Optimization using Scilab

Talk to a Teacher Project
http://spoken-tutorial.org

National Mission on Education through ICT
http://sakshat.ac.in

Script: Mukul R. Kulkarni
Narration: Anuradha Amrutkar
IIT Bombay
Feraury 22, 2013

In this tutorial we will learn:

- **What is Optimization?**

In this tutorial we will learn:

- **What is Optimization?**
- **Use of Scilab function karmarkar in Optimization**

Optimization means:

- **Minimize or maximize a given objective function.**

Optimization means:

- **Minimize or maximize a given objective function.**
- **Which is also called as Cost function sometimes.**

Optimization means:

- Minimize or maximize a given objective function.
- Which is also called as Cost function sometimes.
- By varying the decision variables.

Optimization means:

- Minimize or maximize a given objective function.
- Which is also called as Cost function sometimes.
- By varying the decision variables.
- Subject to constraints on functions of decision variables.

- **These constraints are also in the form of some functions of the variables.**

- **These constraints are also in the form of some functions of the variables.**
- **Optimization is extensively used in areas like**

- These constraints are also in the form of some functions of the variables.
- Optimization is extensively used in areas like
  - Economics

- These constraints are also in the form of some functions of the variables.
- Optimization is extensively used in areas like
  - Economics
  - Control Theory

- These constraints are also in the form of some functions of the variables.
- Optimization is extensively used in areas like
  - Economics
  - Control Theory
  - Operations and Research.

The Scilab function karmarkar is used for

- **optimizing the linear objective function**

The Scilab function karmarkar is used for
- **optimizing the linear objective function**
- **subject to linear constraints**

The Scilab function karmarkar is used for

- **optimizing the linear objective function**
- **subject to linear constraints**
- **on the decision variables**

We will solve the following example using karmarkar function:

Minimize $: -3x_1 - x_2 - 3x_3$

for

$2x_1 + x_2 + x_3 \leq 2$

$x_1 + 2x_2 + 3x_3 \leq 5$

$2x_1 + 2x_2 + x_3 \leq 6$

$x_1, x_2, x_3 \geq 0$

- **Output Arguments :**
  [*xopt*, *fopt*, *exitflag*, *iter*, *yopt*]
  - xopt : **The optimum solution.**

- **Output Arguments :**
  $[xopt, fopt, exitflag, iter, yopt]$
  - `xopt` : **The optimum solution.**
  - `fopt` : **The objective function value at optimum solution.**

- **Output Arguments :**
  $[xopt, fopt, exitflag, iter, yopt]$
  - xopt : **The optimum solution.**
  - fopt : **The objective function value at optimum solution.**
  - exitflag : **The status of execution, it helps in identifying if the algorithm is converging or not.**

- **Output Arguments :**
  [*xopt*, *fopt*, *exitflag*, *iter*, *yopt*]

  - xopt : **The optimum solution.**
  - fopt : **The objective function value at optimum solution.**
  - exitflag : **The status of execution, it helps in identifying if the algorithm is converging or not.**

- **Output Arguments :**
  [*xopt, fopt, exitflag, iter, yopt*]
  - iter : **The number of iterations required to reach xopt.**

- **Output Arguments :**

  $[xopt, fopt, exitflag, iter, yopt]$

  - `iter` : **The number of iterations required to reach xopt.**
  - `yopt` : **A structure containing the dual solution. This gives the Lagrange multipliers.**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun,$
  $A, b, lb, ub)$
  - Aeq : **The matrix in the linear equality constraints.**

- **Input Arguments :**
  ($Aeq, beq, c, x0, rtolf, gam, maxiter, outfun,$
  A, b, lb, ub)
  - `Aeq` **: The matrix in the linear equality constraints.**
  - `beq` **: The right hand side of the linear equality constraint.**

- **Input Arguments :**

  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun, A, b, lb, ub)$

  - `Aeq` **: The matrix in the linear equality constraints.**
  - `beq` **: The right hand side of the linear equality constraint.**
  - `c` **: The linear objective function co-efficients for x.**

- **Input Arguments :**

  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun, A, b, lb, ub)$

    - Aeq : **The matrix in the linear equality constraints.**
    - beq : **The right hand side of the linear equality constraint.**
    - c : **The linear objective function co-efficients for x.**
    - x0 : **The initial guess (default=[]).**

- **Input Arguments :**

  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun, A, b, lb, ub)$

  - Aeq : **The matrix in the linear equality constraints.**
  - beq : **The right hand side of the linear equality constraint.**
  - c : **The linear objective function co-efficients for x.**
  - x0 : **The initial guess (default=[]).**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun,$
  $A, b, lb, ub)$
  - rtolf : **Relative tolerance on** $f(x) = c' * x$
    (default=1.d-5).

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun,$
  $A, b, lb, ub)$
  - `rtolf` : **Relative tolerance on** $f(x) = c' * x$
    (default=1.d-5).
  - `gam` : **The scaling factor (default=0.5).**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun, A, b, lb, ub)$
  - rtolf : **Relative tolerance on** $f(x) = c' * x$ **(default=1.d-5).**
  - gam : **The scaling factor (default=0.5).**
  - maxiter : **The maximum number of iterations (default=200).**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun, A, b, lb, ub)$
    - `rtolf` : **Relative tolerance on** $f(x) = c' * x$ **(default=1.d-5).**
    - `gam` : **The scaling factor (default=0.5).**
    - `maxiter` : **The maximum number of iterations (default=200).**
    - `outfun` : **Additional user-defined output function.**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun,$
  $A, b, lb, ub)$

  - `rtolf` : **Relative tolerance on** $f(x) = c' * x$
    (default=1.d-5).
  - `gam` : **The scaling factor (default=0.5).**
  - `maxiter` : **The maximum number of iterations**
    (default=200).
  - `outfun` : **Additional user-defined output function.**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun, A, b, lb, ub)$
  - A: **The matrix of linear inequality constraints.**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun, A, b, lb, ub)$
  - A: **The matrix of linear inequality constraints.**
  - b : **The right-hand side of linear inequality constraints.**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun,$
  $A, b, lb, ub)$
  - A: **The matrix of linear inequality constraints.**
  - b : **The right-hand side of linear inequality constraints.**
  - lb : **The lower bounds for x.**

- **Input Arguments :**
  $(Aeq, beq, c, x0, rtolf, gam, maxiter, outfun,$
  $A, b, lb, ub)$
    - A: **The matrix of linear inequality constraints.**
    - b : **The right-hand side of linear inequality constraints.**
    - lb : **The lower bounds for x.**
    - ub : **The upper bounds for x.**

Please note that :

- **It is mandatory to specify the input arguments in the same order.**
- **In which they have been listed above, while calling the function.**

Please note that :

- **It is mandatory to specify the input arguments in the same order.**
- **In which they have been listed above, while calling the function.**

In this tutorial, we learned:

- **What is Optimization?**

In this tutorial, we learned:

- **What is Optimization?**
- **Use of Scilab function karmarkar in Optimization to solve linear problems**

To contact the Scilab team, please write to
contact@scilab.in

- Watch the video available at
  http://spoken-tutorial.org
  /What_is_a_Spoken_Tutorial
- It summarises the Spoken Tutorial project

- Watch the video available at
  http://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

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**

- **Spoken Tutorial Project is a part of the Talk to a Teacher project**

- **It is supported by the National Mission on Education through ICT, MHRD, Government of India**

- **More information on this Mission is available at http://spoken-tutorial.org /NMEICT-Intro**