

Module 02: Numerical Methods

Unit 20: Numerical Method: Matrix Structure and Scilab

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Learning Objectives

- To identify different kinds of matrix structures generated from discretization.

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- To identify different kinds of matrix structures generated from discretization.
- To use **scilab** for matrix formation.

Matrix Form

Full Matrix

$$\mathbf{A}\phi = \mathbf{r}$$

Matrix Form

Full Matrix

$$\mathbf{A}\boldsymbol{\phi} = \mathbf{r}$$

$$\begin{pmatrix} a_{11} & \times & \times & \dots & \times & \times & a_{1N} \\ \times & \times & \times & \dots & \times & \times & \times \\ \times & \times & \times & \dots & \times & \times & \times \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ \times & \times & \times & \dots & \times & \times & \times \\ \times & \times & \times & \dots & \times & \times & \times \\ a_{N1} & \times & \times & \dots & \times & \times & a_{NN} \end{pmatrix}_{N \times N} \begin{pmatrix} \phi_1 \\ \phi_2 \\ \phi_3 \\ \vdots \\ \phi_{N-2} \\ \phi_{N-1} \\ \phi_N \end{pmatrix}_{N \times 1} = \begin{pmatrix} r_1 \\ r_2 \\ r_3 \\ \vdots \\ r_{N-2} \\ r_{N-1} \\ r_N \end{pmatrix}_{N \times 1}$$

Matrix Form

Full Matrix

$$\begin{pmatrix} \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \end{pmatrix}$$

Matrix Form

Banded Matrix

$$\begin{pmatrix} \times & & & & & & & & & & \\ \times & \times & & & & & & & & & \\ & \times & \times & \times & & & & & & & \\ & & \times & \times & \times & & & & & & \\ & & & \times & \times & \times & & & & & \\ & & & & \times & \times & \times & & & & \\ & & & & & \times & \times & \times & & & \\ & & & & & & \times & \times & \times & & \\ & & & & & & & \times & \times & \times & \\ & & & & & & & & \times & \times & \times \\ & & & & & & & & & \times & \times \end{pmatrix}$$

Matrix Form

Banded Matrix

$$\begin{pmatrix}
 \times & \times & & & \times & & & & \\
 \times & \times & \times & & & \times & & & \\
 & \times & \times & \times & & & \times & & \\
 & & \times & \times & \times & & & \times & \\
 \times & & & \times & \times & \times & & & \times \\
 & \times & & & \times & \times & \times & & \times \\
 & & \times & & \times & \times & \times & & \\
 & & & \times & & \times & \times & \times & \\
 & & & & \times & & \times & \times & \times \\
 & & & & & \times & & \times & \times
 \end{pmatrix}$$

Matrix Form

Skyline Matrix

$$\begin{pmatrix} \times & & & & & & & & & \\ & \times & & & & & & & & \\ & & \times & & & & & & & \\ & & & \times & & & & & & \\ & & & & \times & & & & & \\ & & & & & \times & & & & \\ & & & & & & \times & & & \\ & & & & & & & \times & & \\ & & & & & & & & \times & \\ & & & & & & & & & \times \end{pmatrix}$$

Matrix Form

Lower Triangular Matrix

$$\begin{pmatrix} \times & & & & & & & & & \\ \times & \times & & & & & & & & \\ \times & \times & \times & & & & & & & \\ \times & \times & \times & \times & & & & & & \\ \times & \times & \times & \times & \times & & & & & \\ \times & \times & \times & \times & \times & \times & & & & \\ \times & \times & \times & \times & \times & \times & \times & & & \\ \times & \times & \times & \times & \times & \times & \times & \times & & \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \\ \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \end{pmatrix}$$

