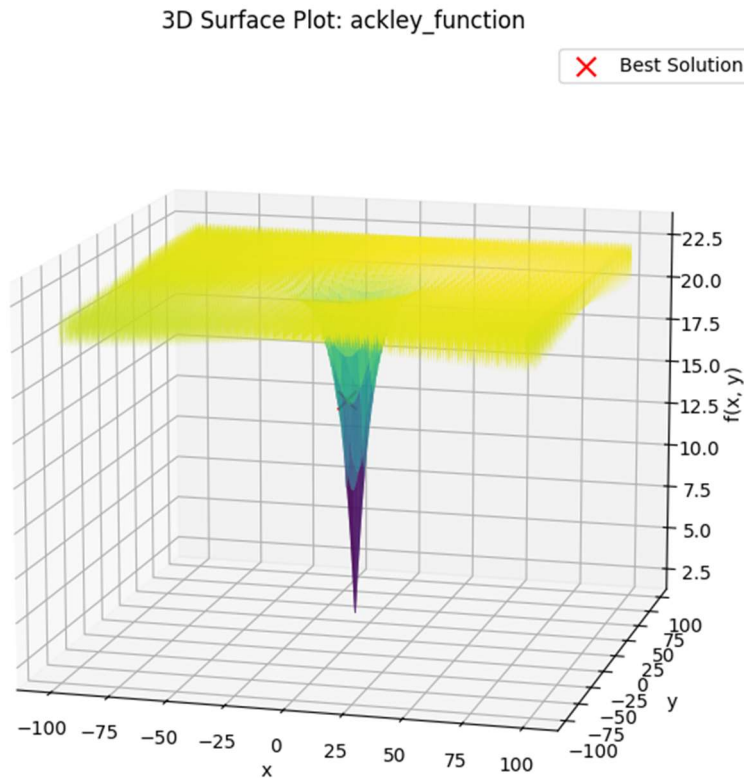
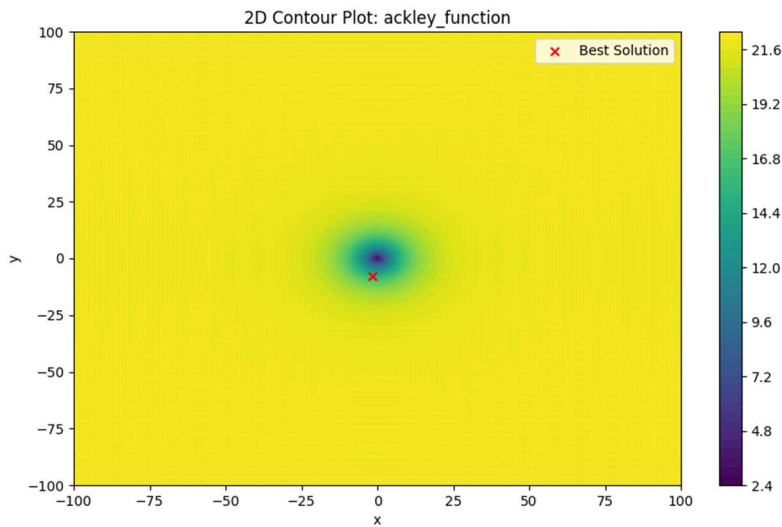


1 ACKLEY FUNCTION

$$f(x, y) = -20 \exp \left[-0.2 \sqrt{0.5(x^2 + y^2)} \right] - \exp[0.5 (\cos 2\pi x + \cos 2\pi y)] + e + 20$$

Best Solution: [-1.61391014 -7.97875332]

Best Value: 15.267744148600805

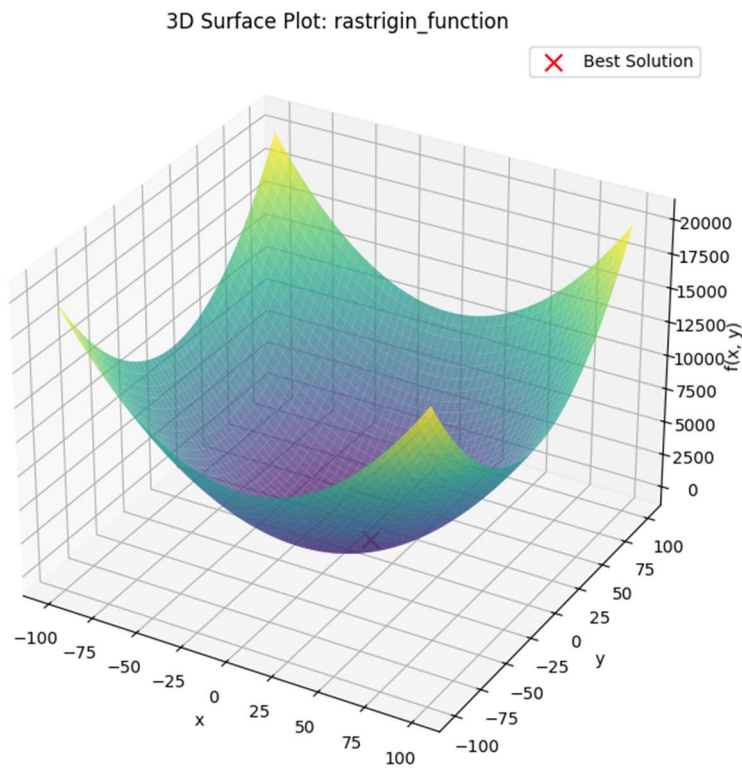
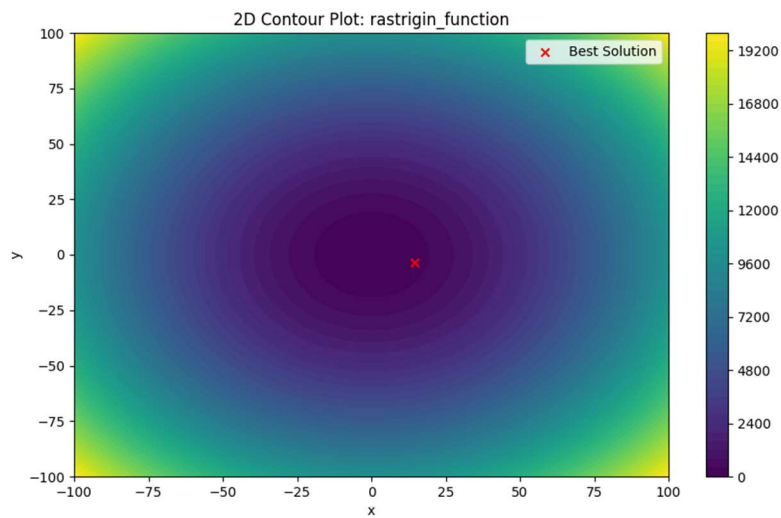


