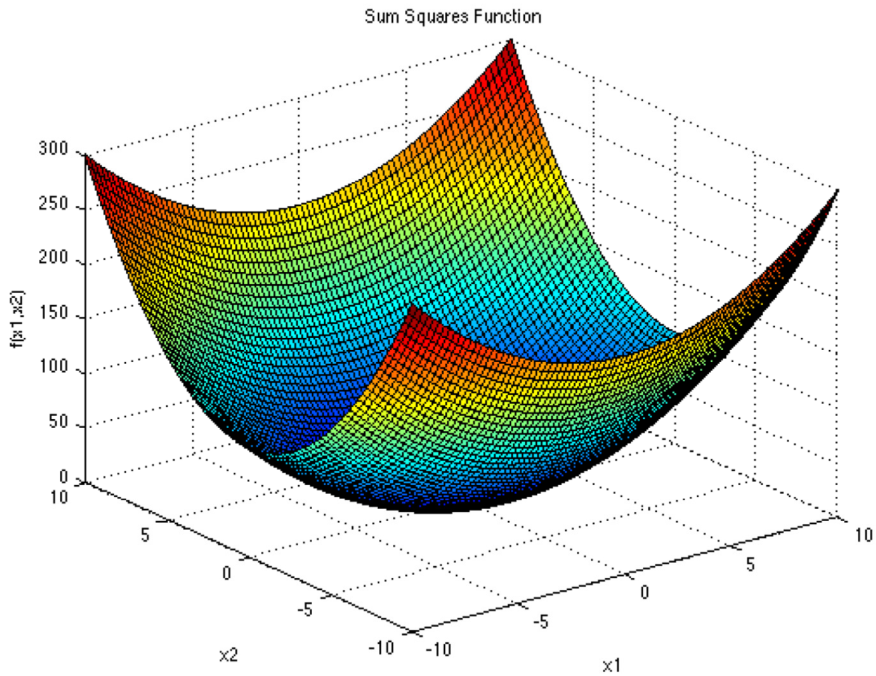
Project-Phase-2 Questions

Instructions:

- All problems are minimization-type.
- Some problems can be scaled to any number of variables. I have mentioned the number of variables in the yellow box.
- **The program should be generic so that any variable problem can be solved. I will ask you to run the examples with a different number of variables**. Meaning, the code should ask for number of variables as one of the input parameters.
- **There should be one code that can solve all the given problems. Use switch case or commenting/uncommenting the functions.**
- **Perform the unidirectional search for all methods assigned to the group, including Marquart's Method.**
- **Always normalize the direction before performing the unidirectional search.**
- **The range of α in unidirectional search should be found from the range of x.**
- No. of variables for a given problem should be read from the input file. Other input parameter should also be written in the same or different input file.
- The codes developed in Project Phase-1 should be used for unidirectional searches. For example, the bracketing method is followed by an accurate method for determining α.
- Include linear independency check between two search directions.
- Make slides and include your results (Table, convergence plots, etc.). You may change initial guess and/or input parameters to see their effect on the results. Run for 10 times.
- Make a zip file of your code(s), and name it as "G_group_number" and upload on TEAMS.
- Deadline for submission: 10 PM, 29 Sept. 2024

SUM SQUARES FUNCTION



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

Description:

Dimensions: d

The Sum Squares function, also referred to as the Axis Parallel Hyper-Ellipsoid function, has no
minimum except the global one. It is continuous, convex and unimodal. It is shown here in its tw
dimensional form.

Input Domain:

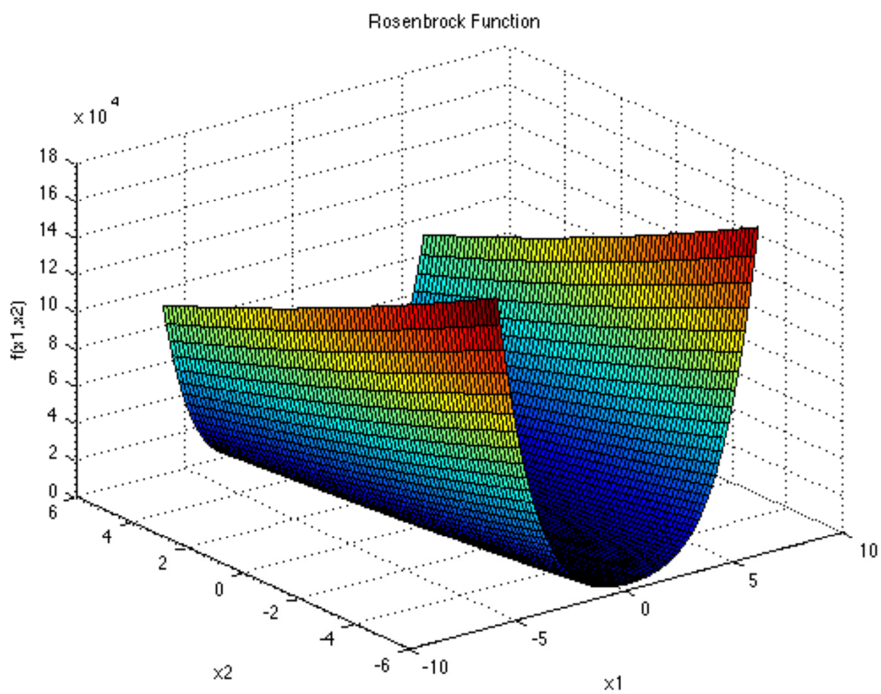
The function is usually evaluated on the hypercube $x_i \in [-10, 10]$, for all i = 1, …, d, although this
restricted to the hypercube $x_i \in [-5.12, 5.12]$, for all i = 1, …, d.

