hodně pomohlo, bylo potřeba dohledat zdroje a ověřit fakta. Celou historii chatu si lze prohlédnout zde: <https://chat.openai.com/share/1ee8ec28-67a5-44c5-beb7-ec8868512922>

# Vizualizace funkcí

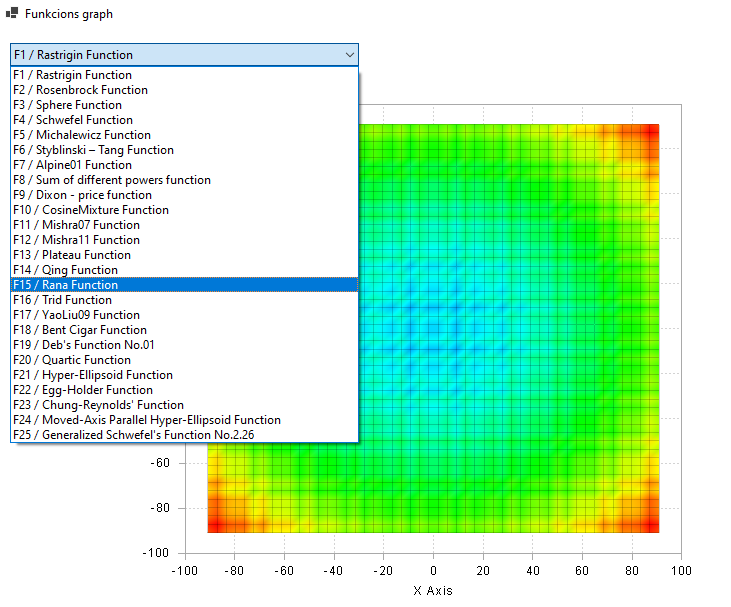
Pro zobrazení funkcí v **2D** a **3D**, jsem vytvořil pomocný program, ve kterém je možné interaktivně zobrazovat zvolené funkce.

Program podporuje posouvání jednotlivých os a manipulaci s prostorem. Ve výchozím stavu zobrazuje funkci ve 2D (heat mapu).

Obsah obrázku diagram, snímek obrazovky, Barevnost, text

Popis byl vytvořen automatickyPři zobrazení funkcí pracuji se zadaným rozsahem: -100, +100.

V pomocném programu se nachází výběrový seznam, který obsahuje seznam funkcí, které lze dynamicky prohlížet. Kompletní seznam funkcí, včetně vzorce a zdroje je detailně popsán níže.



# Seznam vybraných funkcí

|  |  |
| --- | --- |
| F1/ Rastrigin function | |
|  |  |
|  | |
| <https://en.wikipedia.org/wiki/Rastrigin_function>  *Poznámka:* ***a = 10*** | |

|  |  |  |
| --- | --- | --- |
| F2 / Rosenbrock function | | |
|  | |  |
|  | | |
| <https://en.wikipedia.org/wiki/Rosenbrock_function> | | |
| F3 / Sphere function | | |
|  |  | |
|  | | |
| <https://www.sfu.ca/~ssurjano/spheref.html> | | |

|  |  |
| --- | --- |
| F4 / Schwefel function | |
|  |  |
|  | |
| <https://www.sfu.ca/~ssurjano/schwef.html> | |

|  |  |
| --- | --- |
| F5 / Michalewicz function | |
|  |  |
|  | |
| <https://www.sfu.ca/~ssurjano/michal.html>  *Poznámka:* ***m=10*** | |

|  |  |
| --- | --- |
| F6 / Styblinski – Tang function | |
|  |  |
|  | |
| <https://www.sfu.ca/~ssurjano/stybtang.html> | |

|  |  |
| --- | --- |
| F7 / Alpine01 | |
|  |  |
| f_{\text{Alpine01}}(\mathbf{x}) = \sum_{i=1}^{n} \lvert {x_i \sin \left( x_i \right) + 0.1 x_i} \rvert | |
| <https://infinity77.net/global_optimization/test_functions_nd_A.html#go_benchmark.Alpine01> | |

|  |  |
| --- | --- |
| F8 / Sum of different powers function | |
|  |  |
|  | |
| <https://www.sfu.ca/~ssurjano/sumpow.html> | |

|  |  |
| --- | --- |
| F9 / Dixon-price function | |
|  |  |
|  | |
| <https://www.sfu.ca/~ssurjano/dixonpr.html> | |