2 RASTRIGIN FUNCTION

$$f(\mathbf{x}) = An + \sum_{i=1}^n [x_i^2 - A \cos(2\pi x_i)]$$

Best Solution: [14.45896631 -3.54019899]

Best Value: 260.94690561070746

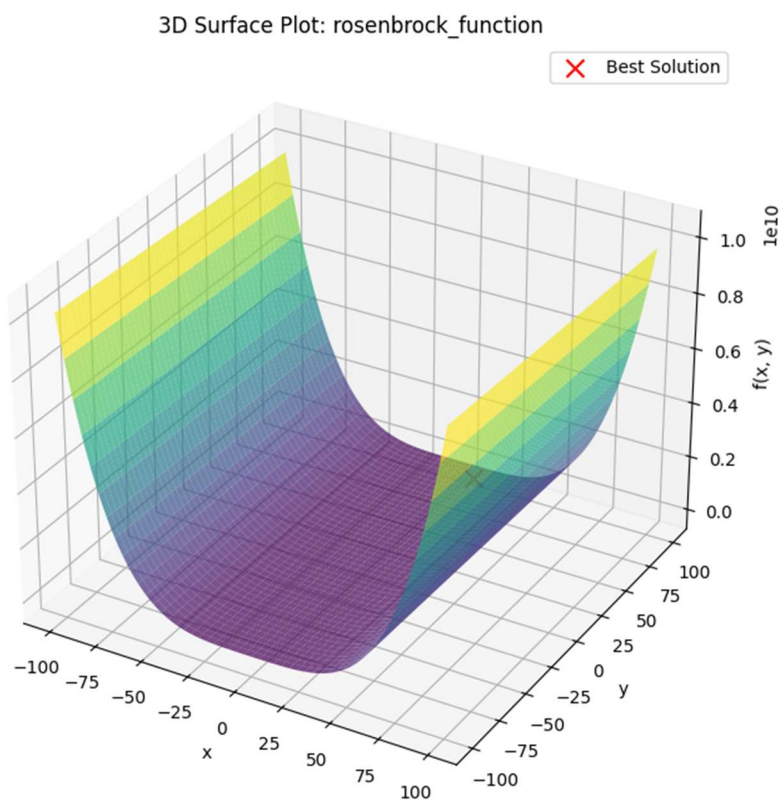
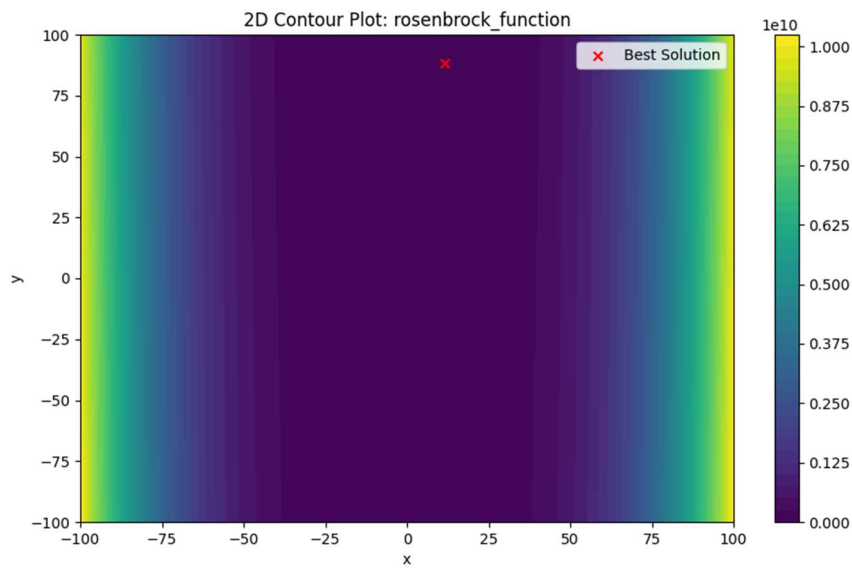


3 ROSENBROCK FUNCTION

$$f(\mathbf{x}) = f(x_1, x_2, \dots, x_N) = \sum_{i=1}^{N/2} [100(x_{2i-1}^2 - x_{2i})^2 + (x_{2i-1} - 1)^2]$$

Best Solution: [11.63927217 88.41616773]

Best Value: 221544.5100245819

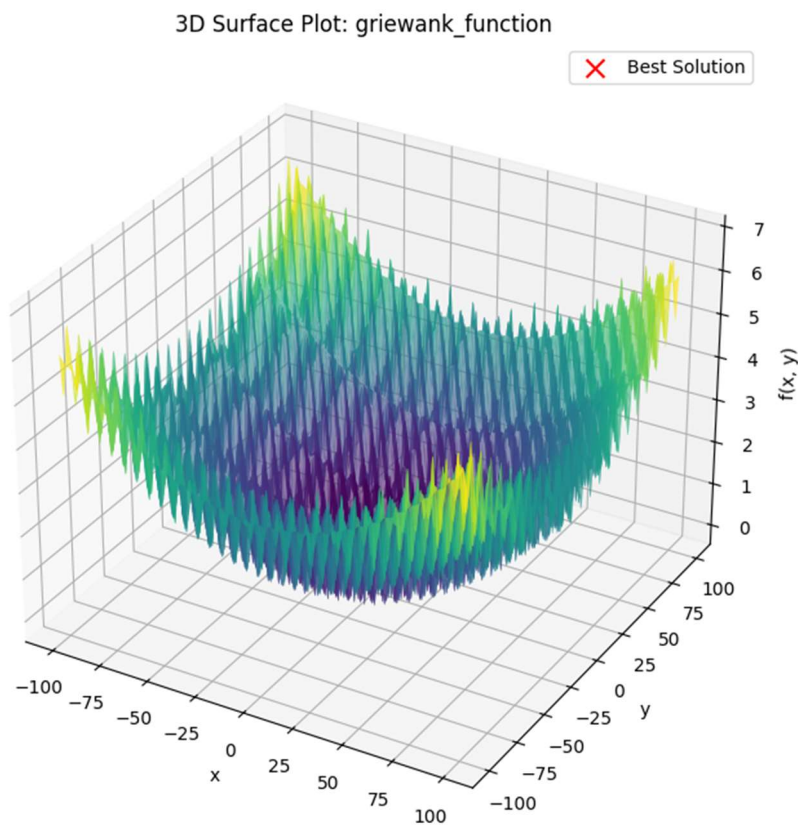
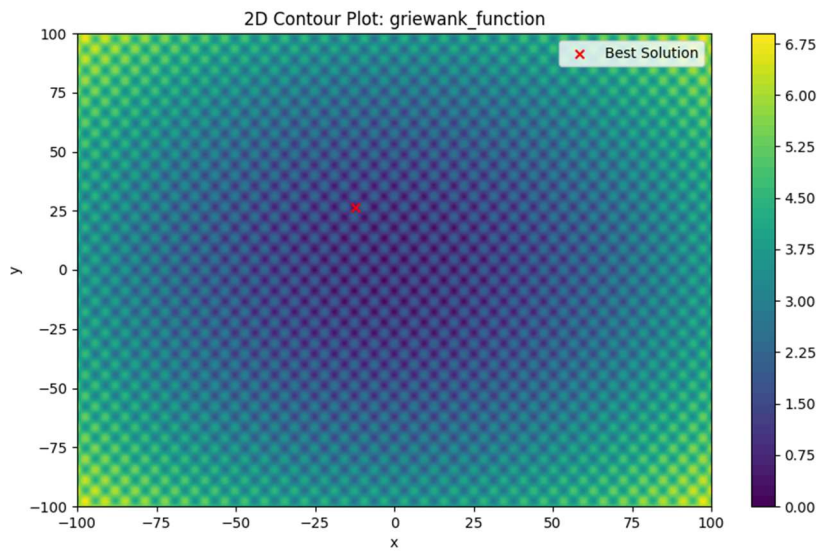