Matrix Form

Upper Triangular Matrix

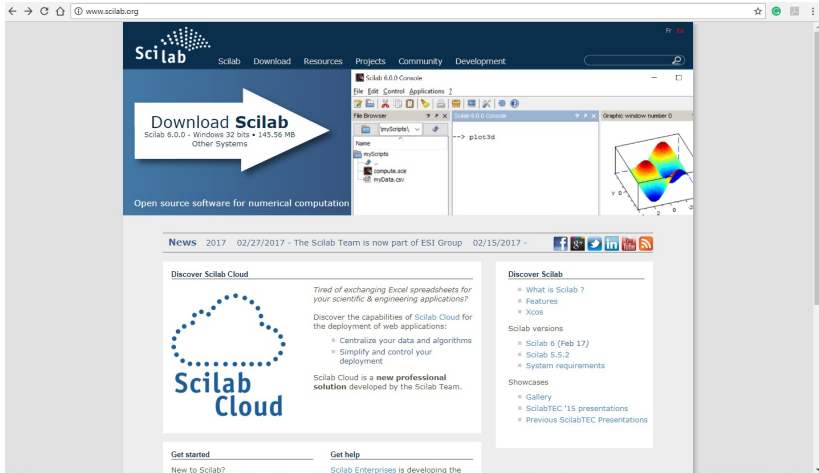
$$\begin{pmatrix} \times & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ & \times & \times & \times & \times & \times & \times & \times & \times & \times \\ & & \times & \times & \times & \times & \times & \times & \times & \times \\ & & & \times & \times & \times & \times & \times & \times & \times \\ & & & & \times & \times & \times & \times & \times & \times \\ & & & & & \times & \times & \times & \times & \times \\ & & & & & & \times & \times & \times & \times \\ & & & & & & & \times & \times & \times \\ & & & & & & & & \times & \times \\ & & & & & & & & & \times \end{pmatrix}$$

Scilab



Scilab

Web Page



The screenshot shows the Scilab website in a web browser. The browser's address bar displays "www.scilab.org". The website has a dark blue header with the Scilab logo and navigation links: Scilab, Download, Resources, Projects, Community, and Development. A large white arrow points to the "Download Scilab" section, which specifies "Scilab 6.0.0 - Windows 32 bits • 145.56 MB" and "Other Systems". Below this, it states "Open source software for numerical computation". The main content area features a "News" section with a date range from 2017 to 02/15/2017, a "Discover Scilab Cloud" section with a cloud logo and text about exchanging Excel spreadsheets, and a "Discover Scilab" section with a list of features and versions. The footer includes "Get started" and "Get help" links.

Scilab

Scilab Download Resources Projects Community Development

Download Scilab
Scilab 6.0.0 - Windows 32 bits • 145.56 MB
Other Systems

Open source software for numerical computation

News 2017 02/27/2017 - The Scilab Team is now part of ESI Group 02/15/2017 -

Discover Scilab Cloud

Tired of exchanging Excel spreadsheets for your scientific & engineering applications?

Discover the capabilities of **Scilab Cloud** for the deployment of web applications:

- Centralize your data and algorithms
- Simplify and control your deployment

Scilab Cloud is a **new professional solution** developed by the Scilab Team.

Discover Scilab

- What is Scilab ?
- Features
- Xcos

Scilab versions

- Scilab 6 (Feb 17)
- Scilab 5.5.2
- System requirements

Showcases

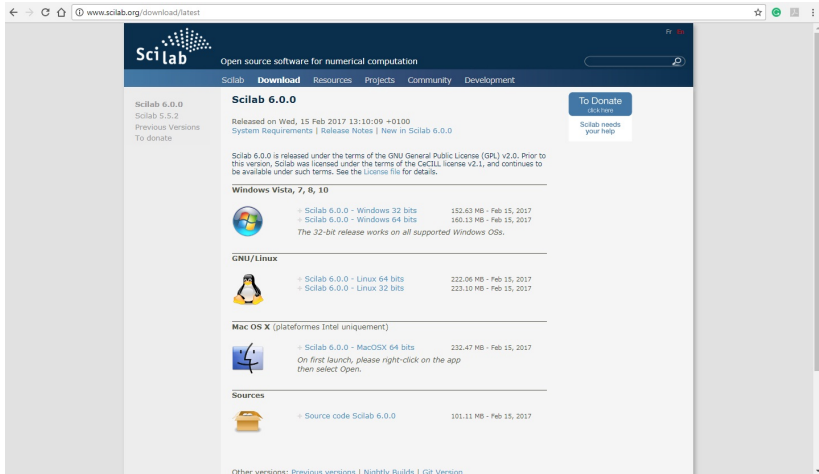
- Gallery
- ScilabTEC '15 presentations
- Previous ScilabTEC Presentations

Get started
New to Scilab?