|  |  |
| --- | --- |
| F10 / CosineMixture Function | |
|  |  |
| f_{\text{CosineMixture}}(\mathbf{x}) = -0.1 \sum_{i=1}^n \cos(5 \pi x_i) - \sum_{i=1}^n x_i^2 | |
| <https://infinity77.net/global_optimization/test_functions_nd_C.html> | |

|  |  |
| --- | --- |
| F11 / Mishra07 Function | |
|  |  |
| f_{\text{Mishra07}}(\mathbf{x}) = \left [\prod_{i=1}^{n} x_i - n! \right]^2 | |
| <https://infinity77.net/global_optimization/test_functions_nd_M.html> | |

|  |  |
| --- | --- |
| F12 / Mishra11 Function | |
|  |  |
| f_{\text{Mishra11}}(\mathbf{x}) = \left [ \frac{1}{n} \sum_{i=1}^{n} \lvert x_i \rvert - \left(\prod_{i=1}^{n} \lvert x_i \rvert \right )^{\frac{1}{n}} \right]^2 | |
| <https://infinity77.net/global_optimization/test_functions_nd_M.html> | |

|  |  |
| --- | --- |
| F13 / Plateau Function | |
|  |  |
| f_{\text{Plateau}}(\mathbf{x}) = 30 + \sum_{i=1}^n \lfloor x_i \rfloor | |
| <https://infinity77.net/global_optimization/test_functions_nd_P.html> | |

|  |  |
| --- | --- |
| F14 / Qing Function | |
|  |  |
|  | |
| <https://infinity77.net/global_optimization/test_functions_nd_Q.html> | |

|  |  |
| --- | --- |
| F15 / Rana Function | |
|  |  |
| f_{\text{Rana}}(\mathbf{x}) = \sum_{i=1}^{n} \left[x_{i} \sin\left(\sqrt{\lvert{x_{1} - x_{i} + 1}\rvert}\right) \cos\left(\sqrt{\lvert{x_{1} + x_{i} + 1}\rvert}\right) + \left(x_{1} + 1\right) \sin\left(\sqrt{\lvert{x_{1} + x_{i} + 1}\rvert}\right) \cos\left(\sqrt{\lvert{x_{1} - x_{i} + 1}\rvert}\right)\right] | |
| <https://infinity77.net/global_optimization/test_functions_nd_R.html> | |

|  |  |
| --- | --- |
| F16 / Trid Function | |
|  |  |
|  | |
| <https://infinity77.net/global_optimization/test_functions_nd_T.html> | |

|  |  |
| --- | --- |
| F17 / YaoLiu09 Function | |
|  |  |
| f_{\text{YaoLiu09}}(\mathbf{x}) = \sum_{i=1}^n \left [ x_i^2 - 10 \cos(2 \pi x_i ) + 10 \right ] | |
| <https://infinity77.net/global_optimization/test_functions_nd_Y.html> | |

|  |  |
| --- | --- |
| F18 / Bent Cigar Function | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/164-bent-cigar-function> | |

|  |  |
| --- | --- |
| F19 / Deb's Function No.01 | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/231-deb-s-function-no-01> | |

|  |  |
| --- | --- |
| F20 / Quartic Function | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/161-quartic-or-modified-4th-de-jong-s-function> | |

|  |  |
| --- | --- |
| F21 / Hyper-Ellipsoid Function | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/177-hyper-elipsoid-function> | |

|  |  |
| --- | --- |
| F22 / Egg-Holder Function | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/187-egg-holder-function> | |

|  |  |
| --- | --- |
| F23 / Chung-Reynolds' Function | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/165-chung-reynolds-function> | |

|  |  |
| --- | --- |
| F24 / Moved-Axis Parallel Hyper-Ellipsoid Function | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/230-moved-axis-parallel-hyper-ellipsoid-function> | |

|  |  |
| --- | --- |
| F25 / Generalized Schwefel's Function No.2.26 | |
|  |  |
|  | |
| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/176-generalized-schwefel-s-problem-2-26> | |