4 GRIEWANK FUNCTION

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

Best Solution: [-12.22985343 26.53658234]

Best Value: 0.2729660804174685

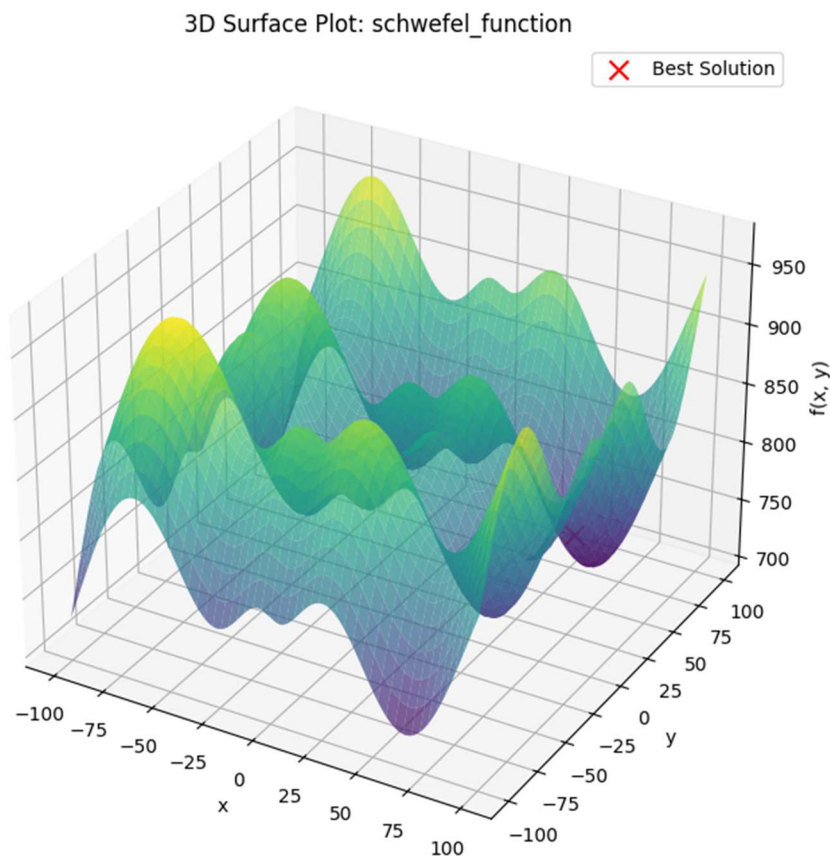
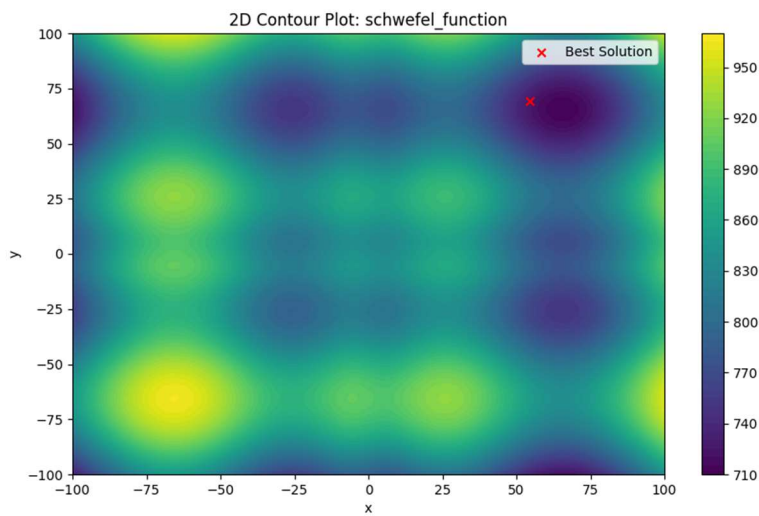


5 SCHWEFEL FUNCTION

$$f(\mathbf{x}) = 418.9829d - \sum_{i=1}^d x_i \sin(\sqrt{|x_i|})$$

Best Solution: [54.46470822 69.42304082]