Get help
Scilab Enterprises is developing the

Scilab

Download Information



The screenshot shows the Scilab website's download page for version 6.0.0. The page has a dark blue header with the Scilab logo and navigation links: Scilab, Download, Resources, Projects, Community, and Development. A search bar is located on the right side of the header. On the left sidebar, there are links for Scilab 6.0.0, Scilab 5.5.2, Previous Versions, and To donate. The main content area is titled 'Scilab 6.0.0' and includes a release date of Wednesday, 15 Feb 2017 13:10:09 +0100. It provides links for System Requirements, Release Notes, and New in Scilab 6.0.0. A 'To Donate' button with a 'click here' link is present. The page explains that Scilab 6.0.0 is released under the GNU General Public License (GPL) v2.0 and continues to be available under the CeCILL license v2.1. It lists download links for Windows Vista, 7, 8, 10 (32-bit and 64-bit), GNU/Linux (64-bit and 32-bit), Mac OS X (64-bit), and Source code. A note for Mac OS X users states: 'On first launch, please right-click on the app then select Open.' At the bottom, there are links for Other versions: Previous versions, Nightly Builds, and Git Version.


Scilab 6.0.0
Scilab 5.5.2
Previous Versions
To donate

Scilab 6.0.0


Released on Wed, 15 Feb 2017 13:10:09 +0100
[System Requirements](#) | [Release Notes](#) | [New in Scilab 6.0.0](#)

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Windows Vista, 7, 8, 10

 + Scilab 6.0.0 - Windows 32 bits 152.63 MB - Feb 15, 2017
+ Scilab 6.0.0 - Windows 64 bits 160.13 MB - Feb 15, 2017
The 32-bit release works on all supported Windows OSs.


GNU/Linux

 + Scilab 6.0.0 - Linux 64 bits 222.06 MB - Feb 15, 2017
+ Scilab 6.0.0 - Linux 32 bits 223.10 MB - Feb 15, 2017

Mac OS X (plateformes Intel uniquement)

 + Scilab 6.0.0 - MacOSX 64 bits 232.47 MB - Feb 15, 2017
On first launch, please right-click on the app then select Open.

Sources

 + Source code Scilab 6.0.0 101.11 MB - Feb 15, 2017

Other versions: [Previous versions](#) | [Nightly Builds](#) | [Git Version](#)



Scilab

General Environment and Console

The screenshot displays the Scilab 6.0.0 Console window. The interface is divided into several panes:

- File Browser:** Shows the file structure of the current project. The 'nptel_codes' directory is expanded, showing subdirectories 'Lecture-23' through 'Lecture-29' and files like 'gausselim.aci', 'gsedel.aci', 'jacob.aci', 'automp.aci', 'scilab-6.0.0.exe', 'scilab-6.0.0_x64.exe', and 'tchina.aci'.
- Variable Browser:** Displays the current workspace variables. The table below shows the variables and their properties.
- Command History:** Shows the list of commands executed in the console.
- News feed:** A section for news, currently showing 'News feed unavailable'.

| Name | Value | Type | Visibility |
|---------|----------|--------|--------------|
| Fv | | 5x1 | Double local |
| count | 15 | Double | local |
| eps_max | 1e-06 | Double | local |
| n | 5 | Double | local |
| phi | | 5x1 | Double local |
| phi01 | | 5x1 | Double local |
| phi02 | | 5x1 | Double local |
| phi03 | | 5x1 | Double local |
| rms | 1.79e-07 | Double | local |

Command History:

```

function r = run_gm;
Fv(1)=phi(1)^2+phi(1)*phi(2)-3
Fv(2)=phi(1)+phi(2)^3+phi(2)*phi(3)-3
Fv(3)=phi(2)^2+phi(3)^2+phi(3)*phi(4)-17
Fv(4)=phi(3)^2+phi(4)^2+phi(4)*phi(5)-27
Fv(5)=phi(4)+phi(5)^2-29
endfunction
function Jf = Jf(phi)
Jf=zeros(length(phi),length(phi))
//1
Jf(1,1)=2*phi(1)+phi(2)
Jf(1,2)=phi(1)
//2
Jf(2,1)=3*phi(2)^2+phi(3)
Jf(2,3)=phi(3)
//3
Jf(3,2)=2*phi(2)

```

Thank You