# Výkonnost algoritmů

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **D2** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 5,10499 | 0,00011 | 439,96329 | 37,56791 | 934,58595 |
| F2 | 1,04798 | 0,03313 | 754475,85764 | 2624,43259 | 11501,15901 |
| F3 | 0,00798 | 1,05E-18 | 0,58890 | 67,35834 | 619,82922 |
| F4 | 441,99961 | 710,69584 | 757,38693 | 734,60592 | 752,72985 |
| F5 | -1,92734 | -1,85146 | -0,85063 | -1,51783 | -1,73317 |
| F6 | -75,88305 | -78,33233 | 42803,61156 | 8882,75714 | 92,28626 |
| F7 | 0,01964 | 2,37E-05 | 1,64004 | 1,45208 | 5,84538 |
| F8 | 0,04851 | 2,17E-13 | 5313,94613 | 151,00540 | 623,74021 |
| F9 | 0,09043 | 3,93E-13 | 53305,89747 | 232,73424 | 1638,09992 |
| F10 | -121076,58724 | -19250,34552 | -15056,07603 | -18514,96740 | -17469,99015 |
| F11 | 0,00077 | 0 | 220,71148 | 0,10146 | 37,04600 |
| F12 | 2,63E-20 | 0 | 0,00790 | 5,31E-08 | 8,91E-08 |
| F13 | 30,22046 | 30 | 35,72549 | 49,49137 | 45,58325 |
| F14 | 0,18138 | 1,61E-22 | 281774,87560 | 31568,22893 | 62563,14761 |
| F15 | -421,11678 | -180,292 | -90,91300 | -140,25166 | -92,72711 |
| F16 | -1,95542 | -2 | 1068,99284 | 163,81973 | 358,75464 |
| F17 | 4,02214 | 0,00027 | 303,64137 | 64,10757 | 105,72650 |
| F18 | 1,54E-06 | 6,65E-159 | 50,48377 | 4,04079 | 13,41171 |
| F19 | 1,23E-05 | 1,12E-06 | 0,00113 | 0,00874 | 0,00362 |
| F20 | 0,00144 | 5,32E-52 | 119141,41918 | 65754,07972 | 10357,69405 |
| F21 | 0,42417 | 1,26E-23 | 451,63477 | 504,94781 | 495,96390 |
| F22 | -393,11544 | -199,68403 | -125,97661 | -110,40750 | -120,92315 |
| F23 | 0,01178 | 1,31E-49 | 48254,24256 | 26352,06893 | 2182434,42509 |
| F24 | 2,92E-09 | 0 | 15,88628 | 1,50621 | 0,26467 |
| F25 | -382,10855 | -127,26996 | -93,28772 | -84,17066 | -106,69759 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **D10** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 3092,49691 | 35,91955 | 10587,59974 | 13178,05193 | 12718,54770 |
| F2 | 136170881,05350 | 14071,35010 | 5356949625,63218 | 2488005843,5554 | 2350489822,56355 |
| F3 | 1945,65171 | 61,08770 | 11698,95763 | 12829,90848 | 15368,60540 |
| F4 | 3445,25351 | 3741,18801 | 4011,47729 | 3848,61876 | 3857,93014 |
| F5 | -4,97345 | -4,09196 | -3,26070 | -2,95892 | -2,68004 |
| F6 | 493554,55468 | -268,15271 | 21557775,49210 | 18489176,90937 | 14834365,23885 |
| F7 | 37,45389 | 4,08058 | 161,23707 | 139,92353 | 72,40820 |
| F8 | 1487598646,89094 | 80185,52967 | 15938242187109,8 | 54040256486129,6 | 4,87505E+15 |
| F9 | 68488835,38806 | 2571,74175 | 2971542652,32211 | 1744528616,42272 | 1983854121,07814 |
| F10 | -261585,40097 | -68033,41475 | -50536,42403 | -57431,91465 | -51448,35550 |
| F11 | 4785657785296,75 | 0 | 2,87926E+26 | 5,34460E+22 | 3,40929E+19 |
| F12 | 0,15848 | 0,00017 | 9,92708 | 7,85963 | 4,32743 |
| F13 | 150,28968 | 40,46836 | 316,11860 | 271,77868 | 354,64150 |
| F14 | 928136,49778 | 123,46525 | 71685848,02000 | 21264604,94842 | 92797114,56907 |
| F15 | -1167,49736 | -910,62955 | -222,32432 | -606,67692 | -634,16009 |
| F16 | 1200,86224 | -177,25260 | 6113,41694 | 9841,34292 | 7374,57993 |
| F17 | 2149,84467 | 69,62447 | 13881,01979 | 8984,23465 | 11936,50010 |
| F18 | 1311455667,41084 | 10822749,53324 | 15148979604,1896 | 7319781836,06107 | 3266363875,70407 |
| F19 | 0,56414 | 1,01433 | 1,83126 | 1,79547 | 0,76916 |
| F20 | 4494098,11677 | 427,85832 | 168546260,66823 | 147457986,77282 | 231685465,81444 |
| F21 | 2254,05027 | 34,91895 | 15609,66421 | 7640,11630 | 17501,36625 |
| F22 | -979,67387 | -662,88915 | -303,86712 | -356,24242 | -473,98366 |
| F23 | 8228542,22386 | 215,05079 | 227253457,43412 | 86842997,70977 | 134988967,08905 |
| F24 | 46890,52059 | 1616,66145 | 276563,98148 | 173677,67371 | 253243,72497 |
| F25 | -762,93157 | -483,31243 | -390,17314 | -328,00327 | -201,35106 |