Best Value: 727.8651453669843

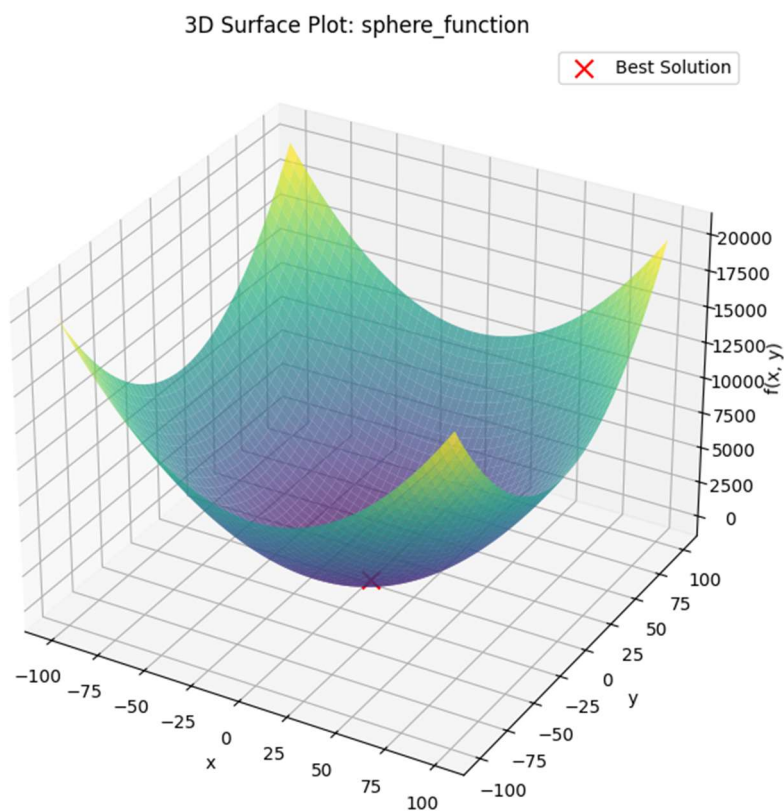
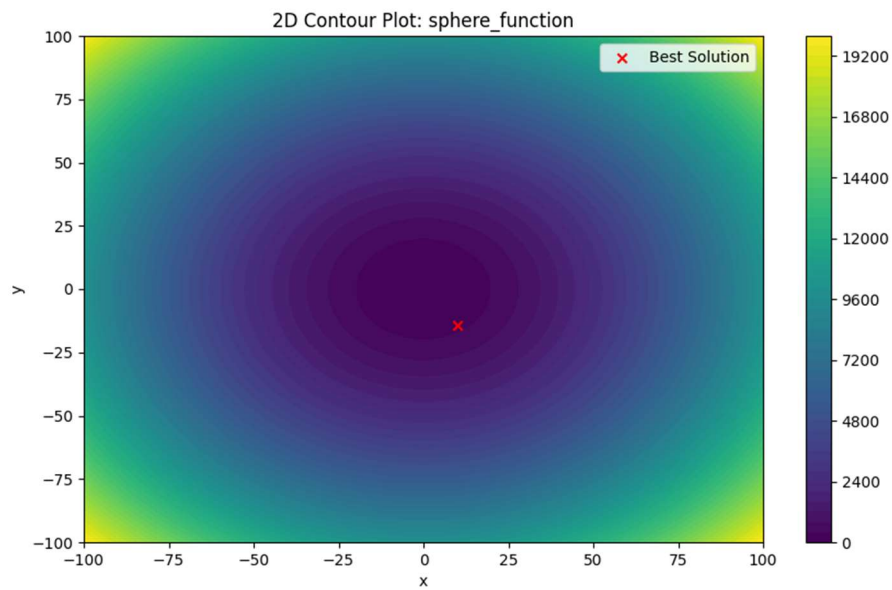


6 SPHERE FUNCTION

$$f(\mathbf{x}) = \sum_{i=1}^d x_i^2$$

Best Solution: [9.97590373 -14.3056945]

Best Value: 217.13057373859215



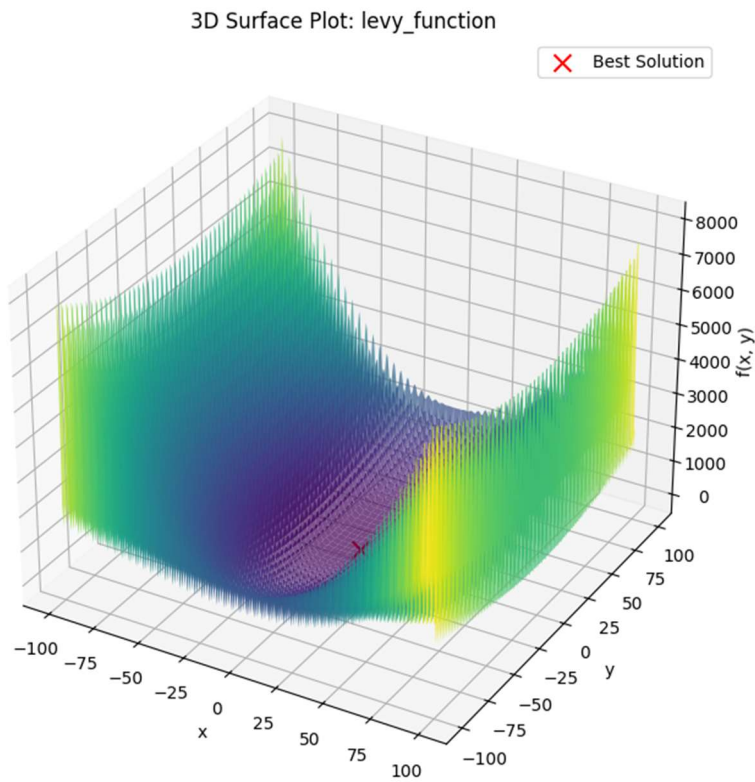
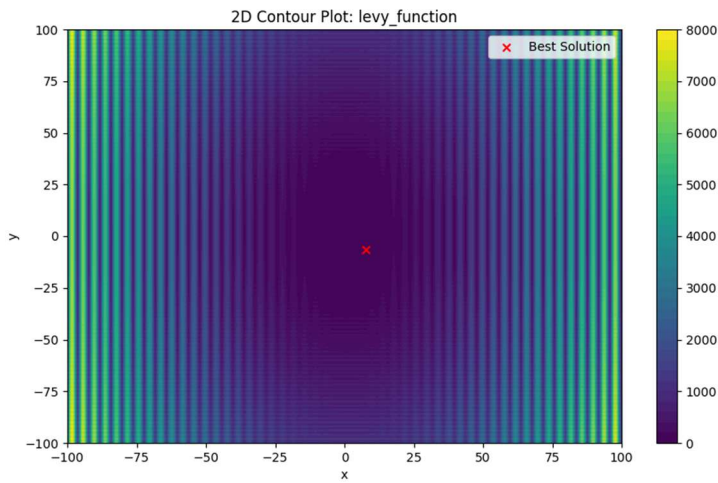
7 LEVY FUNCTION

$$f(\mathbf{x}) = \sin^2(\pi w_1) + \sum_{i=1}^{d-1} (w_i - 1)^2 [1 + 10 \sin^2(\pi w_i + 1)] + (w_d - 1)^2 [1 + \sin^2(2\pi w_d)], \text{ where}$$

$$w_i = 1 + \frac{x_i - 1}{4}, \text{ for all } i = 1, \dots, d$$

Best Solution: [7.71738644 -6.5086629]

