Scientific Programming

Solving linear systems

Suppose that you are given several linear equations to solve, for example

$$\begin{aligned} 2x + y &= 1 \\ 4z + y &= 3 \\ x - y - z &= 6 \end{aligned}$$

There are several ways that Matlab can be used to solve for x, y and z. The textbook discusses one of them; another is to use the **linsolve** command.

The first step is two create a matrix representing the left-hand side of the equations and an array representing the right-hand side. First rewrite the equations so that the variables are in the same order (observe that the second row has changed) and that no variables are missing.

$$\begin{array}{rcrcrcr} \mathbf{2}x & + & \mathbf{1}y & + & \mathbf{0}z & = & \mathbf{1} \\ \mathbf{0}x & + & \mathbf{1}y & + & \mathbf{4}z & = & \mathbf{3} \\ \mathbf{1}x & + & -\mathbf{1}y & + & -\mathbf{1}z & = & \mathbf{6} \end{array}$$

The numbers on the left form our matrix and the ones on the right our array (which is a column).

In Matlab notation the matrix is: `M = [ 2 1 0; 0 1 4; 1 -1 -1 ]` and the array is `b = [1; 3; 6]`. Using the command `linsolve(M,b)` solves for the variables. For example,

```
>> M = [ 2 1 0; 0 1 4; 1 -1 -1 ]

M =

    2     1     0
    0     1     4
    1    -1    -1

>> b = [ 1; 3; 6 ]

b =

    1
    3
    6

>> solution = linsolve(M, b)

solution =

    3
   -5
    2
```

The array `solution` contains the values of x, y and z that solve the equation. The order is the same use we used when converting the equations to a matrix.