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| --- | --- | --- | --- | --- | --- |
| **D30** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 33190,99826 | 1830,52780 | 58906,23861 | 57127,52298 | 72182,02526 |
| F2 | 9751248165,58860 | 20318746,48014 | 28322545052,42540 | 30546141834,87400 | 34433365644,84870 |
| F3 | 31952,79206 | 1592,23671 | 66118,55963 | 69349,36425 | 75462,24759 |
| F4 | 11365,50872 | 11735,40090 | 12218,79251 | 12075,92629 | 12305,46255 |
| F5 | -7,06547 | -7,44789 | -6,31840 | -6,59490 | -4,67331 |
| F6 | 27314585,25368 | 92271,79812 | 127423825,31453 | 133738556,77518 | 151724243,99448 |
| F7 | 364,79095 | 54,89980 | 607,22099 | 482,57560 | 565,64447 |
| F8 | 4,60925E+34 | 7,15529E+22 | 5,55101E+45 | 4,75622E+48 | 4,97750E+49 |
| F9 | 53993931824,55770 | 136543015,03358 | 324763739138,39700 | 221066209829,28100 | 232897494081,26200 |
| F10 | -474188,77448 | -157798,97092 | -145476,66688 | -138617,63574 | -130144,73037 |
| F11 | 1,77825E+58 | 0 | 1,64963E+84 | 3,50349E+78 | 4,28709E+84 |
| F12 | 6,02592 | 0,20251 | 51,90654 | 39,53759 | 49,32805 |
| F13 | 791,69923 | 189,86238 | 1265,33523 | 1180,65954 | 1221,28511 |
| F14 | 106880268,74010 | 119075,36516 | 351010988,82717 | 217443284,73263 | 276734445,61221 |
| F15 | -1587,31913 | -1088,09986 | -487,27182 | -588,73719 | -576,84209 |
| F16 | 19783,84727 | 1060,44486 | 57509,58248 | 51740,28332 | 43293,61067 |
| F17 | 29125,05185 | 1462,52726 | 68606,37740 | 60772,43677 | 68174,57458 |
| F18 | 30764341427,04540 | 1501066319,30036 | 67024336044,21860 | 59731344414,55880 | 73632474769,86400 |
| F19 | 5,55713 | 6,73824 | 9,06382 | 8,76917 | 7,36981 |
| F20 | 1044873391,31101 | 973267,54054 | 4470915905,39053 | 4735750857,31344 | 3960678371,11058 |
| F21 | 27701,59567 | 1169,74561 | 65470,17593 | 66312,76945 | 73844,48937 |
| F22 | -1761,32450 | -1415,15037 | -432,08684 | -315,76247 | -458,43129 |
| F23 | 986537838,34587 | 2751255,06944 | 4542754677,81263 | 4166003251,36463 | 4872658864,42770 |
| F24 | 50299371,36464 | 50204009,28362 | 72583145,04290 | 89317368,68520 | 76864374,05322 |
| F25 | -1174,51181 | -771,75083 | -428,08629 | -516,73602 | -357,73157 |