Global Minimum:

$$f(\mathbf{x}^*) = 0 \text{ , at } \mathbf{x}^* = (0, \dots, 0)$$

Solve for five variables: $x = (x_1, x_2, x_3, x_4, x_5)^T$

ROSENBROCK FUNCTION



$$f(\mathbf{x}) = \sum_{i=1}^{d-1} \left[100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2\right]$$

Description:

Dimensions: d

The Rosenbrock function, also referred to as the Valley or Banana function, is a popular test prc gradient-based optimization algorithms. It is shown in the plot above in its two-dimensional form

The function is unimodal, and the global minimum lies in a narrow, parabolic valley. However, ev this valley is easy to find, convergence to the minimum is difficult (Picheny et al., 2012).

Input Domain:

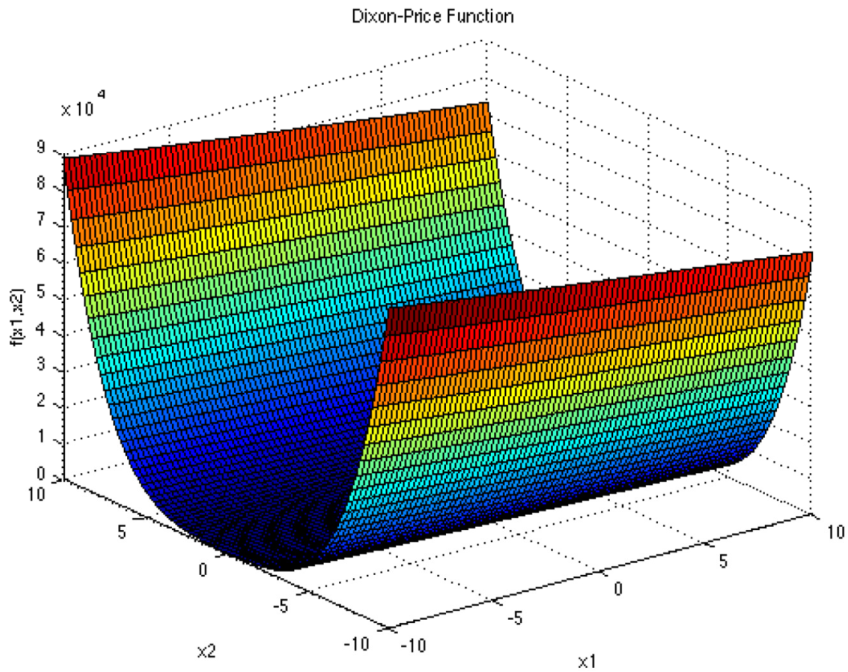
The function is usually evaluated on the hypercube $x_i \in [-5, 10]$, for all i = 1, …, d, although it ma restricted to the hypercube $x_i \in [-2.048, 2.048]$, for all i = 1, …, d.

Global Minimum:

$$f(\mathbf{x}^*) = 0, \text{ at } \mathbf{x}^* = (1, \ldots, 1)$$

Solve for three variables: $x = (x_1, x_2, x_3)^T$

DIXON-PRICE FUNCTION



$$f(\mathbf{x}) = (x_1 - 1)^2 + \sum_{i=2}^{d} i \left(2x_i^2 - x_{i-1}\right)^2$$

Description:

Dimensions: d

Input Domain:

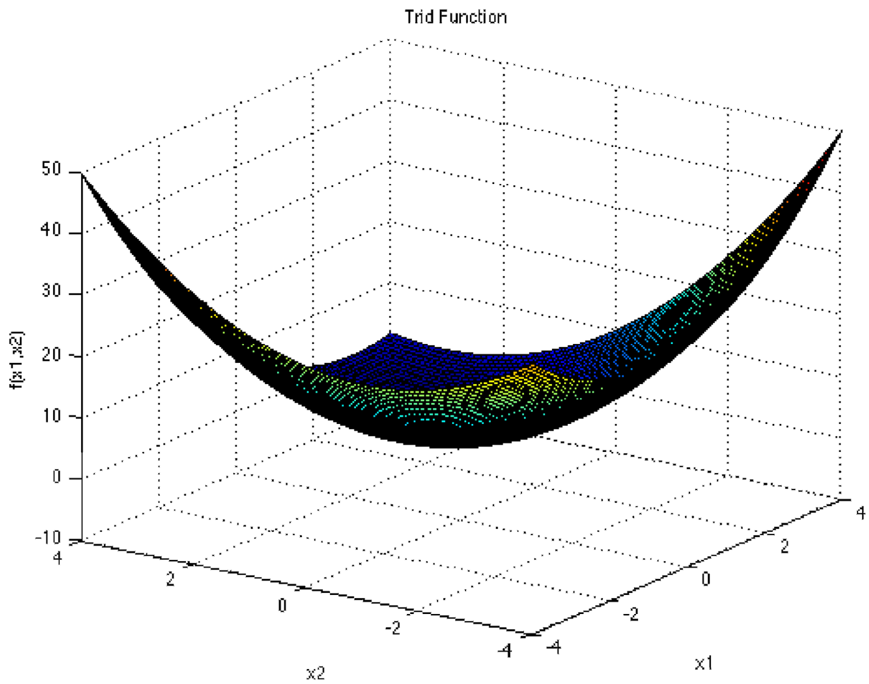
The function is usually evaluated on the hypercube $x_i \in [-10, 10]$, for all i = 1, …, d.

Global Minimum:

$$f(\mathbf{x}^*) = 0, \text{ at } x_i = 2^{-\frac{2^i-2}{2^i}}, \text{ for } i = 1, ..., d$$

Solve for four variables: $x = (x_1, \dots, x_4)^T$

TRID FUNCTION



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

Description:

Dimensions: d

The Trid function has no local minimum except the global one. It is shown here in its two-dimens

Input Domain:

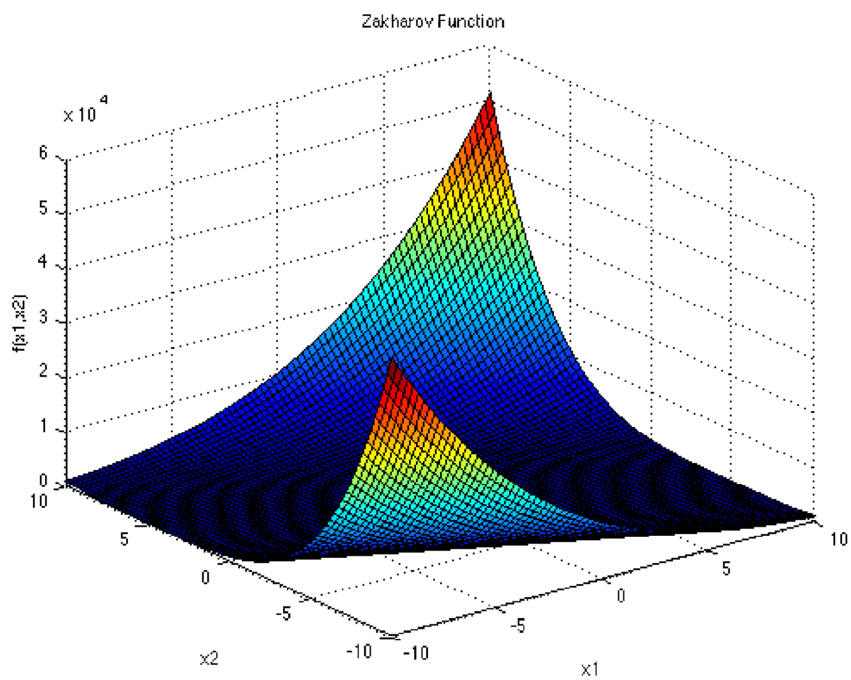
The function is usually evaluated on the hypercube $x_i \in [-d^2, d^2]$, for all i = 1, …, d.

Solve for six variables: $x = (x_1, \dots, x_6)^T$

Global Minimum:

$$f(\mathbf{x}^*) = -d(d+4)(d-1)/6, \text{ at } x_i = i(d+1-i), \text{ for all } i = 1, 2, \dots, d$$

ZAKHAROV FUNCTION



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

Description:

Dimensions: d

The Zakharov function has no local minima except the global one. It is shown here in its two-din form.

Input Domain:

The function is usually evaluated on the hypercube $x_i \in [-5, 10]$, for all i = 1, …, d.

Global Minimum:

Solve for two variables: $x = (x_1,\ x_2)^T$

$$f(\mathbf{x}^*) = 0, \text{ at } \mathbf{x}^* = (0, \dots, 0)$$