

# Unconstrained Optimisation using FOT

Spoken Tutorial Project

<https://spoken-tutorial.org>

National Mission on Education through ICT

<http://sakshat.ac.in>

Script: Siddharth Agarwal, Anandajith TS

Video: Anandajith TS

IIT Bombay

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# Learning Objectives

**In this tutorial, we will learn how to:**



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- ▶ Use `fot_fminunc` and `fot_intfminunc` functions in Scilab



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In this tutorial, we will learn how to:

- ▶ Use `fot_fminunc` and `fot_intfminunc` functions in Scilab
- ▶ Solve unconstrained optimisation problems using `fot_fminunc` and `fot_intfminunc` functions



# System Requirement

**To record this tutorial, I am using**



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► **Windows 10 OS**



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- ▶ **Scilab 6.1.0**





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version 0.4.1**



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**The process demonstrated in this  
tutorial is identical in Linux OS also**



# Pre-requisites

**To follow this tutorial, you should**



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- ▶ **Have basic understanding of Scilab and optimisation theory**



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- ▶ **If not, for relevant tutorials please visit: <https://spoken-tutorial.org>**



# Code Files

- ▶ The files used in this tutorial have been provided in the Code files link





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- ▶ Make a copy and then use them while practising



# What is the Unconstrained Optimisation problem?

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**A function is nonlinear if it has a degree of two or more**

**An Unconstrained Optimisation Problem is a mathematical optimisation model with:**

- ▶ **Nonlinear objective function**
- ▶ **No constraints**



# Mathematical Formulation

**A general form of the unconstrained optimisation problem is:**

$$\min_x f(x)$$



# Example

$$\min_x 100 \cdot (x_2 - x_1^2)^2 + (1 - x_1)^2$$

**Initial condition:**

$$x_0 = [-1, 2]$$





# Integer Nonlinear Programming

- We will now look at integer nonlinear programming problems



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# Integer Nonlinear Programming

- ▶ We will now look at integer nonlinear programming problems
- ▶ These are problems where some decision variables are constrained to be integers



# Mathematical Formulation

**A general form of a unconstrained integer programming problem is:**

$$\min_x f(x)$$

**subjected to:**

$$x_i \in \mathbb{Z}, \quad i \subseteq N,$$



# Example

$$\min_x 100 \cdot (x_2 - x_1^2)^2 + (1 - x_1)^2$$

subjected to

$$x_2 \in \mathbb{Z}$$

$$x_0 = [-1, 2]$$



# Summary

In this tutorial, we have learnt to:

- ▶ Use `fot_fminunc` and `fot_intfminunc` functions of the FOSSEE Optimisation Toolbox
- ▶ Solve unconstrained nonlinear programming examples in Scilab



# Assignment

What will be the solution of the following example:

$$f(x_1, x_2) = 0.6382 \times x_1^2 + 0.3191 \times x_2^2 - 0.2809 \times x_1 \times x_2 - 67.906 \times x_1 - 14.29 \times x_2$$

subjected to

$$x_2 \in \mathbb{Z}$$

$$x_0 = [-1, 2]$$



# Assignment Solution

- ▶ The optimal value will be 2547.7231
- ▶ Optimal solution will be  
 $x_1=64.363297$   
 $x_2=50.720229$





# About Spoken Tutorial project

- ▶ Watch the video available at [https://spoken-tutorial.org/What\\_is\\_a\\_Spoken\\_Tutorial](https://spoken-tutorial.org/What_is_a_Spoken_Tutorial)
- ▶ It summarises the Spoken Tutorial project
- ▶ If you do not have good bandwidth, you can download and watch it



# Spoken Tutorial Workshops

## The Spoken Tutorial Project Team

- ▶ Conducts workshops using spoken tutorials
- ▶ Gives certificates to those who pass an online test
- ▶ For more details, please write to [contact@spoken-tutorial.org](mailto:contact@spoken-tutorial.org)



# Answers for THIS Spoken Tutorial

- ▶ Questions in THIS Spoken Tutorial?
- ▶ Visit `https://forums.spoken-tutorial.org/`
- ▶ Choose the minute and second where you have the question
- ▶ Explain your question briefly
- ▶ The Spoken Tutorial project will ensure an answer

**You will have to register to ask questions**



# FOSSEE Forum

- For any general or technical questions on Scilab, visit the FOSSEE forum and post your question

<https://forums.fossee.in/>



# Textbook Companion project

- ▶ The FOSSEE team coordinates the Textbook Companion project
- ▶ We give Certificates and Honorarium to the contributors
- ▶ For more details, please visit:  
[https://scilab.in/Textbook\\_Companion\\_Project](https://scilab.in/Textbook_Companion_Project)



# Lab Migration

- ▶ The FOSSEE team coordinates the Lab Migration project
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Lab\\_Migration\\_Project](https://scilab.in/Lab_Migration_Project)



# Acknowledgements

- **Spoken Tutorial and FOSSEE projects are funded by MoE, Government of India**



# Thank you

- ▶ This is Anandajith TS, FOSSEE intern 2021, IIT Bombay signing off
- ▶ Thanks for joining