# Pořadí algoritmů

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **D2** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 2 | 1 | 4 | 3 | 5 |
| F2 | 2 | 1 | 5 | 3 | 4 |
| F3 | 2 | 1 | 3 | 4 | 5 |
| F4 | 1 | 2 | 5 | 3 | 4 |
| F5 | 1 | 2 | 5 | 4 | 3 |
| F6 | 2 | 1 | 5 | 4 | 3 |
| F7 | 2 | 1 | 4 | 3 | 5 |
| F8 | 2 | 1 | 5 | 3 | 4 |
| F9 | 2 | 1 | 5 | 3 | 4 |
| F10 | 1 | 2 | 5 | 3 | 4 |
| F11 | 2 | 1 | 5 | 3 | 4 |
| F12 | 2 | 1 | 5 | 3 | 4 |
| F13 | 2 | 1 | 3 | 5 | 4 |
| F14 | 2 | 1 | 5 | 3 | 4 |
| F15 | 1 | 2 | 5 | 3 | 4 |
| F16 | 2 | 1 | 5 | 3 | 4 |
| F17 | 2 | 1 | 5 | 3 | 4 |
| F18 | 2 | 1 | 5 | 3 | 4 |
| F19 | 2 | 1 | 3 | 5 | 4 |
| F20 | 2 | 1 | 5 | 4 | 3 |
| F21 | 2 | 1 | 3 | 5 | 4 |
| F22 | 1 | 2 | 3 | 5 | 4 |
| F23 | 2 | 1 | 4 | 3 | 5 |
| F24 | 2 | 1 | 5 | 4 | 3 |
| F25 | 1 | 2 | 4 | 5 | 3 |
| **Průměr** | 1,76 | 1,24 | 4,44 | 3,6 | 3,96 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **D10** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
|  | 2 | 1 | 4 | 3 | 5 |
| F1 | 2 | 1 | 3 | 5 | 4 |
| F2 | 2 | 1 | 5 | 4 | 3 |
| F3 | 2 | 1 | 3 | 4 | 5 |
| F4 | 1 | 2 | 5 | 3 | 4 |
| F5 | 1 | 2 | 3 | 4 | 5 |
| F6 | 2 | 1 | 5 | 4 | 3 |
| F7 | 2 | 1 | 5 | 4 | 3 |
| F8 | 2 | 1 | 3 | 4 | 5 |
| F9 | 2 | 1 | 5 | 3 | 4 |
| F10 | 1 | 2 | 5 | 3 | 4 |
| F11 | 2 | 1 | 5 | 4 | 3 |
| F12 | 2 | 1 | 5 | 4 | 3 |
| F13 | 2 | 1 | 4 | 3 | 5 |
| F14 | 2 | 1 | 4 | 3 | 5 |
| F15 | 1 | 2 | 5 | 4 | 3 |
| F16 | 2 | 1 | 3 | 5 | 4 |
| F17 | 2 | 1 | 5 | 3 | 4 |
| F18 | 2 | 1 | 5 | 4 | 3 |
| F19 | 1 | 3 | 5 | 4 | 2 |
| F20 | 2 | 1 | 4 | 3 | 5 |
| F21 | 2 | 1 | 4 | 3 | 5 |
| F22 | 1 | 2 | 5 | 4 | 3 |
| F23 | 2 | 1 | 5 | 3 | 4 |
| F24 | 2 | 1 | 5 | 3 | 4 |
| F25 | 1 | 2 | 3 | 4 | 5 |
| **Průměr:** | 1,72 | 1,32 | 4,36 | 3,68 | 3,92 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **D30** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 2 | 1 | 4 | 3 | 5 |
| F2 | 2 | 1 | 3 | 4 | 5 |
| F3 | 2 | 1 | 3 | 4 | 5 |
| F4 | 1 | 2 | 4 | 3 | 5 |
| F5 | 2 | 1 | 4 | 3 | 5 |
| F6 | 2 | 1 | 3 | 4 | 5 |
| F7 | 2 | 1 | 5 | 3 | 4 |
| F8 | 2 | 1 | 3 | 4 | 5 |
| F9 | 2 | 1 | 5 | 3 | 4 |
| F10 | 1 | 2 | 3 | 4 | 5 |
| F11 | 2 | 1 | 4 | 3 | 5 |
| F12 | 2 | 1 | 5 | 3 | 4 |
| F13 | 2 | 1 | 5 | 3 | 4 |
| F14 | 2 | 1 | 5 | 3 | 4 |
| F15 | 1 | 2 | 5 | 3 | 4 |
| F16 | 2 | 1 | 5 | 4 | 3 |
| F17 | 2 | 1 | 5 | 3 | 4 |
| F18 | 2 | 1 | 4 | 3 | 5 |
| F19 | 1 | 2 | 5 | 4 | 3 |
| F20 | 2 | 1 | 4 | 5 | 3 |
| F21 | 2 | 1 | 3 | 4 | 5 |
| F22 | 1 | 2 | 4 | 5 | 3 |
| F23 | 2 | 1 | 4 | 3 | 5 |
| F24 | 2 | 1 | 3 | 5 | 4 |
| F25 | 1 | 2 | 4 | 3 | 5 |
| Průměr: | 1,76 | 1,24 | 4,08 | 3,56 | 4,36 |