Best Value: 8.77416151556682

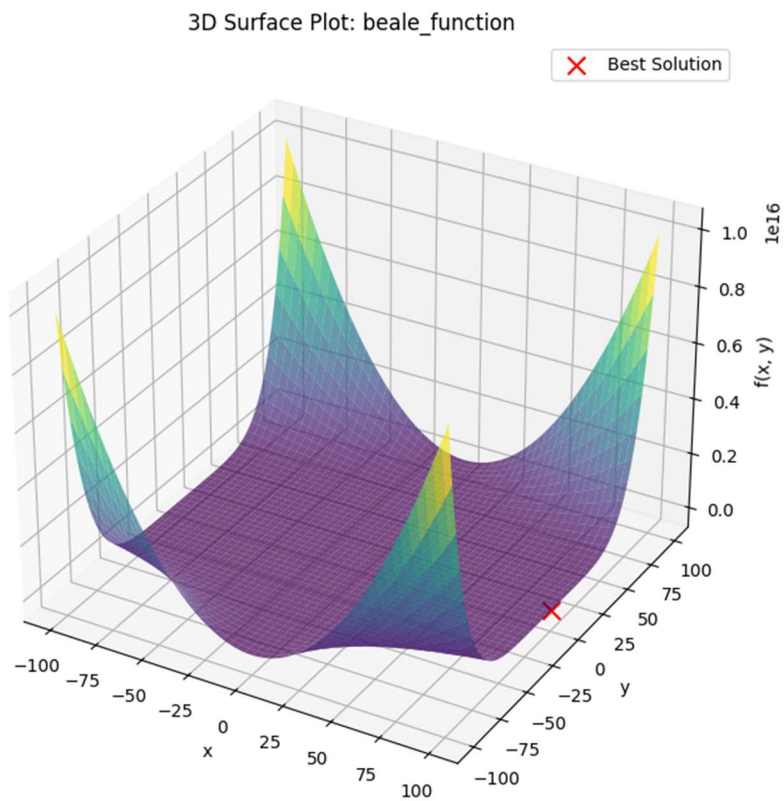
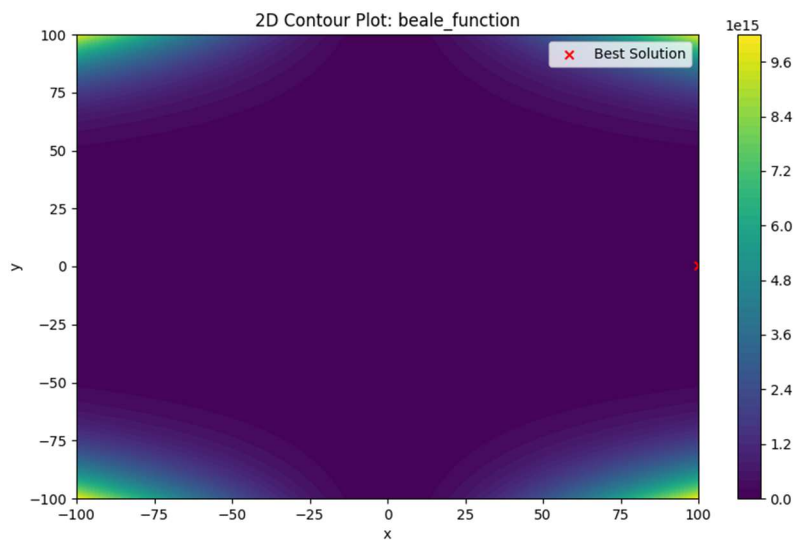


8 BEALE FUNCTION

$$f(\mathbf{x}) = (1.5 - x_1 + x_1x_2)^2 + (2.25 - x_1 + x_1x_2^2)^2 + (2.625 - x_1 + x_1x_2^3)^2$$

Best Solution: [100 0.38893169]

Best Value: 18750.30348157828

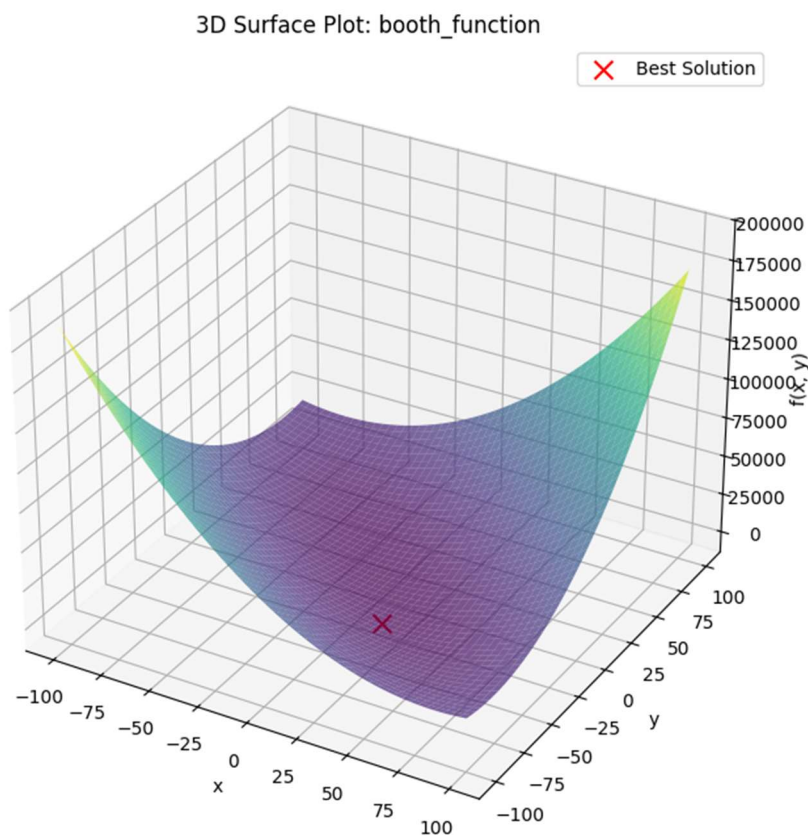
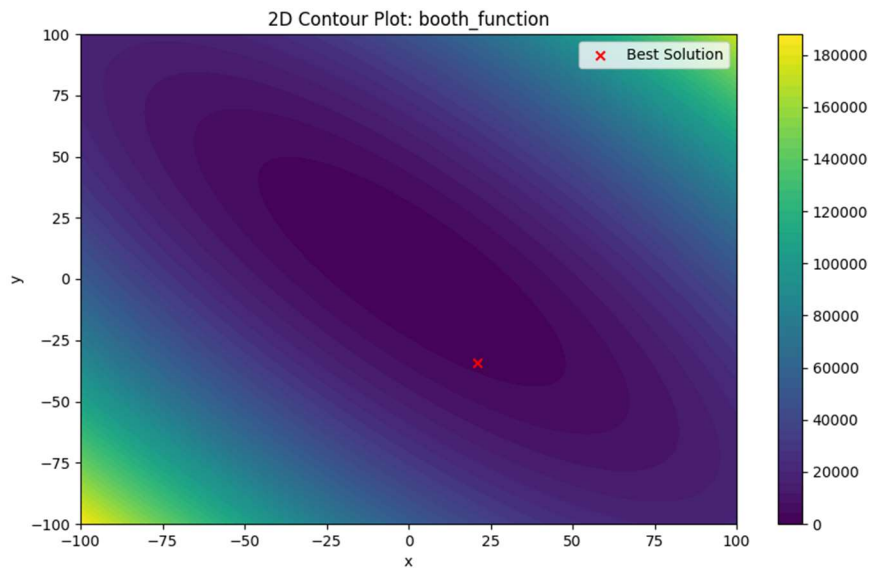


