

# Linear Programming using `fot_linprog` function

Spoken Tutorial Project

<https://spoken-tutorial.org>

National Mission on Education through ICT

<http://sakshat.ac.in>

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Video: Mankrit Singh

FOSSEE TEAM

26 July 2021



# Learning Objectives

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



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- ▶ Solve linear programming problems using `fot_linprog` function in Scilab



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In this tutorial, we will learn how to:

- ▶ Solve linear programming problems using `fot_linprog` function in Scilab
- ▶ Use `fot_linprog` function of FOSSEE Optimization Toolbox



# System Requirement

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



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- ▶ Ubuntu 18.04
- ▶ Scilab 6.1.0
- ▶ **FOSSEE Optimization Toolbox  
version 0.4.1**





# Pre-requisites

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- ▶ Have basic understanding of Scilab and optimization theory
- ▶ 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 Linear Programming?

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**A linear program is a mathematical optimization model with:**

- ▶ **Linear objective function**
- ▶ **Linear constraints**



# Mathematical Formulation

A general form of a linear program is:

$$\min_x c^T x$$

subjected to:

$$Ax \leq b,$$

$$A_{eq}x = b_{eq},$$

$$lb \leq x \leq ub,$$

Where  $c$ ,  $A$ ,  $b$ ,  $A_{eq}$ ,  $b_{eq}$ ,  
 $lb$ , and  $ub$  are given



# Example

$$\min_x -x_1 - 0.33x_2$$

subjected to:

$$x_1 + x_2 \leq 2,$$

$$-0.25x_1 - x_2 \leq 1,$$

$$-x_1 - x_2 \leq -1,$$

$$-x_1 + x_2 \leq 2,$$

$$x_1 + 0.25x_2 = 0.5,$$

$$-1 \leq x_1 \leq 1.5, -0.5 \leq x_2 \leq 1.25$$



# Alternate Input Arguments

- ▶ **file** : A string stating the path of the mps file



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- ▶ **MPS(Mathematical Programming System)** is a file format



# Alternate Input Arguments

It is used to present and archive:

- ▶ **linear programming problems**





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- ▶ mixed integer programming problems



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It is used to present and archive:

- ▶ linear programming problems
- ▶ mixed integer programming problems
- ▶ **param : List of parameters to be set**



# Unbounded Problems I

The problem we just saw was directly solvable using **fot\_linprog**

- ▶ There are cases when the optimal value is unbounded
- ▶ The minimum value may go to negative infinity in the absence of suitable constraints



# Unbounded Problems II

- ▶ Such problems are called  
**Unbounded Problems**



# Infeasible Problems

- ▶ There are instances where no solution exists for all the constraints



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- ▶ There are instances where no solution exists for all the constraints
- ▶ These problems are called Infeasible Problems



# Summary

In this tutorial, we have learnt how to:

- ▶ Use `fot_linprog` function of FOSSEE Optimization Toolbox
- ▶ Solve an LP example using `fot_linprog` in Scilab



# Assignment

**Solve the same example**

$$\min_x -x_1 - 0.33x_2$$

**subjected to:**

$$x_1 + x_2 \leq 2,$$

$$-0.25x_1 - x_2 \leq 1,$$

$$-x_1 - x_2 \leq -1,$$

$$-x_1 + x_2 \leq 2,$$

$$x_1 + 0.25x_2 = 0.5,$$

$$-1 \leq x_1 \leq 1.5, -0.5 \leq x_2 \leq 1.25$$

**With this additional constraint**

$$x_2 - 3x_1 \leq 0$$





# Assignment Solution

**The solution to the assignment is**

$$\mathbf{f_{opt}} = -0.5714$$

$$\mathbf{x_{opt}} = [0.2857, 0.8571]$$



# 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



# 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, the Government of India.**





# Thank you

- ▶ This is Mankrit Singh, a FOSSEE intern 2021, IIT Bombay signing off
- ▶ Thanks for joining