# Průměrný rank

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Napříč dimenzemi** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 2,000 | 1,000 | 3,667 | 3,667 | 4,667 |
| F2 | 2,000 | 1,000 | 4,333 | 3,667 | 4,000 |
| F3 | 2,000 | 1,000 | 3,000 | 4,000 | 5,000 |
| F4 | 1,000 | 2,000 | 4,667 | 3,000 | 4,333 |
| F5 | 1,333 | 1,667 | 4,000 | 3,667 | 4,333 |
| F6 | 2,000 | 1,000 | 4,333 | 4,000 | 3,667 |
| F7 | 2,000 | 1,000 | 4,667 | 3,333 | 4,000 |
| F8 | 2,000 | 1,000 | 3,667 | 3,667 | 4,667 |
| F9 | 2,000 | 1,000 | 5,000 | 3,000 | 4,000 |
| F10 | 1,000 | 2,000 | 4,333 | 3,333 | 4,333 |
| F11 | 2,000 | 1,000 | 4,667 | 3,333 | 4,000 |
| F12 | 2,000 | 1,000 | 5,000 | 3,333 | 3,667 |
| F13 | 2,000 | 1,000 | 4,000 | 3,667 | 4,333 |
| F14 | 2,000 | 1,000 | 4,667 | 3,000 | 4,333 |
| F15 | 1,000 | 2,000 | 5,000 | 3,333 | 3,667 |
| F16 | 2,000 | 1,000 | 4,333 | 4,000 | 3,667 |
| F17 | 2,000 | 1,000 | 5,000 | 3,000 | 4,000 |
| F18 | 2,000 | 1,000 | 4,667 | 3,333 | 4,000 |
| F19 | 1,333 | 2,000 | 4,333 | 4,333 | 3,000 |
| F20 | 2,000 | 1,000 | 4,333 | 4,000 | 3,667 |
| F21 | 2,000 | 1,000 | 3,333 | 4,000 | 4,667 |
| F22 | 1,000 | 2,000 | 4,000 | 4,667 | 3,333 |
| F23 | 2,000 | 1,000 | 4,333 | 3,000 | 4,667 |
| F24 | 2,000 | 1,000 | 4,333 | 4,000 | 3,667 |
| F25 | 1,000 | 2,000 | 3,667 | 4,000 | 4,333 |
| **Průměr** | 1,747 | 1,267 | 4,293 | 3,613 | 4,080 |

# Porovnání algoritmů s největším rozdílem

Upřímně nad tímhle bodem si pořád lámu hlavu…

Jak plyne z výsledků výše, tak diferenční evoluce vyhrává na plné čáře. Snažil jsem se to „prokokovat“ a jsou zkrátka robustní oproti PSO a SOMĚ. Naopak PSO A SOMA jsou lehce efektivnější ve více dimenzích, ale čekal jsem, že rozdíl bude větší…

Výkonost jsem bral jako minimem z 30 opakování (možná se měl brát průměr?).

Dělám na tom celý den a výsledky jsou zavádějící. Můžu tento bod případně doplnit později?

# Friedmanův test

Formálně se Friedmanův test provádí následujícím způsobem:

1. **Hypotézy**:
   * **Nulová hypotéza (H0):** Neexistuje žádný rozdíl mezi algoritmy.
   * **Alternativní hypotéza (H1):** Existuje alespoň jedna statisticky významná odlišnost mezi algoritmy.
2. **Výpočet Friedmanova statistického testu**:

* ​**DE rand/1/bin:** 1,747
* **DE best/1/bin**: 1,267
* **PSO**: 4,293
* **Soma all to one**: 3,613
* **Soma all to all**:​ 4,080

Obsah obrázku text, Písmo, řada/pruh, diagram

Popis byl vytvořen automaticky

Obsah obrázku text, snímek obrazovky, Písmo, číslo

Popis byl vytvořen automaticky

1. **Přijetí nebo zamítnutí nulové hypotézy**:

Obsah obrázku text, snímek obrazovky, Písmo, algebra

Popis byl vytvořen automaticky

1. **Závěr**:
   * Zamítáme nulovou hypotézu a máme důkaz o existenci rozdílu mezi algoritmy.
   * Existuje alespoň jeden algoritmus, který se odlišuje v průměrném výkonu od ostatních algoritmů.

# Zdroje

* Zdroje k funkcím jsou uvedené v [seznamu funkcí](#_Seznam_vybraných_funkcí).
* Využití LLM je podporováno? Okay… Velkou část problematiky jsem řešil s CHAT GPT. Kompletní výpis zde: <https://chat.openai.com/share/f853bc79-0336-4bb7-8d3e-988a4c86b013>