9 BOOTH FUNCTION

$$f(\mathbf{x}) = (x_1 + 2x_2 - 7)^2 + (2x_1 + x_2 - 5)^2$$

Best Solution: [20.93054271 -34.16784648]

Best Value: 2967.1739101552316

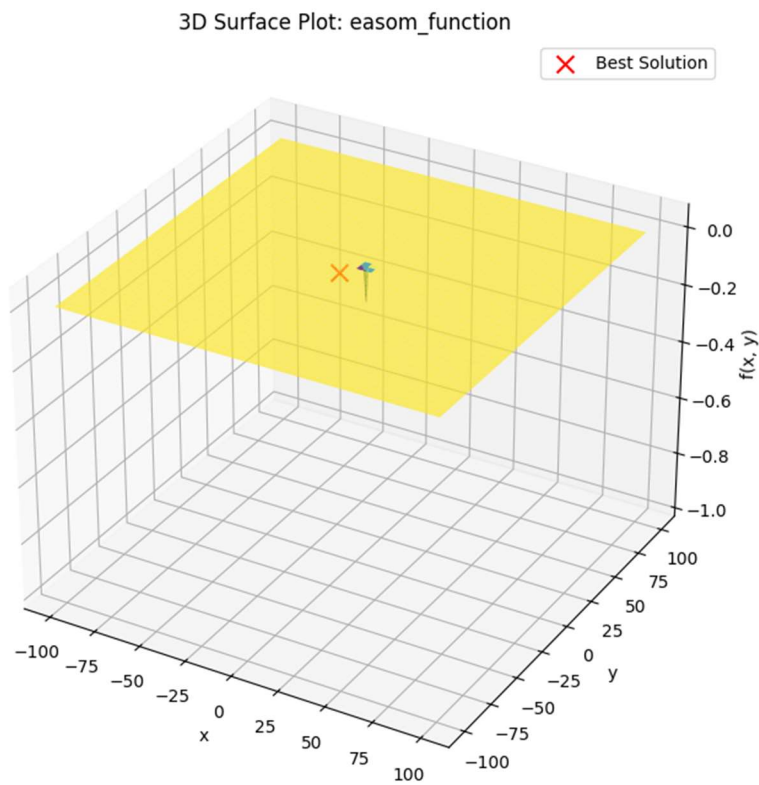
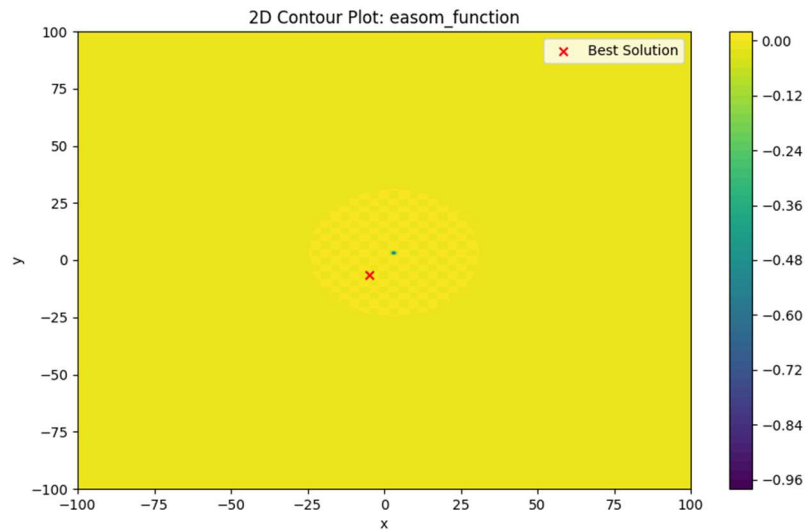


10 EASOM FUNCTION

$$f(\mathbf{x}) = -\cos(x_1) \cos(x_2) \exp(-(x_1 - \pi)^2 - (x_2 - \pi)^2)$$

Best Solution: [-4.89221163 -6.49210949]

Best Value: -8.065241156970764e-70

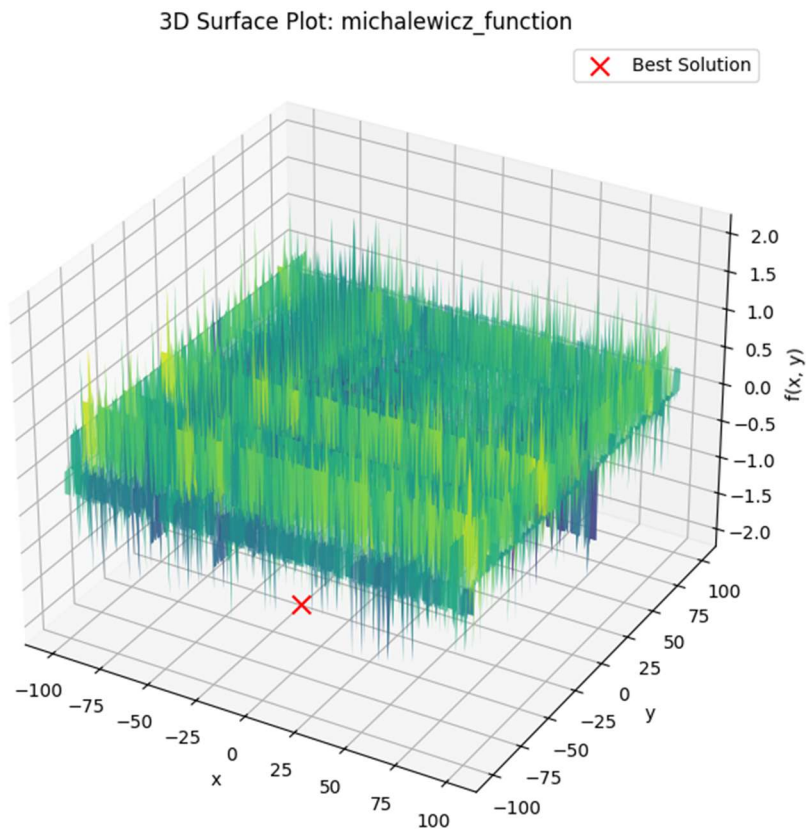
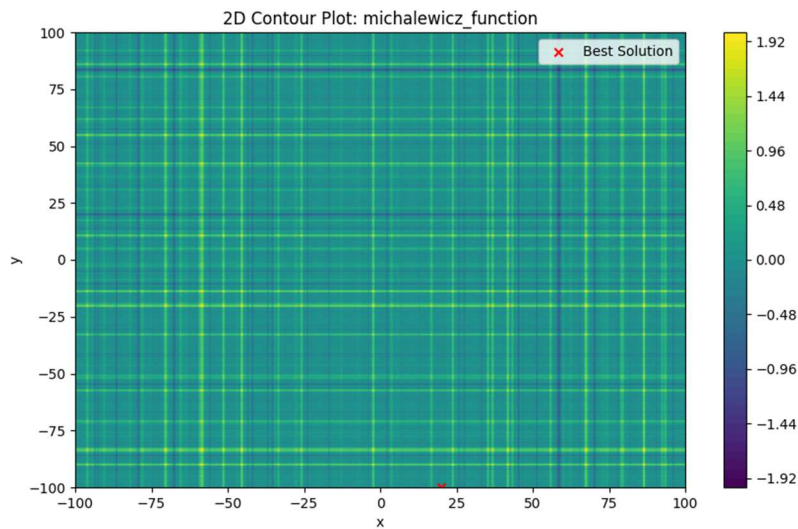


