Függelék

Benchmark tesztfeladatok

Sphere függvény:

$$f_1(x) = \sum_{i=1}^{30} x_i^2$$
$$-100 \le x_i \le 100, \quad \min(f_1) = f_1(0,...,0) = 0$$

Schwefel 1.2 problémája:

$$f_2(x) = \sum_{i=1}^{30} \left(\sum_{j=1}^{i} x_j \right)^2$$
$$-100 \le x_i \le 100, \quad \min(f_2) = f_2(0,...,0) = 0$$

Általánosított Rosenbrock függvény:

$$f_3(x) = \sum_{i=1}^{29} \left[100(x_i + 1 - x_i^2)^2 + (x_i - 1)^2 \right]$$
$$-30 \le x_i \le 30, \quad \min(f_3) = f_3(1,...,1) = 0$$

Lépcsős függvény:

$$f_4(x) = \sum_{i=1}^{30} (\lfloor x_i + 0.5 \rfloor)^2$$
$$-100 \le x_i \le 100, \quad \min(f_4) = f_4(0,...,0) = 0$$

De Jong 4. függvénye:

$$f_5(x) = \sum_{i=1}^{30} i x_i^4 + random[0,1)$$
$$-1.28 \le x_i \le 1.28, \quad \min(f_5) = f_5(0,...,0) = 0$$

Általánosított Schwefel 2.26-os probléma:

$$f_6(x) = -\sum_{i=1}^{30} (x_i \sin(\sqrt{|x_i|}))$$

$$-500 \le x_i \le 500,\quad \min(f_6) = f_6(420.9687,\ldots,420.9687) = -12569.5$$

Általánosított Rastrigin függvény:

$$f_7(x) = \sum_{i=1}^{30} \left[x_i^2 - 10\cos(2\pi x_i) + 10 \right]$$

$$-5.12 \le x_i \le 5.12,\quad \min(f_7) = f_7(0,\ldots,0) = 0$$

Ackley függvény:

$$f_8(x) = -20\exp\left(-0.2\sqrt{\frac{1}{30}\sum_{i=1}^{30} x_i^2} \right) - \exp\left(\frac{1}{30}\sum_{i=1}^{30} \cos 2\pi x_i \right) + 20 + e$$

$$-32 \le x_i \le 32,\quad \min(f_8) = f_8(0,\ldots,0) = 0$$

Általánosított Griewank függvény:

$$f_9(x) = \frac{1}{4000}\sum_{i=1}^{30} x_i^2 - \prod_{i=1}^{30} \cos\left(\frac{x_i}{\sqrt{i}} \right) + 1$$

$$-600 \le x_i \le 600,\quad \min(f_9) = f_9(0,\ldots,0) = 0$$

Shekel Foxholes függvénye:

$$f_{10}(x) = \left[\frac{1}{500} + \sum_{j71}^{25} \frac{1}{j + \sum_{i=1}^{2} (x_i - a_{ij})^6} \right]^{-1}$$

$$-65.536 \le x_i \le 65.536,\quad \min(f_{10}) = f_{10}(-32,-32) \approx 1$$

Schaffer függvény:

$$f_{11}(x) = (x_1^2 + x_2^2)^{0.25} \left[\sin^2(50(x_1^2 + x_2^2)^{0.1}) + 1.0 \right]$$

$$-100 \le xi \le 100,\quad \min(f_{11}) = f_{11}(0,0) = 0$$

Hock et al. (1981) tesztfeladat:

$$f_{12}(x) = x_1^2 + x_2^2 + x_1 x_2 - 14x_1 - 16x_2 + (x_3 - 10)^2 + 4(x_4 - 5)^2 +$$
$$(x_5 - 3)^2 + 2(x_6 - 1)^2 + 5x_2^7 + 7(x_8 - 11)^2 + 1(x_9 - 10)^2 + (x_{10} - 7)^2 + 45$$

feltételek:

$$105 - 4x_1 - 5x_2 + 3x_7 - 9x_8 \geq 0$$
$$-10x_1 + 8x_2 + 17x_7 - 2x_8 \geq 0$$
$$8x_1 - 2x_2 - 5x_9 + 2x_{10} + 12 \geq 0$$
$$3x_1 - 6x_2 - 12(x_9 - 8)2 + 7x_{10} \geq 0$$
$$-3(x_1 - 2)^2 - 4(x_2 - 3)^2 - 2x_3^2 + 7x_4 + 120 \geq 0$$
$$-x_1^2 - 2(x_2 - 2)^2 + 2x_1 x_2 - 14x_5 + 6x_6 \geq 0$$
$$-5x_1^2 - 8x_2 - (x_3 - 6)2 + 2x_4 + 40 \geq 0$$
$$-0.5(x_1 - 8)^2 - 2(x_2 - 4)^2 - 3x_5^2 + x_6 + 30 \geq 0$$
$$-10 \leq x_i \leq 10, \quad \min(f_{12}) = 24.3062091.$$

