

Unconstrained Optimisation using FOT

Spoken Tutorial Project

<https://spoken-tutorial.org>

National Mission on Education through ICT

<http://sakshat.ac.in>

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Video: Anandajith TS

IIT Bombay

7 July 2021



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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- ▶ **FOSSEE Optimisation Toolbox
version 0.4.1**



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



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To follow this tutorial, you should



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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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- ▶ Please download and extract the files



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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
- ▶ 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



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
- ▶ For more details, please visit:
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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**