11 MICHALEWICZ FUNCTION

$$f(\mathbf{x}) = -\sum_{i=1}^d \sin(x_i) \sin^{2m} \left(\frac{ix_i^2}{\pi} \right)$$

Best Solution: [19.97375517 -100]

Best Value: -0.7764574059398142

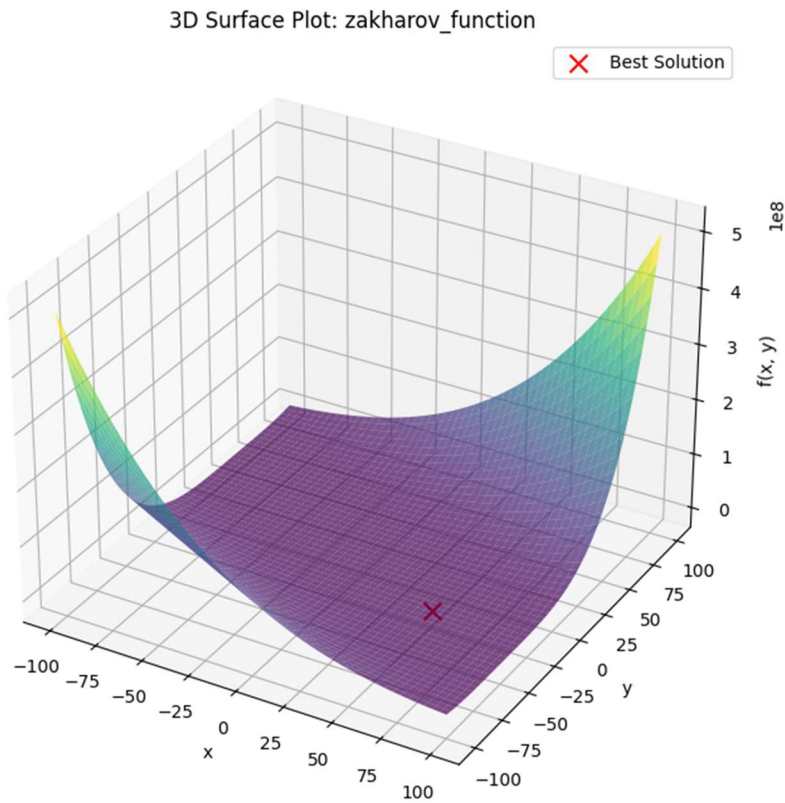
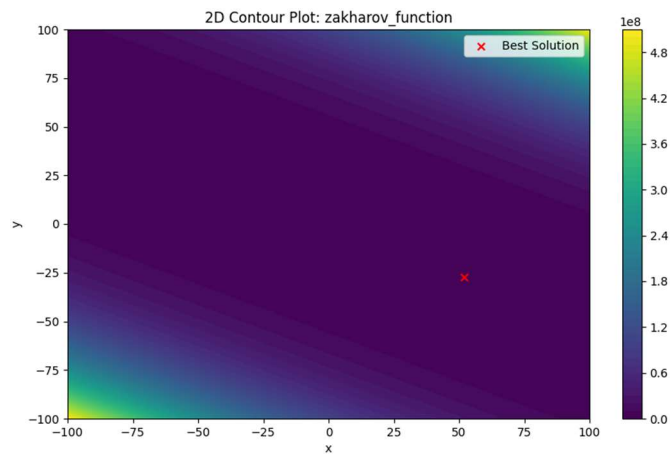


12 ZAKHAROV FUNCTION

$$f(\mathbf{x}) = \sum_{i=1}^d x_i^2 + \left(\sum_{i=1}^d 0.5ix_i \right)^2 + \left(\sum_{i=1}^d 0.5ix_i \right)^4$$

Best Solution: [51.86824984 -27.24543573]