Hock et al (1981) tesztfeladat:

$$f_{13}(x) = (x_1 - 10)^2 + 5(x_2 - 10)^2 + 3(x_4 - 11)^2 + 10x_5^6 + 7x_6^2 + x_7^4 -$$
$$4x_6 x_7 - 10x_6 - 8x_7$$

feltételek:

$$127 - 2x_1^2 - 3x_2^4 - x_3 - 4x_2 - 5x_5 \geq 0$$
$$282 - 7x_1 - 3x_2 - 10x_3^2 - x_4 + x_5 \geq 0$$
$$196 - 23x_1 - x_2^2 - 6x_6^2 + 8x_7 \geq 0$$
$$-4x_1^2 - x_2^2 + 3x_1 x_2 - 2x_3^2 - 5x_6 + 11x_7 \geq 0$$
$$-10 \leq x_i \leq 10, \quad \min(f_{13}) = 680.6300573.$$

Floudas et al. (1987) tesztfeladat:

$$f_{14}(x) = 5x_1 + 5x_2 + 5x_3 + 5x_4 - 5\sum_{i=1}^{4} x_i^2 - \sum_{i=5}^{13} x_i$$

feltételek:

$$2x_1 - 2x_2 + x_{10} + x_{11} \le 10$$
$$2x_1 + 2x_3 + x_{10} + x_{12} \le 10$$
$$2x_2 + 2x_3 + x_{11} + x_{12} \le 10$$
$$-8x_1 + x_{10} \le 0$$
$$-8x_2 + x_{11} \le 0$$
$$-8x_3 + x_{12} \le 0$$
$$-2x_4 - x_5 + x_{10} \le 0$$
$$-2x_6 - x_7 + x_{11} \le 0$$
$$-2x_8 - x9 + x12 \le 0$$
$$0 \le x_i \le 1,\ \ ha\ i = 1,\dots,9\ \ és\ \ 0 \le x_i \le 100\ \ ha\ i = 10,11,12,\ \ \min(f_{14}) = -15.$$

Hock et al (1981) tesztfeladat:

$$f_{15}(x) = x_1 + x_2 + x_3$$

feltételek:

$$1 - 0.0025(x_4 + x_6) \ge 0$$
$$1 - 0.0025(x_5 + x_7 - x_4) \ge 0$$
$$1 - 0.01(x_8 - x_5) \ge 0$$
$$x_1 x_6 - 833.33252 x_4 - 100 x_1 + 8333.333 \ge 0$$
$$x_2 x_7 - 1250 x_5 - x_2 x_4 + 1250 x_4 \ge 0$$
$$x_3 x_8 - 1250000 - x_3 x_5 + 2500 x_5 \ge 0$$
$$100 \le x_1 \le 10000,\ 1000 \le x_2, x_3 \le 10000, 10 \le x_i \le 1000,\ ha\ i = 4,\dots,8$$
$$\min(f_{15}) = 7049.330923.$$

Többdimenziós hátizsák probléma:

$$\max\ f_{16}(x) = \sum_{j=1}^{n} p_j x_j,$$

feltételek:

$$\sum_{j=1}^{n} r_{ij} x_j \le b_i \quad i = 1,\dots,m,\ \ x_i \in \{0,1\}$$

Zitzler et al. (2000) tesztfeladatai:

ZDT1

$$f_1(x) = x_1, f_2(x) = g(x)(1 - \sqrt{x_1 / g(x)}), g(x) = 1 - 9(\sum_{i=2}^{n} x_i) / (n-1)$$

n=30, $x_i \in [0,1]$ i=1,..,n

ZDT2

$$f_1(x) = x_1, f_2(x) = g(x)(1 - (x_1 / g(x))^2), g(x) = 1 - 9(\sum_{i=2}^{n} x_i)/(n-1)$$

n=30, $x_i \in [0,1]$ i=1,..,n

ZDT3

$$f_1(x) = x_1, f_2(x) = g(x)(1 - \sqrt{x_1 / g(x)} - x_i \sin(10\pi x_1) / g(x))$$

$$g(x) = 1 - 9(\sum_{i=2}^{n} x_i)/(n-1)$$

n=30, $x_i \in [0,1]$ i=1,..,n

ZDT4

$$f_1(x) = x_1, f_2(x) = g(x)(1 - \sqrt{x_1 / g(x)})$$

$$g(x) = 1 + 10(n-1) + \sum_{i=2}^{n} (x_i^2 - 10\cos(4\pi x_i))$$

n=10, $x_1 \in [0,1]$, $x_i \in [5,5]$ i=2,..,n

ZDT5

$$f_1(x) = x_1, f_2(x) = g(x)(1/f_1(x))$$

$$g(x) = \sum_{i=2}^{n} v(u(x_i))$$

$$v(u(x_i) = \begin{cases} 2 + u(x_i) \; ha \; u(x_i) \langle 5 \\ 1 \qquad ha \; u(x_i) = 5 \end{cases},$$

ahol *u(x_i)* az x_i bitvektor egyeseinek számát adja.

$n=11,\ x_1 \in \{0,1\}^{30},\ x_i \in \{0,1\}\ i=2,..,n$

ZDT6

$$f_1(x) = x_1, f_2(x) = g(x)(1-(x_1/g(x))^2), g(x) = 1 + 9((\sum_{i=2}^{n} x_i)/(n-1))^{0.25}$$

$n=10,\ x_i \in [0,1]\ i=1,..,n$