Best Value: 3437.3054494549297

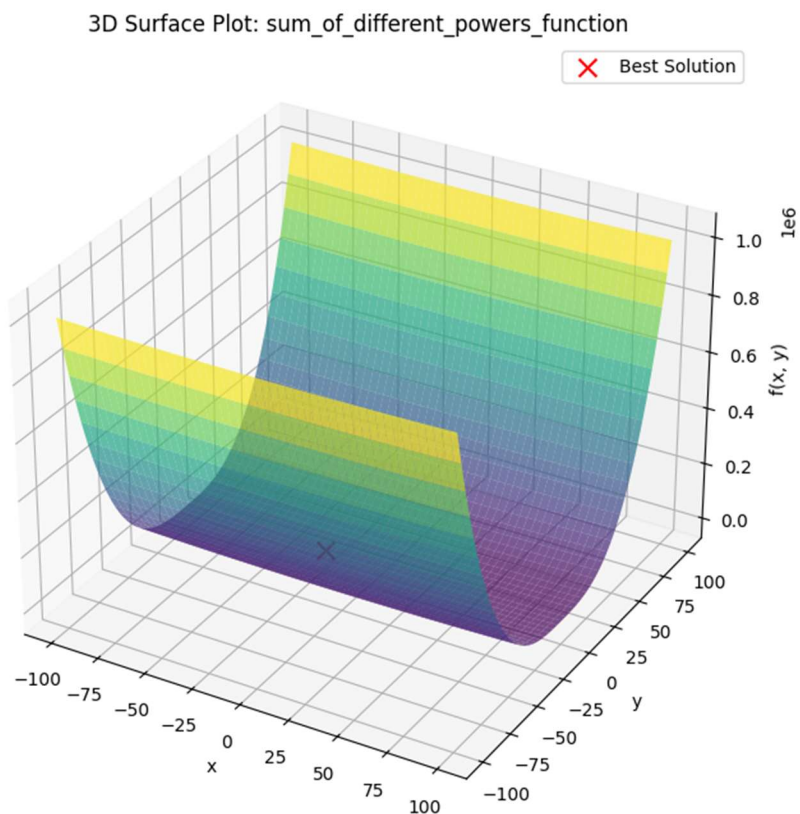
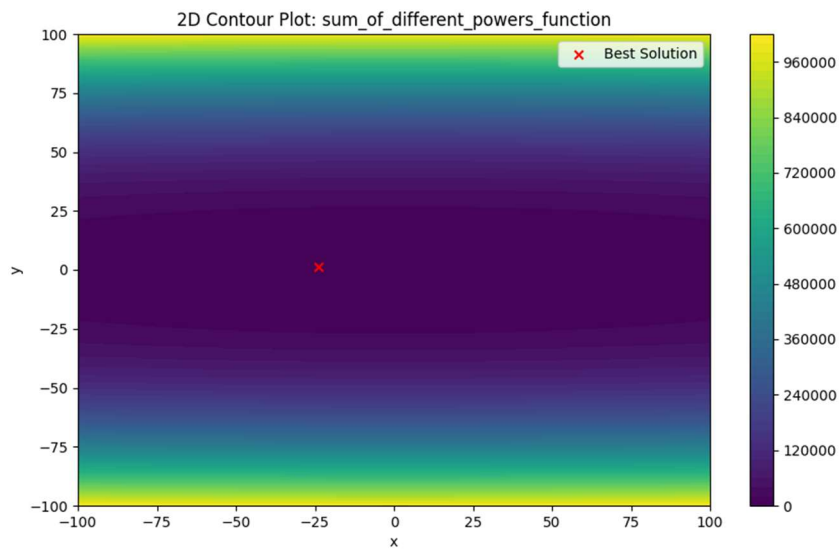


13 SUM OF DIFFERENT POWERS FUNCTION

$$f(\mathbf{x}) = \sum_{i=1}^d |x_i|^{i+1}$$

Best Solution: [-23.99138899 1.18024345]

Best Value: 577.2307949410633

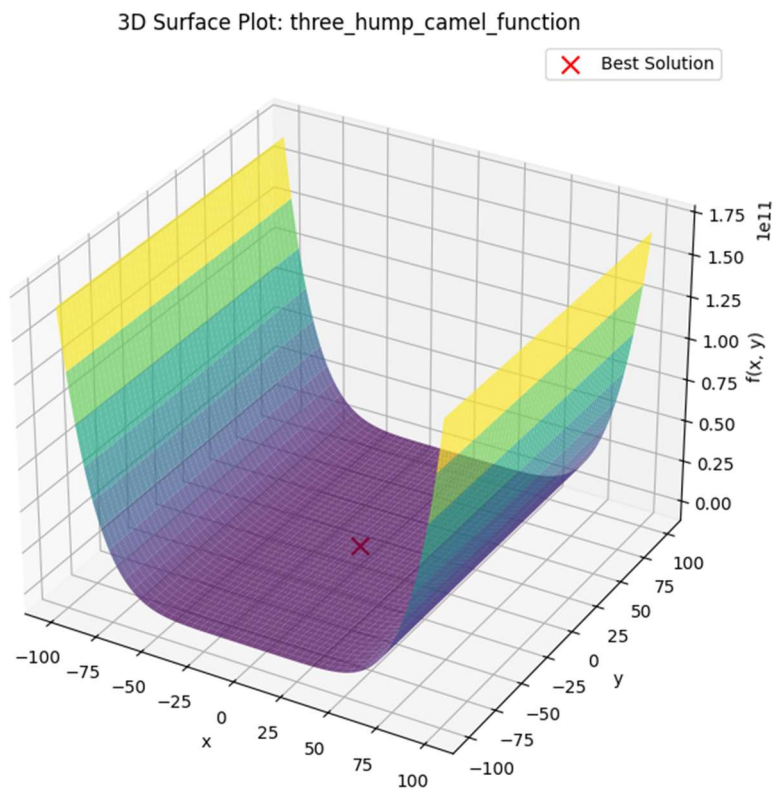
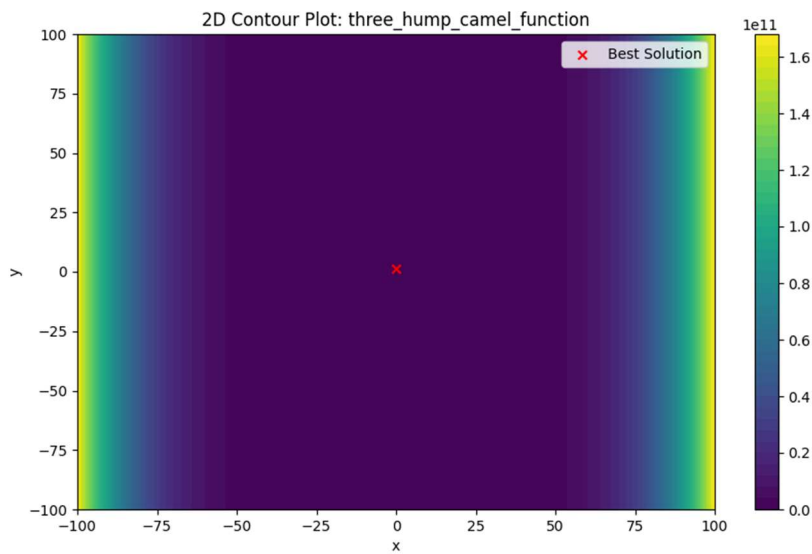


14 THREE-HUMP CAMEL FUNCTION

$$f(\mathbf{x}) = - \sum_{i=1}^d \sin(x_i) \sin^{2m} \left(\frac{i x_i^2}{\pi} \right)$$

Best Solution: [0.03216035 1.25172646]

Best Value: 1.6091425472282752



15 XIN-SHE YANG FUNCTION

$$f(x)=f(x_1, \dots, x_n)=\sum_{i=1}^n (\epsilon_i (|x_i|)^i)$$

Best Solution: [-15.92800396 -24.42901163]

Best Value: 35.65343634033759

